Action Plan for Hsin-Kang Mahi Mahi Fisheries Improvement Project (FIP)

Prepared by
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I. Introduction

The Hsin-Kang Fishermen Association launched Mahi Mahi (*Coryphaena hippurus*) Fishery Improvement Project in June 2015. With the assistance of the Overseas Fisheries Development Council of the Republic of China (OFDC), the pre-assessment of Hsin-Kang mahi mahi fishery has been completed in November 2015, to evaluate the gap between the current fishery and well-recognized sustainable fisheries standard. The action plan is drawn up based on the result of pre-assessment to meet with the requirements for Hsin-Kang mahi mahi fisheries improvement.

The pre-assessment of Hsin-Kang mahi mahi fishery is conducted by using the certification standards set forth by the Marine Stewardship Council (MSC). Starting from 1998, the MSC has revised its certification methods and standards for many times to improve the credibility of such certification. This project has applied the MSC General Certification Requirement 2.1 adopted on October 1st, 2014 and became effective on September 1st, 2015. The certification standards have three major principles as the follows:

- Principle 1: A fishery must be conducted in a manner that does not lead to over-fishing or depletion of exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.
- Principle 2: Fishing operations should allow the maintenance of the structure, productivity, function and diversity of ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.
- Principle 3: The fishery is subject to an effective management system that respects local, national and international law and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

In accordance with the pre-assessment report finished in November 2015, there are five major issues to be improved in the Hsin-Kang mahi mahi fishery, including:

- To improve data collection;
- To establish harvest control rules and tools;
- To develop management strategies for primary species, secondary species, ETP species and ecosystem;
- To clearly define the roles and responsibilities of stakeholders, the management objectives of the fishery; and
- To clearly define the management policy, objectives and the decision-making process.

The main objective of this action plan is to improve Hsin-Kang mahi mahi fishery on those items that are not meeting with the MSC principles. The contents of this action plan will include information on the priority of each action, its current status, implementing schedules, etc, with the expectation to facilitate the Hsin-Kang mahi mahi fishery to meet with the MSC certification standards, so as to ensure the sustainable operation of this fishery.

This document serves as a guideline for Hsin-Kang mahi mahi fishery to moving toward to sustainable operation. In the future, specific detailed actions and their implementing schedule and budget needed should be further developed, for the relevant stakeholders responsible for that action to implement accordingly. In addition, the results generated from this action plan should be reviewed periodically to ensure they will meet the international recognized sustainable targets.

II. Action Plan for Hsin-Kang Mahi Mahi Fishery Improvement Project

1. Actions under Principle 1 of the MSC

The performance indicators under Principle 1 could be categorized into two subjects: (1) outcome (stock status) and (2) harvest strategy. Among which, the theme of stock status can be further sorted out with stock status and stock rebuilding; the theme of harvest strategy can be further sorted out with harvest strategy, harvest control rules & tools, information/monitoring and assessment of stock status.

In accordance with the result of pre-assessment to Hsin-Kang mahi mahi fisheries, there are four items under Principle 1that need to be improved, namely harvest strategy, harvest control rules & tools, information on targeting species, and assessment of stock status, so as to meet with the standards as set forth by the MSC. To this end, current improving actions are planned as the follows: (1) to define stocks and develop procedures for stock assessment; (2) to develop harvest control strategy.

(1) To define stocks and develop procedures for stock assessment

The mahi mahi is a highly migratory species, which can be found in three major oceans and has been exploited by many countries. According to the statistics of the Food and Agriculture Organization (FAO) of the United Nations, the top three countries by the mahi mahi catch amounts are Peru, Taiwan and Ecuador respectively, which shows that this species has higher exploitation rate in the Pacific Ocean than others. In order to have better understandings on the stock structure and biological characteristics of mahi mahi, the stock of this species must be clearly defined so as to conduct stock assessment and management. For such purpose, the following implementing measures will be adopted in this action plan:

A. Definition of stocks

In order to achieve the objective of understanding the phylogenetic relationship between mahi mahi in Eastern Taiwan and in other regions of the Pacific Ocean, the following measures, including genetic factors analysis and mark-recapture research (tagging program), will be implemented:

(A) Genetic factors analysis

The research on deoxyribonucleic acid (DNA) sequencing will certainly be helpful to understand the phylogenetic relationship between mahi mahi in Eastern Taiwan and in other regions of the Pacific Ocean. The existing studies on mahi mahi DNA sequencing in the international academic society include researches on genetic diversity among different samplings regions in the

Pacific Ocean, researches on genetic diversity between Hawaii waters and offshore Mexico, and researches on genetic structures of stocks in Taiwan neighboring waters. Some researches indicate that the mahi mahi in the Pacific Ocean has no significant genetic difference thus it is probably a single stock. However, there is no well-recognized conclusion for genetic stock structure researches by employing different genetic research methods. Therefore, it is necessary to conduct genetic factors analysis to have better knowledge on the stock structure of mahi mahi.

Fish samplings will be conducted in fish market and mitochondrion collected from fish samples will be used to analyze the characteristic of its DNA sequencing, so as to learn about the genetic structure of mahi mahi in Eastern waters of Taiwan.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University and the OFDC
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜24 months
MSC Performance Indicator(s)	PI 1.2.3 Information/Monitoring

(B)Mark-recapture research (tagging program)

Mark-recapture research (tagging program) is quite helpful to understand the migratory route, distribution and growth of fish species. Tagging programs have been used in international researches on tuna species generally and achieved fruitful results. Therefore, it is expected that such research method may also be of assistance to obtain fisheries information of mahi mahi, which is also a highly migratory species.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, other research institute and the OFDC
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜48 months
MSC Performance Indicator(s)	PI 1.2.3 Information/Monitoring

B. Development of fisheries data collection and verification mechanism

According to the result of pre-assessment for Hsin-Kang mahi mahi fisheries, the data collection system for the fisheries has not been well developed, thus the current data collected are insufficient to conduct further

stock analysis and establish management strategy. Therefore, the following measures should be developed to improve the data collection system of Hsin-Kang mahi mahi fisheries:

(A) Collection of fisheries-dependent data

Fisheries-dependent data is collected from the fishery itself on fishing vessel or at point of sale, including location of fishing operation (longitude and latitude), fishing gear, fishing area, landing amount, bycatch information, catch sampling and operational cost, etc. Through the integration of the abovementioned data, it would be helpful to understand the status of specific fishery resources, thus a complete stock assessment would be feasible for the establishment of appropriate management strategy.

In order to obtain sufficient fisheries data for Hsin-Kang Mahi Mahi fisheries, data collection mechanism, such as fishing logbook, port sampling, landing declaration, and observer program, will be carried out under this action plan.

- Fishing logbook: fishing logbook is the record of fishing operation filled in by fishermen with fixed format to collect data on fishing operation (such as operating date, starting and ending operation time, location of hauling (longitude and latitude), length of float line length, branch line length, average length between branches, number of operating persons, number of hooks deployed), catch data (such as number and weight of targeting and bycatch species) and other information (such as information on loss of fishing gear). In order to ensure the correctness and recovering rate of fishing logbook, the design of logbook should be simplified to the extent possible as long as necessary data will be collected, and exclude those information that may be obtained from other approaches, so as to minimize the disturbance that may be caused to fishermen.
- Port sampling: Trained researchers or samplers will measure the fish length and conduct biological sampling for the purpose of genetic factors analysis and stock assessment.
- Landing declaration: Landing declaration is one of most commonly used tool for fisheries management, which monitor the catch amount and the relevant information through that fishermen fill report and declare the information on catch caught by their fishing vessels and landed in ports, so as to ensure the compliance of the relevant law, regulations and conservation and management measures. Landing declaration, which is required to be filled out pursuant to the regulations adopted by the competent fisheries authorities , is one of the official documents with legal effects that may be complementary to the insufficiency of data submitted by fishermen voluntarily.
- Observation record of onboard observer: Due to the facts that fishermen are quite busy during fishing operation and generally do

not have sufficient knowledge on incidental catch species, in spite of that fishermen may have intention and willingness to fill out fishing logbook and landing declaration, the fisheries data collected may still be lack of necessary information because of insufficient time to recording or incapable to indentify incidental catch species. Therefore, there is a need to plan and implement observer program and dispatch observer onboard to observe fishing operation at sea and collect relevant information on fishing vessel, incidental catch, sea turtles, seabirds and other environmental factors, so as to supplement the possible shortcoming of information collected by fishing logbook and landing declaration.

Through the collection of abovementioned data, it is expected to obtain information such as catch efforts, species composition, length frequency, age of sexuality mature, and spawning area of mahi mahi, etc, thus fisheries data can be collected for the purpose of stock assessment.

Key Stakeholders	Fishermen participating in the FIP, the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the OFDC, Hsin-Kang Fishermen Association, and the Fisheries Agency
Priority	High
Status	New (Not being carried out yet)
Timeframe	<24 months(the fishing logbook and landing declaration will be implemented as priority, and other measures will be implemented and information will be collected in a progressive manner)
MSC Performance Indicator(s)	PI 1.2.3 Information/Monitoring

(B) Collection of fisheries-independent data

In ordinary circumstance, when conducting fisheries stock assessment, it would usually need to initiate field research to collect environmental information, biological data, species composition, species distribution, abundance, and financial information, so as to evaluate the stock biomass, fishing rate and financial variation. Such fisheries-independent data may be collected by tagging program, as well as by research vessel or other research project. Therefore, in the future, the research team for mahi mahi resources may be further expanded by inviting the relevant research unit like Fisheries Research Institute, Council of Agriculture, for the collection of such data.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, other research institute and the OFDC
Priority	Medium

Status	New (Not being carried out yet)
Timeframe	＜48 months
MSC Performance Indicator(s)	PI 1.2.3 Information/Monitoring

(C) Establishment of data collection procedure and database

A well-established data collection procedure and an integrated database would be helpful to fisheries stock assessment and monitoring of fisheries resources. At the current stage, the Hsin-Kang mahi mahi fishery has not established a systematical data retrieving and maintenance system. It is suggested that the fisheries authorities may by themselves or assign specialists or institute to carry out such business, for the purpose of fishing activities monitoring and fisheries resources assessment. The database should include, but not limited to, fishing logbook, port sampling data, landing declaration, observer record, and other data that may be relevant.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC
Priority	High
Status	New (Not being carried out yet)
Timeframe	＜12 months
MSC Performance Indicator(s)	PI 1.2.3 Information/Monitoring

(D) Establishment of port inspection and reporting mechanism

The main tasks of port inspection and reporting include record fishing vessels port entry/exit information, inspect and report catch relevant information, verify landing declaration and assist in port inspection on alleged fishing vessels in violation. In the future, the scope of the mechanism may be expanded to cross-check the content of catch reporting and landing declaration, so as to more effectively monitor the fishing mortality.

Key Stakeholders	Fishermen participating in the FIP, the Fisheries Agency, and the Taitung County Government
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜24 months
MSC Performance Indicator(s)	PI 1.2.3 Information/Monitoring

C. Stock assessment

According to the result of pre-assessment for Hsin-Kang mahi mahi fisheries, there are various of stock assessments conducted in Taiwan for mahi mahi fisheries stock. However, there is not any institute constantly tracking the status of this species, and the latest research report was published in 2010. Due to the fact that the past stock assessments indicating mahi mahi in Taiwan is in healthy status, thus fisheries management authorities have not adopted substantial management measures to this fishery. Nevertheless, there is still a need, as indicated by the MSC standard for harvest strategy, to establish a robust and precautionary harvest strategy in response to the possibility of stock variation. Therefore, it is recommended to continue to track and analyze the stock status of Hsin-Kang mahi mahi fisheries, thus there may be a more solid ground to adopt management measures in the future.

(A) Analysis on standardization of relative stock abundance indicators

It is recommended to utilize available data (such as data extracted from voyage data recorder) to standardize the catch per unit effort (CPUE) of mahi mahi by applying the general linear model (GLM). It is also recommended that data on environmental factors (such as water temperature, surface chlorophyll concentration, etc) of surrounding waters of Taiwan should be collected to analyze the relationship between the CPUE of mahi mahi and the environmental factors, and put environmental factors into consideration during CPUE analysis.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC
Priority	High
Status	New (Not being carried out yet)
Timeframe	＜12 months
MSC Performance Indicator(s)	PI 1.2.4 Assessment of stock status

(B) Analysis on length frequency and age structure

It is recommended to use length sample collected over the years and collected by port sampling under the FIP action plan to analyze the length frequency and age structure (using ELEFAN or Multifan model), to re-evaluate the growth parameter and analyze whether there is temporal variation of growth parameter among the years, and to determine the age composition ratio of mahi mahi in the past years based on the result of analysis.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC
Priority	High

Status	New (Not being carried out yet)
Timeframe	＜24 months
MSC Performance Indicator(s)	PI 1.2.4 Assessment of stock status

(C)Preliminary assessment of stock status

It is recommended to employ the adaptive framework-virtual population analysis (VPA) with the data of catch age composition and CPUE, to combine data of catch age composition and relative stock abundance indicators. As the result, it can be used to review stock abundance in the past years and the trend of fishing mortality variation.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜36 months
MSC Performance Indicator(s)	PI 1.2.4 Assessment of stock status

(D) Full assessment of stock status

After combined the data of catch amount, length, and standardized CPUE serial trend over the past years, it is planned to employ stock synthesis (SS) model to conduct stock assessment. The SS model can integrate various fisheries investigation data, including catch amount, stock abundance indicators, CPUE, age and length composition and discard amount. It is highly flexible to integrate data from various resources to conduct evaluation and analysis. The result of the SS model can be used to analyze the trend of variation on biomass, spawning biomass, fishing mortality and other indicators, as well as to estimate reference information that can be used for management, such as maximum sustainable yield, as the basis of making control rules.

Key Stakeholders	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜48 months
MSC Performance Indicator(s)	PI 1.2.2 Harvest control rules and tools; PI 1.2.4 Assessment of stock status

(2) Development of harvest control strategy

The harvest control strategy is the combination of several conservation and management measures with the aims to maintain stock at a higher production level. Such conservation and management measures may include fishing closure, limit of fishing gear (such as the size of hooks), catch quota management, etc. The setting up of fishing closure may protect juvenile fishes from harm made by harvesting before they become recruitment; limit of fishing gear may increase the selectiveness on the catch size and prevent from harvesting juvenile fish with smaller size; the establishment of catch quota management may control the catch exploitation rate and protect the resource from being over-exploited.

A. Development and implementation of conservation and management measures

Based on the current knowledge on Hsin-kang mahi mahi resources, the stock has not been over-exploited. Therefore, the conservation and management measures may be modulated the result of stock assessment. In principle, these measures may be developed toward the following objectives:

(A) Restriction on fishing gear or method: To prohibit the use of fishing gears or methods that may cause irreversible harm to the biological environment, such as bottom longline or trawler.
(B) Restriction on minimum size of catch: Juvenile fish that has not reached sexual maturity should be released alive or restricted with maximum allowable amount.
(C) Restriction on fishing efforts: In spite that the fishery resource is not overfishing or overfished, as a precautionary approach, the total number and tonnage of licensed fishing vessels should be limited at the current level, which should not be increased without sufficient scientific support.
(D) Education and training of fishermen: To give guidance to fishermen on the concept of sustainable fisheries and possible approaches to reach such goal.

Key Stakeholders	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜36 months
MSC Performance Indicator(s)	PI 1.2.1 Harvest strategy; PI 1.2.2 Harvest control rules and tools

B. Development and implementation of harvest control rules

In order to achieve the MSC standard, it is necessary to establish harvest control rules and to implement accordingly. Harvest control rules mean to restrain the exploited rate of specific fisheries resources in accordance with the limit or target reference points as established. In this regard, limit or target reference points are essential information for harvest control rules, which should be decided by best available scientific information and the result of stock assessment. For the implementation of harvest control rules, it is necessary to adopt measures to monitor the resource abundance variation and fishing mortality. When the fisheries resource is below reference points or fishing mortality is above the reference points, measures should be taken to increase the resources abundance or decrease the catch amount, so as to maintain the resources at safety margin.

For Hsin-Kang mahi mahi fishery, the primary objective is to conduct stock assessment for the species to determine appropriate limit reference point as the management target. Furthermore, all stakeholders should collectively decide a set of pre-agreed measures to take immediate actions (such as total allowable catch, individual vessel quota or other measure that may decrease fishing mortality) while the mahi mahi exploited rate exceeds the limit reference point, thus the resources could be utilized in a sustainable manner.

Key Stakeholders	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜36 months
MSC Performance Indicator(s)	PI 1.2.1 Harvest strategy; PI 1.2.2 Harvest control rules and tools

2. Actions under Principle 2 of the MSC

The performance indicators under Principle 2 could be categorized into five subjects: (1) primary species; (2) secondary species; (3) ETP (endangered, threatened and protected) species; (4) habitats; and (5) ecosystem. This principle requires that fishing operations should allow for the maintenance of the structure, productivity, function and diversity of ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

In accordance with the result of pre-assessment to Hsin-Kang mahi mahi fisheries, the following subjects under Principle 2 has not reached the sustainable standards: insufficient data collection for secondary species, ETP species and ecosystem; lack of management strategy or if any, existing information is not sufficient to prove its effect. In order to rectify the above shortcomings, it is planned to improve on the following subjects: (1) improvement on relevant data collection; (2) establishment of management strategy based on information collected and evaluation on its effect; (3) educational training.

(1) Improvement on relevant data collection

At the current stage, Hsin-Kang mahi mahi fishery relatively lacks of information on secondary species, ETP species and ecosystem.

Secondary species mean those species that are neither targeting species of the fishery, nor endangered, threatened and protected fish, shellfish, amphibians, reptiles, birds and mammals, which are incidentally catch or by-catch of the fishing operation. Such species usually are hard to assess stock status due to lack of sufficient available and usable data, thus no management measures are adopted. In fact, because that the secondary species caught by fishing vessels may be various, it is not practical to manage all the species involved. With such contexts, the MSC sustainable standard simply require to manage the “primary” secondary species, which are those species accounting for 2% or above of the total catch. By such definition, there is no primary secondary species in the Hsin-Kang mahi mahi fishery. Nevertheless, there is still need to collect the relevant information, so as to ensure the sustainability of secondary species.

As for the ETP species, even though the authority of Taiwan has adopted management strategy and measures for such species, insufficient data collection still results in lack of credible basic information to prove the effectiveness of such management strategy. Therefore, there is still need to enhance the collection of relevant information to further evaluate whether the management strategy is effective.

Ecosystem refers to at the within a specific and limited time and space, the interaction among living organisms and non-living components through nutrient cycles and energy flows, which are composed of non-living environment, producers, consumers and decomposers. For the reason that information on ecosystem is difficult to collect, there are not many researches or studies on marine ecosystem in Taiwan. It is recommended that information on interaction between fishing activities and spatial information on ecosystem, information on fishing days, information on the direct influence of fishing activities to ecosystem, as well as information on nutrients structure and species composition, should to collected as basis of future evaluation.

A. Reporting on relevant data of primary species, secondary species, ETP species and ecosystem

In order to collect accurate information, in addition to record primary species on the fishing logbook, fishermen also need to record complete information on other species caught, including non-fish living creatures such as seabirds and sea turtles, to facilitate the follow-up researches.

Key Stakeholders	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University
Priority	High
Status	New (Not being carried out yet)
Timeframe	＜12 months
MSC Performance Indicator(s)	PI 2.1.3 Primary species information; PI 2.2.3 Secondary species information; PI 2.3.3 ETP species information; PI 2.5.3 Ecosystem information

B. Establishment and implementation of observer program

Observer program can collect not only fishing operation information for mahi mahi fishery, but also information on the interaction between mahi mahi fishery and secondary species and ETP species. The purpose of such program include: (1) to collect information on composition of non-retained species, which can be used to cross-verify with fishing logbook filled in by fishermen to confirm the scope of primary and secondary species; (2) to collect the number and characteristic of incidental catch of seabirds, sea turtles and sharks; (3) to observe the interaction between mahi mahi fishery and non-retained species; (4) to evaluate and monitor the effect of seabirds and sea turtles mitigation measures. To this end, before observers are dispatched onboard, they should be trained for professional species identification and filling-in of fishing logbook.

<u>Primary and secondary species</u>

In accordance with the landing and trade data from the Hsin-Kang fish market, one of the primary species of Hsin-Kang mahi mahi fishery is large-sized sharks, which are not recorded by specific shark species. In consideration that the stocks of shark are of concerned in the international community in recent years, there is need to have observer onboard to observe and record information on how mahi mahi fishing vessels deal with shark catches, on whether there are discards or special processing methods, as well as on the main shark species caught. In addition, observers can also collect data such as length frequency for further stock assessment and future management.

Seabirds

By the foreign and domestic research and studies, very few large-sized seabirds appear in the surrounding areas of Taiwan. However, from interviews with fishermen for Hsin-Kang mahi mahi FIP, it is mentioned that there are some seabirds bycatch during fishing operation, but the specific species cannot be identified. Because lack of relevant record and information, it is difficult to determine whether and how fishing activities of Hsin-Kang mahi mahi fishery may affect the conservation of seabirds. Therefore, it will be helpful to collect seabirds relevant information through observer onboard, to retrieve information such as the raito of bycatch, status of bycatch species (alive or dead).

Sea Turtles

Among the five protected sea turtle around the world, four of them have appeared in the surrounding waters of Taiwan. Although the authorities of Taiwan has adopted conservation and management measures of sea turtles, the relevant information on interaction between Hsin-Kang mahi mahi fishery and sea turtles is still insufficient. Therefore, it is necessary to collect the relevant information through observer program to understand whether the existing management regulations have good effect on the conservation of sea turtles.

Key Stakeholders	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜36 months
MSC Performance Indicator(s)	PI 2.1.3 Primary species information; PI 2.2.3 Secondary species information; PI 2.3.3 ETP species information; PI 2.5.3 Ecosystem information

C. Collection and recording information on lost fishing gear

In recent years, the international community has begun to pay close attention to the issue of ghost gear. Ghost gear refers to those abandoned or lost fishing gear, which are usually made by plastic thus take a longtime to be decomposed. Though such fishing gears are no longer used in the fishing operation, their drifting in the ocean may continue to trap, entangle or harm marine living or habitats, which may cause serious damage to the marine ecosystem.

In order to resolve the concern on the impact of lost fishing gear that may caused to the environment, it is recommended that any lost fishing gear should

be recorded in the fishing logbook. Fishermen should record the location and configuration of lost fishing gear (including number of hook, type of hook and length of fishing gear accurately), and a reporting mechanism should be establishment for such purpose.

Key Stakeholders	Fishermen participating in the FIP, OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University
Priority	Low
Status	New (Not being carried out yet)
Timeframe	＜24 months
MSC Performance Indicator(s)	PI 2.5.3 Ecosystem information

(2) Establishment of management strategy based on information collected and evaluation on its effect

A. Establishment of management strategy

Management strategy refers to a set of voluntary or customary agreement, practicing agreement or practicing regulations for biological resources, to ensure that with sufficient information, fishing activities would not cause irreversible impact to the marine living resources. The current practice of fisheries management usually would, based on available information collected, set limit reference point or target reference port for specific species, so as to ensure that the impact of fishing activities to living resources would maintain at an acceptable level (eg. the biomass is above the reference point, or the fishing mortality is below the reference point.)

Due to the fact that the existing data collection on mahi mahi fishery is quite limited, it is very difficult to set reference point for specific species, but only can adopt precautionary approach (such as request to release bycatch species without economic value or that the resource is of concerned) based on limited available information. In addition, it is necessary to enhance data collection with the aim to set species specific reference point based on solid data, and to adopt appropriate measures to ensure the management strategy to be implemented may achieve the objectives of sustainability, as well as to review the effect of management strategy based on the data collected in a continuous manner.

Key Stakeholders	All stakeholders
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜48 months

MSC Performance Indicator(s)	PI 2.1.2 Primary species management strategy; PI 2.2.2 Secondary species management strategy; PI 2.3.2 ETP species management strategy; PI 2.5.2 Ecosystem management strategy

(3) Educational training

A. Propaganda seminars on sea turtles, seabirds and sharks

It should be noted that one of the difficulty to collect data of bycatch species such as sea turtles, seabirds, and sharks, is the many fishermen do not have sufficient capacity to identify these species, which makes the record of fishing logbook incomplete, thus such data can hardly be used to conduct stock assessment on these species. With this in mind, it is necessary to hold propaganda seminars on sea turtles and seabirds and invite experts or scholars to teach fishermen how to identify such species and appropriate measures to process these incidental catches, so as to deal with it in a manner to increase their port-released survival rate. In addition, in consideration that shark catches are one of the important resources for animal protein, as well as that international community has place highly concern on the resources of some shark species, it is necessary to ensure the catches to be recorded accurately and that the relevant shark conservation and management measures can be implemented effectively to achieve their objectives.

Key Stakeholders	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University
Priority	Medium
Status	New (Not being carried out yet)
Timeframe	＜24 months
MSC Performance Indicator(s)	PI 2.1.2 Primary species management strategy; PI 2.3.2 ETP species management strategy; PI 2.3.3 ETP species information

3. Actions under Principle 3 of the MSC

The performance indicators under Principle 2 could be categorized into two subjects: one is governance and policy; the other is fishery specific management system. In accordance with the result of pre-assessment to Hsin-Kang mahi mahi fisheries, the following shortcomings need to be addressed: (1) consultation, role, and responsibilities are not clear; (2) lack of definite short-term objectives; (3) decision-making processes have not been implemented; (4) lack of external audit and review. In order to resolve these

issues, it is planned to engage in improvement, including:

(1) Governance and policy

A. Establishment of organizational structure

At current stage, there is already a Steering Committee established for the Hsin-Kang mahi mahi FIP, and Terms of Reference (ToR) of the Steering Committee have been adopted. However, the current ToR only stipulates the composition of Steering Committee, meeting and function of Steering Committee and Finance Working Group, etc. The duties and roles of individual participants and other stakeholders should be defined more clearly. In addition, an appropriate organizational structure should be established to ensure all relevant stakeholders can participate in the decision making process of fishery management, so as to allow all the decisions and actions taken under this FIP can be public and transparent. Furthermore, all the participants can assume their duties and responsibilities under the FIP in accordance with the organizational structure and procedures as agreed.

Key Stakeholders	All stakeholders
Priority	High
Status	New (Not being carried out yet)
Timeframe	＜12 months
MSC Performance Indicator(s)	PI 3.1.2 Consultation, roles, and responsibilities; PI 3.2.2 Decision-making processes

(2) Fisheries management system

Although fisheries in Taiwan have already been set with long-term objectives, and such objectives can meet with the MSC sustainable evaluation standards and objectives. However, there are no fishery-specific long-term and short-term objectives for Hsin-Kang mahi mahi fishery. To address this issue, it is recommended that:

A. Establishment of clear long-term and short-term objectives

It is recommended that through the development of Hsin-Kang mahi mahi protocol or agreement to determine clear long-term and short-term objectives, so as to ensure that the mahi mahi fisheries resources maintain at sustainable level, as well as to ensure the fishery would not cause any risk or threat to any of the components under Principle 2.

Key Stakeholders	All stakeholders
Priority	High
Status	New (Not being carried out yet)

Timeframe	＜12 months
MSC Performance Indicator(s)	PI 3.2.1 Fishery-specific objectives

B. Establishment and implementation of external audit mechanism

At current stage, the Steering committee for Hsin-Kang mahi mahi FIP has been established, which us tasked to evaluate and review the management system periodically, which can meet with the demand of internal audit. However, the mechanism of external audit and review has not been established. In the future, it is recommended to invite external organization, such as non-governmental organization or academic institute, to participate in the audit and review of management system so as to ensure its objectivity.

Key Stakeholders	All stakeholders
Priority	Low
Status	New (Not being carried out yet)
Timeframe	＜48 months
MSC Performance Indicator(s)	PI 3.2.4 Monitoring and management performance evaluation

Annex Summary of Working Items of Action Plan for Hsin-Kang Mahi Mahi Fishery FIP

Tasks	Key Stakeholders	Timeframe (months)	MSC Performance Indicator																												
			P1 Stock Status						P2 Environmental & ecological impacts																P3 Management & governance						
			1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.2.4	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.2.4
1.Principle 1: Stock status and Harvest Strategies																															
(1) To define stocks and develop procedures for stock assessment																															
A. Definition of stocks																															
(A) Genetic factors analysis	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University and the OFDC	＜24 months				M																									
(B) Mark-recapture research (tagging program)	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, other research institute and the OFDC	＜48 months				M																									
B. Development of fisheries data collection and verification mechanism																															
(A) Collection of fisheries-dependent data	Fishermen participating in the FIP, the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the OFDC, Hsin-Kang Fishermen Association, and the Fisheries Agency	<24 months			H																										
(B) Collection of fisheries-independent data	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, other research institute and the OFDC	＜48 months			M																										
(C) Establishment	The research team led by Professor	＜12			H																										

Tasks	Key Stakeholders	Timeframe (months)	MSC Performance Indicator																												
			P1 Stock Status						P2 Environmental & ecological impacts																P3 Management & governance						
			1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.2.4	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.2.4
of data collection procedure and database	Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC	months																													
(D) Establishment of port inspection and reporting mechanism	Fishermen participating in the FIP, the Fisheries Agency, and the Taitung County Government	＜24 months			M																										
C. Stock assessment																															
(A) Analysis on standardization of relative stock abundance indicators	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC	＜12 months						H																							
(B) Analysis on length frequency and age structure	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC	＜24 months						H																							
(C) Preliminary assessment of stock status	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC	＜36 months						M																							
(D) Full assessment of stock status	The research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University, the Fisheries Agency and the OFDC	＜48 months			M			M																							
C. Development of harvest control strategy																															

Tasks	Key Stakeholders	Timeframe (months)	MSC Performance Indicator																														
			P1 Stock Status						P2 Environmental & ecological impacts																P3 Management & governance								
			1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.2.4	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.2.4
A. Development and implementation of conservation and management measures	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University	＜36 months			H	H																									
B. Development and implementation of harvest control rules	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University	＜36 months			M	M																									
2. Principle 2: Ecological and Environmental Impacts																															
(1) Improvement on relevant data collection																															
A. Reporting on relevant data of primary species, secondary species, ETP species and ecosystem	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University	＜12 months												H			H						H								
B. Establishment and implementation of observer program	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC,	＜36 months										M		M	M		M						M								

Tasks	Key Stakeholders	Timeframe (months)	MSC Performance Indicator																												
			P1 Stock Status						P2 Environmental & ecological impacts																P3 Management & governance						
			1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.2.4	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.2.4
	and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University																														
C. Collection and recording information on lost fishing gear	Fishermen participating in the FIP, OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University	＜24 months																			L	L									
(2) Establishment of management strategy based on information collected and evaluation on its effect																															
A. Establishment of management strategy	All stakeholders	＜48 months								M			M			M					M										
(3) Educational training																															
A. Propaganda seminars on sea turtles, seabirds and sharks	Fishermen participating in the FIP, Hsin-Kang Fishermen Association, the Fisheries Agency, the Taitung County Government, the OFDC, and the research team led by Professor Wang Sheng-Pin of the National Taiwan Ocean University	＜24 months								M						M	M														
3. Principle 3: Management and Governance																															
(1) Governance and policy																															
A. Establishment of organizational structure	All stakeholders	＜12 months																						H			H				
(2) Fisheries management system																															

Tasks	Key Stakeholders	Timeframe (months)	MSC Performance Indicator																														
			P1 Stock Status						P2 Environmental & ecological impacts																	P3 Management & governance						
			1.1.1	1.1.2	1.2.1	1.2.2	1.2.3	1.2.4	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.2.4
A. Establishment of clear long-term and short-term objectives	All stakeholders	＜12 months																								H			
B. Establishment and implementation of external audit mechanism	All stakeholders	＜48 months																											L