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Highly instrumented fish aggregating devices (HI-FAD) project

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Background

1. Anchored fish aggregating devices (FADs) are unanimously acknowledged by small-scale fishers as useful fishing infrastructure that provide supplementary economic support to their fishing operations. They provide a focal point for search and rescue should fishers develop problems while fishing in the area, and the fish they attract help alleviate food security issues and coastal resource management problems with increasingly stressed inshore fisheries resources.

2. Safer accessibility to the ocean and its pelagic food resources can be delivered through technological innovation and digitisation throughout the Pacific region, for example by enabling detailed monitoring of sea states and fish. Coastal anchored FADs provide the perfect platform for such monitoring to occur. However, such ocean observation systems have always included technical challenges in terms of deployment logistics and ongoing maintenance. Deploying technology at scale requires considerable funding and adequate testing of the robustness of data flows before it can be judged cost effective at the community, national or even regional level.

3. There is currently a lack of widespread and real-time data to support this safe and effective access to the ocean in the Pacific region. This includes wave data which increase the accuracy of coastal flooding or storm surge forecast modelling, or sea-state information supporting day-to-day decision making of coastal communities. The HI-FAD project will trial a number of recent and emerging technologies to examine the potential for collecting such data.

4. In response to national and regional requests, the trials undertaken in this project aims to transform coastal FADs into highly instrumented scientific platforms, further increasing the regions' capacity for ocean science and innovation. The scientific findings and recommendations of the project will be reviewed with all stakeholders during a wrap-up workshop in 2023 to be held online, or in person if co-funding sources and travel restrictions allow.

5. Project outputs will provide timely recommendations for upcoming initiatives funded by the Global Climate Fund (GCF) and the United Nations Environment Programme (UNEP), supporting large-scale work on food systems and security, natural resources, and blue Pacific economies. It is anticipated that at the national level, the project outcomes will integrate into national FAD management plans as well as upcoming projects on coastal food security. At the regional level, recommendations will naturally feed into existing frameworks through the Western and Central Pacific Fisheries Commission (WCPFC) Scientific Committee and Pacific Tuna Tagging Programme (PTTP) steering committee meetings.

Project objectives and outputs

6. The HI-FAD project aims to assess cost-effective and innovative solutions to strengthen national and regional real-time ocean observation networks. Real-time ocean observation is key to improve ocean access, prediction and early warning systems, which will support increased resilience of coastal communities, their oceanic food systems, and navigational safety.

7. By marrying advanced technological solutions to existing national FAD programmes, we hope to show how an up-scaling of data collection for regional needs can be obtained while still remaining within current capacity levels of local agencies to maintain their FAD systems.

8. This project will enhance collaboration between meteorological services and the fisheries sector in targeted countries. Bringing together these stakeholders, will garner support for early warning systems and regional cooperation. These partnerships will boost the cost-effectiveness of this innovation and overcome logistical constraints.

9. We also anticipate development of formal relationships between higher-end users of the data and agencies tasked with maintaining the systems.

10. The planned activities broadly lie in three categories: improved monitoring of FADs, monitoring of the ocean, and monitoring of fish resources. The outputs stemming from these activity areas are shown below:

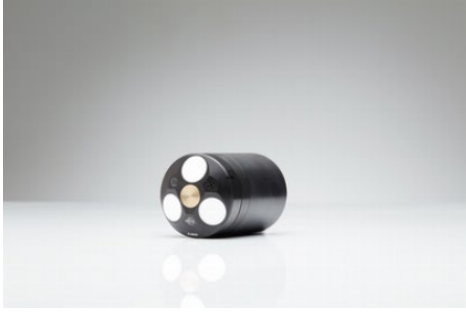| Activities	Outputs	Short-term outcome
A1. Deployment of FAD tracking technologies	O1. Simultaneous data collection of a suite of ocean data from within FAD arrays equipped during trials	Outcome: Improved and strengthened ocean services, scientific knowledge, monitoring, and prediction.
A2. Deployment of fish tracking technologies	O2. Parallel assessment and capacity building of technology use with member partners	
A3. Deployment of ocean state tracking technologies	O3. Evaluation and recommendations of ocean monitoring technology for: - Informing early warning systems, sea safety and meteorological departments - tuna assemblage and movement for regional scientific priorities - FAD tracking and fish availability for coastal communities	
A4. Integrated evaluation of data quality and pipelines for stakeholders		

Project activities

11.   This project will trial existing and emerging technologies within anchored FAD arrays. These trials will simultaneously examine solutions in three areas identified as national and regional priorities by members to increase resilience in coastal communities:

   - safe access to pelagic food resources;

   - ocean monitoring to support early warnings and improved forecasting for sea safety; and

   - efficacy and effect of FADs aggregating target and bycatch species.

12.   These trials will use echo-sounder buoys, wave buoys and ocean current profilers, GPS tracking devices, and acoustic telemetry 'listening stations', on multiple anchored FADs deployments to explore what added value such technologies may provide for national FAD programmes. Sites will be chosen from anchored FAD arrays in Fiji, Cook Islands and New Caledonia. Selected anchored FADs will be highly instrumented with a suite of equipment to monitor the position, movement, detachment, ocean state, and nature of the fish assemblages associated with them.

13.   Echo-sounder buoys may provide coastal fishers with indications of those FADs currently aggregating fish, wave buoys and current profiles provide sea state information and data collection, while GPS tracking devices can inform fishers of the anchored FAD's location and provide location information should an anchored FAD break loose (see Table 1). Acoustic telemetry listening stations may provide new science platforms to examine the nature of tuna schools aggregating at FADs, in both coastal and industrial fisheries. The cost effectiveness of these technologies will be explored, and advice on their utility provided to members.

14.   SPC staff from three divisions will manage deployment and data gathering in partnership with national fisheries, meteorology, or maritime agencies. The project budget is 90,000 Euro, and a list of technologies anticipated for trialling is provided in table 1.

15.   FAME division's Coastal Fisheries and Aquaculture Programme (CFAP) will be responsible for the assessment of anchored FAD GPS tracking technology to improve safe access of coastal fishers, improve deployment and construction, and reduce marine pollution through detached FAD recovery.

16.   The Geoscience Energy and Maritime Division (GEM), in partnership with national meteorological services, will oversee trials using sea state data collected by buoys to provide tailored ocean state information, supporting safe maritime activity, and strengthened early-warning systems. In partnership with the Pacific Community Centre for Ocean Science (PCCOS), CFAP will also trial the deployment of acoustic doppler current profile (ADCP) units to measure current velocity and direction around anchored FADs.

17.   FAME division's OFP will oversee the fish assemblage monitoring trials using echo-sounders and acoustic telemetry to provide information about availability and movements of FAD-associated fish assemblages. The data obtained from echo-sounders, normally calibrated for use on industrial, drifting FADs, will be examined with support from the buoy manufacturer, with the potential for anchored FAD specific calibrations to be tested.

18.   Based on the results of the deployments, a maintenance schedule will be developed around the instrumentation to add to existing maintenance schedules for FADs. This schedule will be developed

after considering results, discussions with local stakeholders responsible for existing FAD maintenance, and recognition of the capacity and resource levels available in countries.

19. The results of the project will be reviewed with all stakeholders during a wrap-up workshop in 2023, to provide recommendations for the incorporation of successful technologies into national and regional FAD/science programmes.

Table 1. Overview of technologies planned for trialling during the HI-FAD project.

Device picture	Device name	Summary
	GPS echo-sounder buoy	Provides real-time GPS data and estimation of the biomass tonnage of target fish species located down to over 100 m depth.
	Wave buoy	Provides real-time location and sea-state information (wave, swell, wind and sea surface state).
	Acoustic receiver and acoustic tags	Records presence of acoustically tagged fish within a range around the receiver.

	Acoustic Doppler Current Profiler (ADCP)	Records current velocities and orientation within the top 20m of water column.
	GPS tracker	Provides real-time GPS location data of FAD position.