



Designing and implementing innovative solutions for smart satellite technology to promote inclusive and sustainable fishing practices in Indonesia

UK Space Agency International Partnership Programme

July 2018

Contents

Programme overview	1
Executive summary	1
Key insights	2
Context	2
Project overview	3
Requirement for a space-based solution	3
UN Sustainability Development Goals targeted	4
Project partner	5
Project consortium	5
Solution development	5
Sustainability model	8
Summary of findings to date	11
Conclusions	12
Challenges to overcome	12

Programme overview

The UK Space Agency's International Partnership Programme (IPP) is a five-year, £152 million programme designed to partner UK space expertise with governments and organisations in emerging and developing economies around the world to deliver a sustainable economic or societal benefit. All IPP projects are fully aligned to the United Nations' (UN) Sustainable Development Goals.

Inmarsat has been awarded IPP funding for three projects which began in 2017. This case study covers our project in Indonesia, designing and implementing innovative solutions for smart satellite technology to promote inclusive and sustainable fishing practices.

Executive summary

In Indonesia, estimated economic losses of up to US\$3 billion a year (source: Indonesian Ministry of Marine Affairs and Fisheries (KKP)) are attributed to illegal, unreported, and unregulated (IUU) fishing. With nearly 55,000 km of coastline, it is extremely costly to control vessel movements in Indonesian waters. The IPP project is designed to test the benefits and challenges of expanding the use of satellite-based Vessel Monitoring Systems (VMS) to vessels currently not required to carry such systems (i.e. vessels under 30 gross tonnage (GT)). The overall goal is to improve the policing of illegal fishing and conservation areas and move the industry towards a more sustainable and profitable path.

This project intends to deliver significant economic, social, environment and security benefits to critical populations in Indonesia through the design of additional VMS services that will incentivise fishers to use VMS actively and in compliance with current – and future – regulations. At the conclusion of this programme, the goal is for Indonesia's fisheries community to be safer, less vulnerable to loss of earnings, and operating in a more responsible way, with tangible benefits to the sustainability of fish stocks and the conservation of marine resources.

For this project, human-centered design (HCD) methodologies were applied to understand the behaviours and needs of fisher communities, rapidly prototype new solutions, and design additional VMS-based features. Solutions initially

selected for testing included those that were most likely to enhance stakeholders' willingness to install and maintain active VMS aboard vessels <30 GT. The first VMS+ version solution included a web-based application called Pointrek, based on Inmarsat's IsaData Pro (IDP) satellite technology.

For the initial pilot project, approximately 200 vessels <30 GT were outfitted with the first VMS+ solution, which included a variety of features:

- > SOS/Mayday function
- > Direct, SMS, or email-based communication capabilities
- > Electronic logbook for reporting of fishing catch and effort
- > Ability to use other software applications such as weather forecasts, marine traffic information, and payment systems
- > Recording of positional data allowing both authorised private sector and government authorities to track the movement of vessels

As of March 2018, the pilot project for vessels <30 GT had been fully active for approximately six months. Preliminary data collected from a sample of participating vessels indicates that fishers are already using the system's two-way communication capability to improve their business operations. The

findings also show positive outcomes and impacts on safety of life, family welfare, and financial resilience of fishers. Data from vessels <30 GT do not yet flow in real-time to government command and control centres; however, once data from the pilot vessels starts being transmitted to the Indonesian Ministry of Marine Affairs and Fisheries (KKP), their experience will be evaluated. A pilot project for vessels >30 GT, for which VMS is already regulated by the Indonesian government, began in June 2018 using Inmarsat's Fleet One broadband service and a web-based application designed to incentivise users to keep their VMS switched on.



Key insights

- > The pilot IDP project showed that VMS devices are already proving their worth for vessels <30 GT. One vessel has been saved from certain loss, and crew earnings are up by 12%. The effort now needs to shift toward encouraging the use of VMS data in fisheries management.
- > Early results indicate that there are many benefits of a VMS+ solution, including improved communication and more efficient fishing operations. These benefits are enjoyed by different users, so the question is: Who should shoulder the costs of VMS for smaller vessels?
- > Pilot project participants were satisfied with the Pointrek VMS' features, particularly the two-way communication options. However, the sample captain and crew interviewed found the current price of the system and monthly service unaffordable.
- > Costs will be an important factor in determining uptake of VMS solutions on vessels <30 GT. Establishing a regulation to require small vessels to carry VMS would facilitate the uptake, but such a regulation may not be approved unless it is clear that the benefits outweigh the additional cost, or a cost-sharing system is set up between beneficiaries (i.e. companies, fishers and authorities).
- > It is likely that some companies and vessels would join a voluntary scheme if offered, but this may not provide information to authorities. If authorities provide a regulatory or enabling incentive (i.e. contribution to the costs of the scheme), this would change.

Context

The Indonesian fishing sector is a critical driver of the economy and society, supporting nearly seven million fishers (Marine and Fisheries in Figures 2015. MMAF), representing 21% of Indonesia's agricultural economy and making US \$3.8bn in global exports. It continues to grow rapidly. However, environmentally unsustainable fishing, including illegal and unreported fishing, harms the entire value chain, as well as introducing safety and security challenges.

Fisheries modernisation is a clear development need in Indonesia, with many people dependent on marine resources that are open to abuse from unlicensed operators. Indonesia has long coastlines, is significantly under resourced, and technically unable to effectively control vessel movements in its waters. This has contributed to widespread illegal fishing, fuelling criminal activity and unsustainable fishing practices. This also causes significant environmental damage, including depleted fish stocks, and is marked by extremely poor treatment of crewmen on some boats. It is estimated by the Indonesian Ministry of Marine Affairs and Fisheries (Kementerian Kelautan dan Perikanan, KKP) that illegal, unreported and unregulated fishing costs the Indonesian economy up to US \$3 billion annually. There is also a significant human impact on fishers and their families, as 92% of fisheries production is undertaken by small scale fisheries (Marine and Fisheries in Figures 2015 MMAF).

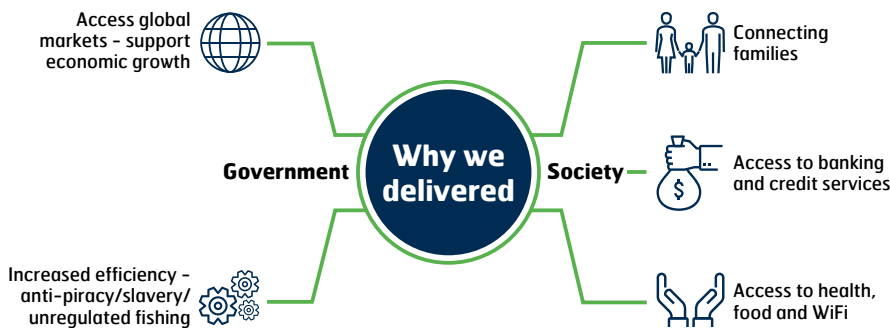


Fig 1: Economic and societal benefits of satellite-based VMS+

Project overview

This project aims to expand the use of satellite-based Vessel Monitoring Systems (VMS) on Indonesian fishing vessels to provide information about the vessels' position and activities. Although Indonesian regulations already require VMS for vessels above 30 gross tonnage (GT), compliance of these vessels is currently low and, in any case, the vast majority of Indonesia's fishing vessels are less than 30 GT. The ambition is to install these devices on vessels below the specified tonnage and to align behaviours and motivations of Indonesian fishers on all vessel sizes to ensure active usage. The programme aims to incentivise fishers to actively use VMS by:

- > Designing additional services for VMS – for safety and communications
- > Designing new operational protocols for policing and fisheries management
- > Reducing illegal fishing to conserve fishing stocks

In addition, by working closely with KKP to create the right processes to interpret and react to the data generated, the project will:

- > Strengthen the surveillance capabilities of the Ministry
- > Improve the policing of illegal fishing and conservation areas
- > Move the industry onto a more sustainable and profitable basis
- > Provide valuable industry information on catches and sourcing to improve fishery management

Requirement for a space-based solution

Satellite connectivity is the critical enabler of the Indonesia project. Terrestrial mobile networks have a limited range off-shore and most fisheries vessels operate outside of their coverage. Seventy per cent of fishing vessels surveyed during the baseline assessment for the current project had no communication methods available at sea (Figure 2).

Satellite communications provide the only viable and reliable communications link, enabling vessel tracking as well as two-way communications and other value-added services such as fishery maps.

Satellite networks are highly reliable when compared to terrestrial networks. They are not susceptible to issues such as infrastructure loss in natural disasters and are optimised around professional user needs, so have higher capacity relative to the number of possible users ("lower contention ratio") than most terrestrial networks found in coastal areas.

The solution employed in this project is a hybrid satellite service, using terrestrial links for the minority portion of the voyage when the vessel is in range of a reliable network.

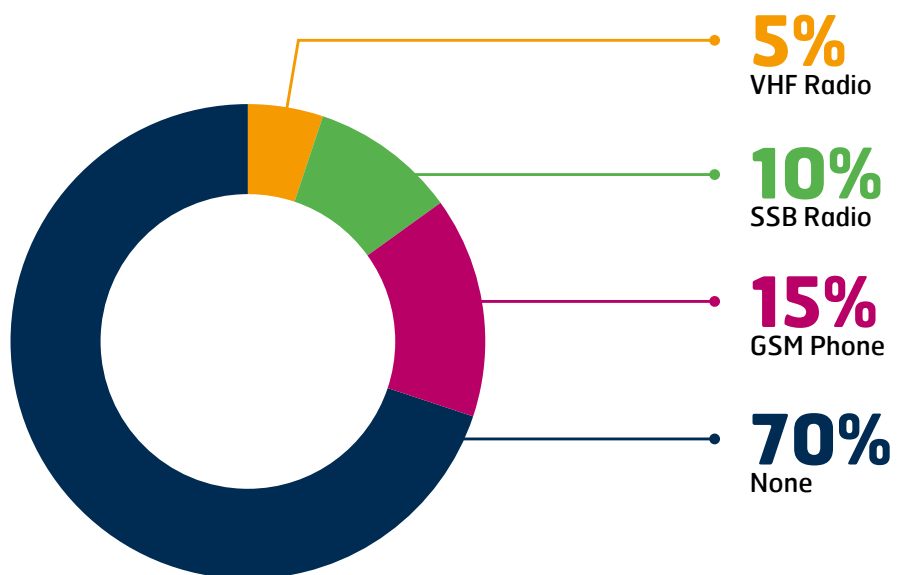


Fig 2: Baseline assessment of communication devices onboard pilot project vessels. Data source: Vessel Registration Baseline (VRB) assessment of 200 vessels, PT Hatfield Indonesia, July-November 2017

UN Sustainable Development Goals targeted



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



1 NO POVERTY



2 ZERO HUNGER



11 SUSTAINABLE CITIES AND COMMUNITIES



SUSTAINABLE DEVELOPMENT GOALS

Project partner

The Indonesian Ministry of Marine Affairs and Fisheries (KKP) is the leading ministry managing marine and fisheries affairs within the Indonesian government. The vision of the Ministry is to develop fisheries that are competitive and sustainable for the well-being of local fishing communities, as well as the broader Indonesian economy. An important overarching goal under this vision is to increase the productivity of fisheries to enhance the role of marine and fisheries sectors in national economic growth. The Ministry has a comprehensive set of strategies to achieve its vision, implemented by five directorates.

KKP supports inter-departmental coordination for this project, with a focus on bringing the departments responsible for enforcement, research, capture fisheries and conservation together around the design of technology and human system solutions. KKP also supports the project by selecting the intervention areas, fleets and staff to be trained and oversees preparations for installing the equipment and testing of the applications at sea, with the command centres, and at the national data analysis centres.

Project consortium

- Inmarsat – the world’s leading provider of global mobile satellite communications
- Satellite Application Catapult – an independent innovation and technology company, created to foster growth across the economy through the exploitation of space
- Sisfo Indonesia – Inmarsat’s local service provider with experience of VMS systems
- Poseidon Aquatic Resources Management Ltd – a consultancy with a wealth of global fisheries management experience including in Indonesia

- Hatfield Consultants – a leading environmental services consultancy with deep experience of Indonesian fisheries
- Marine Change Ltd – experts in sustainable product development
- Dalberg Design Impact Group (DIG) – creative solutions provider
- Devex – a social enterprise and media platform for the global development community

Solution development

Understanding the user’s needs

In June 2017, prior to initiating testing for the first version of the VMS solution, DIG and Catapult applied human-centered design (HCD) methodologies to understand the behaviours and needs of fisher communities, rapidly prototype new solutions, and design additional VMS-based features (i.e. VMS+). Their goal was to collaboratively find out the basic features required to meet the needs of users that could be feasibly and viably implemented. The team specifically looked into the following five opportunity areas:

- Enhanced communication: Is there an opportunity to enable direct, private, and fluid communication across the fishing ecosystem?
- Emergency communication: Is there an opportunity to position VMS as the trusted first point of contact for safety issues and emergencies?
- Simplified compliance: Is there an opportunity to streamline administration and regulatory processes?
- Financial visibility: Is there an opportunity to provide financial visibility to fishers?
- Emotional wellbeing: Is there an opportunity to create a more satisfying, enjoyable, and personalised experience at sea?

Different solutions were designed to appeal specifically to the government, company owners, and crew members, with

those selected for testing considered most likely to contribute to enhancing all stakeholders’ willingness to install and maintain active VMS aboard vessels <30 GT. As the captain and crew are the primary actors while at sea, their interest in actively using the VMS was prioritised, noting the relevance of technical value that falls outside of their influence.

Designing the first solution

Inmarsat and Sisfo designed and deployed the first VMS version solution, which included a web-based application called Pointrek, based on Inmarsat’s IsatData Pro (IDP) technology, to be tested on vessels <30 GT. The primary design considerations for the solution accommodated the key needs captured in the HCD study, and included:

- VMS compliance: Automatically sends location reports at a defined interval to a Fisheries Management Centre. Includes back-up battery power and measures to prevent fraud or abuse. Can be polled on-demand with rapid response. Can be remotely reconfigured to change reporting interval. Supports geofence alerts for operations in sensitive areas.
- Catch reporting: Allows fishers to enter catch data forms and validate with time/date-stamped photograph stored on a tablet. Catch data can be sent via satellite while at sea, based on policy requirements. Has measures to prevent fraud. Allows photo evidence retrieval at sea by local inspector or via cellular/Wi-Fi on shore.
- Text messaging: A value-added feature for fishers to communicate with friends, colleagues and family. Allows cashless top-up of prepaid messaging bundles to mitigate credit issues.
- Safety/distress alerts: A value-added feature for fishers which meets the social responsibility of the government to provide basic safety services to small boat fishermen. Provides visible and audible indicators.
- Other valued-added services for fishers: Cashless payments for pre-ordered fishing supplies. Weather and map location services.

Pilot launch and marketing

Starting in July 2017, 200 vessels <30 GT from handline fisheries in Bena and Lombok, and pole and line fisheries in Larantuka were outfitted with the first VMS+ solution. A key stakeholder, PT Primo Indo lkan, a tuna export processor based in Bali, served as the main channel for marketing efforts for vessels <30 GT. Ten vessels in the two port areas of Lombok and Larantuka that were in the same gear/weight class as the pilot vessels were also selected as control vessels – these boats were not equipped with the VMS solution.

Pointrek is built on Skywave’s IDP-690 two-way short message system using Inmarsat’s global I-4 satellite network. The Pointrek hardware unit (with an estimated value of GBP £1,331) and its monthly airtime service (estimated value of GBP £444 for 12 months) were provided at no cost to participating vessels for a duration of 21 months. Top-ups of SMS were provided to participants at US\$12 per 50 SMS.

In addition to the availability of the free hardware and services, fishers were informed about the additional incentives to adopt VMS for the pilot project: improved safety at sea, and better communication to enhance livelihoods – such as fish catch, fuel efficiency, income per trip, improved prices through links for export to Fairtrade and other certification bodies (Figure 3). The system was also

marketed as a tool to help reduce IUU fishing and increase the benefits from traceability (marketed catch) and sustainable fisheries in Indonesia. It was noted that the current VMS requirements for Marine Stewardship Council (MSC) certification that are applicable to vessels >30 GT may also be extended to vessels 20-30 GT in the future.

A similar pilot project for vessels >30 GT was launched in June 2018 in collaboration with three service providers – Sisfo, Megah Surya Persada (MSP) Indonesia, and Security Operation Group (SOG) Indonesia. The concept is much

the same as for the vessels under 30 GT, apart from one major difference – VMS equipment is already mandatory on vessels >30 GT (averaging about 16 metres or more), and therefore the focus for these larger vessels is on the communications package, rather than VMS feeds to the fisheries control agencies. As a result, the project utilises the more sophisticated Fleet One broadband service, allowing simultaneous voice and IP data at up to 100 kbps with Inmarsat’s 505 Emergency Calling service built-in and Wi-Fi capability to connect smart phones and tablets.

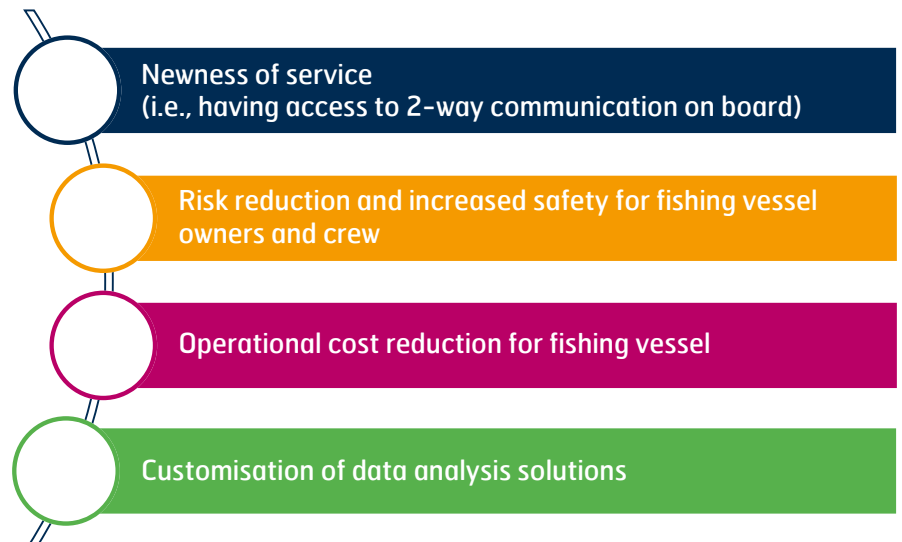


Fig 3: Value propositions

The technical solution

Satellite transceiver equipment was fitted on the pilot vessels <30 GT, with associated Skywave antenna, power (including photo-voltaic power generation), AIS data integration, GPS tracking, Wi-Fi capability and provision of an Android tablet (Figure 4). It also included the web-based application Pointrek which provided vessels with the following capabilities:

- > SOS or Mayday function that broadcasts the position of the vessel in case of an emergency
- > Direct, SMS or email-based (limited to 6.4 kb/message) communication capacity both between vessels and with other SMS or data-enabled devices
- > Electronic logbook reporting of fishing catch and effort
- > Use of other software applications via the integrated Wi-Fi link to mobile devices (e.g. tablets and smartphones, including weather forecasts, environmental conditions, navigation and marine traffic information)
- > Positional and other spatial data allowing both authorised private sector and government authorities to track the movement of vessels

VMS technology is a standard tool for fisheries monitoring and control worldwide; however, the integration of applications specifically designed to incentivise users through improved safety and higher economic productivity is a novel development.

In effect, this project tackles the digital divide that affects the Indonesian fishing community, many members of which are not knowledgeable about modern

technologies and who are presently poorly served by communications providers. By providing incentives for fishers to use VMS, the project seeks to tackle the issue of fishers switching off their VMS due to concerns about being monitored, with the result that all parties will benefit from better marine monitoring and enforcement.

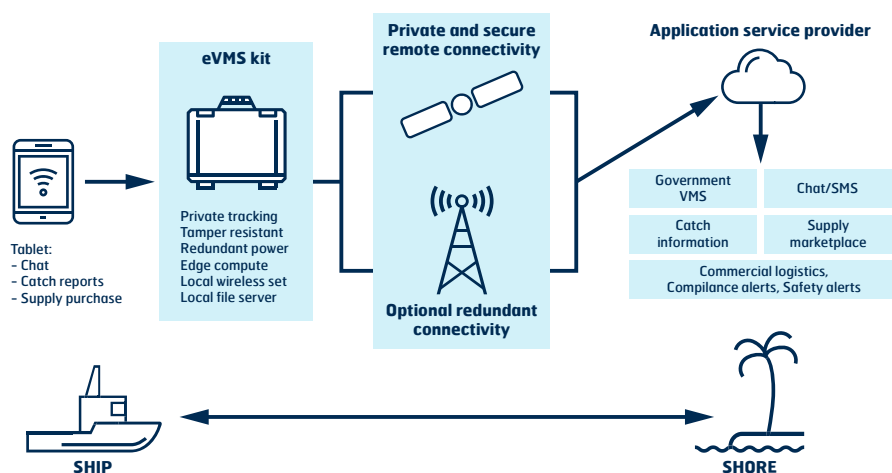


Fig 4: VMS+ solution architecture

Sustainability model

Ensuring the long-term sustainability of the project and that the investments made continue to yield economic and social benefits to Indonesia was a primary consideration for its design and implementation. The project is designed to be sustainable through local funding after completion, and to be scalable to the rest of the country. Technology transfer is hardwired into this project and is undertaken at Inmarsat's expense and risk. Local manufacture of terminals is the shared vision between Inmarsat and Indonesia.

Figure 5 conceptualises the elements leading to the Theory of Change for the project. The benefits of Inmarsat-connected VMS are anticipated to be demonstrated to the Indonesian KKP by aiding fisheries management and by providing value-added services to fishers and their communities. The Ministry itself is institutionally oriented towards implementing widespread VMS. A decision to widen the mandate of VMS use to the <30 GT sector is a part of the KKP regulatory roadmap – providing key indicators and arguments to inform and influence a regulation is a key deliverable.

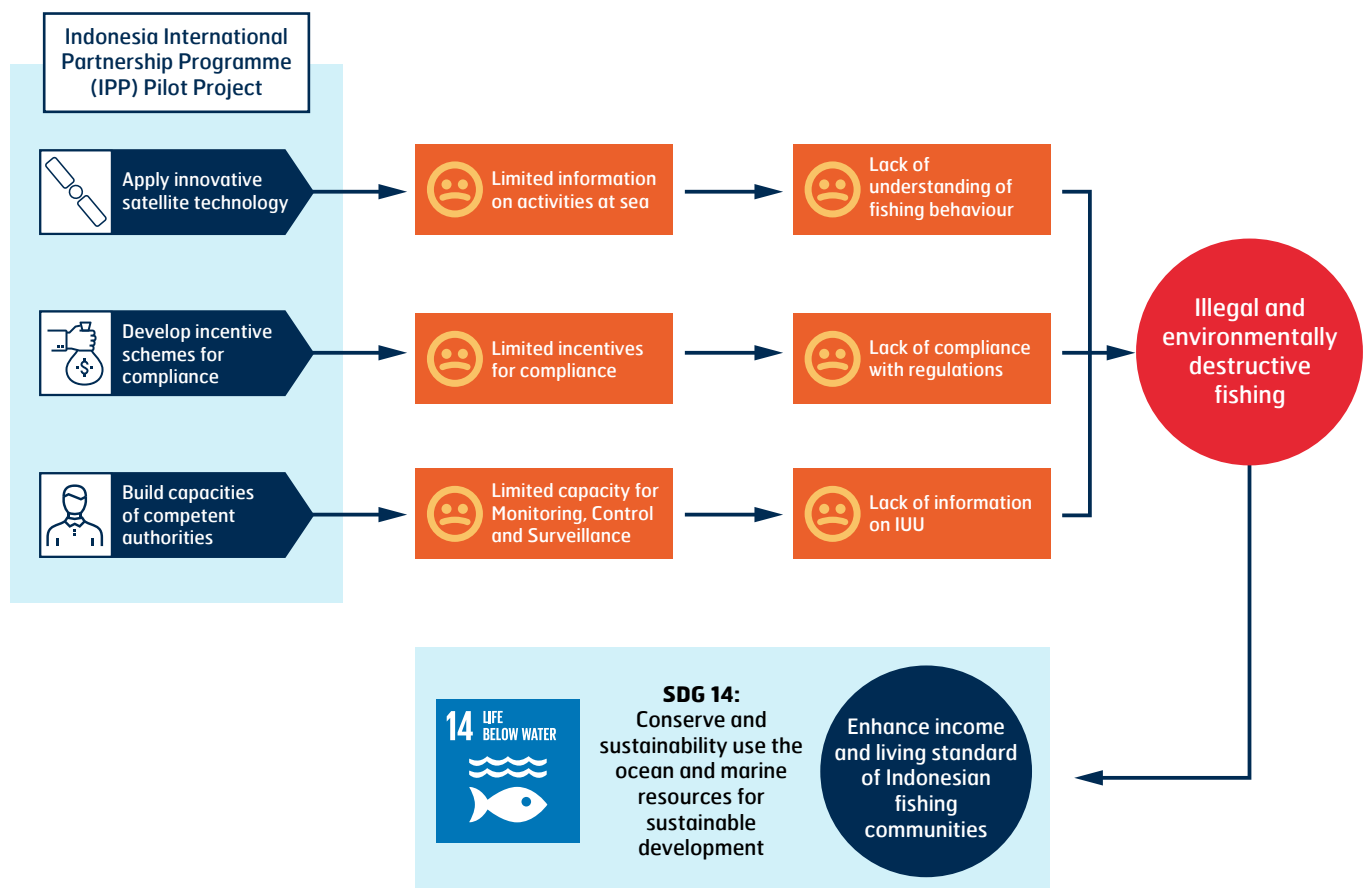


Fig 5: Schematic presentation of the Theory of Change

In addition, through the pilot project and discussions undertaken with key stakeholders as a part of the monitoring and evaluation activities, the partners are becoming confident that, even without a regulatory mandate, a market exists to sell these services to fleet and boat owners who are interested in enhancing catch traceability for export markets and in driving efficiency.

Underlying the project's Theory of Change is a set of reinforcing incentives and benefits that will support expanded voluntary compliance with fishery management rules and practices, which ultimately drives social, environmental, and commercial sustainability goals. The Theory of Change is based on the assumption that fishers can be incentivised to use VMS by the provision of other useful services (identified through the HCD research and designed to reflect user preferences and behaviour patterns), so that they do not switch off the VMS due to negative perceptions about being monitored.

Following this theory, expanding the deployment and use of VMS will result in direct benefits to the fishers who use these systems, while simultaneously improving the capabilities of Ministry enforcement staff to stop illegal fishing activities. These benefits are complementary and reinforcing, as fewer illegal vessels on the water results in better fishing outcomes for legal

fishers, which also reinforces the value of continued VMS usage. Continued usage of VMS will increase the volume of monitoring signals available for surveillance, which in turn makes enforcement efforts more efficient as the Ministry is better able to target illegal vessels. This additional monitoring data will also enable the Ministry to better manage fish stocks to ensure long term sustainability in the fishing industry.

The compatibility and alignment of incentives to benefits realised provides a powerful self-enforcement mechanism that is expected to drive the commercial sustainability of VMS usage over time (Figure 6). There is strong evidence that the proposition is viable and at the completion of this programme, when the necessary innovation and partnering has been completed, will find an educated and enthusiastic beneficiary community.

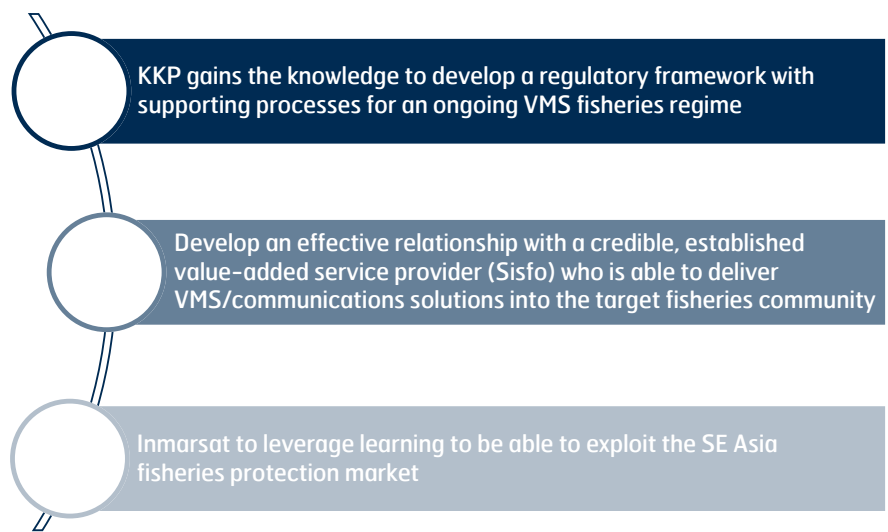


Fig 6: Incentives and benefits to drive commercial sustainability



Monitoring and evaluation

The project employs a robust measurement and tracking methodology to ensure the intended impacts are realised and rigorously measured. To date, a monitoring and evaluation approach and methodology, as well as specific Key Performance Indicators (KPIs), have been developed to track the results of the project.

KPI 1: Safety and security of mid-sized vessels (20–30 GT) and larger (>30 GT) fishing vessels is improved by using satellite-based communications and VMS technology.

KPI 2: Welfare and livelihoods of fishers and their dependants are improved using satellite-based communications and VMS technology.

KPI 3: Levels of IUU fishing (with client fleets) are reduced through targeted Monitoring, Control and Surveillance (MCS) made possible by the use of satellite-based communications and VMS technology.

KPI 4: National and local governments' capacity to plan and implement MCS is improved.

User panel and differences-in-differences analyses are used to evaluate the project's impacts. Four methods are used to establish the baseline and to collect ongoing data:

- 1** Vessel registration baseline (VRB) survey: The VRB collected key baseline data that described the characteristics of every participating boat including the control vessels.
- 2** Focus Group Discussions (FGDs): FGDs were organised at an early stage linked together with the VRB survey to provide further qualitative investigation related to safety at sea, livelihoods and fishing decision making, illegal fishing and MCS aspects. FGD groups included sub-groups of owners/coordinators; fishing boat captains and crew; and the fisheries management, compliance and search and rescue (SAR) authorities.
- 3** Fishing vessel catch income assessment survey: Identified on selected boats how the use of SMS information leads to more efficient fishing resulting in

reduced costs (fuel); income per days fished; and fish catch share amongst crew members.

4 SMS content analysis: Analysis of SMS messages sent to and from the pilot vessels to categorise the function of the communication system, e.g. for emergency communications, managing fishing operations or simply social chatter.

In addition, future data on the operational effectiveness of KKP enforcement activities will be collected and compared to baseline data.

Some of the intended impacts related to ecosystem and fish stock recovery will depend on the underlying marine ecology and growth/reproductive biology of fish species most impacted in the fisheries/geographies that will be targeted, and therefore may take two to five years to materialise.

Summary of findings to date

In March 2018, the pilot project had been active for approximately six months. Not all vessels were fishing the entire time, so observations are still limited and not all types of fishing gears have been included. The data from vessels <30 GT does not yet flow in real-time to government command and control centres so KKP's experience will be evaluated once this occurs in October 2018.

Data collected from a sample of the vessels participating in the pilot project for vessels <30 GT provides an early indication that fishers are using the Pointrek system's two-way communication capability to improve their business operations. The findings showed the following early outcomes and impacts on safety of life, family welfare and financial resilience of fishers:

- The equipment has improved health and safety, with 87 messages responding to emergencies (from a target of five), four SOS (from a target of one), and one vessel saved from certain loss.
- Around 21 extra data packages of 50 SMS each were purchased by pilot vessels, well above the target of one.
- Vessels had an average of 172 pings per month, which is lower than the

anticipated 500 pings due to seasonal factors, as not all vessels were equipped over the pilot period

- Crew retention rates were above target, showing <1% turnover compared to the target of 20%. Gross profitability rose by 12%, well above the 2% target. This data needs to be adjusted to reflect seasonal differences.
- It is too early to evaluate some impacts, but preliminary results of per capita crew earnings are up by 63% from the baseline. This will need to be adjusted for seasonal variation for validation.

Another benefit uncovered in the early assessment of the pilot project was that captains reported using the two-way communication feature to locate better fishing grounds from their coordinators or from other vessels within their fishing group. In some cases, this directly increased the fishing efficiency of the vessel, as they were able to fill their onboard capacity faster and reduce the average trip length.

Likewise, traders used the VMS feed to understand the dynamics of their suppliers' fleet and fishing grounds. Traders, who usually offer logistical support such as providing ice and transporting the fish from port of landing to the processor, use the Pointrek website portal to estimate when the vessels will arrive and prepare the necessary logistics for unloading and transport to the processors.

The GPS coordinates from the VMS also contributed to the safe rescue of a vessel that had an accident while at sea. With more time and further assessments, the pilot project will be able to further quantify the fuel savings, business efficiency, and profitability impacts of using the Pointrek VMS system's additional features.

The early results indicate there are significant cost savings to fishers from using the VMS+ services and Inmarsat is currently gathering information to determine the price points that will make the product attractive to various users.

Beyond the safety, welfare, and economic benefits to fishers, this project is poised to deliver significant economic benefits to the Indonesian economy by reducing the incidence of IUU activities within the fishing sector. Indonesian officials

estimate that the economic costs to Indonesia from IUU fishing amount to USD \$3 billion annually. As this project will directly support the Ministry in its monitoring and enforcement efforts, there is a potential to deliver significant economic value to the Indonesian fishing sector. Even a relatively modest incremental improvement of 5% in the realised outcomes from better enforcement or deterrence translates to US\$15 million in recovered economic value annually for Indonesia. These economic benefits are additional to the benefits realised by individual small-scale fishers as a result of their own improved economic productivity from using VMS services.

Impact on real lives – safety at sea

On 25 September 2017, one of the Benoa pilot vessels, *Rizky Jaya 03*, had an incident at sea. The ship coordinator notified Sisfo at 06:30 local time that the vessel, with six people onboard, had collided with a tanker 120 nm from port. The vessel was taking on water into the engine room, so the captain was attempting to return to port. The crew were bailing water and getting exhausted.

The ship's coordinator received this information through the text message application tested as part of the VMS+ solution. From Jakarta, Sisfo communicated with the ship's coordinator in Bali, relaying updates on the vessel's position and the condition of both it and its crew. The ship's coordinator notified the nearest VMS+ vessel also involved in the pilot project. This vessel, *Rizky Jaya 02*, received a text message with the location of *Rizky Jaya 03* and a request for help. *Rizky Jaya 03* continued to communicate with the other vessel, Sisfo, and the coordinator every 15–20 minutes.

The incident was also reported to the National Search and Rescue Agency (BASARNAS) in Bali via a call centre. Because *Rizky Jaya 02* was on the way to help, the BASARNAS team stood by for updates from the ship coordinator every 30 minutes. Around 23:30, both *Rizky Jaya 02* and *Rizky Jaya 03* arrived at Benoa Harbour in Bali. All crew members were unharmed and their catch of around 2.5 tonnes of fish and squid was saved.

Conclusions

The midpoint results of the project indicate:

- Technology exists to apply VMS on small vessels. Logistical challenges were identified due to the limited availability of electricity on small vessels to run the VMS; however, these issues can be overcome.
- Captains and crew of vessels <30 GT participating in the pilot project demonstrated a high level of satisfaction with the features the system provided by the Pointrek VMS+, particularly the two-way communication.
- Early results indicate that there are many benefits if an extended VMS solution (VMS+) is provided. These benefits include improved communication for safety and social wellbeing and improved efficiency of fishing operations. These benefits are enjoyed by different users of the VMS solution, so the question then is who should pay for the costs related to VMS for smaller vessels?
- Whether these benefits will be valuable and result in real change in the capacity of the authorities to address IUU fishing and in improved wellbeing of the fishing community will depend on several factors:
 - Cost will be an important factor in determining uptake of the VMS solutions on vessels <30 GT. While the cost of the extended VMS was perceived as high by captains and crew members, the possibility of scheduling payments over a year could lessen the financial impact on vessel earnings. Using the data from the pilot project's baseline to simulate the impact of the first-year costs of the Pointrek VMS+ hardware and servicing as a percentage of one trip's profits, it was shown that vessels could potentially repay the cost of a VMS+ within one fishing season without further stretching their finances.
 - In the near future, the Indonesian government may establish a new regulation to require small vessels to carry VMS; however, such a regulation may not pass approval unless it is clear that the benefits outweigh the

additional costs or if there are enabling factors that facilitate sharing of costs between different beneficiaries, such as the companies, the fishers, and the management authorities. A voluntary scheme could be offered, and it is likely that some companies and vessels will join such a scheme; however, this may not provide information to authorities. If authorities can provide a regulatory or enabling incentive such as a contribution to the costs of the scheme, this would change.

Now the system is in operation and proving itself, the effort needs to be turned to encouraging the use of VMS data in local level fisheries management. Monitoring and evaluation FGDs held in October 2017 suggest that fisheries control (Pengawasan Sumber Daya Kelautan Dan Perikanan, PSDKP) is keen to use the data, but requires a combination of extended jurisdiction, data integration and training support to do so. The IPP project will continue to support some of these needs.

In anticipation of the more complete information on impacts later in this project, advice for regulation of extended VMS onboard vessels <30 GT can already be drafted particularly as it relates to a process to support costs of equipment and some of the airtime. Focusing on the cost aspects of such solution, KKP can start consultations on this report with a regulatory scheme in mind, by inviting private sector, insurance companies and other potential users of the added service to consider cost-sharing options.

Challenges to overcome

In addition to the positive experiences and results of the pilot project, a number of challenges have been encountered to date:

- Limitations of the methodology: Attempts to obtain quantitative baseline information were hampered by the lack of record-keeping and low degree of literacy on some of the beneficiary boats.
- Technology and equipment failures: During the pilot project, equipment challenges were observed, mainly

related to power management, power supply, and crews' ability to operate tablets and applications.

- Human capability limitations: One key challenge of applying VMS to vessels <30 GT is understanding the limitations of captains and crew members, and whether they or vessel owners will make the purchase decision. Neither are familiar with VMS, so education is critical to ensure appropriate VMS use. The pilot project provided tangible evidence of the challenges in training users on the Pointrek system, given the low education level of some users.
- Lack of incentives: There are currently limited incentives or motivations for owners of vessels with capacity <30 GT to equip their vessels with VMS devices, and installations within this segment are rare. There are also currently no incentives for the use of the e-logbook capability. Captains often do not have access to scales on board to weigh their catch and can only do inventory management by knowing the capacity of the on-board storage hold. There are no perceived incentives for captains to share with crew the SMS function and other wellbeing benefits included in the project's Theory of Change.
- Sensitivity of KPIs: Many of the indicators are sensitive to seasonal fishing patterns, making it difficult to set recurrent quarterly targets. The endline evaluation will need to examine patterns over the same quarter and against control values.

These challenges remain a focus for the second half of the project. Some of the issues have already been solved and, moving forward, the project consortium and partners are committed to using the lessons learned to date to resolve the remaining issues.

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