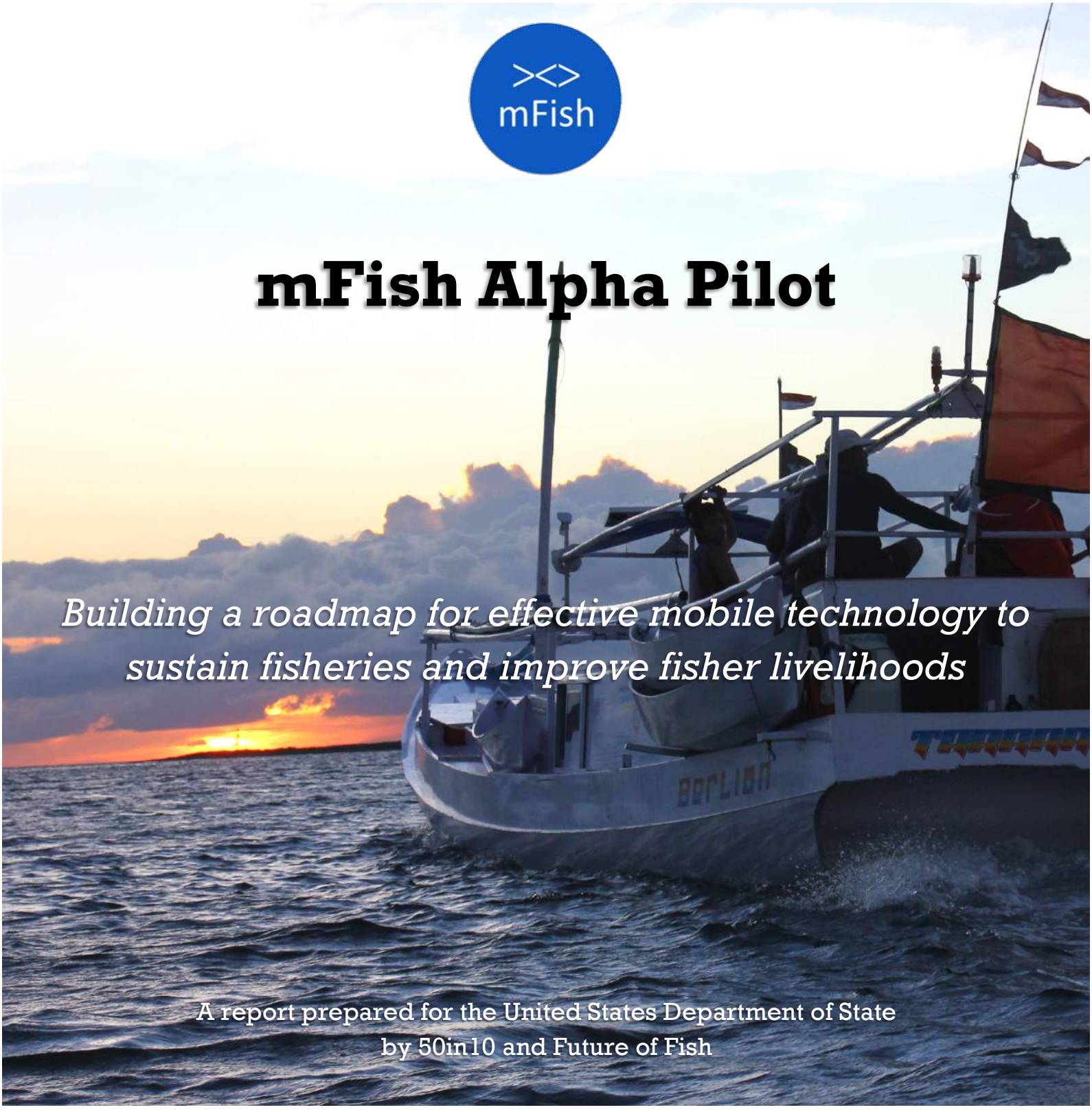

mFish Alpha Pilot

Building a roadmap for effective mobile technology to sustain fisheries and improve fisher livelihoods

A report prepared for the United States Department of State
by 50in10 and Future of Fish

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Executive Summary

PROJECT OVERVIEW

In May 2015, as part of the mFish public-private partnership, 50in10 and Future of Fish designed a pilot to evaluate how to improve adoption of a new mobile technology platform aimed at improving fisheries data capture and fisher livelihoods. Over four weeks, the fishermen carried smartphones installed with the /tone platform with them at all times. Both at sea and on land they trialed mapping, weather, and plankton apps as well as basic communication features on the phones. Each boat was also outfitted with a Pelagic Data Systems VMS unit to track vessel location throughout the pilot. Dockside, enumerators used tablets to record catch data via a newly developed app by Point 97.

Ethnographic studies were conducted during two field trips, following fishermen and documenting their behaviors, relationships, and reactions to the mobile technology. Observations and interviews were also conducted within the community. Overall, due to a lack of connectivity, fishers could not access the apps the majority of the time. Despite this lack of usability, major drivers of technology uptake and key ethnographic insights provide guidance for improving adoption of functional mobile technology in the future.

BACKGROUND

In June 2014 at the Our Ocean Conference in Washington, DC, United States Secretary of State John Kerry announced the ambitious goal of ending overfishing by 2020. To support that goal, the Secretary's Office of Global Partnerships launched mFish, a public-private partnership to harness the power of mobile technology to improve fisher livelihoods and increase the sustainability of fisheries around the world. The three founding partners of mFish are private communications company /tone, the fisheries restoration accelerator 50in10, and the US Department of State.

To complement independent efforts by /tone for large-scale distribution of mobile technology, the US Department of State provided a grant to 50in10 to create a pilot of mFish that would allow for the identification of behaviors and incentives that might drive more fishers to adopt novel technology. 50in10 engaged several partner NGOs to identify a fishing community that could serve as a test pilot for deployment of mFish, and in February 2015 launched the "Labuhan Lombok Alpha Pilot" of mFish in Labuhan Lombok, Indonesia in collaboration with Yayasan Masyarakat dan Perikanan Indonesia (MDPI) and the non-profit Future of Fish. The pilot involved the introduction of 15 smartphones equipped with the /tone platform and apps to fishermen in Indonesia's handline tuna fishery.

ALPHA PILOT DEVELOPMENT AND HUMAN CENTERED DESIGN

To assist 50in10 with the planning, implementation, and evaluation of the Alpha Pilot, Future of Fish used a human centered design (HCD) approach, based in ethnography, to identify individuals' motivations in order to craft incentives that align existing values with desired outcomes. The strategy is based on the premise that people have reasons for behaving the way they do, and most often those reasons stem from the structures of the systems in which people operate. 50in10 and Future of Fish engaged experts in technology deployment in Asia, as well as fisheries experts, to discuss how to most effectively use the mFish pilot to generate fisheries-relevant data and engage fishers. The findings based on those preliminary discussions indicated that there are significant barriers and disincentives to fishers reporting catch data in the region, including:

- The structure of the tax system, in which fishers are taxed based on their reported catch
- Cultural and logistical concerns regarding carrying or using additional devices while at sea
- General suspicion of outside organizations and the government

Additional concerns around the following risks set the Alpha Pilot in new context, which shaped significantly how mFish technology was introduced and implemented in Labuhan Lombok, and should be considered for all future mFish pilots:

Risk 1: Technology meant to help fishers improve their catch may unintentionally result in increased overfishing.

Risk 2: Although seasoned technology users tend to assume new products will have bugs and glitches, the expectation of pilot participants can be that technology will work flawlessly. Introducing an imperfect product creates a risk that participants will become jaded from failed pilots, potentially jeopardizing future technology work with those communities.

Risk 3: Poorly planned pilots not only threaten the future of the program itself as it aims to scale, but also threaten the reputation of the local NGO among participants and thus, risk the success of other on-going programs.

By spending time with and learning from both MDPI and fishers, Future of Fish was able to identify the barriers and incentives around technology uptake, and design the Alpha Pilot to align with both individual and community values.

TECHNOLOGY PARTNERS, DEPLOYMENT, AND FIELDWORK

50in10 and Future of Fish designed the Labuhan Lombok Alpha Pilot to include a suite of products that provided for a diverse and complementary technology ecosystem. Beyond the /tone

platform's standard features, two additional private technology partners (Pelagic Data Systems and Point 97) were recruited for the pilot. The Alpha Pilot was intentionally small to help minimize the risks outlined above. As such, the pilot involved five boats and 15 smartphones: Five phones and Vessel Monitoring Systems (VMS) units went to captains, five phones went to crew, and five additional phones were distributed to each of two suppliers, a local mFish coordinator, and Future of Fish and MDPI staff member. Three tablets also went to enumerators. The mFish technology training occurred at the MDPI office.

The ethnographic fieldwork involved two phases. The first phase consisted of formalized sit-down interviews with Labuhan Lombok fishers at the MDPI office, supplier base, and fisher homes, as well as less structured, in situ interviews, conducted in the observational context of the docks and community. This phase also included a trip to Ampenan, another fishing community on the other side of Lombok island where /tone had launched a separate commercial pilot of 50 phones. The second phase involved at-sea observation of Labuhan Lombok fishers.

ETHNOGRAPHIC INSIGHTS

The ethnographic fieldwork surfaced four overarching insights from the multiple observations and interviews conducted in both Labuhan Lombok and Ampenan. These emergent themes provide a lens through which actions, behaviors, and decision-making can be understood, and motivations and incentives can be identified.

An extended sense of family

Up and down the supply chain and among fishers, relationships are social or familial, not just transactional. At home, at port, and at sea, the community value of looking out for one another often out-weighs economic ambition. Great value lies in the patient building of trust and personal investment in one another over time. An expectation exists that, once initiated, relationships will be enduring and forward-looking. That desire to build connection can fuel long-term engagement in mFish initiatives, but it also requires careful planning so as not to disappoint or fail to meet cultural expectations.

Partnerships and collaboration

This fisher community is a society where teamwork is necessary and embraced. In this system, risk is assumed collaboratively, as is reward. Introducing an individualistic device such as a mobile phone into a setting where group ownership is the norm could disrupt social dynamics. It is important to understand what makes for the most appropriate "unit" of delivery.

The gift economy

Social relationships are reinforced through the tangible exchange of material goods. Through gift giving, individuals nurture enduring relationships that are grounded in both the past and the future. Gifts are not commodities – they reflect the social and personal capital invested between giver and receiver. Gift giving initiates or perpetuates a social obligation to reciprocate, something that may have ripple effects for technology deployed with "free" products or services.

Predictability vs. vulnerability

In an industry riddled with uncertainty, the ability of individuals to mitigate risk through smart decision-making is highly valued. Fishers are constantly faced with weighing their need to fish against the potential dangers of fishing; the benefits of extending their fishing trips and increasing the catch amount, versus the downside of lower quality fish. Ambition and risk are forced trade-offs in every decision. Providing new tools that can reliably reduce vulnerability will be an enormous asset to fishers, but those tools must be deployed with caution. New tools will influence the way people make decisions, and the consequences of a bad decision can be catastrophic.

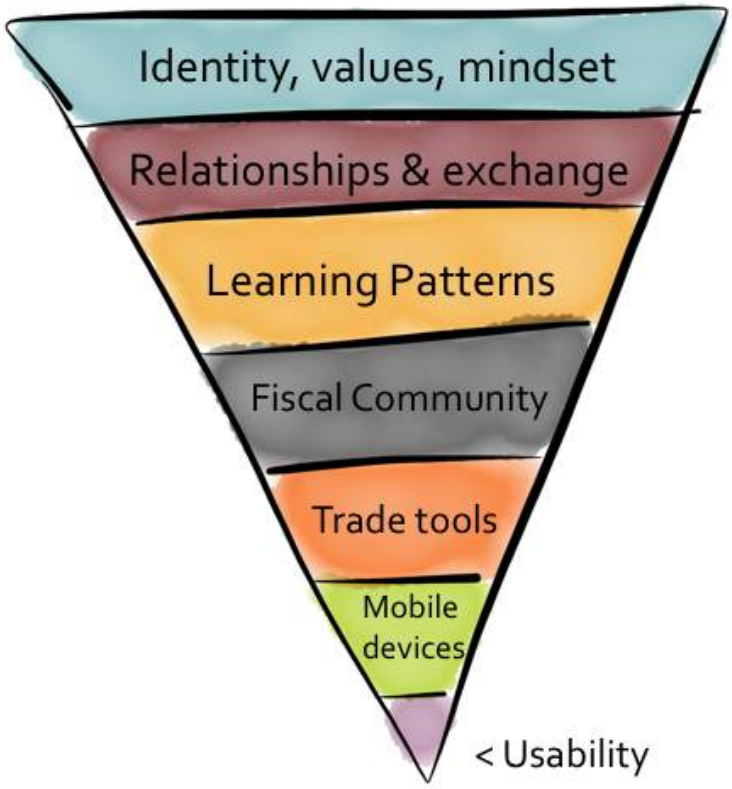
SENSE-MAKING: SURFACING INSIGHTS AND PRINCIPLES FOR FUTURE ROLLOUTS

The goal of mFish is global in reach, seeking to enhance livelihoods and foster sustainable fisheries management across diverse fisheries, geographies, and cultures. To do so successfully requires strategy and design around three aspects of the mFish initiative: the suite of technology solutions, the technology deployment into a community, and pilot site selection and expansion.

Uptake Influencers: Considerations for the Design of the Technology

The usability of a technology is merely one aspect of assessing its success within a test group. Often, social contextual issues have a bigger effect on whether or not a technology is appropriate. Our ethnographic research identified several key layers of influence that affect uptake of technology. Knowledge of these layers will allow developers to design apps or other technology products that have clear value and cultural alignment – factors that greatly improve the chances of adoption.

Identity, values, and mindset: The more a technology is consistent with or reinforces the values and mindset of the community, the more likely it will be to succeed.



Relationships and exchange: How does technology fit into the existing ways relationships are structured? Some apps may need to be far more polished upon release than others if their use affects important relationships.

Learning patterns: Understanding how individuals learn and absorb new information, experiences, or products can inform how technology can be introduced most effectively.

Fiscal community: There are myriad ways fishers and supply chain players may finance the business of fishing—how might technology support or disrupt these systems?

Trade tools: The degree to which tools or technology are used to get work done on a daily basis can indicate whether a smartphone device could be incorporated into the logistics of work at sea, as well as whether introduction of new tools, such as VMS, might be a possibility.

Mobile devices: Understanding where a community currently sits with regard to mobile development, and where it is headed, can help shape the context of future mFish pilots.

Usability: Finally, usability explores the user experience and value of the mFish technology and apps for fishers at sea and on land, in the context of all other influencers.

Recommended Apps for Future Consideration

Alpha Pilot participants were genuinely interested in using the phones and the ethnography surfaced a number of desired apps and services that could be developed.

Fish finder: Fishers wanted to know if the mFish device had a "fish finder" app, like the sonar used by the large purse seiners. The desire to use the phones to more efficiently locate and catch fish is a key leverage point that must be applied with extreme caution.

Fish Aggregation Device (FAD) protector: Fishers were interested in how the mFish devices could be used to better protect their FADs (Fish Aggregation Device) from purse seiners, which many claimed are either fishing illegally in Indonesian waters or had negative impact on other species through high by-catch under their personal FAD.

**Fuel and ice:* The challenge of limited supplies frustrated many captains and crew who were stuck in port for days at a time waiting for fuel or ice. Apps that provide information on fuel and ice availability and prices could help fishers make better purchasing decisions.

Traceability: Some fishers were curious about where their fish goes once it's landed. Because of the dynamics of the fisher-supplier relationship, developing end-to-end traceability and transparency in the supply chain must be done in a culturally sensitive manner.

**Communication at sea:* All fishers like the idea of being able to communicate better while at sea with other fishers on the water as well as with family and suppliers back in port. This communication could also be broadened to serve as a platform for government and NGO communication with fishers as well.

Maritime traffic monitor: An app that could provide information about current ship traffic while out at sea would be of tremendous value for safety purposes. Given VMS and other databases of large vessel tracks already collected, development of this app would be a low-hanging fruit.

**Offshore weather forecasting:* When planning a fishing trip, fishers need *offshore* weather forecasts over 2-3 weeks, not current weather in the homeport. When at sea, the opposite applies.

**Sea conditions:* Fishers repeatedly noted that what they need is information about sea surface conditions such as swell, winds, and currents, as well as depth.

**Fish pix:* The widespread use of the phones to take pictures of fish provides a natural opportunity to develop apps that utilize digital images to record fisheries relevant data.

Preloaded videos: Preloaded videos could provide useful information, including better fish handling, species identification, or other topics of interest, without having to be streamed.

Quick reference guides: Fishers expressed interest in the phones serving as warehouses for important information, including species ID (especially for high value catch), best practices, and updated government regulations.

*These ideas incorporate, or were conceived during the Next Steps Workshop (see Workshop report PDF link).

CORE PRINCIPLES OF FUTURE PILOT DEVELOPMENT

The following core principles provide a framework for continued development of the mFish platform so that it works with, rather than against, the value and cultural context of the target fishery. Although insights are specific to Labuhan Lombok, most are indicative of larger patterns of technology uptake in coastal nation artisanal fisheries and can help guide any future technology pilot.

1. Relationships above all else. Fishermen can be reluctant to engage in new initiatives, especially ones pertaining to resource conservation or management. Thus, local NGOs are critical to getting pilots off the ground. The success, efficiency, and feasibility of a pilot depend on the strength of the relationship between the local NGO and local community.

2. Mitigate risk for the NGO. Of all the stakeholders investing in a pilot, the local NGO stands to lose the most if the technology fails to perform or somehow disrupts the system in a way that leads to negative outcomes. A failed pilot might not only turn fishers off to the idea of that specific technology, but might also jeopardize the local NGOs' future work in the community, especially if the social capital built with the community is spent on damage control.

3. Achieve early proof of concept. A poor track record in conservation and management efforts precedes the work of mFish in many regions around the globe. A consequence of this history is that fishers and NGOs have little tolerance for failure, which reduces the timeline within which iteration can happen. The mFish platform likely needs to be more refined than may be typical of most types of technology deployment in order to avoid derailment early on.

4. Respond in a timely way. The success or failure of early mFish pilots will greatly affect receptivity of future pilots, increasing the pressure for these initial efforts to succeed. Fishers that saw the effort on the part of the mFish team to provide swell data – even in a rough fashion – were noticeably pleased (and surprised) at this level of responsiveness. Setting up the resources for pilots to support rapid response to fisher feedback will go a long way in establishing positive reputation and outcomes of the mFish initiatives.

5. Diversify technology to build ecosystems. Diversifying the number and kinds of technology partners affiliated with mFish is important for long-term success for several reasons. First, it helps to mitigate risk, so that upon release, the chances are greater that some element of the mFish system will work and provide value to fishers, and the chances are lower that any problems with one technology partner will negatively affect the entire mFish program. Second, diversification of technology partners could help drive more efficient and effective product development, helping to address issues of connectivity, app creation and design, as well as the incorporation of a more diverse set of incentive structures. Third, a true technology ecosystem means the different products and services complement and support one another, creating a more powerful and valuable product overall.

6. Address database management needs. MDPI identified early on the need for back-end database management support in order to effectively capture, store, and securely share data gathered by mFish. Collection of data does nothing to help fishers or fisheries if that data cannot be accessed and analyzed in ways that inform better management or provide opportunities for fishers. Many of the emerging market economies that have data poor fisheries, where mFish could be most helpful, also lack government resources or coordination to manage the data. This is a non-trivial concern that requires extreme care in handling: fisheries data is highly sensitive information, for both fishers and governments. Discussions and likely facilitated co-design of effective models for database architecture and management are needed to support the larger mFish initiative.

A DECISION FRAMEWORK FOR MFISH EXPANSION

Need vs. Feasibility

Every potential pilot fishery falls somewhere along an intersection of the two continuums: Need and Feasibility. The Need continuum is a measure of the information deficit of a fishery and the impact of that deficit on the health of the resource and the people who depend upon it. Feasibility is a measure of the logistical and cultural factors that either stifle or stimulate the uptake of mobile-based technology solutions. Together, these two axes build a framework for decision-making. Understanding where a potential pilot fishery falls within this framework will help to identify the easy wins for mFish rollouts, as well as where more resources may be needed in order to effectively scale the initiative.

Impact Metrics

Before selecting new pilot sites, mFish must set a clear strategy for how to define and measure impact. To the extent that early pilots can show how mFish meets fisher needs and fisheries data management goals, the program will see uptake into new regions. Additionally, the power of the mFish platform lies in its potential to address multiple issues facing global fisheries. However,

without clearly defined goals, the program will be unable to manage expectations and design for success. Sites where Need and Feasibility are both high, and where clear metrics can be collected and evaluated, may prove the most strategic sites for the next wave of mFish pilots.

Further Ethnographic Study

Finally, ethnographic research provides insight into the underlying incentive structures that, if designed for, can move a site from low to high Feasibility. While a deep ethnographic study cannot be conducted for every pilot site, the use of this methodology to help identify a broader set of potential incentives could prove extremely valuable for building a Typology of Technology Uptake for emerging market fisheries. That work would allow the mFish initiative to design more impactful technology ecosystems that are readily aligned with the needs and feasibility requirements of fisheries around the globe.

ALPHA PILOT EVALUATION

The ethnographic research and interviews conducted by the Future of Fish team during pilot development, implementation, and evaluation led to a number of observations and lessons, which are summarized below. These lessons inform the Core Principles and Decision Framework presented above.

Small-scale rollout and portfolio approach help mitigate risk

Building a technology portfolio was a successful approach to initiating the Alpha Pilot, both in terms of reducing the impact of a single technology failure, as well as leveraging the core competencies of qualified technology providers with useful apps for fishers. The small size of the pilot also helped alleviate fears that technology failure could have wider-reaching ramifications. Having an independent entity (in this case, Future of Fish) to mediate between partners during negotiations and in executing agreements was critical to advancing the technology collaboration necessary for building out the mFish platform. Prior to Future of Fish involvement, communication among technology vendors had been stalled by concerns over how partnerships would progress.

Importance of local mFish coordinator and on-the-ground tech support

The local mFish coordinator was the bridge between the fishers and mFish partners, providing a personal face and collaborative pathway for fishers as they engaged. Having someone who was familiar with the community, bilingual, and had previously worked with MDPI helped to increase trust in the mFish initiative.

Logistical and technical difficulties highlight need for adaptive planning

Proper reconnaissance, to anticipate key logistical hurdles, such as the strength of basic connectivity on land, will go a long way toward effectively customizing mFish platform to suit the conditions of the region (see Appendix I Pilot Checklist). Even so, unanticipated hurdles are to be expected. Customs delays, problems with hardware, poor connectivity on land, and software glitches significantly delayed the launch of the Labuhan Lombok Alpha pilot and served as key indicators that flexible planning schedules and on-the-ground tech support personnel are needed for effective execution of pilots.

Setting realistic expectations critical for training process

According to MDPI, past experiences with failed initiatives, researchers that asked a lot of questions and disappeared, or other "experts" promising solutions that never materialized have left a lingering skepticism in the Labuhan Lombok fishing community. Thus, for the Alpha Pilot, fishers were told that solutions were still being tested, and that the mFish team needed help refining and improving those solutions, and in turning ideas into reality. That clarification was repeated necessarily several times, as fishers continued to push for more information about what the phones could and would do. The enthusiasm of mFish, while requiring appropriate management of expectations, also meant fishers made helpful suggestions regarding how they wanted to use the phones.

Participants faced double learning curve; more dynamic training needed

For captains and fishers, not only were the /tone platform and apps unfamiliar, but many had never used a smartphone. For that reason, a fair amount of time was spent introducing participants to the devices with a high instructor-to-pupil ratio of 1-to-4 to introduce both the smartphones and the /tone applications. Future pilots should prepare for the possibility of steep learning curves, while also ensuring that trainings align with participants' learning styles. Fishers and captains are not accustomed to classroom-style learning, and should not be expected to grasp abstract ideas and unfamiliar technology by way of written guides and oral presentations. To the extent that training manuals are necessary, they should be brief, oriented toward troubleshooting, and designed for use at-sea.

"Co-Design" aspect of Alpha Pilot appealing to fishers

Fishers in Labuhan Lombok were attracted to the idea that they were part of developing the mFish platform, and liked that trainings were conducted at the MDPI office in a "formal" setting. Fishers enjoyed meeting other MDPI staff and took pride in being seen as part of the official mFish program. If this is the case for fishers in other regions, efforts to demonstrate larger project scope could help to engage fishers and build their sense of pride in being part of something bigger.

Formalizing participation through "contracts" may also increase participation, quality of feedback, and willingness to serve as ambassadors for the program.

Pre-loaded apps miss the mark

The three apps that populated the /tone platform and the enumerator app each faced significant but different challenges. The three apps on the /tone platform failed to deliver the promised information that could have been beneficial to fishers: location, plankton, and weather data. As a result, participant reaction to mFish technology was fairly negative. Fishers expressed frustration with the gap between expected functionality and the reality of what was delivered. The enumerator app designed by Point97 worked flawlessly in terms of technology, but fear from the test group that learning the technology might slow down their paper-based process and thus risk supply chain relationships, impeded uptake.

Mapping app not functional offline

The mapping app on the phones failed to function during the Labuhan Lombok pilot. Although the app was meant to work offline to allow fishers to drop pins and record notes, it did not. Once at sea and away from cellular service, the mapping app did not open on the /tone platform at all. In contrast, the mapping app did work where connectivity was greater in the Ampenan pilot. There, fishers were pleased to be able to locate their buddies on the water and send messages while at sea.

Plankton app data outdated

The idea behind the plankton app is that for some fisheries, higher levels of plankton productivity can be correlated with abundance of different fish species. However, because plankton levels change dramatically over narrow windows of time, any app that provides this information must be near real time to be useful. As deployed during the pilot, the plankton apps were fed data from out-of–region databases and over time-delayed periods, which was unhelpful for fishers.

Weather app fails to forecast

As currently configured, the weather app gathers current weather data (temperature and wind speed) from land-based weather stations. Fishers, however, need weeklong weather forecasts for offshore sites. They want information to help them plan their trips and determine when to set out for sea, or when to stay put. The importance of accurate weather forecasting cannot be underestimated. Safety at sea is a real risk that was noted by fishers in both pilot sites.

Ad hoc addition of makeshift swell data app a hit with fishers

Fishers noted that one of the most important weather features was sea surface swell – data that were not included in the preloaded apps. Future of Fish staff researched surfer community

websites that provided near real-time and forecasted swell information for the region. The local mFish coordinator was then able to upload this website to the news platform for the mFish pilot, providing all fishers connected to the /tone platform the ability to see the new content. Unfortunately the website was in English, so it was not an ideal site for this feature, but it did provide an opportunity to test the responsiveness of the /tone platform to iteration based on fisher feedback. When shown this update, fishers were enthusiastic about the potential, and especially appreciative of the effort to respond to their requests.

Enumerators hesitant to adopt new data-recording technology

Point 97's enumerator app was created to mimic enumerators' paper reporting forms, as well as streamline the data entry process and promote more efficient workflow. While these features functioned well, the pilot version did not allow entries to be modified once they were submitted. Enumerators felt uneasy about their inability to make corrections, and also feared that learning to use the app would slow down their data recording process and strain their relationships with suppliers.[1] In some circumstances, app developers may need more direct insight – preferably on-the-ground observation – of the community for whom they are building solutions in order to increase effectiveness of the apps. Providing funding up front to support such observation and interaction between developers and the users can result in cost-savings and greater effectiveness down the road.

Pelagic VMS initially met with caution, eventually embraced and praised by fishers

Upon introduction to the Pelagic Data Systems VMS, fishers were initially wary of the idea of a tracking device. However, once they learned that the information from the unit would be for their own viewing, as well as for the mFish team, they were excited to try it out. Further, in contrast to the high-touch training and education required to get fishers up to speed to use smartphones, the deployment of the Pelagic VMS was seamless, and data collection effortless. By using GPS to track locations, the VMS provided detailed *ex post* maps of fishers' journeys, which proved popular with fishers who could view tracks once back on land where connectivity occurred.

NEXT STEPS WORKSHOP

On May 20, 2015, Future of Fish and 50in10 hosted a one-day workshop for stakeholders of Indonesian fisheries in Bali, Indonesia. The purpose of the meeting was to share preliminary findings from the Labuhan Lombok mFish pilot and solicit feedback from regional experts in an effort to craft an informed and effective roadmap for future rollouts of mFish. Workshop attendees

[1] In Labuhan Lombok, the first receivers of the fish from fishers are referred to as suppliers, as they often provide additional services to fishers, such as supplying equipment, loans, etc. These are the equivalent of buyers or middlemen in other artisanal fisheries.

included staff from local and international NGOs, government officials, and seafood industry experts. The mFish history and goals were explained by the three founding partners of the program, and the Future of Fish team presented findings from the Alpha Pilot. A panel discussion followed, which featured local NGOs working with pilot programs in Labuhan Lombok and Ampenan. The final workshop activity involved attendees forming groups to design their own apps for the mFish platform. The full report from the Next Steps Workshop can be found here (PDF link)

Feedback from workshop attendees was generally positive. Several regional NGOs expressed interest in how mFish technology might be beneficial to their programs, but were also concerned about feasibility challenges, including funding. The anthropological and design approach and preliminary results resonated strongly with many of the practitioners present, in particular the idea of non-monetary incentive structures for changing behaviors and practices.

Introduction

BACKGROUND

In June 2014 at the Our Ocean Conference in Washington, DC, United States Secretary of State John Kerry announced the ambitious goal of ending overfishing by 2020. To support that goal, the Secretary's Office of Global Partnerships launched mFish, a public-private partnership to harness the power of mobile technology to improve fisher livelihoods and increase the sustainability of fisheries around the world. The three founding partners of mFish are each responsible for a core aspect of the initiative:

/tone is a private communications company based in New York City that works with regional telecommunications partners to provide affordable data plans and specialized content delivered through the /tone platform installed on smart phones.

50in10 is an initiative created by a consortium of foundations, the World Bank, and international NGOs. Its mission: Use partnerships to achieve triple bottom line solutions for fisheries improvement, social well-being, and economic benefit.

U.S. State Department leverages its partnerships in governments around the globe to identify opportunities for deployment of mFish technology. The State Department also provided funding for the Labuhan Lombok Alpha Pilot.

To complement independent efforts by /tone for large-scale distribution of mobile technology, the US Department of State provided a grant to 50in10 to create a pilot of mFish that would allow for the determination of behaviors and incentives that might drive more fishers to adopt novel technology. 50in10 engaged several partner NGOs to identify a fishing community that could serve as a test pilot for deployment of mFish. After multiple conversations over several months, the nonprofit Yayasan Masyarakat dan Perikanan Indonesia (MDPI) agreed to participate in an initial pilot under the conditions that that launch be of a limited scale and highly controlled. This pilot became the Labuhan Lombok Alpha Pilot, which involved the release of 15 smartphones to fishermen in Indonesia's handline tuna fishery.

50in10 commissioned Future of Fish, a nonprofit design and strategy organization that identifies and incubates market-based solutions to ocean challenges, to assist with the development, execution, and evaluation of the Labuhan Lombok Alpha Pilot. Future of Fish, in collaboration with 50in10 and MDPI, worked toward the following objectives:

- Secure a robust technology ecosystem through strategic partnership development

- Assist in the development of on-the-ground logistical and community support for Alpha Pilot deployment
- Conduct research and analysis to evaluate the Alpha Pilot and make recommendations for improvements
- Design a roadmap for effective, large-scale deployment of mFish pilots around the globe.

HUMAN-CENTERED DESIGN

With respect to fisheries management and ocean conservation efforts, NGOs and government agencies often attempt to change how people interact with resources by forcing top-down regulation, or by trying to make fishermen and supply chain actors "care" about sustainability. Human-centered design (HCD) offers an alternative approach. It works to identify individuals' motivations in order to craft incentives that align existing values with desired outcomes. The strategy is based on the premise that people have reasons for behaving the way they do, and most often those reasons stem from the structures of the systems in which people operate. By looking deeply at a system and learning from various actors within it, HCD strives to influence the system without having to change minds.

Ethnography, a qualitative research approach that involves learning-by-doing, is the key methodology behind HCD. It works off the belief that the people within the system are the experts and that the solutions are contained within the system already, they just need to be surfaced. HCD focuses on understanding a system or place by spending time with and learning from numerous people occupying various roles within that place. By experiencing what others experience, it is possible to uncover subtle, often-invisible needs, values, and drivers that influence behavior. Ethnography surfaces not just what and why people do what they do, but the cultural meaning of those actions and decisions. This methodology, rooted in Anthropology, creates a larger cultural framework that serves as context for the observations and data gathered. The result of such research is the identification of cultural patterns that have relevance to other populations or regions, as well as the desires and needs of individuals within a specific place. Ethnography combined with a design approach provides a robust strategy for identifying and testing levers of change within a system.

In contrast to typical technology pilots that focus primarily on usability, Future of Fish, 50in10, MDPI, and cultural anthropologist Charley Scull with Practica Group used HCD in the Labuhan Lombok Alpha Pilot. This approach allowed for an exploration of influencers that might drive or dissuade technology adoption among fishermen, regardless of the specific technology.

An anthropological lens grounds the usability piece in the larger context of the culture and system. Gaining a deep understanding of the experiences of pilot participants not only made it possible to examine the barriers and incentives around mFish technology uptake, but also highlighted opportunities for improving pilot and platform design to achieve greater engagement and success.

FISHERY DESCRIPTION

The handline tuna fishery out of Labuhan Lombok, Indonesia is a relatively new fishery, developed in the last 15 years. Increased demand from the international market has led to growth, sparking concerns over long-term sustainability of the fishery. Currently, the handline fishery is composed of two types of vessels and fishers, both of which utilize Fish Aggregating Devices or FADs, to target pelagic tuna. Mandar vessels carry small canoes, called sampans, which are fished by three to five crewmembers targeting large tuna on trips lasting up to two weeks. The other type of boat are penongkols, which have crews of four to five and often take longer trips (up to three weeks), target the smaller-sized tuna, and enjoy longer turnaround times between trips. The majority of both fishers are from Sulawesi, with the Mandar crews in particular coming to Lombok just for the season, and returning home in the off-season. Mandar fishers speak a language different from the local Labuhan Lombok fishers' language, and often different from fishers from other parts of Sulawesi too.

Penongkol boat, Labuhan Lombok. Photo: Charley Scull

Mandar vessel, Labuhan Lombok. Photo: Charley Scull

Pilot Development

NGO PARTNERSHIPS

50in10 led efforts to engage local NGOs with close ties to fishing communities in both The Philippines and Indonesia. The process of connecting with field practitioners, explaining the mFish initiative, and discussing logistics, funding, and support services needed for pilot roll-out occurred over several months. During that time, practitioners articulated their needs, concerns, and desires for how mobile technology could best serve to advance their missions of improved fisheries management and conservation, as well as assist with improving the lives of fishers.

Those conversations made clear the need for an mFish pilot to advance the work of existing NGO programs and, importantly, to not tax already limited resources. MDPI's current enumerator program to enhance data collection was an obvious way to align mFish technology with their current mission and informed the development of an additional enumerator app for the platform as well as the use of a VMS system to serve as a complementary data source. Future of Fish facilitated several weeks of conversations and negotiations among select technology partners who could provide those products. Once MOUs and statements of work were executed, the programmers and companies worked directly to build the applications.

REGIONAL STAKEHOLDER ENGAGEMENT

The use of mobile technology for sustainable development is not unique to fish. In sectors such as agriculture, healthcare, and finance, mobile technology has helped generate a new wave of innovation focused on improving livelihoods and sustainable environmental management. The fishing sector is unique, however, in its general lack of resource ownership, which adds an element of complexity to the issue of scale and technology uptake.

Prior to the launch of the Alpha Pilot, Future of Fish engaged experts in technology deployment in Asia, as well as fisheries experts, to discuss how to most effectively use the mFish pilot to generate fisheries-relevant data and engage fishers. The findings based on those preliminary discussions indicated that there are significant barriers and disincentives to fishers reporting catch data in the region, including:

- The structure of the tax system, in which fishers are taxed based on their reported catch
- Cultural and logistical concerns regarding carrying or using additional devices while at sea
- General suspicion of outside organizations and the government

Additional conversations with MDPI and other regional experts prior to the pilot launch surfaced several serious concerns around mFish, some of which stemmed from previous technology pilots.

The following risks set the Alpha Pilot in new context, which shaped significantly how mFish technology was introduced and implemented in Labuhan Lombok, and should be considered for all future mFish pilots:

Risk 1: Technology meant to help fishers improve their catch may unintentionally result in increased overfishing. The enthusiasm for bringing mobile technology to fishers in the hopes of increasing data capture for better fisheries management must be balanced with the potential for that technology to be used by fishers to pursue personal, short-term gain.

Risk 2: Although seasoned technology users tend to assume new products will have bugs and glitches, the expectation of pilot participants can be that technology will work flawlessly. Introducing an imperfect technology product or app creates a risk that participants will become jaded from failed pilots, potentially jeopardizing future technology work with those communities.

Risk 3: A poorly planned pilot can threaten the reputation of the local NGO and its relationships with pilot participants. This in turn may jeopardize the other programmatic activity NGOs have in the region, which depends heavily on the continued trust and positive relationship with the community.

By spending time with and learning from both MDPI and fishers, Future of Fish was able to identify the barriers and incentives around technology uptake, and design the Alpha Pilot to align with both individual and community values in order to achieve greater engagement and success. Future of Fish also assisted with developing and implementing real-time, on-the-ground shifts in the pilot plan when significant technological challenges arose. Indeed, unleashing new technologies without an intentionally planned and deliberately executed strategy – including multiple contingency plans – can result in dire consequences for local stakeholders.

TECHNOLOGY PARTNERSHIPS

50in10 and Future of Fish designed the Labuhan Lombok Alpha Pilot to include a suite of products that provided for a diverse and complementary technology ecosystem. Beyond the /tone platform's standard features, two additional private technology partners (Pelagic Data Systems and Point 97) were recruited for the pilot. The expanded technology offering allowed for assessment of three levels of data collection and user engagement: passive, directed, and open choice. This diversified technology offering is unique to the Labuhan Lombok Alpha Pilot and provides exploration of another way in which mFish can be expanded.

Passive data collection, which required no fisher engagement, was achieved through a solar-powered vessel monitoring system (VMS) provided on loan from Pelagic Data Systems. The VMS unit is linked to both GPS and mobile communications to collect vessel location and fish hold temperatures with fine resolution. The system requires no interaction with fishers after installation. Although the information can be automatically uploaded to a mobile phone, that feature was not available for the pilot.

Pelagic Data System VMS unit on boat. Photo: Keith Flett

Directed data collection with moderate engagement occurred through the use of an enumerator mobile app, designed and built by the company Point 97, based in Portland, OR. Enumerators must record certain landings data as part of their job, and the app offered an alternative way to accomplish that task. Working closely with MDPI, Future of Fish, and /tone technologists, the Point 97 team digitized the paper-based sheets enumerators were currently using to record landings. The goal of the app was to increase the efficiency and accuracy of data recording by reducing the number of redundant data entries per catch. This app was deployed on three tablets.

Finally, the apps designed and provided by /tone on their platform were ones fishers could choose to engage with or not, and thus, considered an "open choice" model. These active engagement technology features included text messaging, voice, digital camera, and three fisher-centered apps focused respectively on mapping locations, plankton abundance monitoring, and current weather.

Before fishers and enumerators could be trained on phones and tablets, the hardware and software had to be procured and tested. Both /tone and Point 97 provided virtual training sessions with MDPI and Future of Fish staff. Initial bugs and glitches were identified and addressed.

Technology Deployment and Ethnographic Fieldwork

In collaboration with MDPI, Future of Fish developed a strategy for the technology rollout. Five phones and VMS units went to captains, five phones went to crew, and five additional phones were distributed to each of two suppliers, a local coordinator, and Future of Fish and MDPI staff. Three tablets also went to enumerators.

The /tone kits included phone, solar charger, waterproof bag and guide. Photo: /tone

The technology rollout strategy included:

- Detailed coordination of calendars to maximize the change of meeting fishres while in port
- Discussions regarding database storage and security issues
- Careful communications plan to engage appropriate officials
- In-depth conversations regarding how to most effectively engage fishers and conduct ethnography

The ethnographic work included two phases. For both phases, the interview team consisted of a bilingual moderator, a translator, a cultural anthropologist, and a Future of Fish team member.

The first land-based phase consisted of seven days of on-site interviews and observation spaced over a ten-day period in order to accommodate the unpredictability of fisher arrivals to and departures from port, as well as the fact that the technology was delayed in customs. This included a trip to Ampenan, another fishing community on the other side of Lombok island where /tone had launched a separate commercial pilot of 50 phones. Interviews were a combination of formalized sit-down sessions at the MDPI office, supplier base, and fisher homes, as well as more ad-hoc structured interviews based on observations at the docks and in the community. One-on-one interviews were rare, with most interviewees bringing peers to scheduled meetings or groups of fishers simply joining less-formal sessions. See Appendix I for full Ethnography Media Inventory.

In situ interview with fishers at the dock in Labuhan Lombok. Photo: Keith Flett

The following activities were conducted throughout this first phase:

- Deployment of phones and fisher training in Labuhan Lombok
- Observation of fisher training in Ampenan
- Observation of boats loading and leaving docks, including following a boat out of the harbor, in Labuhan Lombok
- Observation of enumeration process: fish landing, weighing, sorting, grading, and data capture and entry process
- Formal and informal interviews:
    - Five fishers and five captains given mobile phones and VMS units; ad hoc interviews with their accompanying fisher peers

- MDPI staff and enumerators
- Supplier A
- Local processing plant manager
- Families of fishers
- Local mFish coordinator and tech support staff in Ampenan

Phase two was a two-day at-sea participant observation on a penongkol boat. The team traveled out to a FAD approximately 140 kilometers from the Labuhan Lombok port and 30 kilometers to the north of eastern Sumba Island, a 15-hour transit, and observed the following:

- Navigation and communication of fishing vessels at sea
- Small tuna baiting and fishing methods
- Small boat deployment from the Mandar boat that was fishing the FAD
- On-the-water interviews with captain and fishers from penongkol and Mandar boats at sea
- Real-time observation and documentation of large yellowfin tuna catch
- Interview with Supplier B and family
- Post-launch interviews with captains and crew to receive feedback on first tests of technology
- Interview with fishing supply store owner

Fisher home interview. Photo: Charley Scull

Alpha Pilot Evaluation

The ethnography and interviews conducted by the Future of Fish team during pilot development, implementation, and evaluation led to the following observations and lessons. In addition, the Future of Fish team distilled four overarching patterns based on their time spent with pilot participants. These ethnographic insights (see sidebar) are noted in brackets throughout this section, and then are described in detail in the Ethnographic Insights section.

PILOT DESIGN

Small-scale rollout and portfolio approach help mitigate risk

Observation: The addition of a Point 97 enumerator app and the VMS system by Pelagic Data Systems helped to expand the types of technology tested within the Labuhan Lombok Alpha Pilot and distribute risk should any single app or system fail. The small size of the pilot also helped alleviate fears expressed by the technology providers and NGOs that technology failure could lead to long-term damage of relationships and distrust of technology as a solution in the region. Partners agreed that testing the technology on a limited scale was the optimal pilot strategy.

ETHNOGRAPHIC INSIGHTS

Extended Sense of Family
Supply chain relationships are social, not just transactional.

Partnership and Collaboration
The importance and value of teamwork is paramount, with risk assumed collectively and reward shared among the group.

Gift Economy
The tangible exchange of non-monetary, personalized gifts builds a foundation for long-lasting relationships with expectations for future reciprocity and engagement.

Predictability and Vulnerability
As is the case with all fisheries, a strong element of unpredictability and vulnerability permeates most daily decision-making and behavior in the community.

Lesson: While building a technology portfolio was successful in terms of reducing the impact of a single technology failure, significant time and resources were required. For different companies to develop mobile apps and coordinate the back-end technology to produce programs for a particular mobile platform is a significant lift in terms of human resources and financial investment, even if there is interest and enthusiasm among developers. This diversified technology offering is unique to the Labuhan Lombok Alpha Pilot and highlights another way in which mFish can be expanded with proper support.

Mediation necessary for partnership collaboration

Observation: For the Alpha Pilot, third-party facilitation (in this case, provided by Future of Fish) helped advance the technology collaboration that was necessary for building out the mFish platform. Prior to Future of Fish serving as a mediator, communication among technology vendors had been stalled by concerns over how partnerships would progress. Once MOUs were in place, the development and communication among partners accelerated.

Lesson: When working with private companies consideration of proprietary information is paramount. Having an independent entity to mediate between partners during negotiations and in executing agreements was critical to the successful launch of the pilot. Building ample budget for such facilitation as well as time and financial resources for the development of appropriate and functional app design is essential for future mFish pilots.

Importance of a local mFish coordinator

Observation: Hiring a local mFish coordinator was critical to success of the Alpha Pilot. This person was the bridge between the fishers and mFish partners, providing a personal face and collaborative pathway for fishers as they engaged in the project [Ethnographic Insight: Extended Family and Partnership and Collaboration].
Lesson: Having someone who was familiar with the community, bilingual, and had previously worked with MDPI helped to increase the trust in the mFish initiative. At the same time, this on-the-ground presence was necessary for MDPI in order to handle the additional workload of coordinating the pilot. Like many NGOs, MDPI needed additional human resources to support the pilot. Funding the position of a local mFish coordinator was a need on multiple fronts.

TECHNOLOGY DEPLOYMENT

Logistical and technological delays highlight need for adaptive planning

Observation: Fifteen Android phones arrived in Indonesia as part of standard /tone kits, which included a waterproof bag and solar charger. A five-day delay in customs held up the launch of the Labuhan Lombok pilot, despite /tone having shipped dozens of phones into the region already. Due to this delay, the phones for this pilot were not pre-loaded with the /tone platform. This activity had to be done on site, which proved difficult given the limited connectivity. For example, it required approximately 1.5 hours to load the /tone platform and apps onto eight of the phones. In addition, the batteries on the phones were drained approximately 50 percent, possibly due to the delays in customs, and each required charging in order to complete the upload process.

Lesson: Appropriate planning is needed to accommodate government requirements for importing technology, and buffers should be built into pilot launch calendars, especially when scaling mFish to new countries. In regions where connectivity is limited and electricity is expensive, the process of loading apps and charging phones for a rollout involving more than 15 devices could be a drain on local resources. Compensation to the providers of such services should be included in pilot planning. Ideally, mobile devices will arrive in country with apps pre-loaded and batteries fully charged.

DESIGNING FOR VARIABLE CONNECTIVITY ENVIRONMENTS

Coverage on land challenge: low coverage in many rural areas and dispersed coverage by different providers

Coverage on land opportunity: build more towers; create agreements among telecom providers for shared networks; diversify portfolio of telecom partners within mFish

Coverage at sea challenge: for fishers that head more than a few miles offshore, there is no current technology to provide cellular coverage

Coverage at sea opportunity: create an ecosystem of technology solutions for mFish that include satellite-linked products that could complement cellular-based systems.

Application challenge: apps did not function at all once out of coverage; many apps were slow and intermittent because of spotty coverage on land

Application opportunity: design different apps for different connectivity conditions: real-time, full connectivity; limited or intermittent coverage that can support uploads and downloads; no coverage- apps that can store information internally until coverage can be established.

De facto tech support via Future of Fish

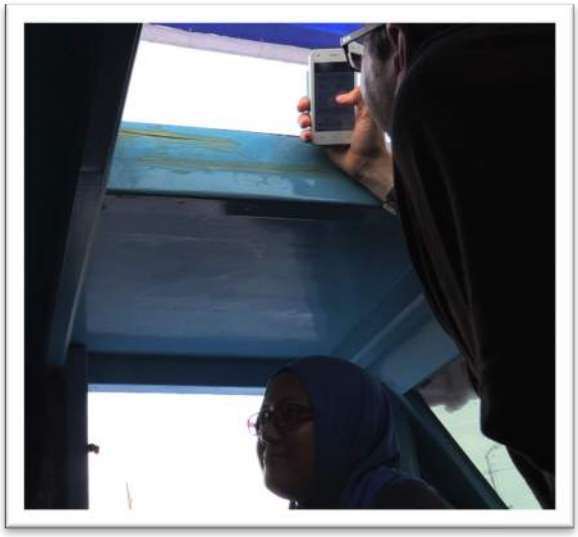
Observation: In contrast to the Ampenan pilot, the Labuhan Lombok pilot did not have on-the-ground tech support personnel. Thus, when unforeseen problems arose (e.g., phones arriving without /tone platforms installed, apps not working, connectivity issues), the fishers turned to the local coordinator and Future of Fish staff for solutions.

Lesson: The technology background of Future of Fish staff provided a stopgap solution to aid with troubleshooting, but this was neither an ideal situation nor a scalable approach. Tech support personnel familiar with the mFish technology and the telecom providers must be on the ground and available to participants for future pilots. This was the case in Ampenan and seemed to alleviate some of the technical glitches.

Phone registration process needs improvement

Observation: Phone registration was a time-intensive process. First, the Android phones required users to have a registered Gmail address in order to access the /tone platform. None of the fishers used email, nor did any desire to have an

account. Instead, an mFish Gmail account was set up as a workaround. After registration on the phones, the SIM cards also had to be registered to the fishers, requiring a spreadsheet to track which SIM cards went with which phones, and which phones were used by which fishers. Slow and intermittent connectivity hampered the process by disrupting uploads.



Attempting to get reception at the docks in Labuhan Lombok. Photo: Charley Scull

Lesson: The lengthy registration process highlighted the need for streamlining, as well as for a database to store and track all relevant information. Fishers were noticeably bored and antsy waiting for their phones. One approach to help overcome these barriers would be to have more sample or "dummy" phones available that fishers could interact with while they waited to set up their registration and receive direct training. The "Apple store model" could be used to introduce fishers to the selection of apps available, and allow them to start engaging with the devices right away.

Poor connectivity on land

Observation: Compared with the Ampenan site, located near a city center that provided reasonable cell service coverage, Labuhan Lombok is a rural area with limited coverage. To boot, the service provider /tone had partnered with for Indonesia had weak coverage in the Labuhan Lombok region, further reducing connectivity in town and at port. The lack of connectivity made trainings difficult, as it was hard to demonstrate the platform and apps. Thus, the deployment process was slowed significantly.

Lesson: Connectivity will likely be a common issue for future mFish pilots. Thus, proactive solutions must be designed for various anticipated challenges resulting from poor connectivity (see "Designing for Variable Connectivity Environments"). Among those is the need for a more diversified portfolio of platform and telecommunication providers. A diversified telecommunication portfolio could facilitate faster scaling of mFish into regions where specific partnerships have not yet been established. For example, local MDPI staff members that loaded the /tone platform to their own personal phones that used a competitor's network had better connectivity than the mFish phones. As business partnerships can take time to develop and secure, one strategy to support more rapid expansion of mFish could be to invite multiple

telecommunication providers to join the initiative. That might even drive more competition for lower-priced data plans and other benefits that could be passed down to the fishers and communities.

Non-existent cell service at sea

Observation: For many fisheries, fishers journey beyond the reach of even the most sophisticated networks. However, while fishers were far from port, they were not always far from land. Boats commonly steer to shore so fishers can SMS their families or friends supply lists along with their coordinates, which would then be passed to other captains heading out as a way to restock at sea. Knowing that these intermittent excursions within cellular range can happen means there are three levels for which mFish apps can be designed: full connectivity that is often slow, intermittent connectivity, and offline solutions.

Lesson: There has yet to be a mobile solution for connectivity at-sea, which presents a major challenge to the mFish program. In the meantime, more focus should be spent developing apps that can work offline, uploading information once fishers return to port. This is especially needed for fisheries such as in Labuhan Lombok where fishers are out to see 25-30 days per month. This kind of intermittent upload/download could also occur when they come within range of shore, which may happen more frequently than realized. The connectivity challenge may also be addressed by looking to partner mobile devices with satellite-based tracking or measuring tools. In thinking through future developments, mobile devices could periodically connect to satellite-based technologies through Bluetooth or another system in order to upload or download information as needed.

LOCAL SUPPORT

Supplier support key to fisher recruitment and retention

Observation: There were two main goals for recruiting and training fishers in the Alpha Pilot. First, the aim was to find fishers who could serve as "ambassadors" for the project, recruiting other fishers and community members to adopt the technology after the pilot phase. Second, the pilot sought to leverage existing relationships to increase support of the initiative within the supply chain. In order to meet these goals, MDPI recommended the initial inroad to the community be through the suppliers [Ethnographic Insight: Extended sense of Family].

Lesson: Supplier buy-in both freed fishers from concerns regarding how their participation might appear to their supplier and facilitated planning as suppliers had the most updated information regarding fishers' schedules [Ethnographic Insight: Predictability vs. Vulnerability]. The suppliers also provided suggestions regarding which captains would be the best suited to trial the mFish technology. Future mFish pilots should make an effort to identify a support network of individuals and influential supply chain players that can not only promote the program and recommend potential participants, but can also provide the encouragement fishers need in order to feel comfortable engaging.

A QUICK GUIDE TO TRAINING FISHERS

Location: Create a research-like setting to encourage a sense of collaboration.

Distribution: Determine the appropriate unit for the phones, whether that is the individual, a boat, captains, crew or other supply chain players.

Set-up: Ensure the smartphones come loaded with the appropriate platform and apps ahead of time, make sure batteries are charged, and have a streamlined registration process for SIM cards and activation.

Training: Small group training with no more than four fishers is ideal. More dynamic, interactive elements such as sample phones for fishers to use while waiting and videos of fishers using the phones from other pilots is also recommended, which requires the build-out of shared resources for the mFish program.

PARTICIPANT ENGAGEMENT AND TRAINING

Setting realistic expectations a critical aspect of training process

Observation: Managing expectations quickly emerged as a critical component of the trainings. In the Labuhan Lombok Alpha Pilot, the local coordinator emphasized that as a pilot, solutions were still being tested, and some were still just ideas. Fishers were told that the mFish team needed them to help refine and improve those solutions, and to help turn ideas into reality. That clarification was repeated necessarily several times, as fishers continued to push for more information about what the phones could and would do. That immediate enthusiasm meant fishers made helpful suggestions regarding how they wanted to use the phones. For example, fishers liked the idea of being able to use the mapping app to mark their FADs or other points of interest at sea, and record their catch. However, the lack of connectivity meant that, at least in the Alpha Pilot, the app could not function that way.

Lesson: Aid organizations and NGOs have approached fishing communities with the promise of projects that will "improve" fisher livelihoods and the ocean resource. Many of those initiatives have made great improvements; many have also fallen short of their promises, and a lingering skepticism pervades fishing communities recruited to engage in new programs. Thus, future mFish pilots must ensure that they do not become yet another "empty promise."

Requests of captains must be aligned with social norms

Observation: During the training, captains were each given a smartphone loaded with the /tone platform and apps, and then were asked to select a crewmember to receive a second device. Culturally, this approach was in conflict with both the strong sense of collective ownership and with the democratic structure of the boat "society." Although the captain was the ultimate decision-maker, he often consulted his crew regarding important matters. In the end, each captain brought along a crewmember selected for the fisher's knowledge of technology, good standing with the captain, or simply because they were available on the day of training.

Lesson: Having more than one person per boat trained on the mFish technology was helpful in providing a second set of eyes and ears for the technology training and troubleshooting, as well as for helping to provide a general "crew" perspective. However, understanding the nature of relationship between captains and crew, as well as the degree to which resources are owned or shared, is essential for designing a pilot roll out that is culturally appropriate. For example, one captain explained in a post-launch interview that the second phone was being shared among all crewmembers on one of the two boats he owned. He noted that after the crew on the first boat was trained, he would pass the phone to the crew on the other boat, so they could learn as well. His goal was to have one phone for each boat and, eventually, one phone in port [Ethnographic Insight: Partnerships and Collaboration].

The double learning curve

Observation: Overall, captains and fishers required fairly high-touch training. Not only were the /tone platform and apps unfamiliar, but many had never used a smartphone. A fair amount of time was, thus, spent introducing participants to the devices, showing them how to navigate with a touch screen, make calls, send texts, run apps, etc. These needs required far longer training sessions than previously anticipated.

Lesson: Future pilots should prepare for the possibility of unexpected learning curves, and plan trainings with built-in time buffers. If possible, the local NGO partner may be able to gauge ahead of time the degree to which participants will need additional instruction on certain aspects of the program.

Fisher training outside MDPI office. Photo: Charley Scull

More hands-on, dynamic training needed

Observation: Training manuals and FAQs were developed in coordination with tech partners for the local coordinator to use with the fishers and the enumerators. A slightly modified version of the fisher guide was also created for the captains to explain the VMS device that would be attached to their boats. General feedback from MDPI staff and fishers was that training manuals needed to be shorter and more oriented toward troubleshooting, and if possible, provided as a laminated guide that fishers could take with them on the boat. The PowerPoint training guides created by /tone

were helpful for giving an overview of the technology, but could be improved as a learning and engagement tool.

Lesson: Fishers and captains are not accustomed to presentation-style learning, and should not be expected to grasp abstract ideas and unfamiliar technology by way of written guides and oral presentations. They tend to learn by seeing and by doing. As mFish pilots develop, including more photos or videos of fishers using the devices in the field would help to ground the technology in the practical applications that are possible. In the future, as more fishers are trained in mFish technology, there may be opportunity for having fisher-to-fisher training within communities. Likewise, as mFish initiatives expand to other regions, fisher-exchange programs might be particularly powerful in helping mFish participants to share knowledge, train on new apps or new technology, and build a sense of community and networking among fishers across islands, countries, and regions.

"Co-Design" aspect of Alpha Pilot appealing to fishers

Observation: Despite the need for more hands-on activities, the training sessions successfully secured enthusiastic, engaged captains and crew to trial the smartphones and apps at sea. Specifically, fishers were attracted to the idea that they were part of a study, and liked that trainings were conducted at the MDPI office in a "formal" setting. Fishers enjoyed meeting other MDPI staff and took pride in being seen as part of the mFish program.

Lesson: The particular characteristic of an mFish pilot that will win participants over may not be immediately apparent. In the case of Labuhan Lombok, fishers seemed especially interested in being part of the development process. If this is the case for fishers in other regions, maps showing locations of existing pilots, photos of other kinds of fisheries where mFish is deployed, and additional ways of demonstrating larger project scope could help to engage fishers and build their sense of pride in being part of something bigger. In addition, MDPI staff suggested that drawing up a "contract of engagement" with fishers might help establish a sense of formal engagement with the program, which could increase the level of feedback from fishers and their willingness to serve as ambassadors for the program. Testing this additional model would be simple to do in future pilot-roll outs.

TECHNOLOGY DEPLOYMENT, RECEPTION, AND FUNCTIONALITY

Pre-loaded apps miss the mark

Observation: The three apps that populated the /tone platform all promised information that theoretically could have been beneficial to fishers: location, plankton, and weather data. However, as currently designed, the apps missed the mark in delivering useable content; some did not work at all due to connectivity issues. As a result, participant reaction to mFish functionality was fairly negative. Both in Ampenan and Labuhan Lombok, fishers expressed frustration with the gap between the expectations of the apps and the reality of the phone's performance. That negative sentiment was also reflected in a reluctance expressed by fishers in Ampenan to see the pilot expanded. The fishers were concerned that their peers would turn on them for not warning them of the failures of the phones, or would look to them, as program veterans, to troubleshoot problems. At the same time, pilot participants desired to see the program succeed and appeared genuinely interested and committed to helping refine the technology, despite the poor performance of the phones.

MFISH SELFIES HIGHLIGHTS OPPORTUNITY

Because the apps did not work offline while fishers were at sea, they used the phones predominantly as cameras, taking pictures of themselves with their catch. This behavior revealed an opportunity for the design of future apps that use photographs for species identification, sizing, date of capture, catch location, and other information that might all be recorded by a smartphone and potentially shared with fisheries managers.

Image of selfie from fisher using /tone phone. Photo: Keith Flett

Lesson: The fact that pilot participants were discouraged and reluctant to share the mFish technology with others highlights the importance of piloting already-tested and proven technology. Tolerance for failure is low. However, failure can be redeemed. The extent to which participants can feel a sense of ownership in the program by being included in the design and improvement of apps can reframe the pilot experience, which given the close connections among community members, ultimately shapes whether and to what degree the program can scale.

Mapping app not functional offline

Observation: The mapping app on the phones failed to function during the Labuhan Lombok pilot. Although the app was meant to work offline to allow fishers to drop pins and record notes, it did not. Once at sea and away from cellular service, the mapping app would not open on the /tone platform at all. Fishers were extremely frustrated by this situation, as they were most enthusiastic about the idea of capturing data on their FAD locations and associated catch. Fortunately, data from the Pelagic VMS units helped to overcome this disappointment. In contrast, the mapping app did work where connectivity was greater in the Ampenan pilot. There, fishers were pleased to be able to locate their buddies on the water and send messages while at sea. Staying near to shore, the messaging and mapping functions were a strong combination that appeared to receive enthusiastic responses from the community.

Lesson: More design work is needed to make the mapping app a useful tool for fishers, especially the ability to plot and record information while at sea. If an app cannot function offline, this must be made explicit to fishers during the training.

Plankton app data outdated

Observation: The idea behind the plankton app is that for some fisheries, higher levels of plankton productivity can be correlated with abundance of different fish species. Maps of plankton concentrations can, therefore, show fishers where target species could be swimming in the region. However, because plankton levels change dramatically over narrow windows of time, any app that provides this information must be near real time to be useful. As deployed during the pilot, the plankton apps were fed data from out-of-region databases and over time-delayed periods. Thus, the information provided by app yielded no value to fishers.

Lesson: Before apps are permitted as part of an mFish program, they must be vetted with appropriate experts to ensure that the theory behind the app is sound, and that the data being provided by the app is accurate and interpreted appropriately. For the plankton app in particular, ideas to input regional data from Indonesian oceanographic institutions were discussed at the Next Steps Workshop and could help address the location and timeliness issues. If successful, that effort could serve as a model for other regions. Combining plankton data with winds, currents, swell, sea surface temperature, and other environmental factors would further provide for more robust predictive models.

Weather app fails to forecast

Observation: One of the biggest issues fishers raised was with the weather app. As currently configured, the app gathers current weather data (temperature and wind speed) from land-based weather stations. Fishers, however, need weeklong weather forecasts for offshore sites. They want information to help them plan their trips and determine when to set out for sea, or when to stay put. Currently, the app supplies fishers in Labuhan Lombok with data from the weather station in Mataram, the city inland on Lombok. More accurate at-sea data and localized weather in general, as well as long-term forecasts, is needed.

Lesson: The importance of accurate weather forecasting cannot be underestimated. Safety at sea is a real risk that was noted by fishers in both pilot sites. Having a reliable tool that could effectively increase predictability of weather patterns would be an enormous asset for the fishers. As such apps are developed, it will be important to consider the consequences of replacing traditional knowledge and decision-making systems with reliance on technology (see "To Leave or Not To Leave), especially if the technology is not yet proven.

Ad hoc addition of makeshift swell data app a hit with fishers

Observation: Fishers noted that one of the most important weather features was sea surface swell – data that were not included in the preloaded apps. Future of Fish staff researched surfer community websites that provided near real-time and forecasted swell information for the region. The local mFish coordinator was then able to upload this website to the news platform for the mFish pilot, providing all fishers connected to the /tone platform the ability to see the new content. Unfortunately the website was in English, so it was not an ideal site for this feature. However, the fishers who had shared their frustrations with the weather app expressed surprise at seeing such a quick response to their query, and were enthusiastic about the possibility that such information could be developed as a more usable app on their phones.

Lesson: First, swell information is a low-hanging fruit that could go a long way toward providing fishers with an immediate, direct, and obvious benefit from the phones. Second, timely responsiveness is an effective way to build trust and to further engagement, despite frustrations. The structure of the /tone platform allows for updates to be shared with all fishers connected to the /tone, which is a powerful model. However, to be effectively harnessed, significant support is needed to provide the appropriate level of responsiveness. The example of uploading the swell app was a temporary patch to keep fishers interested in the pilot and to salvage the usefulness of the phones. True responsiveness would be the ability to pass along this kind of feedback to a

community of mFish or partnered app developers that could then proceed to design an app that delivered the information in a useable and viable format. Such a support structure must be included as part of the mFish program if it is to succeed and scale.

Enumerators hesitant to adopt new data-recording technology

Observation: Point 97's enumerator app was introduced to enumerators in Labuhan Lombok through training sessions led after-hours by Future of Fish in the MDPI office. Created to mimic enumerators' paper reporting forms, the app was also designed to streamline the data entry process and promote more efficient workflow. Due to time constraints during app development, the pilot version did not allow entries to be modified once they were submitted (unlike paper spreadsheets). Enumerators felt uneasy about their inability to make corrections. The app also did not allow for enumerators to easily jump between "data buckets" in terms of entering some information about small fish, then switching to a big fish, and so on. These limitations, as well as general fears that learning to use the app would slow down their data recording process, made the enumerators hesitant to field-test the app lest it strain their relationships with suppliers. [Ethnographic Insight: Extended Sense of Family].

Lesson: The issues raised by enumerators would have been relatively simple to address if the Point 97 team had had the ability and budget to be on site for development. In future mFish pilots, greater efficiency will result when developers can interact with users, preferably in context, to develop and refine products to the point that they can achieve their respective goals. These goals are often not data-specific, but have to do with workflows and habits that are difficult to anticipate yet readily revealed in context. Because tolerance for failure is low in some communities, products and applications must be as close to perfect as possible before being released to a wider user-group. Users are not willing to adopt technology that might jeopardize important relationships in the fishery or supply chain.

VMS PACKAGE PROVES ITS VALUE

The Pelagic Data Systems VMS device used GPS to track locations and provided detailed maps of fishers' journeys. This piece of the technology portfolio was one of the few components that functioned at sea, and the data it collected proved popular with fishers. Having never seen tracks of their journeys before, the fishers responded enthusiastically upon seeing this information, and immediately grasped what the maps were showing.

Within a few minutes, they were walking MDPI and Future of Fish staff through the tracks, explaining what happened where, and why things looked as they did. For example, they knew that journeying to a FAD that had been cleaned out, likely by a purse seiner, was a waste of time and fuel, but this track showed them just how much time and fuel they wasted. Future apps designed to provide personalized data, help fishers tell the stories of their fishing experiences, or yield tangible short-and long-term benefits will likely be adopted and used most readily by mFish participants.

VMS initially met with caution, eventually embraced

Observation: Upon introduction to the Pelagic Data Systems VMS, captains were initially wary of the idea of a tracking device, especially one that attached to the boat. Captains questioned whether the device was permanent or temporary, and were concerned about whether installation of the device would damage the vessel. However, once they understood that the device was small and non-invasive, and that the information from the unit would be for their own viewing, as well as for the mFish team, they were excited to try it out. In contrast to the high-touch training and education required to get fishers up to speed to use smartphones, deployment of the solar-powered Pelagic Data Systems VMS was effortless. Installation took no more than 10 minutes and consisted of attaching (using screws, zip ties, or both) the 10" x 4" x 8" system in a sunny area of the vessel that was away from daily vessel and fishing operations.

Lesson: People for whom sharing electronic information is a routine part of life often feel completely comfortable using new technology that collects potentially personal or confidential data. However, individuals unfamiliar with such data sharing technology may feel uncertain, confused, or even suspicious about how their data might be used. Employing a trusted NGO or supplier to assuage concerns can be key to helping users understand both the technology and how they themselves can benefit from the information collected. Further, because of the minimal training required, using this type of passive technology may be a strategic onramp for future mFish pilots in regions where smart devices and information technology are unfamiliar.

Fishers review track from VMS system for first time. Photos: Charley Scull

Ethnographic Insights

One of the strengths of ethnographic work in informing strategic design of a project or product is the analytical framework used to surface overarching insights from the multiple observations and interviews. Those emergent themes provide a lens through which actions, behaviors, and decision-making can be understood, and motivations and incentives can be identified. This section presents four main insights that emerged from the ethnography conducted in both Labuhan Lombok and Ampenan.

AN EXTENDED SENSE OF FAMILY

What it is: Up and down the supply chain and among fishers, relationships are social, not just transactional. This value system manifests as fishers on a boat refer to one another as brothers, a captain is considered to be a father figure, and suppliers feel a responsibility to fishers as though they are their children. At home, at port, and at sea, the community value of looking out for one another often out-weighs economic ambition.

When asked about what makes for a good captain, some fishers answered that it is someone who brings the crew home safely, not who knows the best fishing grounds or who pays the best wages. The best captain is one who makes the best decisions regarding the wellbeing of the crew.

How it manifests in the community and supply chain: The metaphor of family was invoked by both fishers and suppliers in describing relationships with one another. Sense of family extended beyond the abstract or metaphoric – it was embodied in the actions of individuals. For example, when approaching a supplier for a loan, fishers go in person to meet, have coffee, and engage in a personal way. Sending an email to the supplier in order to save time would not work here. Great value lies in the patient building of trust and personal investment in one another over time. For the supplier-fisher dynamic, such familial support was pragmatic, symbolic, and material in the form of loans for needs such as operational costs, school fees, and family illnesses. Such was the case with one supplier who made a point of visiting the home villages of fishers on Sulawesi a minimum once every five years. These visits allowed her to re-affirm her physical presence to her off-island workforce and their families and to recruit fishers for the coming seasons.

Implications: This framing is critical for understanding how people are able and willing to address their vulnerabilities, such as keeping track of their own finances. There is a built-in level of trust that makes certain practices and potential application of technology inappropriate (see "Tracking Finances").

TRACKING FINANCES

Fishers rely on their suppliers to monitor their debts and earnings, accepting payment at the end of the month without question. Although technically fishers may look at the ledger whenever they wish, few ever do because they fear offending or embarrassing the supplier.

Initially the Future of Fish team saw an opportunity for an accounting app that would empower fishers to track their own finances. However, further discussions with fishers showed they had little interest in one. Instead, by prioritizing the harmony of their relationship with the supplier over the specifics of individual record keeping and transactions, fishers showed they value long-term relationships over short-term financial accuracy.

Put into a Western context, using an app to track finances in this way would be akin to a child asking to see her parents' bank account balance to determine the fairness of her weekly allowance.

On the other hand, the familial relationship structure does not exclude some level of rebellion – some fishers do switch suppliers. Likewise, communities and relationships are not closed systems; they can grow, contract, and re-configure as dictated by needs and inclination. However, an expectation exists that, once initiated, relationships will be enduring and forward-looking. For example, fishers in Labuhan Lombok participating in the mFish pilot continue to congregate around the MDPI office, building the bond with the staff they have met, and frequently asking about the Future of Fish team that is no longer in-region. That desire to build connection can fuel long-term engagement in mFish initiatives, but it also requires careful planning so as not to disappoint or fail to meet cultural expectations (see "A Tale of Two Technologies").

PARTNERSHIPS AND COLLABORATION

What it is: This fisher community is not an individualistic society. Rather, it is a society where teamwork is necessary and embraced. Despite the appearance of handline fishing as one fisher per boat, individualism was neither manifested nor celebrated in either fishery. The reality was a flexible team dynamic that provided support and safety. In this system, risk is assumed collaboratively, as is reward. Whether it was launching a boat, landing a fish, or engaging in interviews, individuals paired or grouped-up to tackle the task at hand.

Fishers socializing after-hours with MDPI staff. Photo: Charley Scull

How it manifests in the community or supply chain: The simplest pattern of group dynamic was the dyadic or pair formations that occurred with fishers: Ampenan fishers launched boats as a pair and made strategic decisions as pairs or groups. In Labuhan Lombok, boats left the harbor in pairs as a safety measure and, at sea, the smaller *sampan* boats that fished off the Mandars paired up when someone had a fish on the line – it took two fishers, one coiling the line and the other pulling in the fish, to land a tuna. Groups also formed in order to take on risk associated with major investments, such as a loan for a FAD. The cultural tendency towards a group norm even overtook the interview process: where individual fishers were invited to come speak with the mFish team, groups of fishers would show up, ready to participate and join the conversation.

Two Mandar fishers assist one another in bringing in a tuna. Photo: Charley Scull

Implications: Introducing an individualistic device such as a mobile phone into a setting where group ownership is the norm could disrupt social dynamics or be a waste of effort if each individual does not expect or need a device. Thus, it is important to understand the optimal group size for the most appropriate "unit" of delivery. Like a GPS unit or CB radio, it may be the case that one phone per boat is enough for both fishers and for the desired environmental impact. The tendency towards communal resources could also be leveraged to provide apps for sharing information and delivering content that reinforces connections and improves well-being for the group.

THE GIFT ECONOMY

What it is: Social relationships are reinforced through the tangible exchange of material goods. Through gift giving, individuals nurture enduring relationships that are grounded in both the past and the future. Gifts are not commodities – they reflect the social and personal capital invested between giver and receiver. They also set a context of obligation and indebtedness that ensures the relationship will extend further into the future.

How it manifests in the community or supply chain: There are different tiers of gift-giving that provide an additional layer of exchange, but not a replacement, to the more formal cash economy.

Oleh oleh, the term for small gifts such as a tin of biscuits, were exchanged with interviewers at all meetings.

Up the supply chain, suppliers provide incentives and bonuses to fishers, such as a motorbike or trip to Mecca as a reward for the "best" fisher. Farther up the supply chain, regional processors provide elaborate gifts to the local buyers. For example, the local supplier's son received a fancy motorcycle (as opposed to the motorbike offered to fishers) from a processor in Jakarta. This extravagant gift served as a way to reinforce the strength of the relationship between the two suppliers as well as to set the expectation of ongoing and future obligation and exchange – important for supply and demand partnerships that involve no binding legal contracts. These gifts can be substantial but are never cash (see "The 'Tuna-Organs-for-Cookies' Exchange").

THE 'TUNA-ORGANS-FOR-COOKIES' EXCHANGE

It was the Future of Fish team's last night out at sea, and they had plans to join the Mandar captain and his crew on their boat for dinner. The captain was particularly excited to share the tuna organs from the yellowfin caught earlier that day as a special treat. Indonesian colleagues insisted that sharing the tuna lungs, liver and gonads was a great honor and the organs provided tremendous health and, not to be overlooked, *virility* benefits. However, when evening came, the seas were rough and it was too dangerous to arrange the transfer

Although dinner was cancelled, the offering of these tuna organs as a gift was so important, the captain dispatched a crewmember in a small canoe called a sampan. Not only did the Future of Fish team find the organs tasty, but also the important social gesture further cemented an already strong bond with this captain. When the team sent back their own *oleh oleh*, a plastic box containing coffee, biscuits, flashlights, water bottles, as well as assorted other snacks, it was met with shouts of thanks and approving nods from the boat's crew.

Implications: Gift giving initiates or perpetuates a social obligation to reciprocate, something that may have ripple effects for technology deployed with "free" products or services. For current pilots, fishers do not pay for phones. Understanding how this "giving" of devices is received and what kinds of expectations result is critical for building programs that are both sensitive and respectful of individuals and cultures. If giving away phones creates expectations for a long-term engagement, then the appropriate structures for supporting a long-term engagement will need to be created. At the same time, the "gifting" of phones could help foster a

Example of an oleh oleh *bin shared with fishers. Photo: Charley Scull*

sense of obligation to comply with data collection aspects of the program. That social contract may be further leveraged to enhance fisher engagement, especially for the purpose of helping to improve and build upon the design of mobile apps.

PREDICTABILITY VS. VULNERABILITY

What it is: In an industry riddled with uncertainty, the ability of individuals to mitigate risk through smart decision-making is highly valued. Fishers are constantly faced with weighing their need to fish against the potential dangers of fishing; the benefits of extending their fishing trips and increasing the catch amount, versus the downside of lower quality fish. Ambition and risk are force trade-offs in every decision. And the stakes are high. Fishers encounter great vulnerability at sea. They cannot control what they catch, or how much. They have no control over the weather, often facing rough seas with very little safety gear (life jackets were commonly used to make FADs). The consequences of a bad decision can be catastrophic, even for day-boat fishers.

Example of tanker traffic in the distance off Ampenan. Photo: Charley Scull

How it manifests in the community or supply chain: In terms of survival, the vulnerability of fishers at sea is addressed through the buddy system – pairing of boats and the constant physical contact fishers keep with one another while in transit. Traditional knowledge systems for assessing weather patterns and determining when and where to fish have been proven over time (see "To Leave or Not To Leave"). Group investment to diversify risk in buying a new boat or a FAD is another way fishers buffer their vulnerability. Finally, employment with a "good" captain – one who looks out for the safety of his crew – was emphasized repeatedly as a critical factor for fishers. This they valued above all else.

TO LEAVE OR NOT TO LEAVE

It is 3 a.m. and a small group of fishers participating in the Ampenan pilot sits on the beach, talking quietly, listening to distant thunder. Two young fishers survey the horizon, standing amidst the tangled mass of outrigger canoes stacked three-deep. They are day-boat fishers, fishing for small mackerel or tuna in the Lombok Straight, where weather can change quickly. They rely on a system of traditional knowledge to determine when to go to sea: Can the stars be seen? Can a light from a distant point on Bali be seen? If neither is visible, the fishers stay put. The methods are trusted, but they are not infallible. Many fishers have stories of heading out under "favorable" conditions and getting blown far from home.

Other factors such as the need for income can push fishers to test the limits, especially if it looks like the weather might be improving.

Talking with these fishers on the beach, they are hopeful the phones can help improve safety on the water through more accurate weather apps or communication with one another. Yet their excitement is tempered by trepidation, as they have experienced problems with connectivity and the inability of the weather app to reliably provide real-time and accurate information.

Implications: Providing new tools that can reliably reduce vulnerability will be an enormous asset to fishers, but those tools must be deployed with caution. New tools will influence the way people make decisions, which can be dangerous in situations where the tool is not infallible. For instance, any emergency or SOS messaging tool must be 100% foolproof. A fisher who thinks his SOS has been received responds to an emergency situation much differently than he does if he assumes no help is coming. Should an emergency device fail to send a message, the fisher's life will be at greater risk. While not all technological innovations will confront such extreme vulnerabilities, it is critical to design those that do with these extreme consequences in mind. Further, the question remains whether and how technology will displace the traditional trusted systems, and what that means for safety overall. How does trust of technology compare with trust of traditional knowledge systems? What are the expectations around technology being accurate, reliable, and infallible? How might technology help support or confirm rather than undermine or contradict current information gathering customs?

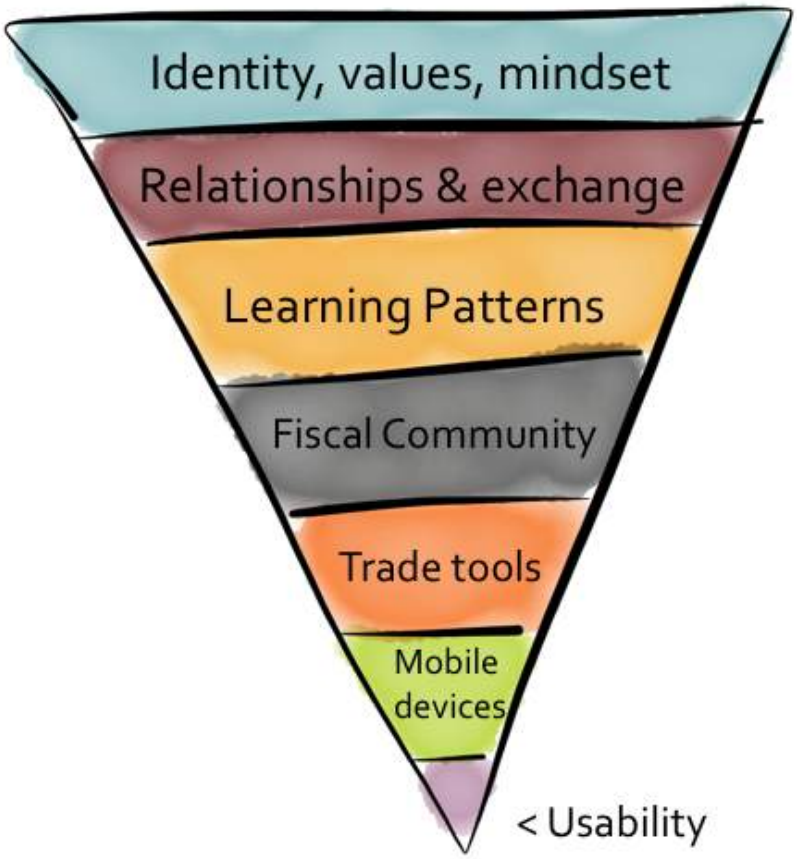
Sense-Making: Surfacing Insights and Principles for Future Rollouts

The goal of mFish is global in reach, seeking to enhance livelihoods and foster sustainable fisheries management across diverse fisheries, geographies, and cultures. To do so successfully requires strategy and design around three aspects of the mFish initiative: the suite of technology solutions, the technology deployment into a community, and pilot site selection and expansion. The following section highlights insights that can aid with each of these components.

UPTAKE INFLUENCERS: CONSIDERATIONS FOR TECHNOLOGY DESIGN

The usability of a technology is merely one aspect of assessing its success within a test group. Often, social contextual issues have a bigger effect on whether or not a technology is appropriate. Our ethnographic study identified several key layers of influence (see figure below) that all affect uptake of technology. Knowledge of these layers will allow developers to design apps or other technology products that have clear value and cultural alignment – factors that greatly improve the chances of adoption.

Identity, values, and mindset: The first and widest layer explores if the technology is consistent with the values and mindset of the community. Understanding this will be critical to achieving success in both the introduction and long-term uptake of technology. The more a technology reinforces the key values such as safety and family the more likely it will be to succeed.



Relationships and exchange: The next level of consideration focuses on how technology fits into the existing ways relationships are structured. The initial hesitancy around the enumerator app is a good example. Here, the developers created a highly efficient app, yet a learning curve to implement the technology was still required. This learning curve was viewed as a risk to the carefully won relationship enumerators had earned by ensuring suppliers they would in no way interfere with the processing of fish upon landing. This trusted relationship was viewed as contingent upon this respect for the suppliers' business first because enumerators wouldn't use the new app on the workplace floor until they had practiced it at home first. Such resistance underscores a narrow tolerance for learning curves in the fishery, indicating that some apps may need to be far more polished upon release than others.

Learning patterns: The third lens explores how individuals learn and absorb new information, experiences, or products. Do people learn by watching others, or learn by doing themselves? These are basic questions that can inform how technology can be introduced effectively.

Fiscal community: The fourth layer asks how the technology aligns with the way individuals conduct business. How does individual vs. group ownership manifest? What are ways in which supply chain players are financially tied up and down the chain? There are myriad ways fishers and supply chain players may finance the business of fishing—how might technology support or disrupt these systems?

Trade tools: The next layer of influence includes the current tools and products that are used to get work done on a daily basis. For fishers, the reliance on simple technology, such as flashlights, as well as more sophisticated tools, such as GPS and cell phones, suggests that a smartphone device could be incorporated into the logistics of work at sea in terms of room for extra devices, and familiarity with technology that needs to be charged, kept reasonably dry, etc. It also indicates that the introduction of additional tools, such as the VMS, as part of an mFish ecosystem of technology, might be a possibility.

Existing technology in Labuhan Lombok. Photo: Charley Scull

Mobile devices: The practicalities of mobile devices on boats highlight the issue of connectivity. For fisheries based on multi-day or weeklong journeys far from coverage, reliance on cellular platforms – as opposed to satellites – may not be the best solution. Yet, for many rural areas, mobile technology offers the most adaptable solutions for bringing the Internet to communities. Understanding where a community currently sits with regard to mobile development, and where it is headed, can help shape the context of future mFish pilots.

Usability: Finally, usability explores the user experience and value of the mFish technology and apps for fishers at sea and on land, in the context of all other influencers.

RECOMMENDED APPS FOR FUTURE CONSIDERATION

Alpha Pilot participants were genuinely interested in using the ethnography surfaced a number of desired apps and services that could be developed.

Fish finder: Fishers wanted to know if the mFish device had a "fish finder" app, like the sonar used by the large purse seiners. The desire to use the phones to more efficiently locate and catch fish is an obvious leverage point that must be applied with caution.

Fish Aggregation Device (FAD) protector: Fishers were interested in how the mFish devices could be used to better protect their FADs from purse seiners, which many claimed are either IUU or had negative impact on other species through high by-catch under their personal FAD. A key problem, however, is that fishers noted a lack of responsiveness from enforcement officers in the case of illegal activities. Use of the phone as a tool for enforcement as well as for communicating across "teams" that monitor the FADs were ideas enthusiastically discussed.

**Fuel and ice*: The challenge of limited supplies frustrated many fishers and captains who were stuck in port for days at a time waiting for fuel or ice. Information on fuel prices, and apps that could assist with calculating the cost-benefit ratio of paying more for non-subsidized fuel right away versus waiting for the lower-priced fuel could help fishers evaluate their positions and make better decisions around trip planning.

Fishers loading ice in Labuhan Lombok. Photo: Charley Scull

Traceability: Some fishers were curious about where their fish goes once it's landed. Because of the dynamics of the fisher-supplier relationship, it would be impolite—and unheard of—for a fisher to ask his supplier for this information. Thus, developing end-to-end traceability and transparency in the supply chain must be done in a culturally sensitive manner.

**Communication at sea*: All fishers like idea of being able to communicate better while at sea with other fishers on the water as well as with family and suppliers back in port.

Maritime traffic monitor: Ampenan fishers noted that for safety reasons, an app that could provide information about current ship traffic while out at sea would be of tremendous value. Given VMS and other databases of large vessel tracks already collected, development of this app would be low-hanging fruit.

**Offshore weather forecasting*: When planning a fishing trip, fishers need *offshore* weather forecasts over 2-3 weeks, not current weather in the homeport. When at sea, the opposite applies. Fishers need weather forecasts on the coast in order to determine when to return home safely.

**Sea conditions*: Fishers repeatedly noted that what they need is information about sea surface conditions such as swell, winds, and currents as well as depth.

**Fish pix*: The widespread use of the phones to take images of fish provides a natural opportunity for developing apps that utilize digital images to record fisheries relevant data, such as size, species, and location of catch.

Preloaded videos: Fishers in Ampenan burned through their data plans watching YouTube videos, supposedly about fishing techniques. Preloaded videos could serve as conduits of useful information, including better fish handling, species identification, or other topics of interest, without having to be streamed.

Quick reference guides: Fishers expressed interest in the phones serving as warehouses for important information, including species ID (especially for high value catch), best practices, and updated government regulations.

*These ideas incorporate, or were conceived during, Next Steps Workshop (see full report (PDF link) from workshop.

CORE PRINCIPLES FOR PILOT DEVELOPMENT

The ethnographic insights and understanding of the layers of uptake influencers in the community help identify strategies for developing the mFish platform so that it works with, rather than against, the value and cultural context of the fishery. Some of the insights are specific to Labuhan Lombok, but most are indicative of larger patterns of technology uptake in coastal national artisanal fisheries. The follow core principles distill these broader patterns to help guide any pilot.

1. Relationships above all else. The key overarching insight to emerge from this work is how much the success, efficiency, and feasibility of a pilot depends on the strength of the relationship between the local NGO and fisher community and consequently, the relationship between the

mFish team and fishers. MDPI's ability to identify the key influencers in the community and guide the specifics of the approach of the pilot was critical to the successful engagement. As Future of Fish observed in the pilot and learned from its discussions with experts in the field, fishers are skeptical of conservation or management initiatives. Similar hesitancies will likely occur in other sites. The more trust that exists between the community and the NGO, the deeper the engagement, and the more genuine and useful the feedback will be. This dynamic can help accelerate adoption of the technology, as higher quality feedback can fuel more effective iteration of the technology to show improvement and increased value to fishers.

2. Mitigate risk for the NGO. Because of the general fisher skepticism to engage in new initiatives, especially conservation or management-oriented ones, local NGOs are critical to getting a pilot off the ground. Yet, despite their interest, many NGOs are also guarded in their enthusiasm to engage in mFish pilots. This hesitancy is understandable in the context of risk. Of all the stakeholders investing in a pilot, from funders to technology partners to the fishers, the NGOs are the ones that stand to lose the most if the pilot should fail. Their hard-won trusted reputation with fishers could be threatened if the technology fails to perform or somehow disrupts the system in a way that leads to negative outcomes for the fishers or the resource. The breakdown of this relationship risks success of their other programs, not just the mFish project. During conversations and interviews, multiple NGO staff voiced concern and expressed reservations about participating for these reasons. Crafting pilots to accommodate and mitigate risk for the NGO must be a key step in scaling mFish (as it was in developing the Labuhan Lombok Alpha Pilot).

3. Achieve early proof of concept. Most people expect major glitches with the release of a new Microsoft or Apple operating system. There is an understanding and a willingness to wait for errors to be corrected within the community of users. This is not necessarily the case with fishers. A relatively poor track record in some major conservation efforts precedes the work of mFish in many cases around the globe. A consequence of this history is that fishers and NGOs have little tolerance for failure, which reduces the timeline within which iteration can happen. The mFish platform likely needs to be more refined than may be typical of most types of technology deployment in order to avoid derailment early on. Creating a system for the capture and sharing of knowledge across mFish pilots will be critical in minimizing mistakes and glitches on both the technological and the social side of mFish rollouts.

4. Respond in a timely way. The success or failure of early mFish pilots will greatly affect receptivity of future pilots, increasing the pressure for these initial efforts to succeed. The Future of Fish team recommends that the best way to build effective pilots is to prioritize the collection of feedback from users and rapidly address that feedback in effective ways. Fishers that saw the effort on the part of the mFish team to provide swell data – even in a rough fashion – were noticeably

pleased (and surprised) at this level of responsiveness. Setting up the resources for pilots to support rapid response to fisher feedback will go a long way in establishing positive reputation and outcomes of the mFish initiatives.

5. Diversify technology to build ecosystems. Diversifying the number and kinds of technology partners affiliated with mFish is important for long-term success for several reasons. First, it helps to mitigate risk, so that upon release, the chances are greater that some element of the mFish system will work and provide value to fishers, and the chances are lower that any problems with one technology partner will negatively affect the entire mFish program. Second, diversification of technology partners could help drive more efficient and effective product development, helping to address issues of connectivity, app creation and design, as well as the incorporation of a more diverse set of incentive structures. Third, a true technology ecosystem means the different products and services complement and support one another, creating a more powerful and valuable product overall. The data collected by one app perhaps becomes a feed for another. The incentives that drive use of one component of the system could also be leveraged to provide engagement with another. From telecommunication providers to hardware to the app developers, a more diversified structure for the private side of the public-private partnership of mFish brings greater stability and reach for the program.

6. Address database management needs. MDPI identified early on the need for back-end database management support in order to effectively capture, store, and securely share data gathered by mFish. Collection of data does nothing to help fishers or fisheries if that data cannot be accessed and analyzed in ways that inform better management or provide opportunities for fishers. Many of the emerging market economies that have data poor fisheries, where mFish could be most helpful, also lack government resources or coordination to manage the data. This is a non-trivial concern that requires extreme care in handling: fisheries data is highly sensitive information, for both fishers and governments. Discussions and likely facilitated co-design of effective models for database architecture and management are needed to support the larger mFish initiative.

In addition to these core principles, Appendix I contains a "Pilot Checklist" to help project leads identify factors that should be considered before, during, and after pilot roll-outs. This Checklist covers operational, logistical, strategic, and social components of a functional mFish pilot.

A Decision Framework For mFish Expansion

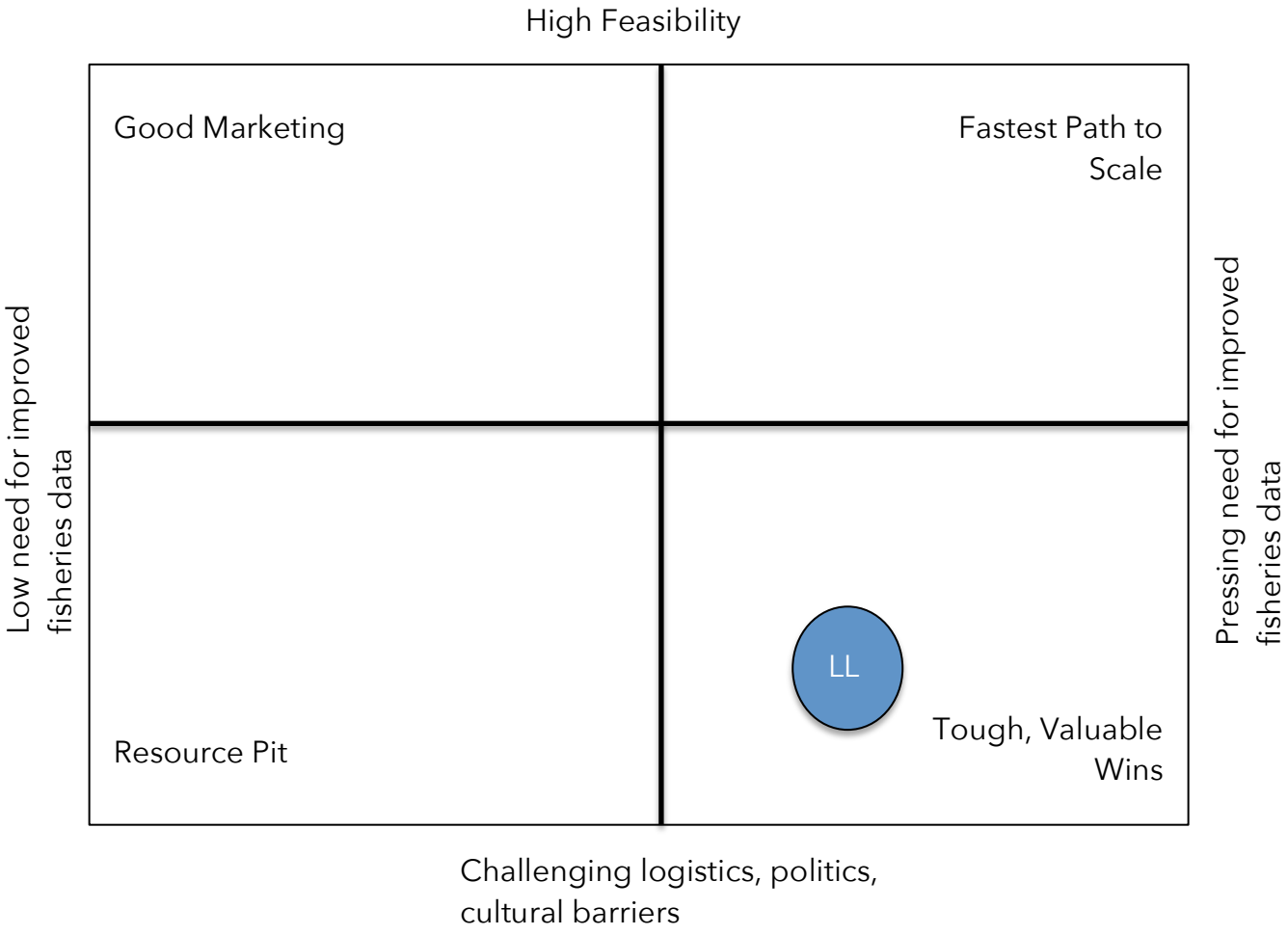
In moving forward with global scaling, mFish faces the question of how to choose the next pilot locations and roll out the initiative to maximize reach and impact.

As is the case with any complex system – and few are more complex than global fisheries –no simple solution can guarantee success. Across geographies, fisheries, and cultures, different opportunities and challenges will present that will require refinement of both the pilot strategy and the technology ecosystem. But despite the lack of a cookie-cutter scaling manual for mFish, useful guidelines can help shape a global strategy that maximizes likelihood of uptake in each new location.

NEED VS. FEASIBILITY

Every potential pilot fishery falls somewhere along an intersection of the two continuums: NEED and FEASIBILITY. The NEED continuum gauges the health of the fishery, the current pressures on the stock, and weighs how additional information could work to increase sustainable management of the fishery and improve fisher incomes, market access, or well being. It is a measure of the information deficit of a fishery and the impact of that deficit on the health of the resource and the people who depend upon it (see Appendix II: mFish pilot Check List)

FEASIBILITY is a measure of the logistical and cultural factors that either stifle or stimulate the uptake of mobile-based technology solutions. This continuum considers the practical and operational costs associated with deploying technology into the region, and weighs the consequences of these costs against the potential benefits. Knowing whether the situation will call for major logistical heroics, or if the site has easy access and, for example, a familiarity with technology to begin with, will greatly help with determining whether a specific pilot should move forward. It can also help mFish partners assess which regions to target globally to prioritize needs in a realistic fashion (see Appendix II: mFish pilot Check List).



Together, these two axes build a framework for decision-making. Understanding where a potential pilot fishery falls within this framework will help to identify the easy-wins for mFish rollouts, as well as where more resources may be needed in order to effectively scale the initiative.

Sites considered High Need represent fisheries under pressure and fishing communities facing hardship; they are likely to attract the most attention and funding. Sites considered High Feasibility have features that invite technological intervention, such as an existing familiarity with technology in a culture or infrastructure that supports connectivity. As will be highlighted in the following section, these descriptors are not categorical, but rather continuous and represent a spectrum of potential Need and Feasibility combinations that may shift as conditions change within the resource or community.

The Fastest Path to Scale sites are those potential fisheries that demonstrate both high Need and high Feasibility. These represent low-hanging fruit for next-stage pilot rollouts. The opposite situation occurs for Resource Pit sites, which have little need for data collection and have very challenging deployment conditions. Such sites, at least for the first wave of mFish expansion, offer little bang for the buck.

Good Marketing pilot sites offer a combination of low need but high feasibility, which can provide ideal testing conditions for new technology or for comparison of mobile solutions with other forms of data collection already in place. Because the need is not enormous, some of the pressures of pilot deployment may be less in these sites, allowing more tolerance for experimentation and iteration.

Finally, there are the Tough, Valuable Wins sites, such as Labuhan Lombok (LL in the diagram above), that require more resources up front, but offer potentially valuable wins in terms of providing much needed information to data poor fisheries.

Labuhan Lombok's level of Need is a function of the fact that increased demand from international markets is putting increased pressure on tuna stocks. Lack of transparency and poor fisheries models highlight the importance of independent programs to improve data capture and traceability. In addition, approximately 25 percent of tuna caught in Indonesia becomes waste—lost value that could be recovered through better handling techniques and tighter logistics. In terms of well-being, most fishers face great safety risks while at sea, and face the consequences of inefficiencies, poor handling, limited fuel access, and various logistical challenges. The mFish initiative could help address many, if not all, of these needs. Despite the fact that the Need for mFish technology is relatively high, Feasibility in the Labuhan Lombok fishery is low. Unreliable connectivity is the primary hurdle, whereas cultural factors can work either for or against adoption, depending on the design of the technology and its deployment. A track record of failed interventions has left fishers skeptical and tolerance for mistakes is low.

In Tough, Valuable Wins sites, such as Labuhan Lombok, determining what is feasible from both a cultural and logistical standpoint is paramount to developing the appropriate suite of services and tools that can provide the most value to fishers, and therefore inspire greatest adoption. Applying the core principles for effective pilot rollouts, as well as considering the uptake influencers, will be particularly important. These sites would also benefit most from insights gleaned from an ethnographic study, such as those that currently guide refinement of the Labuhan Lombok pilot.

IMPACT METRICS

Before selecting new pilot sites, mFish must set a clear strategy for how to define and measure impact. As noted previously, the success of future pilots will rest heavily on the proven success of the inaugural pilots. The NGO community in particular keeps a close eye on the development of innovation in other regions. Likewise, fishers may be most convinced to engage in new technology when they hear or see (or perhaps are even taught by) other fishers with stories of success. To the extent that early pilots can show how mFish meets fisher needs and fisheries data management goals, the program will see uptake into new regions. Additionally, the power of the mFish platform lies in its potential to address multiple issues facing global fisheries. However, without clearly defined goals, the program will be unable to manage expectations and design for success. Sites where Need and Feasibility are both high, and where clear metrics can be collected and evaluated, may prove the most strategic sites for the next wave of mFish pilots.

ADDITIONAL ETHNOGRAPHY

Finally, ethnographic research provides insight into the underlying incentive structures that, if designed for, can move a site from low to high Feasibility. In Labuhan Lombok, for example, knowing the importance of social relationships and expectations for long-term commitments informed the structure of post-pilot engagements. The local coordinator continues to meet with fishers several months after pilot completion, nurturing those relationships by providing on-the-ground and personal support, and showing that mFish had a vested interest in working with fishers. This insight may be appropriate for other communities, and could help foster fisher engagement in sites where skepticism runs high.

While a deep ethnographic study cannot be conducted for every pilot site, the use of this methodology to help identify a broader suite of potential incentives could prove extremely valuable for building a Typology of Technology Uptake for emerging market fisheries. This work would allow the mFish initiative to more deeply explore what kinds of tools and strategies are most applicable to different kinds of communities, leading to reduced development time, more effective technology deployment, and more impactful technology ecosystems that are readily aligned with the needs and feasibility requirements of fisheries around the globe.

Post-Launch Activities

NEXT STEPS WORKSHOP

On May 20, 2015, Future of Fish and 50in10 hosted a one-day workshop for stakeholders of Indonesian fisheries in Bali, Indonesia. The purpose of the meeting was to share preliminary findings from the Labuhan Lombok mFish pilot and solicit feedback from regional experts in an effort to craft an informed and effective roadmap for future rollouts of mFish.

Workshop attendees included staff from local and international NGOs, government officials, and seafood industry experts. Representatives from the three founding partners of mFish provided the history of the initiative, the context and goals of the program, and an update on where the commercial-driven efforts by /tone were headed. The Future of Fish team delivered an in-depth presentation introducing the methodology and theory of change behind the Alpha Pilot, and a summary of preliminary findings from Labuhan Lombok, which were based on a rapid synthesis conducted over four days immediately following the ethnographic fieldwork. A full summary of the Next Steps Workshop can be found here (PDF link).

Following these presentations, Future of Fish facilitated a panel discussion with three practitioners from two of the local NGOs involved with mFish pilots. Momo Kochen represented MDPI and the Alpha Pilot in Labuhan Lombok, and Andre Ali Mustain and Yunaldi represented LINI and the Ampenan Pilot. The panelists shared their reasons for deciding to engage with mFish, the challenges and opportunities the pilots provided, what they hoped could be improved, and what was needed for continued success.

For the final workshop activity, participants worked in groups to design their own apps for the mFish platform. The teams were challenged to think of a pressing need in fisheries management or fisher life and develop an app to meet that need. Each group then "pitched" its idea to the audience of other attendees, answering the following four questions:

- Who is the user?
- Why are they motivated to use this?
- What are the challenges?
- How does it scale?

Workshop participants develop prototypes. Photo: Charley Scull

The five prototypes presented were:

1. Show Me The Money App: an app that incentivizes fishers to register their vessels and report catch by offering a suite of services such as tax breaks and weather information with potential gamification aspects.
2. Oleh Oleh App: A free app to register vessels that gets fishers on board and then adds incentives that can be monetized, from health care to household finances.

3. Captain Decides App: a sophisticated algorithm that incorporates data on weather, market price for catch, fuel prices, season, historical catch data, and more to let a captain know when to go to sea, and when to head home to port.
4. Fish Eye App: takes current apps and makes them more user friendly through a more visual interface (does not require literacy) and focuses on social functions, reporting illegal activity, and news.
5. Ikan Ku: An app that links fishers with buyers and allows buyers to then share enhanced catch information with consumers.

Workshop participants present their prototypes. Photo: Charley Scull

Groups received feedback in the form of rapid-fire questions, which helped surface top-of-mind concerns and interests of stakeholders, as well practical considerations that can be fed back to app developers.

Feedback from workshop attendees was generally positive. Several regional NGOs expressed interested in how mFish technology might be beneficial to their programs. That interest, however, was tempered by strong concerns regarding connectivity issues, the overall business model, and how technology might disrupt social fabric. NGOs were vocal about the need for funding to support any engagement, and were particularly interested in understanding details about how apps design and refinement – to reach fisheries and livelihood goals – would be funded and proceed. The anthropological and design approach and preliminary results resonated strongly with many of the practitioners present, in particular the idea of non-monetary incentive structures for changing behaviors and practices.

Acknowledgements

The mFish Labuhan Lombok Alpha Pilot depended upon the generosity and talents of multiple partners that contributed both expertise and resources to this initiative. Foremost, we wish to thank Director of Science and Programs, Momo Kochen and the staff at MDPI, especially local mFish coordinator Nurie Nababan, Communication Officer Indah Rufiati, Fisheries Associate Nandana Godjali and Sustainable Fisheries Coordinator Wildan Ramadhan for sharing their knowledge and providing endless support across logistical, cultural, and technological aspects of this effort. We are grateful to technology partners Point 97 and Pelagic Data Systems for providing in-kind support for nearly all services and products. We humbly thank the many captains, fishers, suppliers, and other supply chain and community members in Labuhan Lombok and Amepenan for welcoming us into their community and homes and graciously sharing their expertise and insights with us. Thanks as well to the staff at /tone, especially Director of Partnerships Emily Roetzel and Founder Mark Kaplan for assistance with the /tone platform and coordination among partners. Finally, we would like to thank Thomas Debass, Edward Sebelius, and Jason Haserodt of the Office of Global Partnerships at the U.S. Department of State for their support of this pilot.

Appendix I: mFish Pilot Checklist

The following checklist contains recommended considerations for anyone planning to execute a pilot. Conducting the research to satisfy the questions and factors presented here will provide project leads with the majority of information they need in order to design an effective pilot strategy. While this list cannot cover every aspect of pilot development and deployment needs, it provides a strong foundation. We encourage the expansion and refinement of this list as more pilots come online, bringing more insight from the field.

Needs

1. Determine how and what kind of information is needed to improve fisheries and livelihoods
    a) Identify the kind of data capture that currently exists
    b) Consider how increased information could negatively impact the resource or fishers (what kind of disruptions need to be anticipated?)

2. Assess if technological solutions could meet the assessed need and whether that technology exists or needs to be invented (is there already an app for that?)

3. Consider the different types of technology solutions that may be required to meet these needs

Feasibility

1. Review previous attempts at technology intervention and understand what worked and didn't. Are Fishers receptive to the idea of technology?

2. Evaluate if mobile technology is the appropriate solution by considering:
    a. Is there Connectivity?
    b. How savvy are fishers with mobile tech?
    c. How digitally connected are they, and is it mobile tech or web?
    d. Is there receptivity to mobile technology?
    e. What is the level of digital or mobile literacy?

3. Research which technology partners may be best suited to fulfill needs and assess availability (mobile providers, app developers, telecommunications companies, traceability engineers, etc.).

Goals and Impact

1. Elucidate clear, specific goals of the mFish pilot in terms of both quantitative and qualitative change

2. Create a plan for how the pilot will mitigate unintended consequences of technology introduction

3. Determine the plan for how the pilot will respond to emergent needs or opportunities

4. Platforms for shared learning: Over time, as more pilots are launched and news of success spreads, the risk and hesitancies of fishers and NGOs may decrease. Platforms for shared learning (such as that provided by the Next Steps Workshop) can help accelerate this process by allowing practitioners and fishers to exchange knowledge, answer questions, and provide feedback directly to their peers. Consideration of how to capture lessons learned and where to coordinate sharing across sites is highly recommended from the outset.

Logistics

1. Language and literacy barriers are common; more graphically-oriented apps and training guides are recommended

2. Evaluation of connectivity and adjustment of expectations and apps based on availability, bandwidth, and other factors. In other words, design for intermittent or reliable service.

3. Evaluation of database management needs to identify sensitivities and key players that are needed to develop an appropriate strategy. Recommend initiating conversations as soon as possible in order to ensure data capture during the pilot is done in a manner that is approved by all major stakeholders.

4. Details of the fishery:
    a. Offshore or Onshore/Daily
    b. Seasonality
    c. Heterogeneity
        i. Boat Types
        ii. Types of Fishers

iii. Types of catch

d. Scalability of solution: does the pilot seek to meet the needs of a diverse community or a more targeted one?

5. Rules of Engagement
    a. On the ground dynamics between fishers and the market
    b. Units of Deployment (does it make sense for each fisher to have technology, or each boat, or each family, etc.)
    c. Power dynamics throughout the supply chain and within the communities

6. Develop realistic timeline for both initial deployment and long-term engagement
    a. Coordinate launch and deployment of technology with fisher schedules, preferably working in low seasons where fishers have more time

    b. Set expectations for duration of "pilot" and larger uptake or spread of technology through community/fishery. Look to other pilots for guidance as well as previous examples of technology adoption in the community where they exist

Human Resources and Partnerships

1. Assess if there is a strong NGO that can serve as a local partner and liaison between fishers and mFish initiative. This partner needs to have a relationship of trust and respect with the fishing community, and ideally, connections to the supply chain as well.

2. Local mFish Coordinator: capacity to support an on-the-ground long-term (at least 6 months) champion for the project. Best fulfilled by someone with knowledge of fishery and community ties

3. Arrangement for on-the-ground tech support team during training and deployment of technology, with on-going support scheduled for duration of pilot. This requires staff time from all technology partners with solutions featured in the pilot.

4. Work with multiple partners that can provide a diverse suite of technology solutions to address identified need. MOUs and NDAs may be required to move conversations forward.

5. Establish clear expectations and pathways for feedback with tech partners for iterative development of technology, such as new apps or refinement of ones that come on platform

Collateral

1. Guides: for training of coordinator, fishers, and enumerators (where appropriate)

2. Potential "contracts of engagement" to make fishers feel part of something bigger (and increase sense of obligation)

3. T-shirts or other "branded" products, depending on cultural framework, are often expected and appreciated.

Incentives and Aligning Values

1. Identify core values in the culture, such as emphasis on material ambition vs. social well being in order to better inform incentive structures

2. Evaluate the access to government subsidies

3. Note if "Gift Giving" or other future-oriented reciprocity systems are prevalent

4. Consider other technologies that are appreciated as "tools" vs. "toys": how was deployment accomplished? What value do they bring to the community?

5. Anticipate how integration of technology into the community might affect social status of the technology owner

6. Understand the value of Western branding inside the community and whether it needs to be minimized or leveraged to encourage engagement.

7. Non-financial incentives structures should be considered in addition to any monetary compensation.

Appendix II: Project Staff

50IN10

Miguel Angel Jorge, Managing Director
As Managing Director of 50in10, Miguel Jorge works to expand 50in10's network of stakeholders, facilitate knowledge sharing about sustainable fisheries management, and help design and support collaborative fishery restoration programs globally.

Megan Arneson, Program Manager
As Program Manager, Megan Arneson supports 50in10's efforts to build partnerships, managing stakeholder participation, and overseeing broader operations, facilitation, and communications efforts.

FUTURE OF FISH

Cheryl Dahle, Founder & Executive Director
Cheryl is an entrepreneur and journalist who works at the intersection of business and social change. She is founder of Future of Fish, a non-profit innovation hub that supports the collective impact of entrepreneurs whose ideas help end overfishing. Previously, she was a director at Ashoka, where she distilled knowledge from 2,500 fellows to provide strategic insight to foundations. She spent a decade writing about technology, social entrepreneurship, and business for publications including the New York Times, CIO, and Fast Company, where she founded the Social Capitalist Awards. For her work with Future of Fish, Dahle was named a national "Eco-Innovator" by USA Today in 2013 and was a finalist in the Buckminster Fuller Challenge in 2012. She has also been a Change Agent in Residence with Bainbridge Graduate Institute and is the board chair of Criterion Institute.

Keith Flett, Pod Manager
Keith began his professional career as an entrepreneur at the age of 22, when he launched a wholesale seafood company, consulted for a New York-based commodities exchange, and developed risk-management strategies and commodity-analysis programs for hedge funds and Commodity Trading Advisory (CTA) firms. Most recently, Keith founded and served as CEO of Open Ocean Trading, a startup company that provides better financial stability to seafood companies by allowing fishermen to bring their intended catch to market through forward contracts.

Marah Hardt, Ph.D. Research Co-Director
Research Co-Director at Future of Fish, Marah has worked as a primary researcher and strategist for numerous seafood-related projects, such as sustainable aquaculture, entrepreneurial solutions for sustainable fishing, oyster restoration, and recreational fisheries. She is adept at gathering and synthesizing information from diverse stakeholders, including fishers, supply chain players, academics, government officials, and community leaders. Her professional experience combines extensive field research, data analyses, and scientific writing across marine, fisheries, and climate sciences.

Colleen Howell, Ph.D. Research Co-Director
Colleen is a Research Co-Director at Future of Fish. Her work at FoF began in 2008 with an analysis of barriers and strategies related to mid-chain adoption of sustainable seafood. Since then she has led grant-funded projects on oyster restoration, aquaculture, the New England groundfish value chain, and most recently, seafood traceability. Colleen's background and expertise ranges broadly from mathematical ecosystems modeling and soils taxonomy to natural resource economics and sophisticated data analysis.

Charley Scull, Ph.D. Partner at Practica Group, LLC
Charley Scull, Ph.D. is an England-born, Canada-raised cultural anthropologist and filmmaker who lives in Brooklyn, New York. He received his Ph.D. in anthropology and his MA in visual anthropology from the University of Southern California where he explored immigration, identity, gender and youth culture. His work has covered topics as diverse as medical device design in prenatal ICUs, workplace culture in a multi-ethnic bakery, a global online "webnography" for a pharmaceutical client, and ethnographic research of the global supply chain for a project on sustainable fishing. Charley frequently uses video in his research both as a way to gather data and to share findings. His work as a filmmaker includes a feature length biography: *Naturally Attracted: Connecting with Michael J. Cohen*.