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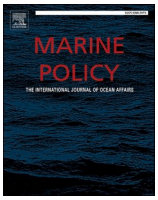

Full length article

Sustain or phase out: Transformation of Taiwan's management scheme on distant water tuna longline fisheries

Chao-Chin Huang [a,1], Shui-Kai Chang [b,*,1], Shiahn-Wern Shyue [a]

[a] Department of Marine Environment and Engineering, National Sun Yat-sen University, 70, Lien-hai Road, Kaohsiung 804, Taiwan
[b] Graduate Institute of Marine Affairs, National Sun Yat-sen University, 70, Lien-hai Road, Kaohsiung 804, Taiwan

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ABSTRACT

Fishing nations worldwide have introduced various measures to manage their fisheries. However, many have failed including Taiwan. Taiwan operated one of the world's largest and most productive distant water tuna longline fleets but overcapacity and an incommensurate fisheries management scheme (FMS) resulted in illegal, unreported, and unregulated (IUU) fishing activities by the fleet. As a result, Taiwan received serious punitive sanction by the International Commission for the Conservation of Atlantic Tunas (ICCAT) in 2005 for illegal "fish laundering" activities. Ten years later, it also received a "yellow card" warning from the European Union (EU) under the EU IUU Regulation. Taiwan struggled to transform its FMS to meet the requirements imposed under the two events through three FMS transformation projects. The ICCAT sanction was lifted in 2006, the EU yellow card was lifted in mid-2019, and the resulting FMS is considered close to completion and a useful example of global best practice. This study reviews the failure of Taiwan's FMS for tuna longline fisheries and identifies the potential drivers: low policy priority, weak institutional arrangements, and insufficient enforcement resources. It documents the evolution of the FMS which was painful but could offer valuable lessons for fisheries managers and scholars worldwide. Key effects of the transformation projects and some recommendations for the future are also provided.

1. Introduction

Taiwan, a small island with only 0.02% of the world's population [1], has become a world-reknowned fishing nation after five stages of development [2] allowed its marine capture production to reach the top 20 worldwide [3]. Catches from >2800 distant water (DW) fishing vessels composed ~75% of Taiwan's total marine catches as of 2004 [4]. These DW fisheries were enormous both in vessel numbers and production and were distributed widely throughout the three Oceans (Fig. 1) [5]. However, prior to 2006 this fleet was laboriously managed by a government agency (Taiwan Fisheries Agency, TFA) with an annual budget of ~$2 million (in USD)[2] [6]. Owing to low policy priority, limited resources were allocated for management of the fisheries, causing weak institutional arrangements such as inappropriate design of management institutions including monitoring, control, and surveillance (MCS) and insufficient fisheries enforcement. This was especially true for the DW tuna longline fishery that was fishing far beyond Taiwan's waters (Fig. 1).

When benefits from insufficient quota could not offset costs, some DW tuna longline vessels – flying the Taiwanese flag or a flag of convenience (FOC) [7] – conducted unmonitored illegal, unreported, and unregulated (IUU) fishing activities and disrupted Taiwan's fisheries management capabilities [2,8]. In one case in 2005, their IUU fishing activities were identified, and Taiwan was severely punished by the International Commission for the Conservation of Atlantic Tunas (ICCAT) [9], mainly Taiwan's large-scale tuna longline[3] (LTLL) fishery. Moreover, ten years later, in 2015, Taiwan received a "yellow card" warning from the European Union (EU, the world's largest market for fisheries products) for non-compliance with international management obligations in combating IUU fishing [10]. The yellow card is a warning of impending trade sanctions under the EU's IUU Regulation [11,12], and in this case the warning impacted the management of both

* Corresponding author.
E-mail addresses: edwardttatta@hotmail.com (C.-C. Huang), skchang@faculty.nsysu.edu.tw (S.-K. Chang), swshyue@mail.nsysu.edu.tw (S.-W. Shyue).
[1] Chao-Chin Huang and Shui-Kai Chang contributed equally to this work.
[2] Excluding personnel salary and scientific research budget and using exchange rate of 1 USD to 30 NTD for the whole study.
[3] >100 gross register tonnage,GRT.

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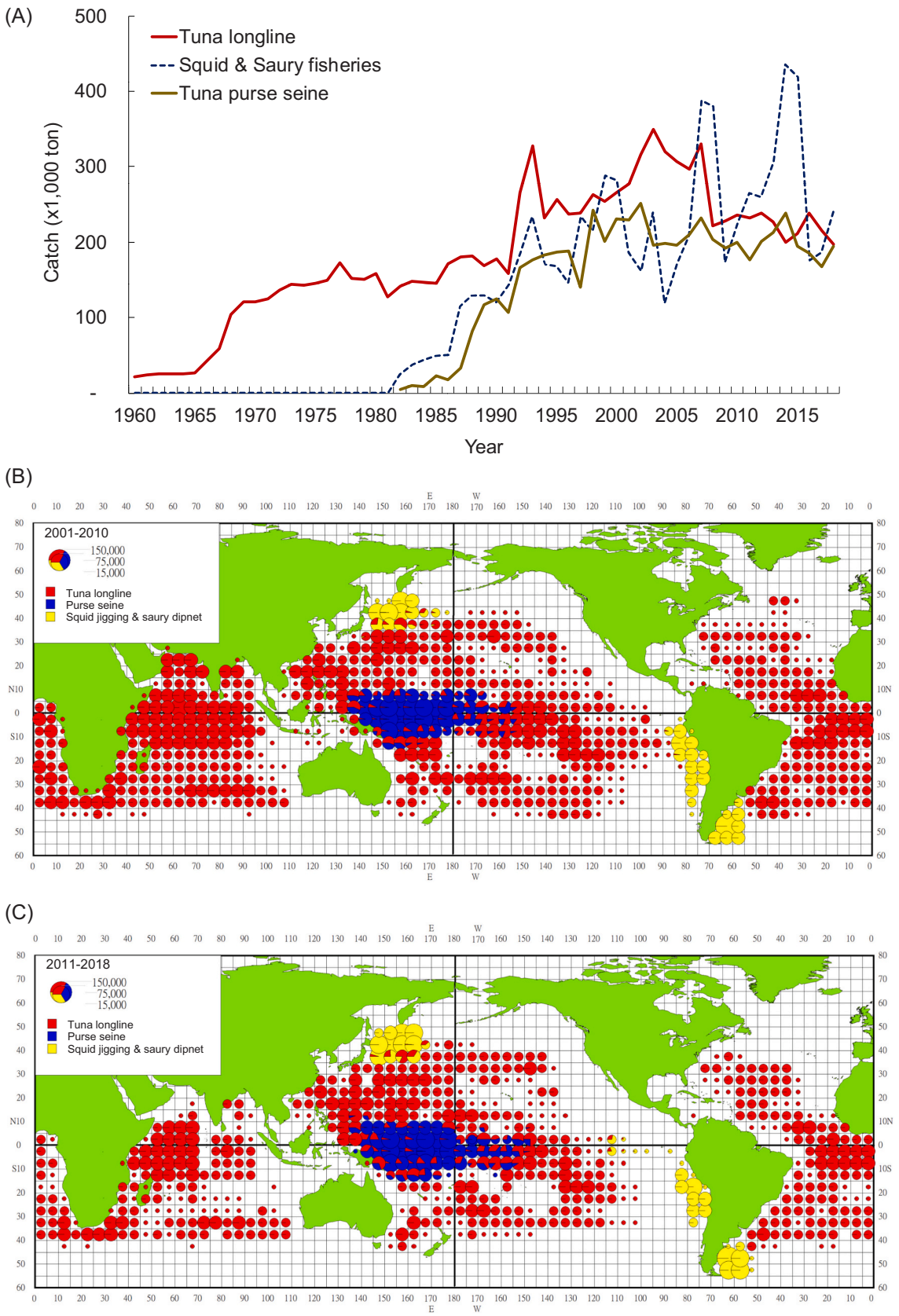

Fig. 1. Annual catch (A) and catch distribution (B for 2001–2010 and C for 2011–2018) of Taiwanese three major distant-water fisheries ("Tuna longline" includes catches from both large-scale/small-scale vessels) between 1960 and 2018. For panels (B) and (C), catches from tuna longline fishery in the tropical region of western central Pacific Ocean were at similar levels as that of eastern Pacific Ocean but have been overlapped with the higher catches of purse seine fishery.

Taiwanese LTLL and small-scale tuna longline (STLL) fisheries.

These international sanction events seriously damaged Taiwan's reputation and needed additional financing from the taxes of the law-abiding general public to deal with the violations committed by a small group who had benefited from their IUU activities; hence they caused serious debates in Taiwan about whether to invest in transforming the fisheries management scheme (FMS) to sustain the fisheries or simply let the overdeveloped fisheries phase out. The debates eventually concluded that it was necessary to raise the policy priority on, and consequently invest more resources in, transforming the FMS including improvement of institutional arrangements (e.g., MCS) and strengthening enforcement. The work was completed stage-by-stage based on three sequential FMS-transformation projects (FMS-TF projects). The 2005 ICCAT sanction was lifted one-year later in 2006 [13], and the 2015 yellow card was removed after three-and-a-half years in 2019 [14].

With increasing awareness of the declining status of marine resources due to overfishing, governments worldwide have introduced various measures aimed at managing a sustainable fishery. However, in many cases these measures have failed [15–18]. A long list of diverse factors contributing to theses failure have been studied and documented, including ineffective governance, incomplete measures, inadequate implementation of regulations, insufficient and weak enforcement, inappropriate incentives, inaccurate and non-transparent data, poor communication with scientists, poor implementation or non-adherence to scientific advice, and political interference, among others [15–17, 19–22].

This study reviews the failure of Taiwan's FMS for tuna longline fisheries and identifies the potential factors for the failure, referencing the three FMS-TF projects addressing the international sanction events. It documents the context and the evolution of the FMS transformation which was painful but could offer valuable lessons to fisheries managers worldwide. The final transformed FMS is presented and key effects of the projects and some recommendations for the future are also provided. To provide credibility, the triangulation method (using multiple approaches to collect and analyze data to enhance the credibility of a research study) [23] was applied because most information was not published openly or was incorrectly documented. Moreover, although the projects' proposals are partially available, not all project tasks have been fully completed. Therefore, additional work will be necessary to verify the full impact of the projects. A literature search was firstly conducted on all of the relevant events from newspapers and magazines and journal articles, many from tertiary literature and grey literature without particular references. Next, in-depth interviews were conducted with eight key informants (from government, industries, and non-profit organization). As budget allocations can be an indicator of investment in improving management, historical budgets for DW fisheries management were reconstructed from the complicated government budgetary system and from interviews.

2. Evolution of the FMS: international requirements and immediate responses by Taiwan

The ICCAT sanction and the EU yellow card event awakened the Taiwan Government to pay more attention to management, and not just production. The following sections document i) a brief overview of the status of Taiwan's longline fisheries before 2005 that gave rise to the ICCAT sanction, ii) the international requests ("the issues") and key points of Taiwan's responses ("the responses") in three periods (2006–2011, 2012–2015, and 2016–2020), corresponding to the periods of the three FMS-TF projects (more details in Table 1), and iii) a summary of the final transformed FMS.

2.1. Before 2005: overcapacity and IUU fishing activities

Following World War II, Taiwanese fisheries developed quickly and vigorously from its small island [2,24,25]. Encouraged by national DW fishery promotion programs and external aid funds [2], DW fisheries catches increased dramatically in the late 1980's to a high of around 800,000 mt, surpassing the catches of Taiwan's coastal and offshore fisheries. Major fishing gears, in order of average catch of the 2000's, were tuna longline, tuna purse seine, squid jigging, and saury stick-held dipnet (Fig. 1A, [4]). In addition to producing the highest catch, the tuna longline fishery also had the highest commercial value. However, its features of operating far from Taiwan in the three Oceans (Fig. 1B), transshipping the catch at sea or unloading it in foreign ports, and seldom calling to homeports made its activities challenging to monitor and verify.

As the DW tuna longline fishery developed in an unbridled manner to its apex in the 1990's and early 2000's, and as the last Policy on Restricting Vessel Building (PRVB) began to curtail the chance for the fishery to further invest in building new vessels flying the Taiwanese flag, the fishery began buying foreign vessels[4] or building new vessels and operating them under FOC arrangements [2,26] (for example, ~150 LTLL vessels bought from Japan versus ~100 vessels newly-built in Taiwan in 2001 [27]). These new vessels combined with the existing, overdeveloped Taiwan-flagged fleet, which exceeded its catch quotas in many cases, created a LTLL fishery that frequently engaged in IUU fishing [28]. Examining the causes of these activities points to economic reasons (e.g., overcapacity, insufficient fishing possibilities, ineffective management) as well as institutional factors (e.g., insufficient level of MCS, insufficient level of sanction, low cost of IUU fishing) [29]. These IUU activities violated international legal arrangements and plans of actions (e.g., [30]), attracting negative attention from other States and international organizations. Japan fired the first shot in 1999 by providing an IUU vessel list to ICCAT [31], which contained mostly vessels which were owned or operated by Taiwanese nationals. This eventually led to a punitive sanction by the ICCAT in 2005 for Taiwanese IUU activities ("fish laundering") [8,9] (see Section 2.2 of [32] and Annex 10 of [33] for details). The sanction was considered over-severe (see below), however, Taiwan was not (and is not) a Member of ICCAT, but a Cooperating non-Contracting Party, and thus has no right to participate in the decision-making process.

2.2. 2006–2011: ICCAT sanction and the 1st FMS-TF project

2.2.1. The issues

In 2005 an ICCAT sanction was made through an adopted recommendation (Rec. 05–02, [8,9]). Overcapacity (incommensurate with the catch quota allocated to Taiwan), insufficient MCS, and an insufficient penalty scheme for IUU fishing by FOC vessels owned by Taiwan nationals were the underlying factors leading to the sanction. The detailed requirements in the recommendation are compiled and categorized correspondingly in Table 1A [8,33].

2.2.2. The responses

To address these requests, Taiwan approved the first FMS-TF project with a total budget of $120 million. The project comprised two parts: i) adjust fishing capacity (budget $69 million) and ii) improve DW fisheries management by enhancing MCS measures and legislating an IUU-combating act (budget $51 million). Table 1A documents the actions taken to respond to the issues and the following explains the key points in the actions.

2.2.3. Adjusting fishing capacity

Overcapacity was the core issue of the sanction event. Actions taken by Taiwan included both reducing and controlling fishing capacity. In

[4] Affected by bubble economy in early 1990's, Japanese tuna industry started selling old vessels and persuading Taiwanese industry to buy them to secure the source of tuna products for the Japanese sashimi market.

Table 1
Summary of major international requirements (and issues) that Taiwan distant water (DW) fisheries management authority faced since 2005 and major responding actions that Taiwan taken based on three fisheries management scheme (FMS) transformation projects. LTLL and STLL are the large-scale and the small-scale longline, MCS the monitoring, control and surveillance, IUU the illegal, unregulated and unreported, VMS the vessel monitoring system, and RFMO the regional fisheries management organization.

Major international requirements	Major responding actions
A. 2006–2011: The 1st project ("Structure Reformation of DW Tuna Industry and FMS Transformation", budgeted $120 million)	
Requirements by the ICCAT Recommendation 2005–02 in 2005: 1. **Fishing capacity:** scrap 160 LTLL vessels (later increased to 183, according to a Japan-Taiwan agreement). 2. **MCS:** For bigeye fishery, limit bigeye-targeting vessels to 15 (from 76) with a total catch limit of 4600 mt (from 16,500 mt, 72% reduction), allowing no at-sea fish transshipments, landing only in one of two designated ports, returning to homeport once the individual quota of 220 mt is exhausted, with a mandatory landing once every 3 months, daily catch reports to Taiwan, quarterly catch reports to ICCAT, and 100% observer coverage compliance. For albacore fishery, limit albacore vessels to 60 and implement necessary MCS measures including port inspection and sampling program, 5% observer coverage, and VMS installation for all vessels >20 m. 3. **IUU fishing:** investigate and take effective measures to eliminate IUU fishing activities conducted by Taiwan flagged and foreign flagged vessels owned or controlled by Taiwan's business.	1. **Adjusting fishing capacity:** totally scrapped 183 LTLL vessels (from 614 vessels) (Table 2) and another 155 vessels of other fisheries. 2. **Enhancing MCS measures:** (for LTLL fishery only) (1) Monitoring: increasing fishery data verification capacity, exploring e-logbook daily report system, strengthening control of catch certificates; (2) Control: implementing species-regional management scheme: quota and fishing area of vessels were approved by target species and region of an Ocean (applied to the three Oceans), bigeye quota reduced 72% for 2006; (3) Surveillance: 100% installation of VMS with an onboard spare set and setup of monitoring center, increasing observer coverage to international standard of 5% (Fig. 4), conducting abroad port inspections and at-sea patrols. 3. **Combating IUU fishing:** stipulated "Act to Govern Investment in the Operation of Foreign Flag Fishing Vessels" in 2008 which has incorporated the term of "fish laundering" and provided a legal foundation for authorities to impose management measures on FOC vessel owners of Taiwan nationals.
B. 2012–2015: The 2nd project ("Project for Sustainable DW Fisheries", budgeted $30.8 million)	
No international event in this period but with the following challenges: 1. **LLTL fishery management:** need of similar level of budget as the first project to manage the fishery to be complying management measures of tuna RFMOs while the measures have gradually increased both in number and gravity of responsibility and have substantially expanded to bycatch and incidental catch species. 2. **STLL fishery management:** not yet any specific MCS imposed on this fishery. 3. **Others:** need of rescue and prevention measures against the attacks of Somalia pirates [54]; need of MCS enhancements on the other two DW fisheries not yet governed by RFMO schemes–Pacific saury and squid– in anticipation of the establishment of two new RFMOs in the North and South Pacific Ocean[55,56].	1. **LLTL fishery management:** maintaining the MCS established in the first project and further enhancing the MCS by increasing VMS reporting frequency (from reporting per 4–6 h to 1–4 h, depending on fishing location and vessel size), improving electronic data reporting and cross-verification scheme, increasing observer coverage, initiating the first shark finning ban in Asia by requiring the simultaneous unloaded of fins and bodies. 2. **STLL fishery management:** requiring approval for fishing in DW with conditions of installation of VMS, deployment of observers, acceptance of port inspections and criteria-based quota allocation scheme. 3. **Others:** a proportion of budget (~18%) was used for compensating the fishing-cessation of Indian Ocean longliners owing to Somalia piracy and for membership fees to RFMOs.
C. 2016–2020: The 3rd project ("Project for Strengthening International Cooperation to Combat IUU Fishing", budgeted $60 million)	
Criticisms from the EU yellow card in 2015[10]: 1. Serious shortcomings in the fishery's legal framework. 2. The sanction system being unable to deter IUU fishing 3. Lack of effective MCS of DW fleet 4. Not having systematically complied with RFMO obligations Additional issues faced: 1. Criticisms of non-compliance by Taiwanese vessels were continuously iterated in RFMO meetings or by coastal countries (e.g.,[38–40]). 2. Global advocations require fish products exporters assuring traceability of their fishery products. 3. Japan and Philippines began taking stronger enforcement actions in the EEZs overlapping with Taiwan, where are traditional good fishing grounds to Taiwan STLL fishery, impelling Taiwan to enhance MCS on STLL fishery to avoid conflicts and disputes.	1. **Enhancing legal framework:** legislated strict "Three Fisheries Acts," as well as relevant implementing regulations and notices authorized by the three acts in 2016. (1) The acts establish a coherent and deterrent sanctioning scheme by clearly defining the extents of serious violations and their corresponding sanctions and rising the fine up to 100 times than the previous amount to deter IUU fishing. (2) The acts have aligned domestic legislation with conservation and management measures of the RFMOs to ensure systematical compliance with RFMO obligations. (3) The acts regulate widely five types of people associating with DW fisheries. 2. **Making MCS effective:** (1) improving measures for catch data monitoring by requiring reporting the catches through e-logbook system (required on all DW vessels) while fishing, allowing landing/transporting the catches only at designated ports after fishing completed, and declaring actual catches through landing declaration scheme and accepting a port inspection. (2) strengthening vessel activities monitoring by requiring permit before leaving port (the permit will be published on website for transparency), preparing a workable spare-set of VMS on all DW vessels to guarantee successful reporting which becomes a necessary condition for applying for catch certificates. (3) increasing observer coverage (Fig. 4) and the ratio of at-sea board and inspection. (4) establishing National Plan of Control and Inspection for Fisheries (NPCI) to integrate and link all MCS measures into an implementation plan. 3. **Ensuring catch traceability:** (1) establishing a catch certification scheme (including landing declaration) to provide legality of the catch of the species covered. (2) developing an integrated system to compile the certificates with all relevant information on the vessel and its catches, from local ports (e.g., licensing information) to fishing grounds (e.g., VMS/e-logbook/observer data) and into landing ports (e.g., transshipping/transporting/landing information), to facilitate cross-validation and verification. (3) strengthening inspection and verification function by utilizing the integrated system, by increasing capacity of official inspectors and third-party inspection institutions, through collaboration with cross-ministries, and through cooperation with foreign port states, to increase credibility of the catch documents. (4) adopting "Strategy Plan for Auditing Industry Related to Distant Water Fisheries" for guiding the industry to establish and implement self-management of fisheries' products traceability and conduct audits to ensure their products are not from IUU fishing vessels. 4. **Establishing international cooperation:** establishing cooperation arrangements with foreign port states, as well as cooperating with RFMOs and complying with their regulations.

total, Taiwan scrapped 183 LTLL vessels from the original 614 vessels during 2005–2007 (Table 2, Fig. 2), as well as bought back 155 vessels (including trawlers and some longliners not targeting tunas but having the potential to do so) in the project period. A total of 130,169 GRT was reduced from the fishery resulting in a shrinkage of catch distribution (Fig. 1B). In addition, since Taiwan is famous for its shipbuilding and exporting industry, to control global fishing capacity, Taiwan also amended the "Regulations on Permission for the Export of Fishing Vessels", stating that any shipyard intending to build a new tuna longline or purse seine vessel for export shall attach documents that an existing vessel of the same tonnage is to be scrapped and replaced in the exporting region and the scrapped vessel has no record of violating management measures of regional fisheries management organizations (RFMOs) [34].

The requirement to reduce fishing capacity was to scrap the vessels physically, rather than just to remove the vessels from tuna fisheries. Three critical questions then arose: whose vessels should be scrapped, what funds could be used for compensating for the scrapped vessels, and how to scrap them.

First, the government requested that the industry negotiate and singlehandedly decide which vessels would be scrapped; otherwise, the choice would be made via a lottery. No operators wanted their vessels scrapped but they preferred not to take their chances in a lottery. Therefore, under international pressure, the industry divided themselves into groups and then determined the vessels-to-be-scrapped within each group, agreeing that the remaining vessel owners would partially compensate the scrapped vessels' owners.

Second, the remaining, functional LTLL vessels still had a very high economic value. After several arguments, a compromise compensation amount based on vessel tonnage was decided jointly by the government and the industry according to a formula of 3:1:3=subsidy from government: cash payments from the remaining vessel owners in the group: payments from the remaining vessel owners in the group through bank loans. In total, the cost for this capacity reduction was estimated to be $200–$230 million; the government share of the cost was 43%, with industry paying the rest [26].

Third, although Taiwan was noted for vessel scrapping, to scrap the first 160 LTLL vessels within the requested short timeframe (i.e. before 2006) became a large issue for this small island considering the shortage of labor and scrapping locations and concerns regarding environmental pollution. Several methods were used to scrap the vessels during the period, one of which was dismantling the vessels to utilize them as artificial reefs. Although this plan would benefit marine bio-resource cultivation, it required substantial efforts to flush environmental pollutants from the vessels in advance.

2.2.4. Enhancing MCS measures

Sound MCS requires sufficient manpower and budget. The project raised the regular budget for managing DW fisheries to ~$8.5 million/year, about four times that in 2005 (Fig. 3). The increased budget made it possible to enhance MCS measures for managing the LTLL fishery and to provide capacity building to cooperating coastal fishing nations on enforcement topics. Table 1A lists major enhancements by MCS category [2,35,36]. Notably, a sophisticated species-regional management scheme was designed for the LTLL fishery: positive list vessels operations were approved, and consequently individual quotas (separated by target and non-target species) were allocated, by target species group (e.g., bigeye/albacore vessels) and by region (e.g., northern/southern Atlantic Ocean). This approach has the benefit of reducing the management burden on the government, facilitating operational management for industry (however, it may also reduce flexibility; see Discussion section), and reducing the possibility of committing "fish laundering."

Table 2
Number of Taiwanese distant water large-scale longline vessels scrapped between 2005 and 2007 (Source: Taiwan Fisheries Agency).

	Requirement from ICCAT		Request from Japan	Total
Year	2005	2006	2007	
Indian Ocean	21	81	9	111
Pacific Ocean	15	12	8	35
Atlantic Ocean	23	8	6	37
Sum	59	101	23	183

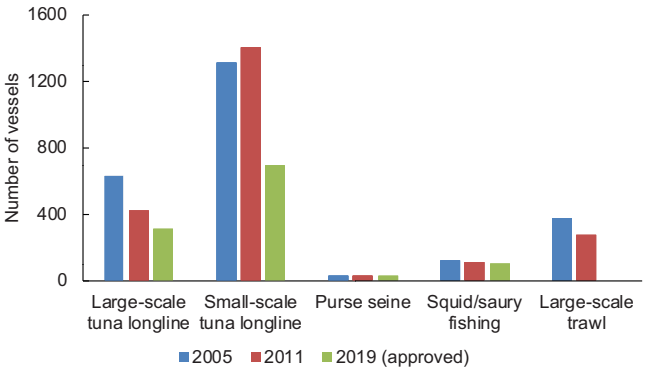

Fig. 2. Number of distant water (DW) fishing vessels, by gear for 2005 (before the first transformation project and fleet reduction program), 2011 (before the second project), and 2019 (end of the third project). The bar for 2019 is based on the number of vessels officially approved by the Act for Distant Water Fisheries. "Squid/saury fishing" includes vessels using squid jigging and saury stick-held dipnet. Large-scale trawlers stopped fishing in DW since 2016. (Source: Fisheries Statistical Yearbook [4,46]).

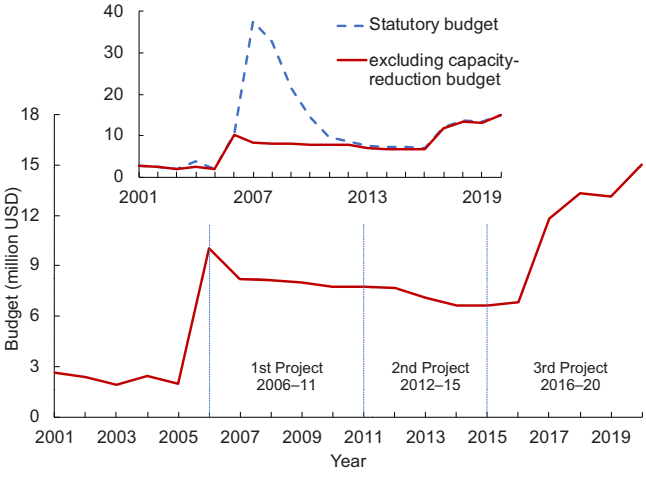

Fig. 3. Statutory budget (excluding personnel salary and scientific research budget, dash line, upper small panel) for managing distant water fisheries and the proportion (solid line) excluding the budget for capacity-reduction program, etc. Budget for capacity reduction of 2005 was unknown and was not included in the figure. Budget of 2006–2011 includes reported statutory amount and estimates from agriculture development fund. (Estimated from Ref. [15]).

2.2.5. Combating IUU fishing

FOC arrangements could provide cover for IUU fishing since the flag States often turn a blind eye and exercise little or no control over the vessels [28]. For possibly the first time ever in the world, Taiwan was requested to take responsibility for the FOC fishing operated by Taiwan nationals rather than place responsibility on the FOC-issuing countries. Taiwan enacted the "Act to Govern Investment in the Operation of Foreign Flag Fishing Vessels" for this purpose in 2008 and incorporated the concept of "fish laundering" into law for the first time. This law provides a legal foundation for authorities to impose regulations on FOC

vessel owners who are Taiwanese nationals [32]. The law controversially uses criminal sanctions and heavy penalties to deter involvement in FOC/IUU fishing activities.

2.3. 2012–2015: maintaining MCS measures and the 2nd FMS-TF project

2.3.1. The issues

Many issues challenged Taiwan's fisheries management in this period (Table 1B), although no specific international events targeted Taiwan. Notably, for the LTLL fishery, the tuna RFMOs' regulations gradually increased year-by-year both in number and in the gravity of responsibilities including expanding to bycatch (sharks) and incidentally caught species (e.g., seabirds, sea turtles and marine mammals). While the management of the LTLL fleet needed to keep pace with the increasing compliance obligations inherent in the RFMOs' regulations, the large STLL fishery continued to be criticized internationally for its poor management [8], therefore, new MCS measures were needed for managing this fleet.

2.3.2. The responses

The second FMS-TF project was proposed to address the above issues. Initially an annual budget of $12.5 million was allocated, however, only ~$7.7 million was obtained (Fig. 3) and a large proportion of this amount was used for membership fees to RFMOs; expanded observer programs due to increasing trips (Fig. 4) and higher salaries for observers onboard STLL vessels with harsh working conditions; compensation for cessation of fishing by Indian Ocean longliners owing to Somalian piracy; and interest on loans to longline vessel owners sharing the cost of the fleet reduction program (see Section 2.2.1 and Discussion). The remaining budget was barely enough to maintain the existing FMS developed in the first project. Therefore, this project was considered unsuccessful.

However, this second project did accomplish a phased goal to expand the MCS for the LTLL fishery to the STLL fishery. In comparison to the LTLL fishery, the STLL fishery has more vessels (Fig. 2) and is more closely connected to harvesters, the post-harvester sector and consumers (the "human system", [37]), and so may result in higher social and political impacts to management sector. Having done the hard work in the LTLL fishery, the project was able to impose some MCS measures on the STLL such as installation of VMS and deployment of observers (Table 1B), and as such, the tuna longline fleet began to be managed as a whole. For allocating the very limited tuna quota, TFA established a prioritization scheme based on fixed criteria (requirements). Many STLL vessels unable to meet the requirements, or expected to become unprofitable if all the requirements were implemented, retreated voluntarily from the tuna fishery. Therefore, the actual number of vessels applying and approved to operate in DW was substantially reduced as a result (Fig. 2).

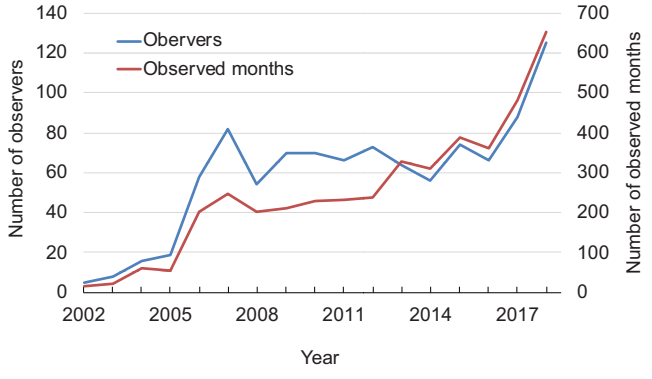

Fig. 4. Number of observers and observed months, 2002–2018. (Source: Taiwan Fisheries Agency).

2.4. 2016–2020: EU yellow card event and the 3rd FMS-TF project

2.4.1. The issues

Although the previous two projects attempted to establish improved MCS measures for the Taiwanese tuna longline fishery, the EU challenged the sufficiency and effectiveness of the legal framework and MCS measures [10] by issuing a yellow card (Table 1C). In addition, Taiwan was also facing several issues during this period including criticisms of non-compliance of Taiwanese vessels by RFMOs and coastal countries (e.g., [38–40]), lack of seafood product traceability, and multilateral disputes involving Taiwan STLL vessels fishing in the overlapping EEZ areas with Japan and Philippines (Table 1C).

2.4.2. The responses

To avoid the serious consequences of receiving a red card from EU, the third FMS-TF project was adopted with a total budget of $60 million for five years (2016–2020) (Fig. 3). Actions to address the EU's requests as well as other issues can be grouped into four core aspects: enhancing the legal framework, making MCS effective, ensuring catch traceability and international cooperation. Table 1C summarizes the actions taken and the following explains the key points of the actions.

2.4.3. Enhancing legal framework

The legal framework in Taiwan's FMS posed to two major concerns in the EU yellow card event. First, lack of implementation of international and regional fisheries management measures into national law sparked EU accusations of not having systematically complied with RFMO obligations [10]. The second concerned the lack of a "coherent and deterrent sanctioning scheme," especially for recidivists of IUU fishing. The fine for illegal fishing was only in the range of $1000–$10,000 at the time and so, for example, punishments of a $5000 fine and suspension of vessel license of eight months for committing shark finning [41] was not considered "coherent and deterrent".

Responding to the deficiencies, Taiwan legislated the so-called "Three Fisheries Acts," as well as relevant implementing regulations and notices authorized by these acts in 2016: (1) the Act for DW Fisheries (a new and special law of the Fisheries Act), (2) the amended Fisheries Act (harmonizing for the special law), and (3) the amended Act to Govern Investment in the Operation of Foreign Flag Fishing Vessels (see Section 2.2.3), amended to prevent nationals from shifting to operate foreign-flagged vessels and conduct IUU fishing.

The new and amended Acts have aligned domestic legislation with conservation and management measures (CMMs) of the RFMOs and the international standards for high seas fishing. Regarding sanctions, the Acts define the extent of serious violations and their corresponding sanctions, considering the trend of international best practice and the spirit of "confiscation of proceeds of crime" and "sufficient deterrence" [42]. Thus, the operator fines rose to $16,000–$1 million, up to 100 times more than the previous amount, or a maximum of five times the value of the concerned catch/product if the imposed fine was less than the value. An additional, lesser fine can also be imposed on employees, if deemed necessary. Repeating offenses are subject to escalating penalties, with fines 1.5 times that of the first violation (i.e., up to $1.5 million). The sanctions are supplemented with suspension/revocation of licenses and confiscation of catch, fishing gear, and/or fishing vessels.

2.4.4. Making MCS effective

A series of MCS measures for managing the DW fisheries were setup during the previous two projects. However, there were problems with sufficiency and effectiveness, principally relating to gaps in monitoring and strength of enforcement. Additional improvement measures were thus designed and implemented to actually monitor the catches from the point of harvest to the point of market sale, and to increase enforcement strength on catches from sea to land and on vessels from home port to landing port (Table 1C, Fig. 5, see Section 3).

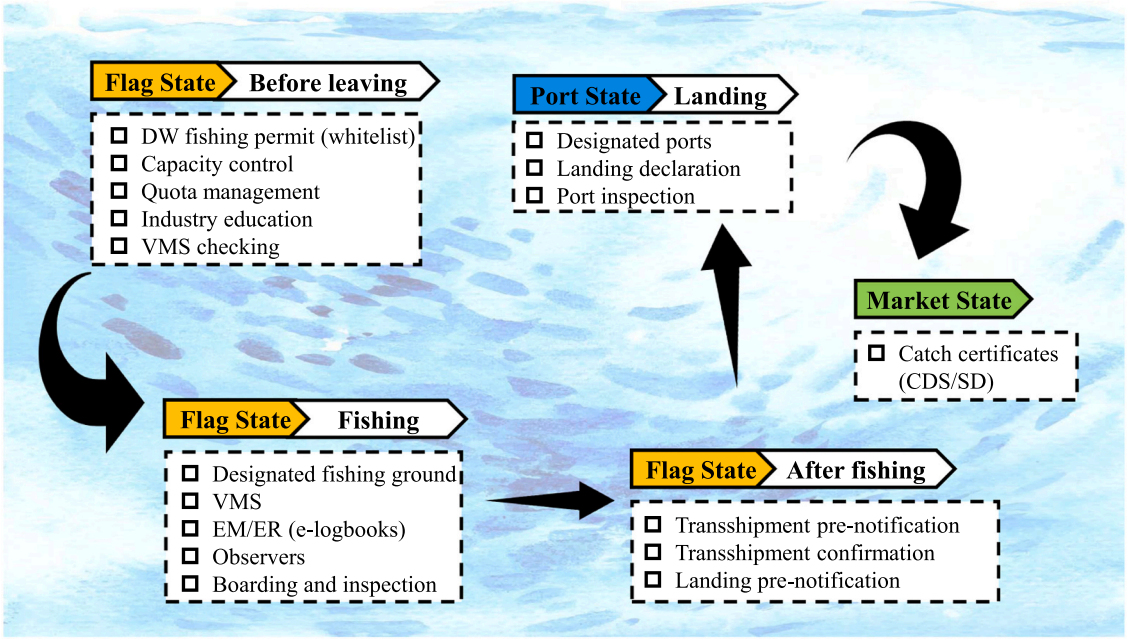

Fig. 5. MCS measures currently implemented by the Taiwan Fisheries Agency (TFA) on distant water tuna fisheries. Before the vessel leaving homeport, TFA issues distant water fishing permit (license) according to policies of capacity control and quota management and conducts regulation education and VMS function checking. While in the sea, the vessel can only operate in designated fishing ground for designated target species, needs to report position through VMS and catches through e-logbook (e-reporting, ER), and accepts observers onboard (or e-monitoring, EM) and boarding and inspection. After operation completed, the vessel needs to pre-notify the TFA before transshipment and confirm the transshipment after completion or to pre-notify the TFA before landing in port. For landing of catches, the vessel can only unload catches in designated ports and needs to submit landing declaration and accepts port inspection. The products are required to accompany with different types catch certificates (five types altogether) that issued by the TFA when entering the markets.

2.4.5. *Ensuring catch traceability*

Traceability is designed to ensure the fish was legally caught and requires that information on the catch be passed on "from hook to plate." TFA took four main measures to address this issue (Table 1C): i) it established catch certification schemes (including landing declarations) to prove the legality of the catch [43] (e.g., bigeye tuna statistical documents introduced by ICCAT and Pacific bluefin tuna catch documentation scheme designed by TFA [44]); ii) it developed an integrated system to compile the certificates with all relevant information on the vessel and its catches to facilitate cross-validation and verification; iii) it strengthened its inspection and verification functions by taking advantage of the integrated system and increased the credibility of the catch documents through cross-ministry and international collaboration, and iv) it legislated a strategic plan (Table 1C) for guiding industry to implement self-management of product traceability and conduct audits with penalties for low audit rates.

2.4.6. *Establishing international cooperation*

DW tuna fisheries are mostly fishing far beyond national waters, unloading their harvest in foreign countries and returning to home ports only on rare occasions. Therefore, to make the FSM effective, Taiwan needs cooperation from foreign port states, as well as cooperation with RFMOs while complying with their regulations. Today, Taiwan has established cooperation arrangements with 22 countries [45]. In addition, the budget for participation in RFMO activities and multi-lateral discussions has increased 40% – from $1.5 million in 2014 to $2.1 million in 2020.

2.5. *Summary of the transformed FMS*

After 15 years of efforts and painful experiences, the FMS of Taiwan's tuna longline fishery has been holistically transformed. Although not yet perfect, the current scheme has integrated most components necessary for managing a fishery. The following summarizes the key components of the FMS.

2.5.1. *Legal framework*

CMMs adopted by RFMOs can now be systematically transposed into national law by the new and amended "Three Fisheries Acts" (Section 2.4.1). Taiwanese vessels violating the CMMs will receive sanctions with appropriate deterrents as defined by the Acts. FOC vessels operated by Taiwan nationals are also under the jurisdiction of the Acts.

2.5.2. *Management targets*

Both LTLL and STLL vessels are now managed as a whole. Fishing capacity of the LTLL fishery has been physically and substantially reduced (Table 2). Overall capacity fishing in DW are controlled by a permit system ("approved" vessels in Fig. 2): all vessels wishing to operate in DW must obtain a permit from the TFA before leaving port and will be managed under the FMS; for transparency, details of the approved DW fishing vessels (positive list) by ocean, fishery, and target species group are published on the TFA website [46]; and the approved FOC vessels operated by Taiwanese nationals are also published on the website [47]. The Acts regulate five types of people: DW fishery operators and business owners, all Taiwanese nationals involved in the fishery, foreign-flagged fishing vessels entering into Taiwan's ports, DW fishery-related industries, and foreign crew hiring agents (intermediaries).

2.5.3. *MCS, inspection and enforcement*

Tuna vessels and catches are monitored during their entire operations (Fig. 5). Before leaving the port, the vessel has to obtain a DW fishing permit from the TFA to control fishing capacity/quota, as well as undergo education in international and national measures and submit to VMS-checking. After leaving the port, the vessel can only fish in its designated fishing ground, which will be monitored through VMS/observers and occasional boarding and inspection. The catch has to be (a) reported through an e-logbook system while fishing, (b) landed/

transported at designated ports (32 designated ports in the three Oceans since 2016) after completing fishing, and (c) declared through the landing declaration scheme and inspected in port (by TFA and third-party inspection institution) (Fig. 5).

For better monitoring, each DW fishing vessel is required to prepare a working spare set of VMS equipment. Vessels failing to transmit VMS data for >15 days are required to stop fishing and directly return to designated ports for repair. Successful transmitting of VMS data also became a necessary condition for issuance of a catch certificate. Since 2017, the required reporting frequency has increased to hourly, except for fish carriers. A new 24-hour VMS monitoring center was established to cope with this heavy task (2253 DW vessels and carriers being monitored in 2018). Additionally, the observer coverage (Fig. 4) and the ratio of at-sea boarding and inspections have also increased.

The landing declaration scheme is unique to this fishery. A DW fishing vessel is required to provide a "landing notification form" to the TFA 72 h (or 24 h for purse seiners) before arriving at the designated landing port and submit a "landing declaration form" to the TFA within two days after completing the landing. The discrepancies in catch amounts between the two forms cannot exceed 10% for those species managed under a quota allocation system, or 20% for the remaining species. Different levels of penalties will be imposed if the vessel fails to fulfill the above requirements, from <$5000 before 2016 increasing to >$16,700 in 2018 with a notable case in which the vessel owner and employees were fined $40,000.

All data associated with the vessels and catches will be input into the integrated data system to facilitate cross-validation and to increase traceability of the catches. All MCS measures are integrated and linked into an implementation plan under the National Plan of Control and Inspection for Fisheries (NPCI) which also sets the monitoring and inspection benchmarks according to the risk of potential IUU fishing activities [48]. From 2017 to April 2020, a total of 227 vessels (comprising 331 applications of sanctions) were detected and punished (Fig. 6), with fines totaling $7.202 million, including vessels of LTLL (24%), STLL (61%), and other DW fisheries, carriers and illegally operated foreign-flagged vessels, as well as brokers hiring foreign crew (Fig. 6) [49]. Excluding the cases of minor infringements, 81 vessels and brokers were sanctioned with an average fine of $79,950 (maximum of $560,000). For some vessels, the sanction was imposed on both the operator and the employees.

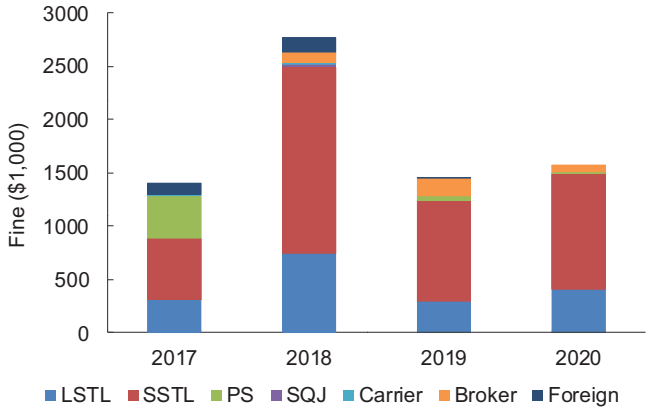

Fig. 6. Sanction fine by Taiwan Fisheries Agency on large-scale (LSTL) and small-scale (SSTL) tuna longliners, purse seiners (PS), squid jigger (SQJ), carriers, brokers for hiring foreign crews, and foreign-flagged vessels that illegally operated by Taiwan nationals ("Foreign"). (Source: Taiwan Fisheries Agency [49]).

3. Discussion and recommendations

3.1. Effects of the international events and implied drivers for FMS failure

Overcapacity was the core complaint in the ICCAT sanction (Section 2.2). The years before 2005 were the "unbridled growth stage" for Taiwan's tuna longline fishery with rapid increases of tuna catches [2] (Section 2.1). It was unrealistic to believe the trend of increasing fishing capacity would stop considering the high commercial benefits from the fishery. At that time, the constitution or "physique", in metaphor, of the FMS for managing the fishery was weak. Except for implementing the last PRVB, the government had placed a low policy priority on establishing a healthy FMS. As such, IUU fishing occurred when the fishing capacity was not commensurate with the quota the RFMOs had allocated and the FMS was unable to detect and deter the behaviors.

Solutions to the sanctions came at a cost. The cost was the investment of financial resources in management and political fallout resulting in a mandate for change. The ICCAT sanction was the first international-level disgrace to the Taiwanese fishery sector and thus aroused serious social controversy, eventually creating a strong political will to solve the issues. This was achieved by providing funds for management and, with social support and international pressure, imposing stricter regulations on the fishery. The DW fisheries were managed by the TFA with a budget of 0.15% of the economic benefits (>$1 billion) in 2005. This meager budget was insufficient to properly assume management of a such a large fleet. To address the issues, the management budget of the first FMS-TF project increased the existing budget by four times, not to mention the substantial amount for the fleet reduction program (Fig. 3).

Japan was the leading member proposing and drafting the recommendation containing the ICCAT sanction, and overcapacity (including Taiwan-flagged and FOC LTLL vessels of the three Oceans, and Taiwan-flagged tuna purse seiners in the Pacific) was Japan's major concern for Taiwan to address (pp. 293–294 of [8]). In the first project, as requested in the recommendation 160 LTLL vessels, and an additional 23 vessels requested further by Japan, were physically scrapped (a 30% reduction overall, Table 2). This is the most important accomplishment of the project.

The second FMS-TF project succeeded the first one with similar or less management budget, seemingly because of no pressure from the international community for further improvement of the FMS. The approved budget intended to merely maintain the FMS level at the previous level, however, this proved insufficient to tackle the increasing international requirements and expectations in the period (Section 2.3). The biggest accomplishment of the project was expanding the MCS for the LTLL fishery to the STLL fishery to ensure the entire tuna fleet was managed. However, sufficiency and effectiveness of the MCS remained major concerns in the FMS.

FAO instruments made "combating IUU" a global campaign, expanding responsibilities from vessel flag States to coastal States, port States, and market States and empowering port States to take action [50,51]. A significant part of the IUU fishing product enters international trade and thus the instruments empower market states to tackle the problems from a trade perspective [52]. Thus, the EU, a major seafood market, took action to challenge Taiwan's FMS by giving a yellow card warning (Table 1C, Section 2.4). If not forestalled, receiving a red card would have led to an estimated loss of ~$240 million for Taiwan fisheries due to the inability to export seafood directly and indirectly to EU markets, as well as many other negative consequences including possible restrictions on entering foreign ports for supply/landing. In addition, there could have been irreparable damage to the international image of Taiwan–with follow-on effects at the industry level as well as at social and political levels.

As such the EU yellow card became a high-level issue and received a high policy priority to address. Joint efforts and resources from multiple ministers were invested in the third project with a gradual annual budget increase (Fig. 3), and the "Three Fisheries Acts" were eventually

adopted despite strong objections from industry. The first two projects transformed the FMS more on horizontal scale to cover a wider range of management topics and establish the prototype system; the third project solidified the FMS by legislating a coherent and deterrent sanctioning scheme, filling the gaps of MCS measures to provide an integrated and cross-connected network for monitoring vessel activities and catch traceability, and increasing labor resources and budget for improving enforcement.

Twenty-two fishery managers and scientists from the South China Sea fishing nations have scored the issues that they considered to be the drivers for the depletion of the region's marine resources, and concluded that low policy priority, weak institutional arrangements, and insufficient enforcement resources are the three main issues [21]. Similar to the above review, these factors were also the drivers for the failure of Taiwan's management of its longline fisheries, as well as the drivers for the success of its transformation.

3.2. Unsolved sequela from the FMS-TF projects

In the fleet reduction program of the first project, three over seven of the compensation to be paid by the remaining active vessels were made through bank loans. The loans increased when more vessels volunteered to be scrapped, with the remaining LTLL vessels bearing a total debt of around $94 million. This ultimately caused more than 50 companies to collapse or retreat from the industry. Currently, the repayment amounts to only 1/3 of the total debt because global adverse environmental changes, such as high fuel price and depreciation of Japanese yen, have affected vessel owners' ability to repay. This situation has resulted in frequent requests for TFA to finance the interest on the bank loans and related fees. This was a shattering but inevitable experience – for both the government and the industry – after allowing overdevelopment of the fishery. The issue remains to be settled to this day and has reduced the competitiveness of the fleet.

Another sequela was the industry's distrust toward the government. The industry believes the ICCAT sanction was a reflection of competitiveness between the fishing industries of Japan and Taiwan (p. 288 of [8]). They also have the opinion that the "yellow card" was a tactic of the EU to throttle foreign fisheries' development (see also the argument in [43][5]). Therefore, the industry was dissatisfied with the results of government's negotiation and compromising responses to the two events. They are especially resentful about the legislation of the "Three Fisheries Acts," mainly because of the weighty and non-proportional penalties legislated in the law and the lack of definition in the articles of offenses. Misgivings and concerns regarding the potential for committing unintentional offenses and being heavily penalized have reduced the fishery's global competiveness. The industry staged a protest and demonstration during the presidential election in late 2019 to pressure the government for relaxation of the law, which unfortunately might reduce political will for future FMS investments.

Although it was beyond the scope of this paper for discussion, the human rights of foreign crews are another issue that has not yet been completely resolved in the FMS. This issue has been raised, and the fisheries have been frequently criticized in recent years over abuse of foreign crews by masters and/or chief crew members on Taiwanese vessels. Sanction data [49] show that 16 cases (~$300,000 fine) were related to foreign crew salary and contract issues, indicating that the FMS has begun tackling this issue.

3.3. Recommendations

3.3.1. Improving the physique of the FMS

The "physique" of the FMS was very weak in the beginning and the increased budget support from the projects are more like "treatments" rather than long-term cures because the projects are funded on short-term basis. Therefore, except for the legislation portion, the projects established many physical centers and sophisticated MCS mechanisms to improve the FMS, but the day-to-day operation of these (the staff salaries and running costs) is nevertheless supported by a temporary project. The future fourth project has the possibility of termination or scale-down (just like the second one), implying an unstable employment status. Furthermore, the government regulation requiring a three-year salary ceiling for project-based staffs – who also have no promotion opportunity – cannot maintain these professionals in the FMS. Project-based staff comprise 66% (excluding scientific observers) of the total management labor in the current FMS. Maintaining a skilled work force in the FMS is a crucial concern for the stability of the scheme.

Meanwhile, new international challenges continue to emerge in recent years, including an increasing number of CMMs by tuna RFMOs,[6] international legal arrangements (e.g., on marine debris and foreign fishing crews), and market States' regulations (e.g., fish and fishery products hazards and controls program and national conservation plans on sharks and marine mammals). Without a good physique, the FMS is not able to tackle these issues well. To sustain the DW fisheries, implanting the project-based transformation of FMS into the official and permanent management structure is necessary.

While formalizing employment terms, a budget for training should also be considered. New international topics continue to emerge and challenge both the TFA and the FMS, such as fishery labor policy, microplastic particles, or biological diversity. These are all beyond the knowledge of regular fisheries managers and contracted staff. Training for those topics will be necessary for handling these issues well.

Finally, scientific research is the basis for sound management and MCS implementation. Unlike other international-scale fishing nations (e.g., Japan, USA, and members of EU), Taiwan does not have a specific scientific institution to support the TFA. The current practice of relying on professors of various universities cannot facilitate good teamwork and timely services to the TFA because they are independent from the TFA and have their own duties within the university. Taiwan with its large tuna fleet and high coverage of logbook and onboard observer data, should invest in establishing an independent institution to provide scientific assessment of the resources, with the collaboration of global scientists, to the FMS.

3.3.2. Adjustment of management thinking

The traditional quota allocation formula of dividing the national quota equally to all vessels was an important driver of fish laundering by the LTLL vessels in the early 2000's, because the quota allocated to each vessel was clearly insufficient to offset the cumulative fishing operation costs. When the MCS was insufficient in detecting illegal activities and the penalty was weak, vessel owners naturally favored fish laundering. In this regard, it is suggested to adjust the formula by dividing the national quota by an acceptable, economically viable minimum quota for each vessel to decide the suitable scale of fleet size.

The "annual-based" quota management approach is also recommended to be adjusted, because fishing conditions vary yearly. Managing the quota on a multiple-year basis, including allowing unused quota to be carried over and overage to be paid back the following year, could provide flexibility to operators in making an operational plan. However, this requires the RFMOs allowing such carryover/payback

[5] The paper [43] argues that, in comparison to the US system, the EU system of identifying countries is opaque and that the standards on which decisions to identify specific countries are based are unclear. It also observed that EU identifications are currently confined to Africa, Asia, the Caribbean and the South West Pacific where most States are developing countries.

[6] The number of CMMs (including resolutions and recommendations) of the four major tuna RFMOs (ICCAT, IOTC, WCPFC and IATTC) has increased 36% from 29 per year during 2005–2010 to 39 per year thereafter.

schemes (e.g., [53]) in their CMMs. Similarly, allowing quota to be transferred among vessels of the same company could also facilitate the management of fleet activities (such as keeping one vessel at port and collecting all quota to the remaining vessels). When the MCS is sufficiently effective and the penalty is enough of a deterrent, the flexibility of quota management, as well as shifting fishing grounds based on fishing conditions, could provide benefits to vessel operators in their fleet management and create much need breathing space in this competitive world.

Flexibility should also be considered in fleet enforcement. The LTLL fleet operates under corporate management with extensive global experience, whereas STLL fleet operators are mostly one-man businesses and with limited global experience. Therefore, more patience and education may be needed for the STLL fleet which has not been given full consideration under the FMS for some time now. Interviews indicated that STLL operators are willing to support a strict FMS; however, they need more supportive actions such as education and communication. Transformation of the FMS to its current status was completed hastily with a strong intention to secure the lifting of the EU yellow card. After this was accomplished, communication and provision of flexibility would regain the industry's trust to support and comply with the FMS, which in turn may help to maintain the government's policy priority on the FMS.

The last recommendation is to form a team in the FMS with auditing capabilities to target fishery agents. Current management focuses mostly on vessels and their operators. Most DW fishery operators lack sufficient capability of selling their harvests and thus entrust agents for this task. There are thousands of tuna vessels; comparatively, there are not many agents. Such an audit team focused on the agents could help improve the MCS's effectiveness and reduce IUU fishing opportunities.

CRediT authorship contribution statement

Chao-Chin Huang: Investigation, Resources, Writing - original draft. **Shui-Kai Chang:** Conceptualization, Methodology, Validation, Investigation, Writing - original draft, Writing - review & editing, Visualization, Supervision. **Shiahn-Wern Shyue:** Supervision, Project administration.

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Declarations of interest

None.

References

[1] CIA/USA, The World Factbook - Central Intelligence Agency, (2020). ⟨https://www.cia.gov/library/publications/resources/the-world-factbook/⟩ (Accessed March 19, 2020).
[2] S.-K. Chang, K.-Y. Liu, Y.-H. Song, Distant water fisheries development and vessel monitoring system implementation in Taiwan-History and driving forces, Mar. Policy 34 (2010) 541–548, https://doi.org/10.1016/j.marpol.2009.11.001.
[3] FAO, The state of world fisheries and aquaculture 2018 - Meeting the sustainable development goals, FAO, Rome, 2018.
[4] Fisheries Agency, Fisheries Statistical Yearbook - Taiwan, Kinmen and Matsu Area, 2018 [in Chinese], Fisheries Agency, Council of Agriculture, Taipei, 2019.
[5] OFDC, Annual report of Taiwanese distant water fisheries statistics [in Chinese with English abstract & figures], (2019). ⟨https://www.ofdc.org.tw:8181/web/app/display.xhtml?id=9#CatchStatisticsAnnualReport⟩ (Accessed March 26, 2020).
[6] Fisheries Agency, Statutory budget of the Fisheries Agency, Taiwan (2001–2020) [in Chinese], (n.d.). ⟨https://www.fa.gov.tw/cht/GovBudget/index.aspx⟩ (Accessed March 21, 2020).
[7] E.R. Desombre, Flags of convenience and property rights on the high seas, in: R. Allen, J. Joseph, D. Squires (Eds.), Conservation and Management Transnational Tuna Fisheries, Wiley-Blackwell, 2010, pp. 269–281, https://doi.org/10.1002/9780813820262.ch16.
[8] K.J. Mengerink, H.N. Scheiber, Y.-H. Song, Japanese policies, ocean law, and the tuna fisheries: sustainability goals, the IUU issue, and overcapacity, in: R. Allen, J. Joseph, D. Squires (Eds.), Conservation and Management Transnational Tuna Fisheries, Wiley-Blackwell, Oxford, UK, 2010, pp. 283–320, https://doi.org/10.1002/9780813820262.
[9] ICCAT, Recommendation by ICCAT regarding control of Chinese Taipei's Atlantic bigeye tuna fishery (Rec. 05–02), (2005). ⟨https://www.iccat.int/Documents/Recs/compendiopdf-e/2005–02-e.pdf⟩.
[10] European Commission, Fighting Illegal Fishing: Commission warns Taiwan and Comoros with Yellow Cards and Welcomes Reforms in Ghana and Papua New Guinea, European Commission (2015). ⟨https://ec.europa.eu/commission/presscorner/detail/en/IP_15_5736⟩ (Accessed March 25, 2020).
[11] European Commission, Tackling Illegal, Unreported and Unregulated (IUU) Fishing (infographic), (2015). ⟨https://ec.europa.eu/fisheries/sites/fisheries/files/docs/publications/2015–04-tackling-iuu-fishing_en.pdf⟩ (Accessed March 25, 2020).
[12] European Commission, Handbook on the Practical Application of Council Regulation (EC) No. 1005/2008 of 29 September 2008 Establishing a Community System to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (The IUU Regulation), (2009). ⟨https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/handbook_en.pdf⟩ (Accessed March 25, 2020).
[13] ICCAT, Recommendation by ICCAT Regarding Chinese Taipei (Rec. 06–01), (2006). ⟨https://www.iccat.int/Documents/Recs/compendiopdf-e/2006–01-e.pdf⟩.
[14] European Commission, Illegal Fishing: EU lifts Taiwan's Yellow Card, European Commission (2019). Accessed March 26, 2020⟨https://ec.europa.eu/commission/presscorner/detail/en/IP_19_3397⟩.
[15] T. Daw, T. Gray, Fisheries science and sustainability in international policy: a study of failure in the European Union's common fisheries policy, Mar. Policy 29 (2005) 189–197, https://doi.org/10.1016/j.marpol.2004.03.003.
[16] M. Cardinale, G.C. Osio, G. Scarcella, Mediterranean sea: a failure of the European fisheries management system, Front. Mar. Sci. 4 (2017), https://doi.org/10.3389/fmars.2017.00072.
[17] L. Cao, Y. Chen, S. Dong, A. Hanson, B. Huang, D. Leadbitter, D.C. Little, E. K. Pikitch, Y. Qiu, Y. Sadovy de Mitcheson, U.R. Sumaila, M. Williams, G. Xue, Y. Ye, W. Zhang, Y. Zhou, P. Zhuang, R.L. Naylor, Opportunity for marine fisheries reform in China, Proc. Natl. Acad. Sci. USA 114 (2017) 435–442, https://doi.org/10/f9m469.
[18] S. Khalilian, R. Froese, A. Proelss, T. Requate, Designed for failure: a critique of the common fisheries policy of the European Union, Mar. Policy 34 (2010) 1178–1182, https://doi.org/10.1016/j.marpol.2010.04.001.
[19] Swan J., Gréboval D., Report and Documentation of the International Workshop on the Implementation of International Fisheries Instruments and Factors of Unsustainability and Overexploitation in Fisheries. Mauritius, 3–7 February 2003. FAO Fisheries Report, No. 700, FAO, Rome, 2003. ⟨http://www.fao.org/3/a-y5242e.pdf⟩.
[20] G. Shen, M. Heino, An overview of marine fisheries management in China, Mar. Policy 44 (2014) 265–272, https://doi.org/10.1016/j.marpol.2013.09.012.
[21] S.-K. Chang, N.-T.A. Hu, S. Basir, H.V. Duyen, P. Nootmorn, M.D. Santos, F. Satria, A step forward to the joint management of the South China Sea fisheries resources: joint works on catches, management measures and conservation issues, Mar. Policy 116 (2019), 103716 https://doi.org/10/ggnt5c.
[22] W. Battista, R.P. Kelly, A. Erickson, R. Fujita, Fisheries governance affecting conservation outcomes in the United States and European Union, Coast. Manag. 46 (2018) 388–452, https://doi.org/10.1080/08920753.2018.1498711.
[23] A. Decrop, Triangulation in qualitative tourism research, Tour. Manag. 20 (1999) 157–161, https://doi.org/10.1016/S0261-5177(98)00102-2.
[24] M. Haward, A. Bergin, Taiwan's distant water tuna fisheries, Mar. Policy 24 (2000) 33–43, https://doi.org/10.1016/s0308-597x(99)00005-6.
[25] C.-I. Sha, Overview and Prospect of Taiwan Distant Water Fisheries [in Chinese], in: C.-I. Sha (Ed.), Taiwan Fisheries Strategy Research, Chung-Chen Agriculture, Technology, Social Foundation, Taipei, 2007, pp. 34–63.
[26] H.-W. Huang, C.-T. Chuang, Fishing capacity management in Taiwan: Experiences and prospects, Mar. Policy 34 (2010) 70–76, https://doi.org/10.1016/j.marpol.2009.04.014.

[27] T.-Z. Wu, Cohesive consensus and Taiwan's arrangement: fisheries administration and policies. Section 3, Chapter 3 [in Chinese], in: H.-H. Hu (Ed.), Centuries Cultivation of Taiwan Agriculture: Elegance of Taiwanese Fisheries, Council of Agriculture, ROC, 2012, pp. 224–267, accessed April 5, 2020, https://www.fa.gov.tw/upload/168/20130820812483391468.pdf.
[28] M. Gianni, W. Simpson, The Changing Nature of High Seas Fishing: How Flags of Convenience Provide Cover For Illegal, Unreported and Unregulated Fishing, Australian Department of Agriculture, Fisheries and Forestry, International Transport Workers' Federation, and WWF International, 2005.
[29] B.L. Gallic, A. Cox, An economic analysis of illegal, unreported and unregulated (IUU) fishing: key drivers and possible solutions, Mar. Policy 30 (2006) 689–695, https://doi.org/10/dcmcgk.
[30] FAO, International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated fiShing., Food and Agriculture Organization of the United Nations, Italy, 2001.
[31] ICCAT, Report for Biennial Period, 1998–99. Part II (1999), ICCAT, Madrid, 2000. ⟨https://www.iccat.int/en/pubs_biennial.html⟩.
[32] C.-L. Chen, Taiwan's response to international fisheries management after 2005 as influenced by ICCAT and fishers' perception, Mar. Policy 36 (2012) 350–357, https://doi.org/10.1016/j.marpol.2011.06.012.
[33] ICCAT, Report for Biennial Period, 2004–05. Part II (2005)–Vol. 1, ICCAT, Madrid, 2006. ⟨https://www.iccat.int/en/pubs_biennial.html⟩.
[34] C.-C. Liu, Promoting globalization and enhance management of distant-water fisheries, Agric. Policy Rev. 175 (2007) 51–54.
[35] C.-C. Liu, Achievements and prospects of distant water tuna fishery management, Agric. Policy Rev. 191 (2008) 51–53.
[36] H.-W. Huang, The impact of ICCAT management measures on the Atlantic fishing fleets and the response [in Chinese], Intg. World Fish. Info. 170 (2007) 49–57.
[37] A.T. Charles, Chapter 3 - the Human System. Sustainable Fishery Systems, Blackwell Science Ltd, 2008, pp. 44–68.
[38] WCPFC, WCPFC IUU Vessel List for 2017, (2016).
[39] ICCAT, Information Submitted by a Contracting Party in Accordance with Rec. 08–09. (ICCAT Doc. No. COC-307), (2016). ⟨https://www.iccat.int/com2016/⟩.
[40] European Commission, Commission decision of 1 October 2015 on notifying a third country of the possibility of being identified as a non-cooperating third country in fighting illegal, unreported and unregulated fishing (2015/C 324/10), Off. J. Eur. Union 58 (2015) 17–28.
[41] F.C. Jocylin, Taiwan's Illegal Fishing Scandal Faces Possible Import Ban, Taiwan News. (2015). ⟨https://www.taiwannews.com.tw/en/news/2827006⟩ (Accessed April 11, 2020).
[42] COA (Taiwan), Entry into Force of Three Distant Water Fisheries Related Laws Requiring Industry's Full Compliance, (2017). ⟨https://eng.coa.gov.tw/theme_data.php?theme=eng_news&id=480⟩ (Accessed April 11, 2020).
[43] G. Hosch, Trade Measures to Combat IUU Fishing: Comparative Analysis of Unilateral and Multilateral Approaches, International Centre for Trade and Sustainable Development (ICTSD),, Geneva, Switzerland, 2016.
[44] S.-K. Chang, H.-I. Liu, H. Fukuda, M.N. Maunder, Data reconstruction can improve abundance index estimation: an example using Taiwanese longline data for Pacific bluefin tuna, PLOS One 12 (2017), e0185784, https://doi.org/10.1371/journal.pone.0185784.
[45] COA (Taiwan), The European Commission lifts Taiwan's Yellow Card on Tackling Illegal Fishing, (2019). ⟨https://eng.coa.gov.tw/theme_data.php?theme=eng_news&id=571⟩ (Accessed April 11, 2020).
[46] Fisheries Agency, List of Authorized Distant Water Fishing Vessels by the Council of Agriculture, Taiwan [in Chinese], (n.d.). ⟨https://www.fa.gov.tw/cht/BoatListInIFMO/index.aspx⟩ (Accessed March 27, 2020).
[47] COA (Taiwan), Approved Non-Taiwan Flagged Vessel List Operated by Taiwanese Nationals, (n.d.). ⟨https://www.fa.gov.tw/cht/FOC/⟩ (Accessed April 19, 2020).
[48] COA (Taiwan), To combat illegal fishing activities, the Executive Yuan established a Task Force for Effectively Integrating Cross-ministerial Fisheries Control Measures, (2016). ⟨https://eng.coa.gov.tw/theme_data.php?theme=eng_news&id=468⟩ (Accessed April 13, 2020).
[49] Fisheries Agency, List of Sanctions According to Act for Distant Water Fisheries, (n.d.). ⟨https://www.fa.gov.tw/cht/PolicyIUU/index.aspx⟩ (Accessed April 12, 2020).
[50] B. Hutniczak, C. Delpeuch, Combatting Illegal, Unreported and Unregulated Fishing: Where Countries Stand and Where Efforts Should Concentrate in the Future (TAD/FI(2017)16/FINAL), OECD Publication, 2018. ⟨tinyurl.com/yb3452at⟩ (accessed April 6, 2020).
[51] FAO, Agreement on Port State Measures (PSMA), (n.d.). ⟨http://www.fao.org/port-state-measures/en/⟩ (Accessed April 6, 2020).
[52] Popescu I., Illegal, Unreported and Unregulated (IUU) Fishing. (Briefing prepared by European Parliamentary Research Service (EPRS), (2017). ⟨tinyurl.com/ybzqd9vk⟩ (Accessed April 6, 2020).
[53] WCPFC, Conservation and Management Measure for Pacific Bluefin | WCPFC, (2019). ⟨https://www.wcpfc.int/doc/cmm-2019-02/conservation-and-management-measure-pacific-bluefin⟩ (Accessed May 12, 2020).
[54] Wikipeida, Piracy off the Coast of Somalia, Wikipedia. (2020). ⟨https://en.wikipedia.org/w/index.php?title=Piracy_off_the_coast_of_Somalia&oldid=948510664⟩ (Accessed April 4, 2020).
[55] NPFC, About NPFC - the North Pacific Fisheries Commission, (n.d.). ⟨https://www.npfc.int/about_npfc⟩ (Accessed March 20, 2020).
[56] SPRMO, South Pacific Regional Management Organisation, (n.d.). ⟨https://www.sprfmo.int/about/⟩ (Accessed April 4, 2020).