Food and Agriculture Organization of the United Nations

Ministry of Fisheries and Aquatic Resources Development

REPORT ON COST-BENEFIT ANALYSIS OF THE MONITORING, CONTROL AND SURVEILLANCE (MCS) SYSTEM AND TOOLS DEVELOPED BY SRI LANKA

Technical Cooperation Project on Capacity Building to
Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing in Sri Lanka

Report on cost-benefit analysis of the Monitoring, Control and Surveillance (MCS) System and tools developed by Sri Lanka

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Abbreviations

CA	Competent Authority
CBA	Cost Benefit Analysis
DFAR	Department of Fisheries and Aquatic Resources
EC	European Commission
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization
FMC	Fisheries Monitoring Centre
HACCP	Hazard Analysis and Critical Control Points
I DAY	Inboard Single-day Boats
IMUL	Inboard Multi-day Boats
IOTC	Indian Ocean Tuna Commission
IUU Fishing	Illegal, Unreported and Unregulated Fishing
kg	Kilogram
km	Kilometer
LKR	Sri Lanka Rupees
MCS	Monitoring, Control and Surveillance
MFARD	Ministry of Fisheries and Aquatic Resources Development
mt	Metric Ton
NARA	National Aquatic Research Agency
nm	Nautical Mile
NPOA-IUU fishing	National Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
NPV	Net Present Value
PV	Present Value
UN	United Nations
USA	United States of America
USD	United States Dollars
VMS	Vessel Monitoring System

Executive Summary

The marine fisheries sector plays an important role in Sri Lanka's economy as a major source of foreign exchange, as well as providing livelihoods for coastal communities. The main destination of Sri Lankan fish exports is the European Union (EU). Sri Lanka is committed to combating Illegal, Unreported and Unregulated fishing (IUU fishing). However, in October 2014, the EU imposed a ban on the importation of raw and processed fish from Sri Lanka to the Union, due to the failure to take substantial measures to prevent IUU fishing activities. The Government of Sri Lanka has taken several technical measures to address the EU's red card by demonstrating its national and international commitments since 2015. The EU announced on May 2016, that the red card was being lifted in recognition of the efforts undertaken by the Sri Lankan Government to prevent IUU fishing activities.

As per a market review of economic literature related to the fisheries sector, the demand for fish is growing strongly and continuing. The EU countries, the US and Japan are the three major import markets in the global fish trade. The world's fastest growing economies of China, South Korea and India have also become emerging fish markets in the Asian region for the global fish trade. Furthermore, demand for high value sustainable fishery products has been increasing in the global fish market in recent years. The main product categories are Tuna, Swordfish, Marlin and other fish species. Sri Lanka's fish export is constituent with a larger portion of Tuna and Billfish from the total quantity exported over the past period. Sri Lanka has an opportunity in the global fish market to focus on sustainable product markets through the managing of marine ecosystems and fish stocks.

The current Monitoring, Control and Surveillance (MCS) system in Sri Lanka comprises of a number of tools which include; inspections, observers, port samplers, a satellite based vessel monitoring system, institutional arrangements such as the High Seas fisheries monitoring unit and the investigation unit for supporting the MCS system. The Sri Lankan Government has realized the need to strengthen the existing MCS system for the sustainable management and conservation of fishery resources. Hence, the FAO project on "Capacity building to prevent, deter and eliminate Illegal, Unreported and Unregulated fishing (IUU fishing)" which provides capacity building assistance to the Government of Sri Lanka, to ensure long term conservation of fishery resources and continued access to markets through combating IUU fishing. This project has identified that one of the areas that need capacity strengthening is economic studies related to the costs of fisheries management and sustainability. The cost benefit analysis on the current MCS system is therefore, undertaken to strengthen the capacity of the above aspects, and identify the best possible ways to minimize the cost of implementation as well as to provide recommendations for policy adjustment.

The estimated benefits and costs including the MCS cost borne by the public sector was assessed by discounting to derive the net present value of benefit gained from the large pelagic fisheries within EEZ and High Seas in Sri Lanka. The results of the cost benefit analysis reveal that the sum of the net present value of benefits (NPV) is positive. This positive value can be described as a good sign of positive outcomes in the implementation of the current MCS system and tools for the future. The positive value of net benefit (NVP) reveals that the current MCS system and its tools (MCS programme) can be efficiently supported for this industry. Furthermore, since the ratio of benefits to costs is more than 1, it shows that the benefits are higher than the cost. The proportion of net present value of benefits to present value of benefits (resource rent) is around 19 percent of the estimated

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total landed catch value. Hence, this contribution of resource rent is substantial for the industry. It is quite clear from these results that implementation of the MCS system and tools are beneficial for the marine fisheries industry of Sri Lanka.

The implementation of the current MCS system will positively impact the economic benefit of large pelagic fisheries within the EEZ and High Seas, by opening a strong gateway to the export markets for sustainable fisheries products and will subsequently contribute to the economy of Sri Lanka. Therefore, it is a wise economic decision for the government to invest in further strengthening the MCS activities, in order to increase its efficiency and effectiveness for sustainable fisheries management in Sri Lanka. This is because it is an important contributor to the food and nutritional security of the country, as well as a source of livelihoods for thousands of people living in coastal communities. Therefore, it can be concluded that the implementation of a sound MCS system and tools can bring a win-win situation with multiple benefits in terms of economic, social and ecological benefits for the country.

1. Introduction

1.1 Background

The marine fisheries sector plays a pivotal role in Sri Lanka's economy as a major source of livelihoods for coastal communities and as a foreign exchange earner. The marine fisheries sector of Sri Lanka comprises of coastal and offshore fisheries. Approximately 85 percent of the total capture fisheries production comes from marine fisheries (Fisheries Statistics 2015, MFARD). The country has exported 26 320 tonnes of fish and fishery products in 2014 and the total export value was LKR 34.7 billion (USD 2 313 million). The main destination of Sri Lankan fish exports is the European Union (EU). Nearly 42 percent of the country's fish exports has been to the EU in 2013.

Sri Lanka has remained committed to combating Illegal, Unreported and Unregulated fishing (IUU fishing). However, the EU informed the country in 2012 of the possibility of being identified as a non-cooperating third country, after having considered the extent of IUU fishing activities taking place within Sri Lanka and by vessels flagged to Sri Lanka and operating on the High Seas. In fact, the EU imposed a ban on the importation of raw and processed fish from Sri Lanka to the Union in October 2014, for failing to discharge the duties incumbent upon it under international law. Sri Lanka was failing to comply with IOTC and other international management and conservation agreements which have been ratified by the country for combating IUU fishing activities. However, since 2015 the Government of Sri Lanka has taken several technical measures to address the EU's red card by demonstrating its national and international commitments. In recognition of the efforts undertaken by the Sri Lankan Government, in May 2016, the EU announced that the red card was being lifted.

The country has realized the need to strengthen the existing Monitoring, Control and Surveillance (MCS) system and mechanism for conservation and sustainable fishery resources management. Thus, several actions have been taken by the Sri Lankan Government to fulfill this commitment in combating IUU fishing. In this context, the Government of Sri Lanka has requested FAO to provide the capacity building assistance, which will enable the Government to strengthen its capabilities to effectively implement its NPOA-IUU fishing and regain its market access. The FAO project on "Capacity Building to prevent, deter and eliminate Illegal, Unreported and Unregulated fishing (IUU fishing)" provides capacity building assistance for the Government of Sri Lanka, to ensure long-term conservation of fishery resources and continued access to markets through combating IUU fishing.

The current MCS system in Sri Lanka comprises of a number of MCS tools including; inspections, observers, port samplers, satellite based vessel monitoring system, institutional arrangements such as the High Seas fisheries monitoring unit and investigation unit for supporting the MCS system. The implementation of the current MCS system with these MCS tools is a comprehensive process for sustainable fisheries resource management. However, it is still necessary to strengthen the capacity gap in implementation. On the other hand, the cost of implementation is also considerably very high. Thus, the project has identified that one of the areas that need capacity strengthening is economic studies related to the costs of fisheries management and the sustainability of the present system. This cost benefit analysis on the current MCS system is therefore undertaken to strengthen the capacity on the above aspects and to identify the best possible ways of minimizing the cost of implementation. It will also be taken into consideration for adjusting required policies, in order to enhance the cost effectiveness and efficiency of implementing a sound MCS system in Sri Lanka.

1. Introduction

1.2 Objective of the study

The overall objective of this study is to conduct a cost-benefit analysis of the Monitoring, Control and Surveillance system and tools that Sri Lanka has developed.

1.2.1 Specific objectives

To review the economic analyses carried out in the past and on-going work in other projects (DFAR and NARA) in order to gain a better understanding of the economics of Sri Lanka's international fisheries trade with different markets (the EU, the USA, South Asia, Southeast Asia and East Asia)

1. To specify the cost and benefit (financial and non-financial) of the prevailing MCS system in Sri Lanka
2. To conduct cost - benefit analyses of the different fleet segments within the EEZ and High Seas by gear types: a) Multi Gear, b) Gillnet and c) Tuna Longline

1.3 Scope of the study

The cost benefit analysis is mainly focused on fishing efforts in High Seas at different fleet segments targeting the export market. However, Sri Lanka has territorial waters of 30 000 sq. km (continental shelf) and an Exclusive Economic Zone of 517 000 sq. km within national jurisdiction. Therefore, this analysis is not limited to High Seas, but also takes into account the fishing efforts in the Exclusive Economic Zone (EEZ) and the quantity of the catch that caters to the export market. This analysis also intends to examine the benefit received from the local market. All registered vessels under the MCS system of DFAR and registered exporting companies have been taken into consideration for the necessary secondary data collection and estimations. The MCS cost for fishing efforts in High Seas and EEZ is considered together as a total cost of the MCS for the analysis.

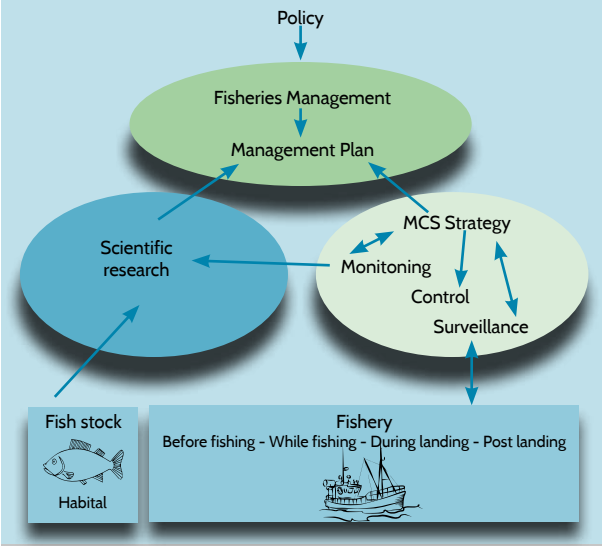

Figure 1: The main link between fisheries management and the MCS functions

Source: Food and Agriculture Organization; http://www.fao.org/docrep/005/y3427e/y3427e0a.htm

1.4 Framework for the study

Good fishery management is necessary to ensure the sustainable use of fisheries resources. A balanced approach is required for good management of fisheries resources, in order to comply with conservation-based measures. The MCS system contributes towards a good fishery management by ensuring the setting of appropriate controls, monitoring measures and processes as well as compliance mechanisms. Fisheries management plans are often based on good scientific (i.e. fish stocks) and MCS strategies that minimize the rational exploitation of the resource due to illegal fishing activities (IUU fishing). Therefore, the national policy on fisheries resource management should create an enabling environment for the implementation of MCS strategies, based on good

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science and in compliance with national and international regulations for sustainable resource use. The main link between fisheries management, science and the MCS functions is illustrated in figure 1.

1.5 The Monitoring, Control and Surveillance (MCS) system and tools developed by Sri Lanka

The concepts of Monitoring, Control and Surveillance (MCS) in fisheries management are closely interlinked and often overlapping, although they are three different concepts.

MCS is defined as follows: **Monitoring** - "the collection, measurement and analysis of fishing activity including, but not limited to: catch, species composition, fishing effort, by catch, discards, area of operations etc. This information is primary data that fisheries managers use to arrive at management decisions. If this information is unavailable, inaccurate or incomplete, managers will be handicapped in developing and implementing management measures," **Control** - "involves the specification of the terms and conditions under which resources can be harvested. These specifications are normally contained in national fisheries legislation and other arrangements that might be nationally, sub regionally or regionally agreed. The legislation provides the basis for which fisheries management arrangements, via MCS, are implemented" and **Surveillance** - "involves the regulation and supervision of fishing activity to ensure that national legislation and terms, conditions of access, and management measures are observed. This activity is critical to ensure that resources are not overexploited, poaching is minimized and management arrangements are implemented" (FAO, 2013).

The sustainability of the marine fisheries sector is facing a severe threat today. This is due to IUU fishing activities, excess fleet capacity resulting in overexploitation, natural and man-made negative impacts, increasing demand, as well as lapses in understanding the ecosystem approach to fisheries management. IUU fishing has been recognized by the world community, as one of the greatest threats to marine ecosystems and the coastal communities depending on these ecosystems. Therefore, protection and promotion of the health of the oceans within the EEZ and beyond the EEZ are essential for the nation's wellbeing. A strong Monitoring, Control and Surveillance (MCS) system and mechanism in fisheries governance is a prerequisite for sustainable fishery management. The MCS is an integrated part of good fisheries management. It provides system solution for implementation of good fisheries management. Thus, Sri Lanka is implementing MCS activities under the mandate of DFAR.

The Fisheries and Aquatic Resources Act, No. 2 of 1996 (FARA) and the Fisheries (Regulation of Foreign Fishing Boats) Act, No. 59 of 1979 (FFBA) are the two primary legislations that support the MCS in Sri Lanka. The following regulations: the Fishing Operations Regulations of 1996, the High Seas Fishing Operations Regulations of 2014, the Registration of Fishing Boat Regulations of 1980 (amended in 2011), Satellite Based Vessel Monitoring System for Fishing Boats Operating in High Seas Regulations of 2015, Fish Catch Data Collection Regulations of 2014 are derived from the Fisheries and Aquatic Resources Act, No. 2 of 1996 (FARA) for enabling legal provision in the implementation of MCS activities. The ultimate aim of the MCS system in Sri Lanka is to not only protect the resources but to stabilize the sector and optimize benefits, through a sustainable fishery resource management.

The MCS system includes MCS tools such as data collection and stock monitoring; licensing of fishing vessels; vessel monitoring system (VMS) and satellite tracking; on-shore and at sea patrolling; landing site monitoring; etc. The MCS system in Sri Lanka is currently operated by the DFAR with the following MCS tools: inspections,

observers, port samplers, VMS, institutional arrangement of high sea monitoring unit and investigation unit for supporting the MCS system. The status of the application of MCS tools in Sri Lanka is briefly described below.

1.5.1 Inspections

Implementation of inspections is twofold: port inspections for foreign fishing vessels and boat inspections for local IMUL boats. There is a well trained staff (15 port inspectors) to carry out port inspections for foreign vessels which anticipate landing at the declared five harbors in Sri Lanka. All inspections at the point of arrival and departure of these foreign fishing vessels are conducted by the port inspectors, who report to the head office of the DFAR for required action. The port inspectors closely inspect the foreign fishing vessels to ensure that they comply with the regulatory requirements (before arrival). Boat inspections for local IMUL boats take place before departure and on arrival at 21 harbors, and are conducted by fisheries field officers (boat inspectors). These boats should complete departure forms and approvals before their departures. Boat inspectors who observe log book records at arrivals and collect data, send regular reports (on a daily basis) via fax to the management division of DFAR for verification and necessary action.

1.5.2 Port sampling programme

A comprehensive port sampling programme is implemented to collect data on large pelagic fisheries in Sri Lanka. The DFAR and NARA together are involved in the data collection process on large pelagic fisheries, covering major fish landing centers, by using over 40 enumerators (port samplers). This port sampling programme covers a range of 15 percent – 18 percent of total landing and recording data on catch, effort by gear or gear combination and length by species. The methodology, sampling strategy, data collection, data storage, data handling as well as reporting, has improved during the past (National Report submitted to IOTC Scientific Committee, 2016).

1.5.3 Observer programme

The fishing fleet of Sri Lanka consists of vessels ranging from 10 m – 18 m in length. These vessels do not have the minimum requirements such as safety, accommodation and space for deploying the observers. Hence, Sri Lanka is unable to implement the national observer programme as per the Indian Ocean Tuna Commission (IOTC) Resolution 11/04. However, Sri Lanka commenced a national observer programme on a pilot basis with support from the Fisheries Improvement Project in September 2014. Twenty fisheries officers of the DFAR were trained as observers to carry out this pilot programme. Only one long line vessel (more than 24 m) from Sri Lanka carried out operations at high seas in 2015 and this vessel had two trips in the year 2015. A trained observer was deployed in this vessel for each trip (National Report submitted to IOTC Scientific Committee, 2016). Trained observers under the above project are now available in Sri Lanka.

1.5.4 Vessel monitoring system (VMS)

VMS is a tool to support the MCS system. Fishery management agencies use the VMS to track and monitor the activities of fishing vessels, for accurate and real time information about the location and activity of fishing vessels. VMS is mainly used for fisheries surveillance. Hence, VMS can monitor the movement of vessels through satellite-based technology. It consists of several components such as satellites that transmit data from the

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vessel to the Fisheries Monitoring Center (FMC), as well as equipment (e.g. Transponders etc.) which are installed in fishing vessels to provide information about the vessels' position and activity via satellite-based technology (DGS-MMAF 2010; FAO 2013).

The DFAR of Sri Lanka established a VMS unit (at Head Office, Colombo) with a satellite based VMS. This VMS unit has been operating at full scale since June 2015. This unit mainly focuses on High Seas vessels and therefore transponders have been issued only for such vessels (registered IMUL boats for High Seas operation). All High Seas IMUL boats are equipped with transponders. Currently this unit monitors 1500 IMUL boats operating in the High Seas. This VMS unit has a well-equipped FMC with sophisticated monitoring devices. Currently the FMC consists of a well trained staff: information technology officers (2), monitoring officers (10), technical officers (1) and other supporting staff. Monitoring officers are allocated on shift duty basis on 24-hour service.

The FMC closely monitors whether these IMUL boats violate fisheries rules and regulations within the EEZ and beyond the EEZ, especially at High Seas (international waters) and compile the tracking (satellite data) reports. These tracking reports are verified by the High Seas unit using log book records. Other divisions also use these tracking reports. Furthermore, if the VMS tracking indicates that any vessel is violating fisheries regulations, this unit informs other divisions via radio communication, for necessary action.

1.5.5 High Seas fisheries unit

This unit was established (at Head Office, Colombo) by the DFAR as an institutional arrangement supporting implementation of the MCS system. The log book data of all IMUL vessels in Sri Lanka are managed by the High Seas fisheries unit. This unit also plays a significant role in supporting the VMS management process. The unit analyzes VMS alerts, conducts investigations on identified IMUL vessels involved in IUU fishing activities and provides support for legal action against any IMUL vessel found to be engaging in IUU fishing. The cruise track data of the VMS are manually crosschecked with log book data, and verification reports are provided. In addition, the High Seas fisheries unit is now engaged in introducing the Electronic Catch Data Recording (E-log books) and verification system for an efficient monitoring process.

1.5.6 Investigation unit

The investigation unit (at Head Office, Colombo) of the DFAR also provides institutional support on investigations and takes action against the violation of fisheries regulations, in order to strengthen the MCS activities. This unit carries out investigations based on the reports of analysis of VMS alerts and cruise track data provided by the High Seas unit, issues related to vessels, departure without approved forms and approvals, and issues of log book entry or log book records provided by boat inspectors at fisheries harbors. After investigations, steps are taken by this unit if necessary, to proceed with legal actions against IUU fishing activities and the violation of fisheries regulations.

This section provides an economic review on the global fisheries trade, demand and supply situations at different markets along with main market requirements, as well as its competitiveness and trends in the global market. It is further extended to include a market analysis on Sri Lanka's international fisheries trade with different international markets, which include marine fish production and supply to the export and domestic markets in the recent past.

2. Sri Lanka's International Fisheries Trade

2.1 The trend of demand in the global fisheries trade

Fish is the most highly traded food commodity in the world and the demand for fish continues to grow steadily. It is one of the largest commodities in world trade by value. Fish and fisheries products account for about 10 percent of total world agricultural exports in world trade (Stephen and Abir, 2014). Table 2.1 below shows the global trends in the fish trade by imports (volume) and average annual growth from 1980 to 2010. This table is a testament to the trend of growing demand at international markets over the past three decades.

Table 2. 1 Global trends in fish trade by import volume (million tonnes) from 1980 to 2010

	1980	1990	2000	2010	Avg. Annual Growth Rate - % (1980-2010)
Total Imports	19.7	33.5	48.8	59.2	5.7
To All Developed Countries	14.6	23.8	30.5	34.2	4.3
To All Developing Countries	5.1	9.7	18.4	25	8.3

Source: FAO (2012) and Stephen and Abir, (2014)

The 59.2 million tonnes of total imports of fish in 2010 was almost triple the volume of 1980. This growing trend in the global fish trade can be attributed to several reasons such as; increased demand of consumption especially in developed countries, depletion of fish stocks in fishing waters of developed countries and technical advances in preservation, processing and transport (Stephen and Abir, 2014). There are several markets involved in the global fish trade. The major markets and top ten importers by values in USD (billion) from 2011 -2015 are given in table 2.2.

2. Sri Lanka's International Fisheries Trade

Table 2. 2 World's top ten fishery importers

Major Markets	USD (billion)				
	2011	2012	2013	2014	2015
EU Countries	25.8	23.82	25.6	27.26	24.37
Japan	18.71	17.28	14.74	14.13	12.81
USA	16.6	16.52	17.8	20.08	18.54
China	7.5	5.64	6.1	6.83	6.55
Hong Kong	3.51	3.3	3.07	3.34	3.28
Thailand	2.69	3.95	3.13	2.71	2.47
Russia	2.57	2.56	3.2	2.92	1.58
Canada	2.64	2.48	2.63	2.78	2.5
Australia	1.34	1.46	1.53	1.62	1.33

Source: INFOFISH (2016) and FAO Globefish

The EU countries, the US and Japan are the three major import markets in the global fish trade according to the value of importations. These three countries are largely dependent on fish imports from developing countries. The EU is the largest market which currently accounts for slightly more than a quarter of world fish imports and mainly caters for more than 50 percent of domestic fish consumption (AICP-CEP, 2013; Stephen and Abir, 2014). In addition, the EU is the largest single market with 28 member nations and a common regulatory system for imported fish products.

2.1.1 Emerging markets

In the recent past, Asia has become a hub of emerging markets due to fast economic growth. The world's fastest growing economies in the Asian region are China, South Korea and India. These countries are increasingly becoming the key drivers of the global economy. Robust economic growth, rising disposable income and changing consumer lifestyles, along with a strong preference for seafood are contributing towards a growing market for fish products. The demand for food fish including imports has shown a steady growth in these markets, despite the negative growth rate of many traditional western markets over the last few years. In addition, many of these emerging markets have been developed as lucrative seafood markets like the US and Europe for high value products. Hence, these emerging markets in Asia have indicated a considerable growth of fish consumption due to the rising consumer demand and better price (INFOFISH, 2016; FAO Globefish).

China and South Korea are unable to produce enough fish products to feed the growing demand within their countries. Therefore, these two countries inevitably need more imports to meet their domestic demand. As booming economies and increasing consumer demand continue in China and South Korea, new opportunities have opened for seafood exporters globally. For instance, South Korea showed a 2 percent growth in fish imports

from 2014 to 2015. Viet Nam and Thailand are important exporters to the South Korean fish market. In addition, demand is also rising in many medium and small-scale imports in the Indian fish market, even though India is traditionally not considered a fish eating nation (INFOFISH, 2016; FAO Globefish).

2.1.2. The trend in fishery products

The demand for high value fishery products has been increasing in the global fish market in recent years. The main product categories are Tuna, Swordfish, Marlin and other fish species, exported in fresh and frozen filleted forms. The global fish market encourages the purchase of sustainable fish products with value additions (high value fish products). Demand for tuna products continue to rise in the global market. Growth in consumption in new regions of the world has also arisen. Traditional canned tuna and sashimi/sushi are the two main tuna products in the markets. Bluefin and Bigeye tuna species are the main preference for the sushi and sashimi market. Increase in sushi consumption is becoming a global trend as consumer concerns about healthy food grows worldwide (Lappo, A., Bjørndal, T., Fernández-Polanco, J.M. and Lem, A. 2015). The markets for sushi and sashimi are mainly Japan, the USA and the EU countries. The tuna markets are also growing in Australia, China, South Korea and Thailand. Despite the demand for tuna products in the global market, consumer's concern on safety and sustainability may continue as the greater challenge in future market development (José Fernández-Polanco, 2017).

Furthermore, one of the high-value products in the European market is fresh tuna, of which the mainly imported species are Yellowfin and Albacore tuna. Spain, France and Italy are the top three markets for fresh tuna in the European Union. Portugal, Belgium, the United Kingdom and Italy in the European Union are also growing markets due to the rising popularity of sushi products. The imports of fresh tuna in European countries have increased by 5 percent per year on average from 2011-2015. A total of EUR 142 million of fresh tuna were imported to European countries, of which the total import of Yellowfin tuna was EUR 59 million in 2016. Hence, it is important to denote that Yellowfin tuna is the most vital tuna species for all European countries. It is mostly consumed as steaks and is available in fresh and frozen form in the market (CBI, 2017).

2.1.3. Compliances and international regulations

Exporting countries have to comply with mandatory regulations of the EU, the USA and Japan in order to export their marine fisheries products. These regulations provide mandatory quality and safety standards in production and sustainable fisheries management. The regulations of the EU, the USA and Japan are different from each other, thereby exporting countries and companies have to comply with regulations according to their export destinations. Compliance with these International Regulations is a major requirement in the international market.

The EU legislations provide enabling provision and compliance for entering the international market in European countries. The EC Directive 91/493 of 1991 is the main legislation, which necessitates member countries and importers to have in place Good Hygiene Practices and HACCP systems. EU Regulation 466/2001 sets maximum limits for heavy metals on several important species of fish. EU Regulation 2065/2001 imposes labeling requirements for wild-caught fish (Ponte, 2007). Recent EU laws relating to Illegal, Unreported and

2. Sri Lanka's International Fisheries Trade

Unregulated (IUU) fishing prevent fish products obtained from uncertified fishing vessels from entering the international market (Josupeit, 2011). Also the exporting country must establish a Competent Authority (CA) that enforces EU-like regulations and harmonizes national regulatory laws with those of the EU, to ensure that operators at all levels of the fisheries value chain comply with mandatory regulations. Furthermore, exporting countries must have legislation that ensures safety and hygiene at the same level as the EU's own legislation, prior to establishing a CA (Doherty, 2010; Stephen and Abir, 2014).

In the USA, the Federal Food, Drug and Cosmetic (FD&C) Act, the Public Health Service Act and related regulations make enabling provision a mandatory safety programme for all fish and fishery products. The USA is instituted with compliances of the HACCP system. Fish is subjected to the Food and Drug Administration mandatory inspections. Seafood quality and safety inspection is optionally provided by the National Oceanic and Atmospheric Administration of the US Department of Commerce (Stephen and Abir, 2014).

Japanese Regulations are constituent with the Food Sanitation Law and the Food Safety Basic Law. Exporters must comply with these two regulations. Food Sanitation Law bans imported foods containing potentially dangerous residues. The Food Safety Basic Law mandates a risk assessment approach, like the HACCP systems in the EU and USA. The Food Safety Commission of the Japanese government comprises of scientific experts to oversee food testing (Stephen and Abir, 2014).

2.2. Situation of supply in the global fisheries trade

The volume of global fish exports has tripled from 1980 to 2010 (Stephen and Abir, 2014). The main drivers for increased global fish exports are the diffusion of storage and packaging technology, together with improved processing methods. Processed fish contributes to 90 percent of total world trade, due to the highly perishable nature of fish commodities. China, Thailand and Viet Nam have established major fish processing industries in the Asian region to supply the global fish market and the trade (Stephen and Abir, 2014). The world's top ten fishery exporters by values from 2011 to 2015 are mentioned below in table 2.3. These fishery exporters are the major suppliers to the global fish market.

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Table 2. 3 World's top ten fishery exporters in USD (billion)

Country	2011	2012	2013	2014	2015
China	16.97	18.01	19.19	20.58	19.38
Norway	9.23	8.74	10.14	10.56	8.84
Viet Nam	6.11	6.13	6.72	7.80	na
Thailand	8.42	7.97	6.81	6.33	5.38
USA	5.12	5.45	5.56	5.73	5.54
India	3.25	3.35	4.54	5.50	4.76
Chile	4.41	3.78	4.36	5.22	4.31
Canada	4.14	4.14	4.25	4.47	4.64
Indonesia	3.18	3.58	3.82	4.23	3.29
Denmark	3.87	3.59	4.03	4.16	3.70

Source : INFOFISH (2016) and FAO Globefish

In this context, it is important to emphasize the global tuna supply situation to the global fish market, with a special focus on European countries, since it is the largest single market. The leading suppliers of fresh tuna to the European market are Spain, France and the Maldives, which together accounted for 54 percent of the fresh tuna supply to the European market in 2015. The Netherlands, Italy and the United Kingdom are the other leading suppliers to the European market. The Maldives is the leading non-European supplier of fresh tuna and accounts for 12 percent of market share of fresh tuna supply. Furthermore, it is important to denote that the Maldives has been the most important non-European Union supplier of Yellowfin tuna to the European market since 2011. Sri Lanka was the second-largest non-European supplier of tuna and fishery products with 6.4 percent of market share in 2014, before the European Union imposed a ban due to non-compliance with Illegal, Unreported and Unregulated fishing (IUU) regulations. Hence, the Sri Lankan market share in the supply dropped to 0.4 percent in 2015 (CBI, 2017).

2.3 Marine fisheries production of Sri Lanka

The marine fisheries industry plays an important role in the economy of Sri Lanka. Sri Lanka has an Exclusive Economic Zone (EEZ) of 517 000 sq. km and territorial waters of 30 000 sq. km (continental shelf). In addition, 45 major brackish water and estuaries cover an area of 158 000 ha for marine fishing (Ministry of Fisheries and Aquatic Resource Development, 2013). This marine fisheries industry can be divided into two sub sectors; coastal fisheries and offshore/deep sea fisheries. Coastal fisheries take place within the continental shelf. Fishing crafts engaging in single day operations are mainly used in coastal fisheries, and contribute to 92 percent of the entire fishing fleet of the country. In contrast, the offshore/deep sea fisheries take place outside the continental

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shelf and beyond, extending up to the edge of the Exclusive Economic Zone (Sri Lankan waters) and the High Seas (International waters). Multi-day boats/vessels (IMUL boats) operations are undertaken in this subsector. This has the fastest growth potential according to the Ministry of Fisheries and Aquatic Resource Development (2015).

Marine fish production contributes more than 87 percent of the total fish production in the country. Coastal fisheries contribute around 52 percent, while offshore/deep sea fishery contribution is around 35 percent of the total fish production (Ministry of Fisheries and Aquatic Resource Development, 2015). The contribution of coastal fisheries to the marine fish production is higher than the deep sea fisheries due to a higher number of small fishers engaged in coastal fisheries. Thus, Sri Lanka's marine fisheries sector is mainly constituent with substantial artisanal fisheries. However, it has been observed that the contribution of deep sea fisheries to the total marine fish production has gradually increased over the years in Sri Lanka. Hence, this is the most important subsector of the Sri Lankan fisheries industry in the future.

The contribution of offshore/deep sea fish production to the total fish production has increased over the last ten years in Sri Lanka. In 2015, coastal fisheries and offshore/deep sea fisheries production (by major commercial groups) is 452 890 mt according to the Fisheries Statistics Unit of the Ministry of Fisheries and Aquatic Resource Development (2017). Sri Lanka exported 11 807 mt of food fish [1] in 2015 and generated an export value of LKR 15 276 million (Fisheries Statistics, 2017). In contrast, marine fish production in 2014 was 459 300 mt with exports of 18 236 mt of food fish (Billfish, Tuna, Mackerel, Sharks and Skates and other fish), before the EU ban on fish exports to Europe was imposed. The export value generated in 2014 by food fish exports was LKR 23 230 million (Fisheries Statistics, 2016). The total quantity of production of food fish by types from 2011 to 2015 can be found in table 2.4. Sri Lanka is ranked amongst the first 50 countries in world exports, with a total share of 0.2 percent in the world fish export market. The country has significant scope to increase the level of contribution, through more tuna fishing in the High Seas and value addition.

Table 2. 4 The total quantity of production (mt) of food fish by types from 2011 to 2015

Type	2011	2012	2013	2014	2015
Tunas	81,013	90,069	91072	89,238	74,573
Billfish	14,036	11,791	12,800	10,224	11,386
Sharks	4382.3	2581	1804	1612	1214
Seer fish	812	1121	1047	1370	1697
Total	100,243	105,562	106,723	102,444	88,870

Source: National Report submitted to the IOTC Scientific Committee in 2016 based on PELAGOS database (NARA), log book database-(DFAR) & land based sampling database (DFAR/MFARD)

1. Billfish, Tuna, Mackerel, Sharks & Skates, Seer fish types and other fish are categorized as food fish by Fisheries Statistics Unit of MFARD

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2.3.1 Export market supply

The main export product categories of fish are fresh fish, frozen fish and fish fillets of Tuna, Sword, Marlin and other fish species. The major export destinations are the EU countries, the USA and Japan. Other than the above, Shark fins, fish maws, Beche-de-mer, Cuttlefish, Squid and Sprats are also exported mostly to the Asian markets. Prawns, Lobsters and other edible fish have been exported mainly to Asian countries. The exported quantity of food fish by types from 2013 to 2016 is given in table 2. 5.

Table 2. 5 Exported quantity (kg.) of food fish by types

Type	2013	2014	2015	2016
Tunas	13,137,423	15,374,115	9,845,057	8,863,042
Billfish	160,808	117,140	159,163	463,852
Sharks & Skates	-	26,510	-	-
Mackerel	24,000	3,044	92,833	29,336
Other Fish	3,107,510	2,715,201	1,392,895	1,571,207
Total	16,429,741	18,236,010	11,489,948	10,927,436

Source: Fisheries Statistics Unit of the Ministry of Fisheries and Aquatic Resource Development (2017)

Tuna and Billfish contributed largely to the quantity of total exports. The total exported quantity, especially Tuna, has reduced during the period of 2015 to 2016, due to the EU ban on the importation of raw and processed fish from Sri Lanka in October 2014. The exported quantity of Tunas and Billfish to major export destinations from 2013 to 2016 and generated values are given in table 2. 6 and 2. 7 respectively.

Table 2. 6 Exported quantity and values of Tuna from 2013 to 2016

	2013		2014		2015		2016	
	Exported Quantity (kg)	Value (LKR)	Exported Quantity (kg)	Value (LKR)	Exported Quantity (kg)	Value (LKR)	Exported Quantity (kg)	Value (LKR)
European Union	5,402,714	9,270,725,391	6,366,367	10,746,474,552	1,491,468	3,018,021,493	1,738,561	3,356,186,848
Other European	248,795	416,936,559	376,314	623,242,081	516,740	854,608,702	451,683	801,275,477
U. S. A.	2,253,480	2,873,121,902	2,947,944	4,113,717,048	3,026,584	4,969,137,609	2,782,790	5,021,995,819
Japan	2,130,607	2,035,678,601	1,044,685	973,149,714	907,950	808,349,196	294,280	273,744,429
Other Non European	3,101,827	1,997,567,052	4,638,806	3,341,837,703	3,902,314	4,037,739,403	3,595,729	4,157,385,243
Total	13,137,423	16,594,029,505	15,374,115	19,798,421,098	9,845,057	13,687,856,404	8,863,042	13,610,587,816

Source: The Statistics Unit of the Ministry of Fisheries and Aquatic Resources Development (2017)

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Table 2. 7 Exported quantity and values of Billfish from 2013 to 2016

	2013		2014		2015		2016	
	Exported Quantity (Kg)	Value (LKR)	Exported Quantity (Kg)	Value (LKR)	Exported Quantity (Kg)	Value (LKR)	Exported Quantity (Kg)	Value (LKR)
European Union	124,921	128,071,810	88,054	97,118,872	22,445	27,713,865	68,172	87,446,049
Other European	200	305,512	968	2,231,329	1,880	2,565,249	12,274	16,676,869
U. S. A.			17,952	17,108,764	61,588	51,723,401	202,644	279,422,009
Japan	22,914	24,185,530	7,104	5,327,078	67,818	42,648,206	107,297	75,234,074
Other Non European	12,773	12,260,305	3,063	3,925,239	5,432	5,821,549	73,466	47,767,872
Total	**160,808**	**164,823,157**	**117,140**	**125,711,282**	**159,163**	**130,472,270**	**463,852**	**506,546,873**

Source: The Statistics Unit of the Ministry of Fisheries and Aquatic Resources Development (2017)

Tuna accounts for 43 percent of the total fish exports from Sri Lanka. Europe is the main market for Sri Lanka's Tuna. France, Italy, Netherlands and Germany are the other main destinations. There are 31 processing establishments to process captured fisheries for exports. Out of these 31 processing establishments, a majority of them are located in the Western Province, while other processing establishments are located in the North Western and Southern Provinces. These exporting companies are currently targeting two main markets - Japan and the European Union (Ministry of Fisheries and Aquatic Resource Development, 2017).

The quantity of Billfish exports seems comparatively low from 2013 to 2015. However, the export quantity of Billfish has dramatically increased by 3 times in 2016, compared to the supply of 2015. This indicates that Sri Lanka has the potential to increase the quantity of Billfish supplied to the export market. There is an increasing demand in EU countries for sustainable fisheries products. This is an opportunity to develop sustainable marine fish production through managing of marine ecosystems and fish stocks in a sustainable way. The competitiveness of Sri Lanka's marine fishery products in the export market can be enhanced by focusing on sustainable products, which can be differentiated from the other fisheries products of rivals. Therefore, Sri Lanka can gain a competitive advantage and benefit from this development by focusing on sustainable product markets. Currently, a large extent of the total quantity supplied to the export market is Tuna fish. However, large pelagic Tuna like other species (e.g. Billfish) supply is still at a low level. Sri Lanka can focus on these products, by targeting product markets through the managing of marine ecosystems and fish stocks in a sustainable way. Sri Lanka can also develop new market linkages with aforementioned emerging markets, to enhance the export supply through sustainable fisheries resources management.

2.3.2 Domestic market supply

A large proportion of the marine fisheries production directly feeds the domestic market in Sri Lanka. It is worth to denote that the coastal fisheries industry makes the largest contribution to the domestic market. The marine fish supply chain to the domestic market consists of larger collectors or assemblers, commission agents of the wholesale market, local market distributors and retailers. The larger collectors or assemblers, buy fish directly from vessels when they come ashore and send it to the wholesale market in Colombo and other places. The commission agents in the wholesale market sell the fish to the local market distributors (the final intermediaries) and retailers.

High quality Tuna and Billfish are selected from the catch of vessels when they come ashore and are sent to exporting companies. These companies pay a higher price for high quality fish. The rest of the catch is channeled to the domestic market. The average wholesale prices of selected fresh fish species (including Tuna and Billfish types) at the main fish market in Colombo from 2012 to 2015 can be found in table 2. 8, as an example to understand the trend in price changes of fish in the domestic market.

Table 2. 8 Annual average wholesale prices of fresh fish at main fish market in Colombo (LKR/kg)

		2012	2013	2014	2015	2016	2017 (up to June)
1	Balaya /Skipjack tuna	269.00	272.00	309.00	314.00	336.84	352.14
2	Kelawalla/ Yellowfin tuna	400.00	407.00	421.00	478.00	508.06	565.71
3	Thalapath/Sailfish (Type:Billfish)	532.00	542.00	573.00	601.00	559.48	631.18
4	Thora/Seer	849.00	918	982.00	1035	1126.76	1088.83
5	Mora/Sharks	326.00	402.00	415.00	431.00	488.58	528.09
6	Paraw/Trevally (Type: other fish)	412.00	459.00	466.00	499.00	564.98	631.18

Source: Fisheries Statistics (2017), the Statistics Unit of the Ministry of Fisheries and Aquatic Resource Development

The table 2. 8 shows that the average wholesale prices of Tuna and Billfish types as well as other species have increased in the domestic market from 2012 to 2015. The costs of fishing efforts and domestic transportation, as well as the cost of ice production have increased, due to the rise in the prices of fuel and electricity in last few years. This has directly affected the prices of fresh fish in the domestic market. This situation has exacerbated with unexpected adverse weather conditions, as well as the poor catch experienced in the recent past.

3. Cost Benefit Analysis

3.1 Methodology and approach

Cost - Benefit Analysis (CBA) is a methodological framework that can be used for public policy and programme decision-making. CBA provides a method for making direct comparisons among alternative policies (Weimer, 2011). CBA is an economic technique applied to public decision making that attempts to quantify the advantages (benefits) and disadvantages (costs) associated with a particular policy, programme or project. Policy actions are evaluated based on the size of the policy benefit to all parties.

The proposed approach is to provide information that will materially assist to guide the justification (within certain limitations) for policy decision-making on current MCS system and tools, towards good fisheries management in Sri Lanka. This study involves identifying, quantifying and where possible, valuing in monetary terms the costs and benefits of the MCS system and tools. It also involves quantifying the costs and benefits of the MCS system and extrapolate that occur at different points in time on a comparable basis. Cost - Benefit Analysis requires estimates of costs and benefits to be expressed in units of currency (e.g. LKR).

3.1.1 Approach to estimate the benefits and cost

The quota given by IOTC resolutions (e.g. resolution 16/01, resolution 17/01 etc.) is considered as the total allowable catch limit. Sri Lanka's marine fish export performance dropped in 2015 and 2016 due to the EU ban. Therefore, data on export performances and catch in 2014 were considered as the base year (after consultation with DFAR) for the estimation in this cost-benefit analysis. The total number of registered vessels (for both High Seas fleets and EEZ) and total landed catch (species- wise) in 2014 was identified. The quantity of the total landed catch to the export market (through export companies) and the local market was identified based on available data in 2014 and assumed as the quantity of the total landed catch of 2017. The total value of the export quantity of fish in 2017 is estimated as benefit in 2017. In addition, the total value of the quantity of the landed catch distributed to the local market is also estimated separately, as benefit from the local market in 2017. It is also further assumed that the effectiveness of the benefits will gradually increase by 5 percent per year. Therefore, the total benefits in 2017 (total values of fish quantity supply to both export and local markets) are extrapolated over 05 years separately for the analysis.

The MCS cost components in 2016 were identified separately and estimated. Annual MCS operational cost is estimated based on the MCS cost in 2016 and extrapolated forward over 05 years separately for the analysis. The total running cost of registered vessels in 2016 was identified separately and estimated. In addition, the average cost of production per unit (LKR/kg) in 2017 was collected from exporting companies. The exported quantity of 2014 is assumed as the exporting quantity of 2017. Thereafter, the total cost of production of exported quantity in 2017 was estimated based on the aforementioned assumption. The total cost of production of exported quantity in 2017 is also extrapolated forward over 05 years separately for the analysis.

3.1.2 Data collection

Economic data pertaining to the cost and benefit of large pelagic fisheries (e.g. Tunas, Billfish, Sharks types etc.) was obtained from the DFAR and MFARD for this analysis. This data covers a period of three years from 2014 to 2016. However, production and catch data (which is more relevant for this study) was obtained from the National Report

(2016) submitted by the DFAR to the IOTC scientific committee. This National Report provides production and catch data mainly for two years from 2014 and 2015. Several individual interviews, discussions and consultative meetings were conducted during the data collection process. The checklist for data collection can be found in annex 1.

3.1.3 Assumptions

Sri Lanka's MCS system is largely impact on IUU fishing of Tuna and Billfish types in High Seas fisheries and offshore fisheries within EEZ. It is assumed that the impact of this MCS system is very little on coastal fishing activities. Therefore, the study is mainly focused on catch of Tuna and Billfish types.

The impact of MCS implementation is assumed as being directly associated with IMUL boats (Inboard Multi-day Boats) and IDAY boats (Inboard Single-day Boats), since the current MCS system targets these fleet segments. Therefore, this study considered only IMUL and IDAY boats data for estimation in the cost–benefit analysis.

It is assumed that the impact of the MCS implementation is effective in full scale from 2017 onwards. The initial investment of the MCS tools and its operational cost in 2016 were taken into consideration as initial cost without any return for the particular year 2016. Hence, it is further assumed that no other cost and benefit was generated during 2016 due to the impact of MCS implementation.

In this study, the roles of the Sri Lanka Coast Guard and Sri Lanka Navy are assumed as being one of national security and protection for all in the sea. Therefore, the cost associated with their role is omitted from the MCS cost estimation.

Sri Lanka's fish export performances dropped in 2015 and 2016 due to the EU ban. Therefore, data on landed catch in 2014 was considered as the base year for the estimation in this cost-benefit analysis.

It is assumed that both production (catch) and export quantity of Billfish type can be increased within the limitation. The exporting quantity of Tuna type can also be increased within the IOTC quota. Therefore, it is assumed that the effectiveness of the benefits will gradually increase by 5 percent per year within the IOTC resolutions and quota limits.

3.1.4 Limitations

Data of MCS costs is not available separately for EEZ and High Seas fishing. Total MCS cost includes both MCS cost of EEZ and High Seas fishing. In addition, data on quantity supplied to the export market and the domestic market from the total landed catch of EEZ and High Seas fishing is not available separately. Therefore, it is not possible to provide a separate analysis by maritime zones.

Data on landed catch, species and efforts by gear types is available for EEZ and High Seas fishing separately only for year 2014 and 2015. Gear types related catch information is not available until 2013.

There is a data gap with the national statistics on catch and species wise production until 2013, due to lapses in the data recording process.

3. Cost Benefit Analysis

3.2 Estimated monetary cost

The estimation of cost includes public sector and private sector costs. The public sector cost for this study is specific to the implementation of the current MCS system and tools, as per the national fisheries policy and regulations. The public sector cost (expenditures) on the marine fishery is a social cost for good fishery management and resource conservation in a sustainable manner for the future. However, it is difficult to quantify the costs of the public sector due to a number of reasons. Several public agencies (such as MFARD, DFAR, NARA, Sri Lanka Navy, Sri Lanka Coast Guard etc.) and their budgets are involved with this. Thus, it is difficult to obtain the accurate share of these various budgets and expenditures to the implementation of the current MCS system and tools for marine fisheries management. In addition, other costs (e.g. research) are also indirect and extremely difficult to estimate accurately. Also, there are no maritime zones or species specific budgets in the implementation of the current MCS system and tools. Therefore, available cost data has been obtained only from DFAR for this analysis, since it is the competent authority with the key mandate for the implementation of the current MCS system and tools.

3.2.1 Cost of MCS system and tools

The cost associated with MCS tools such as fisheries management cost (including port sampler cost, both port inspection and boat inspection cost, other costs etc.), cost of VMS, cost of radio communication network, cost of institutional arrangements supporting MCS, such as the High Seas fisheries unit and investigation unit, have been obtained to estimate the MCS cost in 2016 (see annex 1 for more details). The estimated cost of MCS components and the total MCS cost are as follows:

a) The cost of MCS activities in the High Seas fisheries unit, radio communication and fisheries management

It is difficult to identify the cost of MCS activities separately in the High Seas fisheries unit, radio communication unit and fisheries management (including port sampling, port inspection and boat inspection, catch documentation and reporting, awareness workshops and seminars on IUU fishing, boat registration and issuing fishing operation licenses and other costs). This is because all these cost components come under the fisheries management cost of the DFAR budget. Details of these expenditures in 2016 can be found in annex 2. The total cost related to the above activities is as follows:

Description	LKR (million)
The cost of MCS activities in the High Seas fisheries unit, radio communication and fisheries management	460.28

b) Cost of Vessel Monitoring System (VMS)

The VMS cost includes the initial cost of investment to establish FMC with a satellite based vessel monitoring system and VMS equipment, as well as the annual VMS operational cost in 2016. The details of the cost incurred with VMS in 2016 is available in annex 3. A summary of the VMS cost is given in table 3.1.

3. Cost Benefit Analysis

Table 3. 1 A summary of VMS cost

	Description	LKR (million)
i	Cost associated with VMS monitoring (Cost of land based fisheries monitoring center-FMC with a satellite based vessel monitoring system)	66.93
ii	VMS satellite equipment (Cost of Transponder etc.)	547.47
	Total initial cost of investment	614.40
iii	Total annual VMS operational cost in 2016	72.00

c) Cost of Investigation

The cost of investigation includes investigation activities carried out by DFAR district offices, as well the investigation unit of DFAR head office in Colombo. The details of cost incurred with investigation activities in 2016 can be found in annex 4. The total cost of investigation activities in 2016 is given below.

Description	LKR (million)
Total cost of investigation activities in 2016	1.42

The total cost of MCS system and tools and its implementation in 2016 is summarized in table 3. 2.

Table 3. 2 Total MCS cost and its implementation in 2016

	Description	Cost in LKR (million)
a	The cost of MCS activities in High Seas fisheries unit, radio communication and fisheries management in 2016	460.28
b	Cost of Vessel Monitoring System	
b.1	Total initial cost of investment	614.40
b.2	Total annual VMS operational cost in 2016	72.00
c	Cost of Investigation in 2016	1.42
	Total MCS cost in 2016	1148.10
	Total MCS operational cost in 2016 (a + b.2 + c)	533.70

The estimation of private costs includes the vessel running cost and the cost of production of exporting companies in 2017. It is important to note that the capital cost of companies and vessels' owners cannot be applied directly for these estimations. This is common in cost-benefit analysis. Therefore, the cost estimations do not include the opportunity cost of the equity capital of companies and vessels' owners, as well as depreciations.

3. Cost Benefit Analysis

3.2.2 Vessel running cost

The vessel running cost includes operating expenses (e.g. fuel, other), crew wages and fixed annual cost (e.g. repairs and gear). Details of the total vessel running cost estimation for all fleet segments pertaining to large pelagic fisheries (Tuna, Billfish, Sharks and Seer fish types) within the EEZ and High Seas, can be found in annex 5. A summary of estimated total vessel running costs is given in table 3. 3

Table 3. 3 Estimated vessel running cost (LKR million)

	Description	LKR (million)
a	Running Cost for vessels operated within EEZ	16938.65
b	Running Cost for vessels operated beyond EEZ (High Seas)	9664.46
c	Total Vessel Running Cost	26603.11

3.2.3 Cost of production

The cost of production at exporting company level includes cost of raw material (fish), labour, quality control, packaging, operating expenses (e.g.: electricity, telephone, security and other) and freight charges. The cost of production may vary from time to time during the year due to price fluctuations, mainly of raw materials etc. Therefore, the average cost of production per unit (LKR/kg) was collected as primary data from five exporting companies and the approximate average cost of production per unit was worked out. The details of this calculation can be found in annex 6. The total value of the cost of production (at exporting companies) in 2017 was estimated according to the average cost of production per kg above and it is given in table 3. 4 below.

Table 3. 4 Estimated total value of cost of production for expected quantity to be exported in 2017

	Expected Total Quantity (kg) in 2017	Average Cost of Production per kg (LKR)		Estimated Value of Total COP (LKR)
Tunas	15,374,115	2206	15,374,115 x 2206	33,907,918,115
Billfish	117,140	1800	117,140 x1800	3,238,848.10
Total Value (LKR)				33,911,156,963
LKR (million)				33,911.16

Extrapolated cost, with an effectiveness of cost increases by 5 percent per year, forwarded over 5 years from 2017 and estimated cost streams for the analysis can be found in table 3. 5 and 3. 6 respectively.

3. Cost Benefit Analysis

Table 3. 5 Extrapolated costs forwarded over 5 years from 2017

	Value of total cost increase by 5% per year						
	MCS Cost (LKR million)			Vessel Running Cost (LKR million)		Cost of Production (LKR million)	
	Initial cost	Operational cost	Total MCS cost		Total running cost		Total COP
2016	614.40	533.70	1148.10	-	-	-	-
2017		533.70	533.70	26603	26603.00	33911	33911.00
2018		533.7x105/100	560.40	26603 x 105/100	27933.15	33911 x 105/100	35606.55
2019		533.7x110/100	587.07	26603 x 110/100	29263.30	33911 x 110/100	37302.10
2020		533.7x115/100	613.76	26603 x 115/100	30593.45	33911 x 115/100	38997.65
2021		533.7x120/100	640.44	26603 x 120/100	31923.60	33911 x 120/100	40693.20

Table 3. 6 Estimated cost streams

Cost Stream (LKR million)	2016	2017	2018	2019	2020	2021
MCS Cost	1 148	534	560	587	614	640
Vessel Running Cost	-	26 603	27 933	29 263	30 594	31 924
Cost of Production of Exporting Companies	-	33 911	35 607	37 302	38 998	40 693
Total Cost Stream	1 148	61 048	64 100	67 152	70 206	73 257

3.3 Estimated monetary benefits

Marine fisheries in Sri Lanka takes place widely in the coastal seas, within the EEZ and a limited amount in the High-Seas area which is beyond the EEZ. Traditional coastal fishing mainly focuses on neritic tuna and associated fish species within the continental shelf (40 km distance from the shore). Offshore fisheries occur beyond the continental shelf within the EEZ (up to 200 nm from the shore), as well as High Seas beyond the EEZ by targeting tuna and tuna like fisheries. Inboard motor boats which range from 8 m to 24 m in fleet size operate in offshore and High Seas fisheries. The table 3. 7 gives the total number of registered vessels (national fleet structure) operating in the EEZ and High Seas for large pelagic fisheries in 2015. This fleet structure includes Inboard Multi-day Boats (IMUL) and Inboard Single-day Boats (IDAY).

3. Cost Benefit Analysis

Table 3. 7 Total number of registered vessels operated in the EEZ and High Seas

	IMUL Boats -2015			
	Boat Type	Total # of Boats Registered for Large Pelagic Fishery	Vessels Operated within EEZ	Vessels Operated Beyond EEZ (High seas)
a	10 m -10.3 m	1750	1750	-
b	10.3 m -15 m	2458	874	1558
c	15 m - 24 m	25	07	18
d	More than 24 m	01	-	01
	Total	**4234**	**2631**	**1577**
	IDAY Boats -2015			
d	8 m – 10 m	789	789	

Source: Vessel Registry - DFAR and National report (2016) submitted by DFAR to the IOTC Scientific Committee

The total landed catch from IMUL boats and IDAY boats are considered for this CBA, since there is a direct impact of implementation of MCS associated with these fleet segments. Sri Lanka's MCS tools are mainly focused on this fleet structure. Gillnet was the mostly used fishing gear for large pelagic fisheries targeting Skipjack and Yellowfin tuna in offshore and High Seas. Longline and Gillnet-long line combinations are also used in offshore and High Seas. Ring net is used especially for coastal seas, targeting neritic tuna and associated fish species. The contribution of each fishing gear type to the total fishing effort in 2015 is given in table 3. 8 below.

Table 3. 8 The contribution of fishing gear types for the total fishing effort

Fishing Gear type	Contribution to the total fishing effort
Gillnet	53%
Longline	10%
Longline and Gillnet-long line combination (Multi-Gear)	17%
Ring nets	20%

Source: National Report (2016) submitted by DFAR to the IOTC Scientific Committee

The large pelagic fisheries are a multi-species and multi-gear fishery in Sri Lanka. The estimated total landed catch by species and gear types within the EEZ and High Seas from 2014 – 2015 is given in annex 7 and 8 respectively. The estimated total landed catch altogether (both EEZ and High Seas) by species can be found in annex 9. These estimations were made by the DFAR based on the analysis of recorded data from their boat-

sampling programme at fisheries harbors. A summary of the total landed catch (EEZ and High Seas) is presented in table 3. 9 below.

Table 3. 9 A summary of estimated total landed catch (mt)

Type	2014			2015		
	EEZ	High Seas	Total Landed Catch	EEZ	High Seas	Total Landed Catch
Tuna	66405	22832	89238	57777	16794	74573
Billfish	6635	3588	10224	9573	1813	11383
Seer fish	922	488	1370	1523	281	1697
Sharks	1126	485	1612	864	362	1214

Source: National Report (2016) submitted by DFAR to the IOTC Scientific Committee

3.3.1 Expected total quantity and estimated values for year 2017

The total landed catch (table 3. 9) and exported quantity in 2014 is considered as the base year for this CBA. As indicated in table 2. 6 of the previous chapter, Sri Lanka's marine fish export performances dropped in 2015 and 2016 due to the EU ban. Therefore, the total exported quantity of 2014 is assumed as the total quantity of 2017, which is expected to be exported. Hence, the value of this quantity is estimated on the following basis.

The competition between Sri Lanka's fish exporting companies is substantial. These exporting companies maintain a very competitive price margin (markup) based on the unit cost of production, by aiming to export a high volume of quantity with a low price margin per unit. Therefore, the price margin per kg ranges between USD 0.5/kg and USD 1/kg (as per the interview conducted with a few fish exporting companies on 14.08.17). In this study, the price margin based on the cost of production is considered as USD 1/kg for the estimation of total export value given below.

Average Selling Price/unit (at export market) = Average Cost of Production/unit + Price Margin/unit

Type	COP/kg (USD)	Price Margin/kg (USD)	Selling price/kg (USD)	Selling price/kg (LKR)*
Tunas	14.51	1	15.51	2358.00
Billfish	11.84	1	12.84	1952.00

* 1 USD = 152 LKR (August 2017)

The estimated value of the total expected quantity of 2017 to be exported is given in table 3. 10.

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Table 3. 10 Estimated value of the total expected quantity of 2017 for the export market

	Expected Total Quantity (kg) in 2017	Average Selling Price (LKR) 2017		Estimated Value (LKR)
Tunas	15,374,115	2358.00	15,374,115 x 2358	36,252,163,170
Billfish	117,140	1952.00	117,140 x1952	228,657,280
Total Value (LKR)				36,480,820,450
(LKR million)				36480.82

The quantity supplied to the domestic market in 2017 is also calculated based on the total landed catch of the base year 2014 (total landed catch of 2017 is assumed as total landed catch of 2014) and is given in table 3. 11 below. The conversion rate of fish is between 45 percent and 50 percent when loining and other processing for the export market. Furthermore, the conversion rate depends on both the size of the fish and the cutting method used by processing companies (according to the post harvesting division of NARA, 2017; Noel Taylor, 2008). The conversion rate of fish is considered as 50 percent for the below estimation.

Table 3. 11 Estimated quantity supplied to the domestic market distribution in 2017

Type	Total Catch (EEZ +High Seas)* MT x 1000 = (kg)	Expected Total Quantity (kg) to be Exported	Total Quantity Required for Export Processing (with 50% Conversion rate)	Total Quantity Supplied to Domestic Market (Total catch - Total Quantity Required for Export Processing- kg)
Tunas	89,238,000	15,374,115	30,748,230	58,489,776
Billfish	10,224,000	117,140	234,280	9,989720
Seer fish	1,370,000	0	0	1,370,000
Sharks and Skates	1,612,000	0	0	1,612,000

* As per Annex 9

The total value of the domestic market supply is calculated using annual average wholesale prices in 2017 (as per table 2. 8 of previous chapter). Annual average wholesale price per kg of Yellowfin tuna was considered for all tunas in this calculation. The estimated value of domestic supply in 2017 (based on the landed catch from IMUL and IDAY boats in 2014) is given in table 3. 12. This is the expected estimation of total benefit from the domestic market supply in 2017.

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Table 3. 12 Estimated value of domestic supply to domestic market in 2017

	Total Quantity of Supply to Domestic Market (kg)	Annual Average Wholesale Price* per kg in June 2017 (LKR/kg)	Total Value (LKR) (Total Quantity of Supply to domestic market X Annual Average Wholesale Price per kg)	
			LKR	LKR (million)
Tunas	58 489 776	565.71	33088251181	33088.25
Billfish	9 989 720	631.18	6305311470	6305.31
Seerfish	1 370 000	1088.83	1491697100	1491.70
Sharks and Skates	1 612 000	528.09	851281080	851.28
Total Value			41 736 540 831	41 736.54

* Fisheries Statistics (2017), the Statistics Unit of the Ministry of Fisheries and Aquatic Resources Development

Estimated benefits (both export market and domestic market earnings) are extrapolated forward over 5 years from 2017. It is assumed that the effectiveness of the benefits will gradually increase by 5 percent per year. Therefore, the total benefits in 2017 (total values of fish quantity supplied to both export and local markets) are extrapolated forward over 5 years from 2017 separately for the analysis. Extrapolated benefits (export earnings and domestic market earnings) from 2017 to 2021 and a summary of the estimated total benefit stream are given in table 3. 13 and 3. 14 respectively for the analysis.

Table 3. 13 Extrapolated benefits from 2017 to 2021

Year	Export Market (increase, by 5% per year)		Domestic Market (increase, by 5% per year)	
		Benefit Value LKR (million)		Benefit Value LKR (million)
2017	36480.82	36 480.82	41736.54	41 736.54
2018	36 480.82 x 105/100	38 304.86	41736.54 x 105/100	43 823.37
2019	36 480.82 x 110/100	40 128.90	41736.54 x 110/100	45 910.19
2020	36 480.82 x 115/100	41 952.94	41736.54 x 115/100	47 997.00
2021	36 480.82 x120/100	43 776.98	41736.54 x 120/100	50 083.85

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Table 3. 14 Estimated total benefit stream

Benefit Stream	2017	2018	2019	2020	2021
Benefit from export market (LKR million)	36 480.82	38 304.86	40 128.90	41 952.94	43 776.98
Benefit from domestic market (LKR million)	41 736.54	43 823.37	45 910.19	47 997.00	50 083.85
Total benefit (LKR million)	78 217	82 128	86 039	89 949	93 860

3.4 Analyzing the cost and benefit of the MCS system in Sri Lanka

This study employed a simple method of calculating the cost benefit for the analysis using Net Present Value (NPV). Net Present Value is the difference between the present values of current benefits to the present value of costs (MCS cost, vessel running cost and cost of production in exporting companies). NPV indicates net benefits received from implementing the MCS system over a forwarded period at a certain discount rate (r).

Having estimated the costs and benefits in monetary terms, it becomes necessary to express monetary amounts in present value terms (PV) by discounting the cost and benefit flows. All costs and benefits are therefore discounted using a discount rate that is assumed to be the real rate of interest (r). The present value of cost or benefit (X) received at time (t) is calculated as follows:

$$PV(X\ t) = X\ t\ [(1+r^{-t}\ )]$$

As highlighted earlier, the main purpose of the CBA is to evaluate the MCS system and tools in its efficiency in terms of resource use. Determining the efficient use of resources is achieved by applying the Net Present Value (NPV) test. The NPV test is computed by way of summing up the discounted total benefits and discounted total cost. If the sum of NPV is positive, then the policy, programme or project can be referred to as being efficient according to Hanley and Spash (1998). The function of net present values to be used is mentioned below.

$$\sum NPV = \sum B\ t\ (1+r^{-t}) - \sum C\ t\ (1+r^{-t})$$

Where B = benefits (gains) and C = costs

The estimated flow of costs and benefits was computed and the results of the analysis are given in table 3.15.

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Table 3. 15 The results of the cost benefit analysis

Year		2016	2017	2018	2019	2020	2021
Cost Streams (LKR million)							
MCS Cost		1,148	534	560	587	614	640
Vessel Running Cost		-	26,603	27,933	29,263	30,594	31,924
COP of Exporting Companies		-	33,911	35,607	37,302	38,998	40,693
Total Cost Streams (LKR million)		1148	61,048.00	64,100.00	67,152.00	70,206.00	73,257.00
Benefit streams (LKR million)							
Benefit from exports market		-	36480.82	38304.86	40128.90	41952.94	43,776.98
Benefit from domestic market		-	41736.54	43823.37	45910.19	47997.00	50083.85
Total Benefit Streams (LKR million)			78,217.0	82,128.0	86,039.00	89,949.00	93,860.00
Net Benefit Stream		-1,148.00	17,169.00	18,028.00	18,887.00	19,743.00	20,603.00
Net Present Value (NPV) (LKR million)		53,359.38					
Present Value of cost (PV) (LKR million)		222,269.74					
Present Value of benefits (PV) (LKR million)		284,781.03					
B/C ratio		1.28					
Resource Rent (Economic Rent)		18.74%					
Discount Rate	15%						
Guess Rate for IRR	8%						

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This analysis focuses on the current economic value. All estimated benefits and costs including social cost (MCS cost of fisheries management by public sector) were assessed by discounting, to derive the net present value of benefit gained from the large pelagic fisheries within the EEZ and High Seas in Sri Lanka. The results in the table 3. 15 reveal that the sum of the net present value of benefits is positive. This positive value can be projected as a good sign of positive outcomes in the implementation of the current MCS system and tools in future. Hanley and Spash (1998) have provided evidence by indicating that if the sum of NPV is positive, then any programme can be referred to as being efficient. Hence, the positive value of net benefit (NVP) indicates that the current MCS system and tools (MCS Programme) can be efficiently supported for this industry in Sri Lanka.

The numerical results of the analysis in table 3. 15 further reveal that the ratio of benefits to costs is more than 1 (nearly 1.3), which means benefits are higher than the cost. Therefore, it is quite clear from these results that implementation of the MCS system and tools are beneficial for the industry of marine fisheries in Sri Lanka.

However, the estimated MCS cost reveals that a large percentage of the total MCS cost is required annually for implementation of activities in High Seas fisheries, radio communication and fisheries management, as a public cost. The operational cost of VMS is also comparatively substantial as a public cost. The percentage of cost for investigation activities is comparatively low. Furthermore, the estimated annual cost of production at exporting companies' level is very high. One of the main reasons is the very high cost of fishing efforts (annual running cost of vessels). This may cause for the change of the business interests against cost of capital, opportunity cost and expected incentives in exporting companies in the long run, unless authorities take necessary policy measures for adjustments in the economy.

The results in the table 3. 15 further indicates that the proportion of net present value of benefits to present value of benefits (resource rent), is around 19 percent of the total harvested value (landed catch). Hence, this contribution of resource rent is considerable for the industry and subsequently to the economy of Sri Lanka. This indicates that implementation of the current MCS system and tools contribute to generate a substantial resource rent in the industry of marine fisheries, through sustainable fisheries resource management. Therefore, it is a wise economic decision for the government to invest in further strengthening the MCS activities, to increase its efficiency and effectiveness for sustainable fisheries management in Sri Lanka. However, the resource rent depends on factor conditions such as the limitation of a natural resource (fish stock and IOTC quota) and the cost of development (public cost of fisheries resource management) and the producers' cost (cost of fishing efforts and cost of production at exporting companies). Resource rent may vary from year to year due to changes in these factor conditions. Therefore, sustainable fisheries resources management is indispensable to a substantial resource rent.

3.5 Analyzing the non - monetary benefits of the MCS system in Sri Lanka

This cost-benefit analysis was used to evaluate the total anticipated costs of MCS activities to the total expected benefits, in order to determine whether the implementation of MCS tools and activities is economically viable for sustainable fisheries management in Sri Lanka or any alternative cost reduction. The cost-benefit analysis listed all potential costs that are incurred and all anticipated benefits. Hence, it is possible to determine whether the positive benefits of fisheries management outweigh the negative costs of the MCS system in monetary

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terms. However, in the case of implementing the MCS strategy and policy for sustainable fisheries management, there are additional factors that must be taken into consideration such as social and ecological benefits. These are not listed in the anticipated financial benefits in the above. Therefore, a qualitative approach was employed to specify these non-financial benefits against the same MCS cost estimated in monetary terms.

Social and ecological benefits are identified at High Seas and the EEZ by reviewing relevant past and ongoing studies, as well as discussions with experts and scientists at related organizations (e.g.: DFAR, NARA etc.). Identified non-financial benefits were clustered into social and ecological benefits separately, by eliminating the duplication. These clustered benefits were categorized into a dashboard table indicating low, medium and high level of benefits with a color code, for better visual illustration in table 3. 16.

Table 3. 16 Non-monetary benefits of MCS tools implementation

Non – Monetary Benefits	EEZ	High Seas
Ecological benefits		
• Conservation of eco system: biodiversity and eco system services		
• Target fishing through resource mapping and utilizing resources in a sustainable manner		
• Reduction of marine pollution by fishing activities		
• Increase regeneration and fish stocks		
• Increase the production with low harvesting efforts		
Social benefits		
• Food and nutritional security		
• Ensuring livelihoods of coastal communities		
• Enhancing the wellbeing of coastal communities		
• Effective demarcation of fishing areas and reduction in user conflicts		
• Sea-safety		
• Stabilization of catch per boat and income		
• Reputation of good fishery management and ethical values		

Benefit level	Low	Medium	High
Color indicator			

The table 3. 16 shows that there are a number of high positive non-financial benefits and sentimental values in terms of ecological and social benefits through a good fishery management. It is important to denote that implementation of the MCS system and tools also contribute to the conservation of the ecosystem, such as biodiversity and maintaining of ecosystem services, reduction of pollution in marine ecosystems and maintaining the regenerating function of fish species (fish stocks). Factors such as its contribution to national food and nutritional security, as well as providing a number of livelihood opportunities for coastal communities and their wellbeing are also significant, even though these benefits are yet to be quantified.

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3.6 Conclusion

The economic benefit of large pelagic fisheries is a positive contribution to the industry of marine fisheries in Sri Lanka. The resource rent of the large pelagic fisheries within the EEZ and High Seas is substantial and it is around 19 percent of the total landed catch value.

Thus, the implementation of the current MCS system will positively impact the economic benefit of large pelagic fisheries within the EEZ and High Seas, by opening a strong gateway to the export market for sustainable fisheries products, which will subsequently contribute to the economy of Sri Lanka. On the other hand, it contributes to sustainable fisheries management in Sri Lanka. Furthermore, it is an important contributor to the food and nutritional security of the country, as well as providing a source of livelihoods for thousands of people who live in coastal communities. Therefore, implementation of a sound MCS system and tools can bring a win-win situation with multiple benefits in terms of economic, social and ecological advantages for the country. The following recommendations are made for further strengthening the process of sustainable fisheries management in Sri Lanka.

3.7 Recommendations

1. There is a good demand for sustainable fisheries products in the export market. The government aims at increasing the marine fishing production through increasing the capacity of vessels and reducing post harvesting losses. Sri Lanka can achieve this goal by further strengthening the MCS system and tools, to develop marine ecosystems and fish stocks in a sustainable way, by targeting sustainable product markets in the EU and other countries. Therefore, fisheries policies in the future need to be more focused on sustainable fisheries products and sustainable product markets, in order to gain a competitive advantage and enhance the competitiveness of Sri Lanka's marine fishery products in the export market.

2. It is important to address information gaps on the status of fisheries resources (by large pelagic species), especially the commercially important fish stocks and their exported quantities separately, from High Seas and the EEZ fisheries and other economic data. Design and develop a relational database with spatial and non-spatial data that can be used to strengthen the traceability in the MCS system further. Technical assistance and training on database management are required for the DFAR staff.

3. In policy adjustment, it is better to consider measures and practices to reduce the cost of implementation of activities in High Seas fisheries, radio communication, and fisheries management, to enhance the resource use efficiency. Therefore, it is necessary to explore further cost reduction strategies in implementation of activities in High Seas fisheries, radio communication and fisheries management and advocate for necessary policy decisions.

4. Estimated annual cost of production at exporting companies' level is very high due to the extremely high cost of fishing efforts (annual running cost). Therefore, it is required to advocate for necessary policy adjustment to enhance the economic efficiency, through reducing the cost of production in fishing efforts, for the long term benefit and sustainability of this industry.

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5. It is possible to develop a system to recover the cost of MCS implementation, through collecting a substantial part of resource rent, without impacting the incentives of the exporting companies. The cost of MCS can be gradually transferred to the beneficiaries through this system, in order to make the MCS system sustainable.

6. It is important to revisit the current organizational supporting arrangements for the implementation of the MCS system in DFAR, streamline all related functions and establish one particular division for MCS operations. All supporting units for the MCS system can be placed under this particular division to strengthen the coordination further. It is recommended that the current VMS system be strengthened further, in order to assist in the establishment of multiple channels of communication, which can provide information to the fisher community.

7. The DFAR cannot practice MCS in isolation and thus, coordination among stakeholders is essential. In this regard, an important approach to MCS is to foster a strong local awareness on the need for conservation and management through preventing IUU fishing activities. However, there is no separate section currently available at the DFAR for the provision of training and awareness. It is therefore recommended that a separate training section be established under the DFAR in order to carry out training and awareness programmes for local communities.

References

References

Hanley, N. and Spash, CL. (1998). Cost Benefit Analysis and the Environment. Cheltenham, UK: Edward Elgar Publishing Limited.

José Fernández-Polanco, (2017). http://www.fao.org/in-action/globefish/fishery-information/resource-detail/en/c/880744/

Josupeit, Helga. (2011). "Challenges to Sub-Saharan African Fish Exports." Third Workshop On Fish Technology, Utilization And Quality Assurance In Africa. FAO, 2011. 157-70.

Lappo, A.; Bjørndal, T.; Fernández-Polanco, J., and A. Lem, (2015). Consumers' concerns and external drivers in food markets. Fisheries and Aquaculture Circular No. 1102. FAO, Rome, Italy.

Stephen Golub and Abir Varma, (2014). Fishing Exports and Economic Development of Least Developed Countries: Bangladesh, Cambodia, Comoros, Sierra Leone and Uganda. Paper Prepared for UNCTAD by Swarthmore College, Pennsylvania, United States.

Weimer, D. L. (2011). Cost- Benefit Analysis Concept and Practice. New Jersey, USA: Prentice Hall.

Yugraj Singh Yadava & Rajdeep Mukherjee (Eds.)(2009). Report of the National Workshop on Monitoring, Control and Surveillance in Marine Fisheries – Sri Lanka, November 2009, Pages 92

AICP-CEP, (2013).

CBI, (2017). The Centre for the Promotion of Imports from developing countries, Netherlands. Available at: https://www.cbi.eu/market-information/fish-seafood/fresh-tuna/

Central Bank Annual Report, (2015)

FAO, (1981). Report of an Expert Consultation on Monitoring, Control and Surveillance Systems for Fisheries Management. FAO Report FAO/GCP/INT/344/NOR

FAO, (2013). Food and Agriculture Organization of the United Nations (FAO). [December 2012] <www.fao.org: http://www.fao.org/fishery/topic/3021/en>

DGS-MMAF, (2010). Annual Report - The Directorate General of Surveillance. Jakarta: Ministry of Marine Affair and Fisheries.

Ponte, Stefano. (2007. "Bans, Tests, and Alchemy: Food Safety Regulation and the Uganda Fish Export Industry." *Agriculture and Human Values* 24 (2007): 179-93.

Performance Report, (2015). Ministry of Fisheries and Aquatic Resource Development, Colombo, Sri Lanka

INFOFISH, (2016). 31st INFOFISH Governing Council Meeting 20-23 December 2016 Kuala Lumpur, Malaysia http://www.srilankabusiness.com/pdf/sea-food-ebrochures/1-Market-Review.pdf

FAO Globefish: Available at: http://www.fao.org/in-action/globefish/en/

Annexes

Annex 1: The check list of data collection

Economic data pertaining to benefits:

- Total number of registered vessels (for both High Seas Fleets and EEZ) in 2015
- The quantity of the total landed catch (species-wise) to export market (through export companies) and local market in 2014
- Total value of fish quantity (species-wise) exported in 2014
- Total value of fish quantity (species-wise) supplied to local market in 2014

Economic data pertaining to cost:

The MCS cost and private cost (which includes average vessel running cost per vessel and a unit cost of production) was considered as cost data:

MCS Cost in 2016

1. Fisheries management costs: (Cost of issuing fishing operation licenses, Cost of registering local fishing boats, Cost of training of personnel in FMC, Cost of commencing legal proceedings and Cost of awareness workshops and seminars on IUU fishing, Catch documentation and reporting costs)
2. Costs associated with inspection: (Includes sea inspection, port inspection or inspection of facilities on land)
3. Operational Cost of Radio Communication Unit: (Cost of a radio communication network to facilitate communication between fishing boats and district fisheries offices or FMC Communication Unit)
4. Operational Cost of High Seas Monitoring Unit
5. Operational Cost of the investigations unit
6. Cost for port samplers

Private cost

- Average running cost per vessel according to fleet segments
- Cost of production of the exporting company in 2016

Annexes

Annex 2 : Expenses related to MCS activities in High Seas fisheries unit, radio communication and fisheries management

Sub Projects	Object Code	Items	Fund	Category/Object Title	2016 Actual	Expenses related to MCSU/ MGT/ High Seas LKR (million)
				RECURRENT EXPENDITURE		
				Personal Emoluments		
	1001			Salaries and Wages	144,507,813	110.00
	1002			Overtime and Holiday Payments	5,999,169	1.50
	1003			Other Allowances	154,881,044	120.00
				Travelling Expenses		
	1101			Domestic	5,378,685	1.20
				Supplies		
	1201			Stationery and Office Requisites	6,761,675	2.50
	1202			Fuel	5,195,532	2.00
	1205			Others		
				Maintenance Expenditure		
	1301			Vehicles	2,752,094	
	1302			Plant, Machinery and Equipment	1,393,007	0.50
	1303			Buildings and Structures	144,537	
				Services		
	1401			Transport	94,900	0.01
	1402			Postal and Communication	4,715,731	2.20
	1403			Electricity and Water	7,066,656	3.00
	1404			Rents and Local Taxes	1,378,578	0.60
				Transfers		
	1505			Subscription and Contribution fees (MCSU)	186,861	0.19
				Rehabilitation and Improvement of Capital Assets		
	2001			Building and Structures	19,140,181	6.00
	2002			Plant, Machinery and Equipment	740,890	3.00

Annexes

Sub Projects	Object Code	Items	Fund	Category/Object Title	2016 Actual	Expenses related to MCSU/ MGT/ High Seas LKR (million)
				RECURRENT EXPENDITURE		
	2003			Vehicles	4,082,813	0.30
				Acquisition of Capital Assets		
	2102			Furniture and Office Equipment	13,042,963	10.00
	2103			Plant, Machinery and Equipment (MCSU)	1,996,400	2.00
	2104			Buildings and Structures	13,486,947	2.00
				Capacity Building		
1	2401			Staff Training	1,380,293	0.20
				Other Capital Expenditure		
	2502			Training & awareness	2,392,924	2.39
7	2502			Introduction of 55' boats with new technology		48.00
	2502			Financial support to purchase equipment - CFC		110.70
	2502			Financial support to purchase equipment - CFHC		32
				Total		460.29

Annexes

Annex 3 : The cost of the Vessel Monitoring System

1	Cost associated with VMS monitoring (Cost of land based fisheries monitoring center - FMC with a satellite based vessel monitoring system)		Cost (LKR)	LKR million
a	FMC Server hardware items including VPN connection and Server UPS	Euro 31000 x 158*	4898000	4.898
b	Installation of software, consultancy & training	Euro 25000 x 158*	3950000	3.95
c	vTrack software license	Euro 295000 x 158*	46610000	46.61
d	Oracle database license (4 CPU License)	Euro 72600 x 158*	11470800	11.47
	Sub Total		66928800	66.93
2	**VMS Satellite equipment (Cost of Transponder etc.)**		**Cost (LKR)**	**LKR million**
a	Thrane & Thrane 6140 mini C maritime transceivers with land mobile alert capability + Alarm panel + 12-24V DC power supply battery + Configuration of 6140 mini-C transceivers include function test	Euro 3225000 x 158*	509550000	509.55
b	Installation of Transceivers on board vessels (Including maintenance cost for two years after the installation)	Euro 240000 x 158*	37920000	37.92
	Sub Total		547470000	547.47
	Total Initial Coast		614398800	614.40

3	VMS Operational cost		Cost (LKR)	LKR (million)
a	Satellite charges (Monthly) 200x1500x0.08 USD	USD 24000 x145** x 12	41760000	41.76
b	Server hosting (Monthly)	LKR 149000 x 12	1788000	1.80
c	Software license (Annual)	USD 120000 x 145**	17400000	17.4
d	Oracle database license (Annual)	USD 15400 x 145**	2233000	2.23
e	VPN Charge (Monthly)	LKR 95000 x 12	1140000	1.14
f	Internet service charge (Monthly)	LKR 3000 x 12	36000	0.04
g	Telephone service charge (Monthly)	LKR 2500 x 12	30000	0.03
	Sub total		64,357,000	64.36
4	Cost of staff of VMS operation (Salary of staff) approximately LKR 640 000 per month	LKR 640,000 x 12	7,680,000	7.68
	Total annual operational cost		72,037,000	72.04

Rate of Sri Lankan Rupee Exchange on the 31st December 2015

* 1 EUR = 157.5920 LKR

** 1 USD = 145.0230 LKR

Annexes

Annex 4 : Total expenses of each fisheries district and investigation unit in 2016 for raids of illegal fishing activities

	District	Fuel	Transport	Labour cost	Food	Other	Total
1	Killinochchi	36,576	129,500	16,000	8,620	0	190,695
2	Trincomalee	37,500	133,000	54,250	11,310	815	236,875
3	Puttalam	14,160	66,350	15,000	0	0	95,510
4	Mullaitivu	1,200	84,000	23,000	5,400	2,600	116,200
5	Jaffna	3,000	163,800	0	14,395	0	181,195
6	Mannar	6,000	7,500	0	0	0	13,500
7	Kalmunai	0	33,000	24,000	0	1,360	58,330
8	Matara	3,380	41,500	10,750	3,035	0	58,665
9	Chilaw	0	40,000	11,200	0	0	51,200
10	Batticaloa	0	6,000	13,000	0	0	19,000
11	Tangalle	6,000	50,0000	3,000	0	0	59,000
12	Negombo	2000	5,650	500	16,180	13,020	37,350
	Cost of Investigation unit		Monthly @ 25,000/= x 12				300,300
	Total Cost of Investigation Activities LKR						1,417,820
	Total Cost of Investigation Activities LKR (milion)						1.42

Source : Investigation unit of DFAR, (2017)

Annex 5 : Estimated vessel running cost

Boat Type	Vessels Operated within the EEZ			Vessels Running cost LKR (million)
	# of Vessels	Annual Cost/Vessel (LKR)	# of Vessels x Annual Cost/ Vessel	
10 m-10.3 m (28-32 Ft)	1750	4,712,684	1750 x 4,712,684	8247.20
10.3 m -15 m (33-40Ft)	874	6,116,825	874 x 6,116,825	5346.11
15 m - 24 m (41-60Ft)	07	7,074,995	07 x7,074,995	49.53
More than 24 m	-	-	-	-
8 m -10 m (IDAY Boat)	789	4,177,200	789 x 4,177,200	3295.81
Sub Total				16938.65
	Vessels Operated Beyond EEZ (High seas)			
10 m -10.3 m (28-32 Ft)	-	-	-	-
10.3 m -15 m (33-40Ft)	1558	6,116,825	1558 x 6,116,825	9530.01
15 m - 24 m (41-60Ft)	18	7,074,995	18 x 7,074,995	127.35
More than 24 m	01	7,074,995	01 x 7,074,995	7.10
Sub Total				9664.46
Total Vessel Running Cost (EEZ + High Seas)				26603.11

This estimation is based on the following Average Vessel Running Cost data as per Socio-economic Survey of NARA in 2016.

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	28-32 Ft			33-40 Ft			41-60 Ft		
	Cost per trip	Annual Cost	%	Cost per trip	Annual Cost	%	Cost per trip	Annual Cost	%
Labour	112247	2357177	50	233572	3036436	50	381672	3435044	49
Fuel	62605	1314705	28	124566	1619358	26	237405	2136645	30
Food	19548	410508	9	53552	696176	11	83337	750033	11
Preservative	16336	343056	7	39750	516750	8	61352	552168	8
Other cost	13678	287238	6	19085	248105	4	22345	201105	3
Total variable cost	224414	4712684	100	470525	6116825	100	786111	7074995	100
Number of Trips per year	21			13			9		

IDAY fishing boats
Trip duration – 1 day
Number of crew members – 3 to 4
Number of trips per month – 19 days

Annual Maintenance cost = LKR 175 800
Operation cost per trip = LKR 17 550
Annual Operational cost per IDAY Boat (17,550 x 19 x 12) = LKR 4 001 400
Annual cost = 4 001 400+175 800 = LKR **4 177 200**
Source: Socio-economic Survey/SED/NARA/2016

Annex 6 : Average cost of production of exporting companies

Type	Cost of production per kg (COP/kg) in USD - 2014					Average COP/kg in USD	Average COP/ kg in LKR
	Company 1	Company 2	Company 3	Company 4	Company 5		
Tuna	11.75	17.06	12.95	11.56	19.25	14.51	2205.52
Billfish	10.25	15.86	11.45	10.6	11.06	11.84	1799.68
Shark	Assumed as same as COP of Billfish					11.84	

Source : Primary data collected from 05 companies and calculation based on collected primary data
1 USD = 152 LKR

Annexes

Annex 7 : The estimated total landed catch within EEZ by species and gear types from 2014-2015 (MT)

Species	Gillnet		Longline		Ringnet		Handline		Trolling		Total Landed Catch	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
TUNA												
Skipjack	32,185	21909	588	1,072	5915	9,578.8	7.3	42	20	137	38715	32,739
Yellowfin	6,789	5,074	8360	8,924	2455	3,424	484	208	58	204	18146	17,834
Bigeye	75	18	687	2,664	56	2	38	77	-	-	856	2,761
Frigate tuna	2,232	141	-	-	1933	520	0.2	7	12	-	4177	668
Bullet	1,684	764	169	10	1474	1,910	0.2	0.2	-	0.2	3327	2,683
Kawakawa	853	557	13	6	270	409	4	6	6	5	1146	984.3
Other tuna	5	9	7	9-	25	-	-	0.2	-	-	37	105
Total Tunas Catch	43,824	28,472	9824	12,772	12127	15,843	533	341	96	346	66405	57,777
BILLFISH												
Swordfish	434	447	2087	3,739	7	6	9	45	0	-	2537	4,238
Sailfish	1013	1,124	685	579	3	3	24	7	19	4	1745	1,717
Blue Marlin	106	198	124	280		4	0.1	5	-	-	230	488
Marlin (unidentified)	50	51	247	159	-	-	0.2	-	-	-	297	211
Striped marlin	1	2.5	4	2.2	-	-	1	-	-	-	6	5
Short-billed spearfish	1.3	-	-	-	-	-	-	-	-	-	1.3	-
Total Billfish Catch	2115	2,2434	4424	7,207	10	17	67	96	19	9	6635	9,573
SEERFISH												
Wahoo	415	92	24	27	-	149	72	2.3	1	1.0	512	272
Spanish												
Other Seer	68.4	108		-	1	-	22	3.2	-	-	91	219
SHARKS												
Silky Shark	254	135	613	348	36	45	15	0.8	-	-	918	529
Blue Shark	35	15	46	124	-	-	-	-	-	-	81	139

Annexes

Species	Gillnet		Longline		Ringnet		Handline		Trolling		Total Landed Catch	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Oceanic												
Shortfin mako	6.2	6.1	3	23	-	-	-	-	-	-	9	29
Scallop hammerhead	4	5	9	17	-	-	-	-	-	-	13	22
Smooth hammerhead	7	4	-	16	-	-	-	-	-	-	7	20
Spot-tail	10	-	-	-	-	-	-	-	-	-	10	-
Longfin mako	4.2	3.6	8	4.5	-	-	-	-	-	-	12	8
Great hammerhead	2.4	4.7	2	-	-	-	-	-	-	-	4.4	4.7
Other sharks	22.2	1.0	13	3.0	-	-	0.4	0.2	-	-	35.6	4.2
Whale shark	-	2.4	-	-	-	-	-	-	-	-	-	2.4
Total Sharks Catch	368	241	707	577	36	45	15.5	1.0	0	-	1126	864

Source : National Report (2016) submitted to the IOTC Scientific Committee 2016 based on PELAGOS database (NARA), log book database-(DFAR) & land based sampling database (DFAR/MFARD)

Annexes

Annex 8 : The estimated total landed catch beyond EEZ (High Seas) by species and gear types from 2014-2015 (MT)

Species	Gillnet		Longline		Ringnet		Total	
	2014	2015	2014	2015	2014	2015	2014	2015
TUNAS								
Skipjack	9144.2	6320	222.2	191	570	751	9936.4	7263
Yellowfin	1589.7	1131	8624.9	5934	167.1	109	10381.7	7374
Bigeye	11	51	1731.9	1763	0	37	1742.9	1851
Frigate tuna	36	46	0	0.2	25.1	266	61.1	312
Bullet	42	5.5	0	8	519.2	25	561.2	38
Kawakawa	117	46	24	1.3	6	51	147	98
Albacore	2	4.3	0	40.5	0	13	2	58
Total Tunas Catch	10,942	7,605	10,603	7,937	1,287.4	1,252	22,832	16,794
BILLFISH								
Swordfish	136	69	1,615	760	-	4.7	1,751	834
Sailfish	208	81	378	151	2	0.4	588	232
Black Marlin	169	51	968	432	0	-	1,137	483
Blue Marlin	47	1.6	33.9	233	0	-	83	234
Marlin (unidentified)	17	23.5	0	2.6	0	1.8	17	27
Striped marlin	3	0.1	11	2.8	0	-	14	3
Short-billed spearfish	0	0	0	-	0	-	-	-
Total Billfish Catch	580	226	3,006	1,580	2	6.9	3,588	1,813
SEER FISH								
Wahoo	421.1	260	1	6.8	0	10.9	428	277.7
Spanish Mackerel	21	1.5	3.2	0.3	0	1.6	24	3.4
Other Seer	2	-	0	-	0	-		-
Total Seer Fish Catch	444.1	261.5	4.2	7.1	0	12.5	448	281
SHARKS								
Silky Shark	15	114	187	106	2	1.4	204	221.4
Blue Shark	48	24.7	74	42	0	0.2	122	67
Oceanic Whitetip shark	0	-	42	0.1	0		42	0.1
Shortfin mako	5	6.6	27.1	12.4	0	-	32	19

Annexes

Species	Gillnet		Longline		Ringnet		Total	
	2014	2015	2014	2015	2014	2015	2014	2015
Smooth hammerhead	0	15.6	11	9	0	-	11	24.6
Spot-tail	0	-	0	-	0	-	-	-
Longfin mako	2	1.5	0	-	0	-	2	1.5
Great hammerhead	0	-	0	-	0	-	-	-
Other sharks	51	12.5	1	2	0	1.5	52	15.8
Whale shark	0	-	0		0	-	-	
Total Sharks Catch	131	185	352	181.5	2	3.1	485	369

Source : National Report (2016) submitted to the IOTC Scientific Committee 2016 based on PELAGOS database (NARA), log book database-(DFAR) & land based sampling database (DFAR/MFARD)

Annex 9 : The estimated total landed catch (EEZ and High seas) by species from 2014-2015 (MT)

Species	Total (MT)	
	2014	2015
TUNAS		
Skipjack	48,652	40,001
Yellowfin	28,528	25,009
Bigeye	2,598	4,612
Frigate tuna	4,239	980
Bullet	3,889	2,722
Kawakawa	1,293	1,082
Albacore	-	57
Other tuna	39	109
Total Tunas Catch	89,238	74,573
BILLFISH		
Swordfish	4,288	5,072
Sailfish	2,333	1,949
Black Marlin	2,957	3,397
Blue Marlin	311	722
Marlin (unidentified)	314	238
Striped marlin	20	7.6

Annexes

Species	Total (MT)	
	2014	2015
Short-billed spearfish	1	-
Total Billfish Catch	1370	1697
SEER FISH		
Wahoo	935	549
Spanish Mackerel	342	1,036
Other Seer	93	111
Total Seer fish Catch	1370	1697
SHARKS		
Silky Shark	1122	750
Blue Shark	203	207
Oceanic White tip shark	78	87
Shortfin mako	41	49
Scallop hammerhead	33	42
Smooth hammerhead	18	44
Spot-tail	10	-
Longfin mako	14	9.6
Great hammerhead	4	4.7
Other sharks	88	19
Whale shark	0	2.4
Total Sharks Catch	1612	1214

Source : National Report (2016) submitted to the IOTC Scientific Committee 2016 based on PELAGOS database (NARA), log book database-(DFAR) & land based sampling database (DFAR/MFARD)

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