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Emerging technologies and their suitability for coastal fisheries and aquaculture monitoring control and surveillance

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Introduction

1. In 2021, the Pacific Community (SPC) commissioned a study on emerging technologies and their suitability for Coastal Fisheries and Aquaculture Monitoring Control and Surveillance (CFA MCS). The study was in response to SPC members increasing interest in drones, small craft tracking systems, hydrophones and automated cameras to assist with their coastal fisheries MCS operations.
2. The proverbial “net” was cast wide for this study to capture as many potential tools and technology as possible. The findings come from an assessment of over 175 tools from over 135 companies around the world. Most of the research was done online using web resources. The consultant had direct consultations via video conferencing with 75 different companies to better understand their offerings for the Pacific context.
3. A copy of the report from the study is available on request and can be emailed to those members who express an interest in more information on emerging technologies or wish to undertake a trial with the assistance of SPC.

Key findings

4. Fancy tools and technologies are not a panacea for coastal and aquaculture MCS anywhere in the world, including the Pacific Islands. Effective MCS comes from suitably skilled and resourced Fisheries Officers working with a clear mandate and authority to regulate fisheries rules and regulations. This work is made much easier if the rules and regulations are based on good science, fisheries management and community involvement and awareness. If a good base can be achieved, all the other tools and technologies will be more effective.
5. The findings of this report may not apply to every Pacific Island Country and Territory (PICT) in every context. All MCS solutions need to be tailored to the situation on the ground considering resources, capacity and the actual need and circumstances. A number of key findings that are likely to have application in the Pacific Island context are presented below:
 - **Baseline MCS tools and capacity** - key equipment for field officers including official uniform and photo identification badges, safety gear such as a first aid kit and protection from the natural elements, a torch, multi tool and smart phone with a good digital camera and access to binoculars, gauges and measuring devices should all be included in the fisheries officers basic MCS kit. Participation in fisheries officer training such as the Certificate IV in Coastal Fisheries and Aquaculture Compliance is encouraged along with specific training in the deployment and use of tools and equipment used to gather evidence of an infringement. Access to awareness raising material and presentations to give to communities on the importance of following rules and regulations is also critical for an officer working in the field.
 - **Vessel tracking** - There are several small Vessel monitoring systems (VMS) and solar VMS units on the market now or in development that are targeting smaller artisanal vessels. Costs to purchase the devices has reduced significantly along with the cost of monthly cellular or satellite services that support the VMS. There is a range of features that increase

the efficiency of a VMS such as having the ability to send emergency messages to authorities, warning signals that alert a fisher when they are entering closed waters and being able to report catch and effort data via a cell phone or internet connection. These features can help drive the uptake of VMS amongst fishers.

- **Automatic identification system (AIS)** – This technology offers a simple and inexpensive alternative to traditional VMS systems that need cell or satellite access to work. They work on VHF radio signals which required line of sight for functionality and the coastal station or base station is generally located up high to cover the most area at sea. If the base stations¹ can be located around the island areas for maximum coverage and/or vessels can relay signals via each other to a coastal station, there is very little in running costs other than retrieving data from the coastal stations. The benefit of a simple solution for fishers that can alert them of geofences, send distress messages, and send/receive other messages makes this an interesting solution.
- **Shore based monitoring**
 - **Active radio frequency identification (RFID)** – uses a system of sensors to count vessels as they move to and from port and launch sites. Relatively inexpensive and low-tech way of monitoring vessels.
 - **Cameras** – there are many options to choose from that allow you to monitor vessels movements and detect infringements in closed waters or other illegal activity. Cameras can be miniaturised and fixed in location points where they are unlikely to be detected.
- **Radar/other systems** - The radar-based systems with commercially available components have good potential in the Pacific Islands and are being trialled/used in Hawaii, Palau, American Samoa, and Tuvalu. They may be good solutions for monitoring remote areas such as MPAs as they are multisensory system with radar detection (Furuno), FLIR Infrared (IR), AIS identification, camera, and weather sensors.
- **On water monitoring**
 - **Unmanned surface vessels (USVs)** may have an application for coastal fisheries monitoring if they can be run in collaboration with other users to defray costs as well as in fleets so that operator costs can be minimized. They have long range capability and are relatively undetectable given their low profiles. Given their significant cost, they would also likely need to be deployed with other air/vessel assets at the same time to get the most benefit of their use.
 - **Hydrophones** - Acoustic sensors could give valuable insights into use patterns in remote areas. Acoustic sensors linked to cameras or other sensors such as auto learning processors can determine if the sounds are vessels, explosives and potentially

¹ The AIS coastal or base station is the primary component in an AIS physical shore station, and the most important component in a coastal AIS network. The AIS base station receives and communicates AIS data from all AIS sources (AIS mobile stations, other AIS base stations, AIS aids to navigation units etc.) within the coverage area.

even spearfishing. Fisheries Officers can use this information to get an idea of the amount of usage in a particular area and can even help to determine if there are patterns to this usage. For example, if it can be determined that there is a recurring time/day that the area is being accessed, this can give the Fisheries Officers an opportunity to target when they go there to investigate in person.

- **E reporting solutions** – There are many free and open-source E reporting solutions on the market that essentially all collect catch and effort and location data that is transmitted to a central repository either directly as it is collected or once the collector has internet or cell phone connectivity. There are two approaches to collecting catch data in the coastal areas that have had some success. One is by training either local hires or volunteers to collect data at points of landing. Another approach is by using the fishers to collect data which also gives them more control over the data for their own use.
 - **Fisheries officer field work solutions** – two complementary and linked systems - Earth Ranger and SMART, were identified that were initially developed to support rangers working in Africa. They are both free and open source. They have since expanded their scope to support coastal Fisheries Officers, particularly in managing marine protected areas. These have very good potential as a tool for coastal fisheries management in the Pacific. The key potential benefits are that they can work as a quasi-intelligence solution over time and help managers better target tasking of Fisheries Officers.
 - **Community engagement solutions** – there are several software packages used extensively elsewhere in the world that offer easy to use monitoring solutions that can be undertaken by communities. The range of these solutions is only limited by one's imagination and the complexity of the system being monitored. ODK Cloud is one such data collection system and is used across a multitude of fields by organizations like CSIRO, WHO, and Red Cross.
 - **Traceability solutions** – a significant number of traceability solutions exist that can track fish and invertebrates from initial capture right through to the end purchases (also known as bait to plate). These are currently used in the offshore tuna fishery to verify that tuna have been caught from sustainable fisheries. These have good potential for use in coastal fisheries as they can also be used for MCS purposes.
6. The emerging technology report also details other monitoring solutions that don't necessarily have MCS&E implications but may have value in other areas of coastal fishery's management. These include:
- remote water quality monitoring,
 - oceanography, and
 - sonar fish aggregating device buoys.

Field trials

7. Many of the emerging technologies are yet to be proven in the coastal fisheries space and most will work best as part of an integrated package to address MCS issues in coastal waters,

rather than stand-alone solutions. SPC is keen to undertake field trials to evaluate the effectiveness of the emerging technologies and assist countries to strengthen their coastal fisheries and aquaculture MCS capacity at the community, national and ultimately even regional level.

8. Several suppliers and vendors of some of the emerging technology equipment have indicated a willingness to participate in trials and some have offered to trial their equipment free of charge. SPC has funding available that could go to supporting the logistics and monitoring the trial, rather than providing the equipment, so cost-effective pilot studies can be undertaken.
9. Members who are interested in further information and being part of these trials should contact coastal fisheries and aquaculture adviser, Ian Freeman at ianf@spc.int