An assessment of plastic waste generation from fishing vessels in the western and central Pacific, and potential measures to improve onboard waste management

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This article is based on the executive summary of a report[2] commissioned by the Pacific Islands Forum Fisheries Agency (FFA) to gain an understanding of the situation regarding plastic waste that is dumped into the western and central Pacific Ocean from fishing vessels. Given the current situation with the COVID-19 pandemic, this desktop study reviewed the existing literature on the subject to gain insight about waste management practises onboard fishing vessels. Fishing boat officers and/or company personnel were surveyed when possible, and the extensive experience of the authors in the fields of fishing vessels and waste management were also relied on to make an overall assessment of the current situation regarding waste disposal on vessels in the Pacific.

The ultimate aim of the study was to provide possible strategies and actions that could be taken at both the national and regional level to eliminate all plastic waste disposal at sea. The authors have endeavoured to address this central point through a thorough and careful analysis of the information available. It is essential to bear in mind from the outset, the reason why an attempt was being made to determine the amount of waste that is dumped in the ocean: to prevent it.

Estimates of waste generation by fishing vessels

Estimates of waste generation by fishing vessels is only ever amenable to broad estimates, as the amount changes every day and there are many variables, including vessel size, crew numbers, type of fishing, length of voyage, vessel condition and operating standards on board.

Similarly, given that waste management practises onboard vessels vary widely, it is not realistic to make any meaningful estimate of the amount of waste being dumped unless an extensive, real-time study of several vessels during whole fishing trips is conducted. To make a broad sweeping claim regarding the amount of waste dumped from all fishing vessels might discourage those operators who are doing their best to deal with waste problems onboard, while making those – if any – who dump everything over the side, actually look better.

Faced with this conundrum, and mindful of the ultimate purpose of this study, the authors have taken the approach of trying to estimate the amount of waste that certain vessels might generate.

The full report differentiates between: 1) operational and maintenance waste that is related to crew and vessel size and condition, and days at sea; and 2) fishing operations waste that is directly related to the type of fishing and total fishing effort. Using existing literature, observer reports and the authors' varied experience, some broad estimates have been made that might allow a determination of a vessel's expected waste generation. These estimates are of a conservative nature and are applicable to a broad range of vessels.

The study did not look at the issue of lost and discarded fishing gear, as this was not part of the terms of reference. The issue could, however, be addressed through recommendations and standards that are already in place, such as of the International Convention for the Prevention of Pollution from Ships (MARPOL)[3] and the International Maritime Organization (IMO).[4] The strategies and actions proposed below take account lost or discarded fishing gear and allow for the integration of measures to combat this problem into the proposals, through the marking of fishing gear.

Our estimate of waste generated by the different tuna fishing fleets in the western and central Pacific Ocean (WCPO) is as follows.

Longline vessels. For the 1700 active vessels in the WCPO:

- Plastic liners in bait boxes: 402–935 tonnes; median: ~ 670 tonnes per annum.
- Cardboard: 2958–6879 tonnes; median: ~ 4920 tonnes per annum.
- Using 60% as a proxy based on observer reports: **between 241 and 560 tonnes of plastic waste from bait alone is being dumped at sea every year, while the figure for cardboard is between 334 and 776 tonnes.**

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[2] Leney A., Blaha F. and Lee R. 2021. An assessment of fishing vessel plastic waste generation in the WCPO region – And potential measures to improve waste management in the fleet. Honiara, Solomon Islands: Pacific Islands Forum Fisheries Agency.
[3] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx
[4] https://www.imo.org/en

Salt bags for brine stored in a purse seiner. (image: © Francisco Blaha)

Purse-seine vessels. For the 253 vessels in the FFA register:

- Salt bags for brine making: 210 tonnes, equivalent to 2,800,000 individual bags.
- Using a 37% proxy: **77.7 tonnes of woven plastic salt bags (equivalent to 1,036,000 individual bags) are dumped into the ocean every year.**

Operational and maintenance waste:

- Longline vessels: 1000 tonnes produced, 600 tonnes dumped into the ocean every year.
- Purse-seine vessels: 220 tonnes produced, 80 tonnes dumped into the ocean every year.

Existing international frameworks and guidelines

Having determined some idea of the type and scale of the problem regarding the waste generated on fishing vessels, the study then looked at the practicalities of dealing with those quantities and types of waste. The current institutional frameworks that exist – under MARPOL, the Western and Central Pacific Fisheries Commission (WCPFC) conservation and management measure (CMM) 2017-04,[5] and IMO agreements – are looked at in detail to determine if a good framework and clear guidance already exists. It is clear that all of the institutional frameworks, guidance documents, standards and agreements that might be needed by ship operators to address the issue of onboard waste management are, in fact, already in place.

Waste reception capacity at Pacific ports

The study examined the potential to off-load waste at several Pacific Island ports. The picture is grim: of the five fishing ports in the region that were looked at, only one – Suva in Fiji – has access to a landfill facility that is in any way compliant with any desirable standards. The other four nations – the Federated States of Micronesia, Kiribati, Marshall Islands and Solomon Islands – struggle with their own local waste management to varying degrees, and their landfill facilities are mostly already overwhelmed. Adding foreign commercial waste to existing domestic waste is not a viable solution, where that is avoidable. While some fishing vessels do operate out of Pacific Island ports as a home base (e.g. one company in the Marshall Islands and another in Noro, Solomon Islands) and have to dump their waste in local dumpsites, the majority of fishing vessels are actually foreign-based, and materials that are now waste were once provisioned onto those vessels either at overseas ports or from carrier vessels.

[5] https://www.wcpfc.int/doc/cmm-2017-04/conservation-and-management-measure-marine-pollution

Waste disposal for the distant-water fishing nations vessels

Taking a conventional solid waste management approach of investigating "reverse logistics" pathways,[6] and following the internationally accepted principle that the country to which a fishing vessel belongs is also responsible for the waste that vessel produces (in this case, the flag state or de facto home port). The carrier fleet provides an excellent opportunity to improve waste management at sea. Carrier vessels are typically larger than fishing boats, and have adequate deck space for taking waste back to an appropriate port to be dumped. Because the actual waste takes up less space than the products that originally generated that waste, there is clearly an opportunity to involve the carrier fleet in a formal waste management function.

It is fully accepted that the carrier fleet fills its holds with fish that take up some of the space of supplies that were carried out. But while longline vessels consume vast numbers of boxes of bait, and purse-seine vessels take on many tonnes of 50-kg sacks of salt, there is space on decks and in dry holds to store carefully managed waste that can be taken back to shore. Carriers have the potential to have small compactor baling machines onboard that can compress waste, increase the density, and thus reduce the stowed volume of waste. And some vessels have IMO-compliant incinerators that are much safer for both ship and crew than rusty oil drums with holes that are common on the decks of many fishing vessels. Oil drum incinerators are undesirable from a ship safety point of view and are a known health hazard to crew as they generate carcinogenic smoke in significant quantities.

In short, if the waste produced by fishing boats is to be professionally addressed, then it must become part of the everyday operation of running a tight ship, and waste needs to be managed and stowed for off-loading at the appropriate place and time. Good ship operators are already doing this, and all the guidance that is needed to help other operators improve their onboard waste management exists in great detail under the MARPOL and IMO frameworks. The logistical problems are quite easily solved, and there is no shortage of guidance on how to address them; the major challenge at present is the indifferent attitudes toward proper waste management.

On this note, the full report provides some simple and practical advice on onboard waste management that is derived from the direct experience of the authors in this field, one of which spent several years at sea during which one of his tasks was to manage the waste onboard, ensuring that nothing went over the side except food waste.

Economic incentives for improved waste management

Having determined that, for the carrier-supplied fleet at least, there is a clear alternative to dumping waste in the ports of Small Island Developing States (SIDS), and that commercial and financial considerations are a significant driver in how waste is managed onboard. The report takes a brief look at the economic incentives that currently exist and may drive how waste is managed on fishing vessels. It can be clearly seen that the economic incentives are entirely aligned to encourage poor waste management and ocean dumping. This is an important insight, and one recognised by the IMO, and several MARPOL documents call for the creation of incentives to improve waste management. The report quotes a ground-breaking recent economic analysis[7] from the British government to support the conclusions reached here. Improved waste management will incur additional costs, but this is simply part of the cost of running a responsible business and cannot be used as a justification to pollute the natural environments of small Pacific Island nations. Currently, the "avoided cost" (i.e. financial benefit) of poor waste management is, de facto, a subsidy from island nations to those businesses that evade their responsibilities under MARPOL. In fact, a "secondary market" in waste may appear whereby carriers charge fishing vessels to take their waste away, thus allowing those vessels to fulfil their waste bond requirements.

Strategy to eliminate the dumping of waste at sea

With all of the above now providing some clarity to the waste management situation onboard fishing vessels, we reach the heart of the matter: How might any dumping of waste from fishing boats cease? From the above, strategic points can be developed and enumerated, and resulting actions that can be taken to implement these strategic points can become clear.

The resulting strategic points are as follows:

1) Either waste is dumped into the sea, or it is returned to port at some point, and in some form. MARPOL does not allow the dumping of any solid wastes considered in this study to be dumped into the ocean, including incinerator ashes, thus:

   All vessels should return with some quantity of waste to be off-loaded at port.

[6] "Reverse logistics" differs from traditional waste management in that it adds value back into the chain by recovering and repurposing products, whereas waste management focuses mainly on disposal.

[7] The Economics of Biodiversity: The Dasgupta Review February 2021: https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review

2) If something is to be managed, then it will need to be measured. Therefore, the questions are: How much? and How do we measure it? There are two separate waste streams to consider: fishing operations waste, and operational and maintenance waste. The first is related to fishing effort while the second is related to crew and vessel size, and the number of days at sea, thus:

   A measure of expected waste generation by vessel is required.

3) The overall framework of institutional and technical standards and guidelines already exists with MARPOL and IMO. The overall aim must be to ensure that those vessels that do not currently have good waste management practices, must change their current practices, thus:

   Under the FFA Harmonised Minimum Terms and Conditions, all licensed fishing vessels must comply with MARPOL, whether the flag state is a Party or not.

4) There is actually an economic incentive to operate a vessel with poor waste management; an economic incentive must be created to improve waste management, thus:

   An economic incentive to follow MARPOL requirements must be created.

5) Measures must be simple to implement where possible for both FFA and fishing companies. Onerous and complex reporting systems that require significant additional effort and cost to report, monitor and enforce are unlikely to be adopted, thus:

   Simple metrics must be used, and effort must focus on a small number of key ports and/or locations.

6) The issue of onboard waste management is fundamentally a logistical challenge; all of the materials that become waste were put on the ship either in port or during a carrier transshipment, thus:

   Existing reversed logistical pathways must be used.

7) Pacific Island ports already have a domestic waste crisis and are, in very large part, unsuitable places to take foreign waste generated by overseas business operations. Therefore, aside from local-based fishing vessels, vessel waste needs to be returned to originating home ports, thus:

   Wastes from vessels of distant-water fishing nations should not be off-loaded at Pacific Island ports.

Managing waste on small islands is a real challenge, Majuro, Marshall Islands. (image: ©Alice Leney)

8) Larger vessels are much better placed to have better waste management systems because they have more space, can operate small compactors to increase waste density, can operate safe and compliant incinerators, and can handle and stow larger waste containers, thus:

   Carrier vessels must accept waste from fishing vessels.

9) There must be a long-term element to the strategic actions that is aimed at changing, over time, the culture onboard those fishing vessels that do not currently have good waste management systems in place, thus:

   Easy waste management measures should be imposed at the start, and the bar should be raised over time.

10) Ship owners and operators who can show that they have MARPOL-compliant systems already in place, and already take waste management seriously, must be recognised. Those who do not must be held accountable, thus:

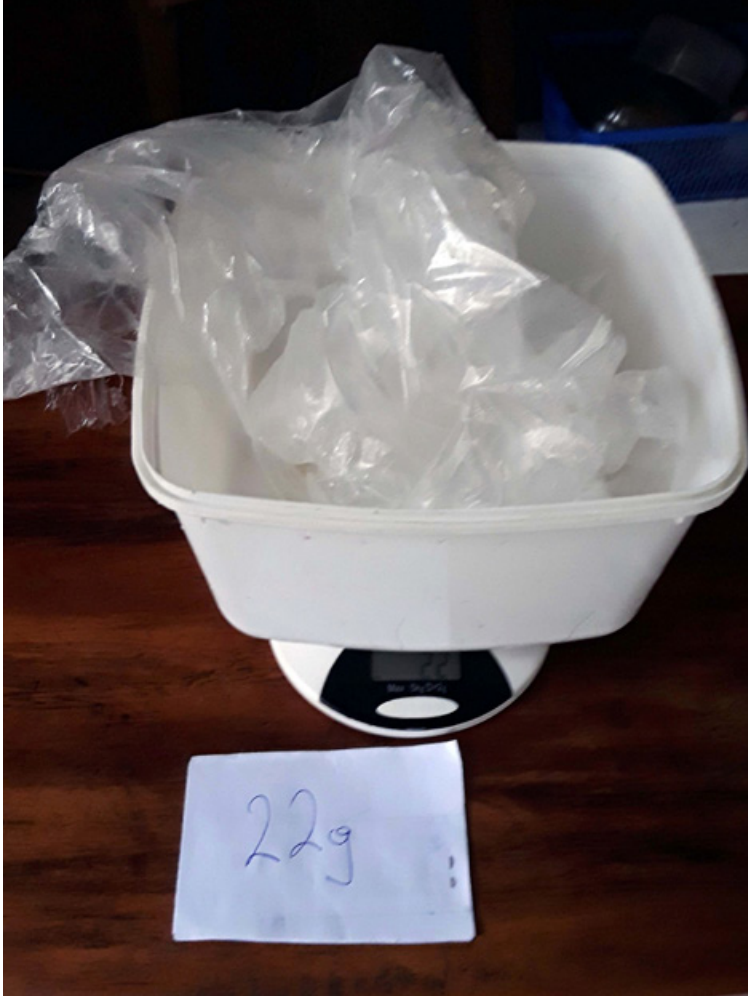
   Good businesses should be rewarded, and poor operators should be targeted.

These strategic points rest on two fundamental pillars: 1) simple ways to measure and monitor onboard waste to know that change is occurring; and 2) the development of incentives to reward those already doing the right thing, encourage change in those who need to, and sanction those who resist.

Proposed actions to take

From this strategic analysis, and a close look at the realities of dealing with waste onboard ships, the report recommends a divergence from the MARPOL method of measuring waste by volume in cubic metres, to that of weight in kilograms. The reasons for this are elaborated on in the report, and the key considerations are provided by strategic points 5 and 9. Measurement must be as simple as possible and consistent with reasonable estimates because reasonable estimates are the bedrock of waste measurement. This approach meets the requirements of the first pillar on which the strategy rests.

For the second pillar, the heart of the proposed actions is the FFA Harmonised Minimum Terms and Conditions that require demonstrated effort to comply with WCPFC CMM 2017-04 as well as MARPOL requirements. Alongside this, using the widely used waste management principal of extended producer responsibility, a "waste bond" is proposed, whereby a vessel must show that a reasonable quantity of waste is disposed of onshore in an acceptable manner to avoid sanction.



Weighing plastic liners from a standard bait box used by tuna longliners. (image: © Robert Lee)

This waste bond would be held in escrow in some conventional form[8] to ensure that good operators are not penalised, but poor ones are. Greater detail of this proposal is provided in the report, but in essence the following "action points" are proposed.

A. Provide, as part of licensing (under the Harmonised Minimum Terms and Conditions), vessels with a simple electronic template for a Garbage Record logsheet

Some work will need to be conducted to develop a suitable electronic Garbage Record logsheet template, that will minimise the quantity of information required to be recorded so that it is as simple as possible to fill out and check. This would be similar to vessels that presently do electronic reporting. For example, the garbage categories used in MARPOL can be simplified significantly for the purposes of this action: there is no need to identify so many categories.

Weight in kilograms should be entered into the Garbage Record logsheet, which could consist of a simple MSExcel spreadsheet. The logsheet should be uploaded regularly to a shared database managed by either the Secretariat of the Pacific Regional Environment Programme

[8] There are a range of potential financial mechanisms by which businesses operate escrow arrangements, for example "trust accounts" and "bank guarantees" to name but two.

(SPREP), the Pacfic Community or FFA. Each ship would have a specific identity, just like with electronic catch and effort logsheets. Each uploaded logsheet, with new information added, would replace the previous one, allowing to gather an annual total for each fishing vessel. This is consistent with strategic points 1, 2 and 5 described earlier.

B. Set up a database for Garbage Record books/logsheets.

An electronic repository for the standardised Garbage Record Books is needed on the servers of SPREP, SPC or FFA, or "in the cloud", on which vessels can upload their data. This is an electronic reporting task and complements action point A.

C. Require all FFA-licensed vessels to provide a garbage management plan.

This plan should be as simple as possible and consistent with representing the realities of waste storage on the vessel in question. A concise template plan should be drafted to assist standardisation and encourage simplicity, and to avoid recording any unnecessary information. Carrier vessels should be expected to include provisions in their plans to take waste from fishing vessels during transshipments. Carriers will be expected to show compaction capacity and/or large waste holding capacity.

Standardising plans will help ensure that only the important information is in the plan (e.g. how waste is contained and stowed, any compaction measures, scrap metal separation, description of any incinerator used). There is no need to describe recycling capacity, waste type and separation. A template should be drafted and field tested on a small number of suitable candidate companies and vessels that are prepared to assist in this endeavour, so as to develop the simplest plan but one that fits the purpose. This is consistent with strategic points 3, 5, 6 and 8.

D. Develop a formula for calculating expected waste generation per vessel.

The goal here is to identify a small number of vessels that have good waste management systems, learn what works best, and use that information to develop a simple formula based on vessel size, number of crew members, days at sea, fishing type and fishing effort. This current report can provide some guidance to for how to go about this, but because it is a desk-top study, it is not ideal. The use of existing observers to collect data for such a study is ideal, and training could be easily provided to them for this purpose.

This action can be combined with action point C so that the same field testing of a management plan can be used to collect data. The study period need not be too long, the intention is to determine a number for a reasonable quantity of expected waste generation, and feed into the development of onboard systems. Good measurements will provide good data to help vessel owners determine waste stowage requirements for an expected voyage length.

Vessel owners could be encouraged to participate in such a study by being given a waiver from having to post an initial waste bond, if that approach was subsequently taken. This is consistent with strategic points 2, 9 and 10.

E. Require all onboard incinerators to meet IMO standards.

Any waste incineration that takes place onboard should be done so in a proper incinerator that is made for the purpose, and not in a non-compliant device that is a potential health and safety hazard. Incinerators that are IMO-compliant are larger, more complex and expensive. It is expected that these will mainly be used on carrier vessels. This will concentrate monitoring effort on a smaller number of vessels, especially as incinerated waste is harder to measure.

This action requires that vessels submit pictures and specifications of their installed incinerator, at the same time as – and as part of – their waste management plan. Non-compliant incinerators could cause rejection of the plan. A date should be set as to when a vessel must comply. MARPOL standards for incinerators are extant;[9] this action requires no additional effort to develop standards. This action is consistent with strategic points 3, 4, 8 and 10.

F. Develop a waste bond system that is payable at the time of licensing.

The action points above will feed into the development of a waste bond. With a reasonable estimate of the amount of waste expected to be generated, consistent with ship operations and size, the amount of waste bond that should be posted can be determined. Many factors that must be considered when setting the bond amount, including practical, economic and political factors. The waste bond would be held in escrow, possibly using a conventional commercial mechanism, and rolled over annually for each license period, or as required. Those vessels that consistently fail to manage their waste may lose their bond.

Action points A to E could be conducted over the course of a year, so that by the end of the first year the formula for expected waste will have been developed, and templates for Garbage Record books and management plans have been field tested. The study of a select small number of vessels that currently have good waste management systems can be conducted using a cohort

[9] Resolution Mepc.244(66) 2014 Standard Specification for Shipboard Incinerators

of waste-trained observers. At the start of a new licensing period, vessels will be required to post a waste bond that will be fully refundable when, at the end of the period, the expected amount of waste has been off-loaded. Vessels that are being re-licensed can roll-over their waste bonds. Non-compliant vessels will lose their bond and be required to pay another. Fishing vessels that pass their waste on to a carrier vessel can be deemed to have effectively fulfilled their responsibility, thus transfering that liability to the carrier vessel. Carriers will also be required to have waste bonds as part of their licensing conditions, and will acquit those responsibilities at the point of off-loading waste to a port, and recorded in their Garbage Record book.

The amount of a waste bond to be paid could be set at the end of each permit period, using a sliding scale that rewards good operators, and puts pressure on the worse ones by increasing the level of their bond.

Vessels that can demonstrate full compliance with MARPOL and produce records and plans to support that compliance, including pictures of the current waste management situation on the vessel, may not be required, at the discretion of FFA, to post a waste bond. This rewards businesses that are already making the required effort to manage their waste responsibly. This is consistent with strategic points 4 and 10.

G. Communicate the new waste regime to FFA stakeholders.

If the above action points are adopted and implemented, then the rationale for following them needs to be communicated to key stakeholders during the development stage. This could be refined and spelled out in at least two briefing papers: one that is more detailed along the lines of an executive summary that might go to key stakeholders, and one that is a factsheet that can be more widely circulated to those who are less interested in the details but need to know about the coming changes to licensing conditions.

Subsidiary actions

Strengthening enforcement and reporting of WCPFC CMM 2017-04

The MARPOL requirements described above must be viewed in the light of WCPFC CMM 2017-04, which expressly addresses waste from fishing vessels. The section of this report that discusses this alignment clearly demonstrates that these proposals to drive as much waste as possible back along the logistical pathway provided by the carrier fleet is the cheapest option for both SIDS and distant-water fishing nations and Flag State operators.

[10] WCPFC CMM 2017-04 Adoption Point 8

CMM 2017-04 explicitly recognises that WCPFC members, cooperating non-members and participating territories (collectively referred to as CCMs) should follow MARPOL; it also explicitly recognises that SIDS are challenged through an inability to provide adequate facilities for receiving and managing waste from ships in their ports; and explicitly states that[10]:

CCMs shall cooperate, consistent with national laws and regulations, directly or through the Commission, and in accordance with their capabilities, ***to actively support*** *SIDS and territories* ***through the provision of adequate port facilities*** *for receiving and appropriately disposing of waste from fishing vessels*. [emphasis added.]

It is incontestable that it will be far cheaper for both SIDS and Flag States to drive waste back through the logistical chain to ports that do have adequate facilities to accept commercial wastes from fishing vessels. The cost of building landfills and other waste management facilities in SIDS is not only immense, but a long-term programme of improvement completely unsuited to the vagaries of short-term commercial considerations.

Through the waste bond system proposed, which would of course also apply to carrier vessels and any other FFA-

Standard bait box used by tuna longliners showing the plastic liner. (image: © Robert Lee)

licensed vessels, the carrier fleet can actively participate in ensuring that waste only goes to ports that have adequate facilities. As carriers take on the waste from fishing vessels – even from vessels belonging to a different Flag State to the carrier – a secondary market will spring up whereby carriers are paid by the fishing vessels to take their waste away – just as vessels would normally pay to have their waste disposed of in port.[12]

The Garbage Record book/logsheet will record transshipment to a carrier as a transfer of ownership just as it does with fish, and so fulfil fishing vessels' obligations to dispose of their waste correctly under the conditions of the waste bond. The cost will be up to the market and will also be influenced by the amount at which the waste bond is set: if set too low, the market will not function. Carriers will then in turn pay to dispose of the waste at a port with adequate facilities. This proposal is using market mechanisms to enact point 8 of the CMM, and at a far lower cost than that of financing waste management facilities and landfill construction in SIDS.

Similarly, the action points recommended in this report will help address CMM points 9[12] and 10[13]: the loss and recovery of fishing gear. The proposed Garbage Record book/logsheet to be developed could easily incorporate a lost fishing gear component; if fishing gear were both marked (as required by the Harmonised Minimum Terms and Conditions) and logged as lost, then this study proposes using a waste bond as an incentive to those vessels that recover lost fishing gear, in line with strategic points 9 and 10 above.

Inclusion of CMM 2017-04 and MARPOL issues as part of electronic monitoring objectives

Electronic monitoring is set to be further deployed in the region and already plays a role in pollution monitoring, despite the political, logistical and operational problems discussed. Therefore, the potential of incorporating issues related to waste offloading to the present scope of electronic monitoring is consistent to both areas of compliance.

Off-loading fish to a carrier vessel or at a home port should be accompanied by off-loading of waste, and thus could be easily verified through video footage. Video observers should not be expected to look through large quantities of footage for incidents of waste being dumped overboard during normal ship operations. This is consistent with strategic points 5 and 6.

Strengthening existing requirements of marking fishing gear and using biodegradable fish aggregating devices

The IMO Action Plan[14] suggests that fishing gear should be marked with the deploying vessel's identifiers, and this should also apply to FADs. If this measure was enacted, it would be possible to reward those who collected discarded fishing gear by using the waste bond money of those who lost the gear.

There is a large area of potential study and policy development to consider when working out a sliding scale to sanction those who lose large amounts of fishing gear at sea. For example, the loss of a FAD that was built with only biodegradable materials, designed to break down over time in the ocean, and not entrap bycatch of any sort might not incur penalties; the loss of a FAD made of plastic components, on the other hand, would. A waste bond could provide the source of funds. Such work would need to be conducted after the effort to develop an initial waste bond level.

Conclusion

If the above proposals were to be accepted and acted upon, there are many details to be worked out; but the proposals developed here are offered as a workable way forward to address what has been, until now, somewhat of an intractable problem. These proposals show a clear way forward using the principals of waste management and economic incentives that have been tried and tested, and proven to be successful, albeit in quite different fields. They could, however, well work in this one too.

[11] If a fishing vessel is not already paying to have its waste disposed of in port, then it is clear why the WCPFC states in CMM 2017-04 Preamble: "convinced that certain activities associated with fishing may affect the Western and Central Pacific marine environment ... and impacts on marine ecosystems".

[12] CMM 2017-04 Adoption Point 9: "CCMs are encouraged to develop communication frameworks to enable the recording and sharing of information on fishing gear loss in order to reduce loss and facilitate recovery of fishing gear."

[13] Ibid, Point 10: "CCMs are further encouraged to develop frameworks or systems to assist fishing vessels to report the loss of gear to their Flag State, relevant coastal States, and the Commission."

[14] Resolution Mepc.310(73) Action Plan to Address Marine Plastic Litter from Ships