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Tracey – your traceability and trade data companion

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Abbreviations

AG	Aktiengesellschaft
EEZ	Exclusive economic zone
dApp	decentralized Application
ESC	Executive Steering Committee
FAD	Fish aggregating device
FAME	Futuristic Aviation and Maritime Enterprise, Inc.
FIP	Fisheries Improvement Project
GDP	Gross domestic product
GDST	Global Dialogue on Seafood Traceability
IUU	Illegal, Unreported and Unregulated
MVP	Minimum viable product
MSY	Maximum Sustainable Yield
OWG	Operational Working Group
PDP	Project Delivery Plan
QA	Quality Assurance
QR	Quick Response
UB	UnionBank
UI	User Interface
UX	User Experience
WWF	World Wide Fund for Nature

Tracey vision

Tracey is a decentralized application for fisherfolk that will use blockchain technology for documenting and verifying catch and trade data. There's a number of benefits — such as immutable history of data and the use of decentralized identity — that the dApp brings to the fisherfolk and to other members of the seafood value chain.

As background, it has become apparent in recent years that some of the most popular species of fish — e.g. yellowfin tuna — are currently at risk due to declining stocks. Illegal, unreported and unregulated fishing is common. And while accurate data on catch yields is paramount for an accurate determination of maximum sustainable yield thresholds, a significant and increasing number of seafood products are being mislabelled. At the same time, the fisherfolk in the coastal areas remain poor and often without access to banking facilities.

Although the problems are particularly acute in the Philippines, these are global problems. A globally relevant and innovative solution to improve data provenance throughout the entire seafood value chain is needed.

Tracey is the dApp which unlocks the value in catch and trade data. It gives the fisherfolk the resources required to implement a full and accurate traceability system in line with European and US standards. This enables them to sell their catch in foreign markets at much higher prices than they are currently able to.

Using Tracey, fishermen at the point-of-harvest as well as other parties in the value chain are incentivized to share verified traceability data with third parties such as WWF-Philippines, government authorities, customs offices, and final buyers and seafood consumers. The fisherfolk will get remunerated for the catch data they provide.

Historically, fisherfolk have been perceived as high-risk customers and therefore have largely remained unbanked. The data captured by Tracey will enable financial institutions — such as UnionBank — to conduct proper credit assessments based on verified fish catch and trade records. In this fashion, Tracey enables much needed microlending. And microloans, in turn, allow Filipino fisherfolk to engage in other business ventures, and thereby bridge the gaps between fishing seasons.

Tracey will be based on Ethereum blockchain and Streamr stack, and it leverages the Streamr Network, an open-source, decentralized data transportation layer for real-time data. Network is used to transfer traceability related time-series data from third party sensory platforms (e.g. FAME) and internet connected devices to the Streamr Marketplace. Third parties can subscribe to the data streams, and the income generated from the data sales will be sent directly to the fisherfolk who produce the data. Core (Streamr's real-time data toolkit) can be used to create insights such as use of the fishing grounds within a defined geo-location.

Data monetisation in Streamr Marketplace is subject to proper consent, and ownership rests with the data contributor. Tracey opens the gateway to a number of benefits, but the data owners are under no pressure to share their data.

In sum, Tracey is a technological solution which not only solves the sparsity of trustworthy seafood traceability data. It helps the fisherfolk earn higher revenue for catch with verified provenance, achieves a more equitable distribution of supply chain benefits, and contributes to better fish stock management and sustainable fishing practices. The catch data is also a basis for credit assessments which will allow the fisherfolk to become bankable and access new economic opportunities.

These are the core objectives of Tracey:

- Improve the quality of traceability data throughout the seafood value chain;
- Provide access to seafood traceability data to a wide range of stakeholders;

- Provide banks and other financial institutions with data for assessing the creditworthiness of Micro-SME market participants;
- Create a simple platform for submitting micro-loan applications and approvals;
- Reward fisherfolk and members of the subsequent supply chain for the provision of good quality traceability data that demonstrates sustainable fishing practices;
- Improve fish stock management with better data on maximum sustainable yield (MSY) thresholds; and
- Help transition currently unbanked individuals to become banked.

Project rationale

This section of the white paper discusses the rationale behind Tracey. We first take a look at the current state of the fisherfolk and fisheries in the Philippines, and then discuss traceability on open sea fisheries.

The current state of fisherfolk and fisheries in the Philippines

Philippines is a country that lives from the sea. According to Pearce et. al (2015) in ".. 2012 the Philippines was the second highest ranked Southeast Asian nation in terms of total fish catches, behind only Indonesia". When it comes to tuna "...the Philippines is the world's third largest tuna producer" with almost half of the "...country's seafood exports coming from yellowfin, skipjack, and frigate tuna" (WWF 2019b). For the fisherfolk, tuna is the most valuable fish product and the "...fisherfolk and coastal communities rely on tuna for income and food" (WWF 2019b).

Fisherfolk are facing multiple challenges in the Philippines. The economy is growing fast but the economic status of the fisherfolk is stagnating (WWF 2019b). According to World Bank, the Philippines economy has grown since 2000 at an average rate of 5.3 percent per year and the GDP per capita has nearly doubled from US$1,607 in 2000 to US$2,753 in 2016 (Qian et. al 2018). However, "...2 out of 5 fisherfolk [are] living below the poverty line" (WWF 2019b).

The livelihood of fisherfolk is being challenged by the dwindling tuna stocks. According to WWF Philippines "...tuna stocks are in danger because of climate change, overfishing and illegal fishing" (WWF 2019b). In 2013 the estimated losses from Illegal, Unreported and Unregulated fishing (IUU) "...in the Philippines EEZ are estimated to average between USD 574.77 and 2,001.29 million" (Pearce et. al 2015).

The periodic nature of tuna fishing with a low season and a high season opens a personal economic risk for the fisherfolk. Between the seasons, their income can be highly uncertain and irregular.

Fisherfolk are also finding it difficult to finance their operations as many lack bank accounts. From a traditional banking perspective, the fisherfolk are often seen as too risky to establish credit worthiness.

According to Qian et. al (2018) "...a well-functioning financial sector that efficiently allocates credit is paramount for productivity growth". However, the traditional credit options are out of the reach of fisherfolk and they have become financially dependant "...on their local traders, known as *casas*" (WWF 2019b). These casas operate outside the financial regulation as independent lenders setting their own and often (for fisherfolk) unfavourable terms for financing.

Traceability

Traceability can be defined as "...the ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identifications" (Olsen & Borit 2013).

Seafood traceability has multiple different drivers such as consumer attitudes, production management, regulatory requirements, market requirements, IUU fishing and seafood fraud (Sterling & Chiasson 2014).

Companies, organizations and governments alike recognize the importance of traceability. Where companies "...recognize that transparency and traceability are critical to brand equity, risk mitigation, food safety, and consumer confidence" (Sterling et. al 2015) the policymakers recognize "...that 'bait to plate' seafood traceability is key to achieving sustainable fisheries, combating illegal fishing, and ensuring food security" (Sterling & Chiasson 2014).

However the fish product in "bait to plate" model — i.e. the route from the catch to the end consumer — forms a complex value chain in global trade (Sterling et. al 2015). "Seafood often moves very long distances, in and out of multiple ports, and changes hands among various brokers, wholesalers, processors, and retailers before reaching the consumer" (Sterling & Chiasson 2014, Pramod et. al 2014, Waage & Kraft 2013).

Effective traceability gives an ability to "...identify the origin of the product and sources of input materials, as well as the ability to conduct backward and forward tracking using recorded information to determine the specific location and life history of the product" (Sterling & Chiasson 2014).

According to Chiasson & Sterling (2014), effective traceability offers many business benefits. These include sustainability through the ability to validate sustainability claims, quality assurance, continuous improvement, value capture by being able to trace products to the source and trade through "...increasing access to markets and new customers."

Implementing and operating traceability systems impose a variety of costs. For example, tags, identifying devices and information systems are needed to track and trace animal products in the value chain (Greene, 2010). As the needs for traceability systems evolve e.g. from no-traceability to one up and one down to full value chain traceability so do the costs. A question may arise of whom will bear these costs as the smaller operations may "...not possess the resources required to purchase and implement a full traceability system" (Sterling & Chiasson 2014, Greene 2010).

Work to date and timeline

This section first gives a summary of the progress to date, followed by a discussion of the upcoming phases of work, important amendments to delivery process and the introduction to the co-founding organisations.

Progress to date

In February 2019, the initial participants — i.e. WWF-Philippines, TX - Technology Exploration Oy (TX) and Streamr Network AG — took part in the Global Dialogue for Seafood Traceability (GDST) hackathon. The objective was to design an innovative solution that could incentivize fisherfolk to share data on traceability of fish catch and fish sales. The team created a basic demonstrator tool that enabled fisherfolk to capture their catch & trade data. The hackathon produced a concept with these properties:

1. The data will be streamed to the Streamr Marketplace and subsequently sold to third parties, with the data producer, e.g. a fisherman, being the sole beneficiary of the income generated by the sale.
2. The “trade” and catch log data can be used by banks to ascertain the creditworthiness of a fisherman and their eligibility for accessing a micro-loan.

Following the hackathon, TX, WWF and Streamr held further discussions on the potential of the solution. The participants collectively raised initial funding sufficient to produce a white paper, conduct further primary and secondary research and meet the key stakeholders.

During the stakeholder meetings, two new key partners were identified: UnionBank, the ninth largest bank in the Philippines (Robles, 2018 & BSP, 2019) . The UnionBank will perform an important role within the consortium as the main recipient of the data. Using the data captured by Tracey, creditworthiness of applicants will be assessed and

micro-loans will be offered where appropriate. The bank will also provide E-Wallets and Know-Your-Customer (KYC) technology solutions.

During a meeting on the 23rd September 2019 at the UnionBank offices in Ortigas (Manila, Philippines). TX, Streamr and WWF agreed that going forward, UnionBank would also be recognised as one of project co-founders, given the extent of the role that the bank would have in the project development. For the remainder of this document TX, WWF, UnionBank and Streamr will be collectively referred to as the "co-founders."

See Figure 1 below for the timeline, including the work completed to date and the subsequent phases of work as planned.

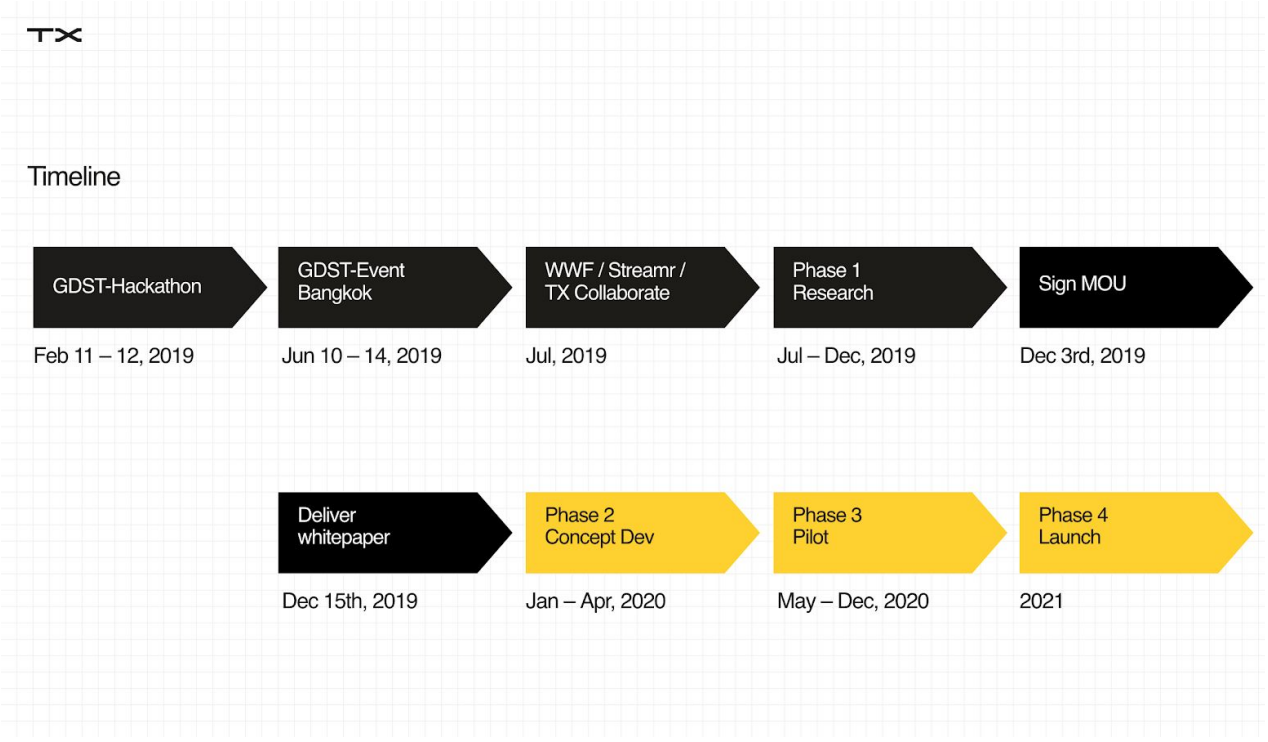

Figure 1. The Tracey project timeline.

Amendments

A number of amendments have been approved since the inception of the project. These are documented below.

1. The purpose of the original grant by WWF was to produce a white paper called “Change On The Water”. Since project inception, however, additional funding from TX and Business Finland has been raised, and as such the project was renamed as “Tracey - your traceability and trade data companion”.
2. WWF, TX and Streamr originally created the concept and co-founded the project in February 2019 at the GDST hackathon (Bangkok, Thailand). In October 2019, UnionBank was invited to join the project consortium and were recognised as co-founders due to the critical role of the bank in the project.

Co-founders

A short description of each co-founder is given below.

TX — https://tx.company/

TX is a Finnish advisory and software development company specializing in data monetisation, application of blockchain technology and decentralized data. TX’s goal is to develop solutions that empower industries, organizations and people by unlocking the value in the data. TX promotes a data economy through the application of Streamr technology stack (Streamr, 2017).

WWF – https://wwf.org.ph/

WWF-Philippines is a national organization and has been part of the WWF network since 1997. “WWF-Philippines has successfully been implementing various conservation projects to help protect some of the most biologically-significant ecosystems in Asia. WWF-Philippines works to improve Filipino lives by crafting solutions to climate change, providing sustainable livelihood programs, and conserving the country's richest marine and land habitats.” (WWF Philippines 2019a)

Streamr AG – https://streamr.network/

Streamr is an open-source project which is being built by contributors around the world. Crowdfunded with CHF30M in October 2017, it is an open source project with the Network at its core, plus the Marketplace and Core apps. Functional versions of each component exist today, with full decentralization being the goal over the next few years. The project was created by real-time data veterans with backgrounds in algorithmic trading and finance.

UnionBank – https://unionbankph.com/

Established in August 1968, “...UnionBank distinguishes itself through superior technology, unique branch sales & service culture, and centralized backroom operations. UnionBank’s superior technology allows the delivery of online, real time business solutions to meet our customers’ changing and diverse needs through innovative and customized cash management products and service offerings. UnionBank’s unique branch culture ensures efficient and quality service as well as mitigating operational risk and their centralized operations enables them to provide responsive, scalable, and secure transaction processing” (UnionBank, 2019).

Alliances

Global Dialogue on Seafood Traceability (GDST)

GDST is a business-to-business platform which aims to advance a unified framework for interoperable seafood traceability practices. To ensure the data captured within Tracey meets international standards used by import agencies to the EU and US markets, the Key Data Elements (KDEs) developed by the GDST will be incorporated into Tracey. Close dialogue with GDST will be maintained throughout the project development to ensure that Tracey is utilising up to date industry standards.

Challenges and hypothesis

The following challenges have been identified in relation to fisherfolk in the Philippines and the traceability of artisanal hand line tuna fishing.

- There's a lack of low-cost solutions that enable seafood traceability at micro-SME scale.
- There's a lack of solutions that enable seafood traceability data monetization.
- Traceability data production should be incentivized for the fisherfolk.
- Traceability is required to enter many international markets e.g. EU and USA.

The following hypothesis have been formed.

- Fisherfolk can be incentivized to produce traceability data.
- Fisherfolk have capabilities to produce traceability data.
- Traceability data can be collected, stored and monetized utilizing Streamr technologies.
- Traceability data can be utilized to improve fisherfolks access to financing.

Survey and results

To be able to set the baseline and to gain insights to set hypothesis, TX and WWF jointly conducted surveys in August 2019 at two different sites.

The two WWF Philippines Fisheries Improvement Projects (FIP) at Occidental Mindoro, located in the West Philippines, and at Lagonoy Gulf at Bicol, located in the East Philippines, were chosen as survey targets. The fisherfolk in these projects form a diverse target group, have long standing relationships with WWF Philippines and are jointly interested in sustainability, long-term economic success and the continuity of the artisanal tuna fishing (WWF 2019c, WWF 2019d). In addition to the survey, the later phases of the Tracey project are planned to be implemented at these FIPs.

These two FIPs together involve approximately 5500 artisanal fisherfolk. They constitute a strong and well organized group which aims to achieve "...Marine Stewardship Council (MSC) certification, the best seafood certification scheme available" (WWF 2019c).

The survey was conducted orally, and it consisted of a semi-structured questionnaire with a mix of nineteen open-ended and closed-ended questions. There were questions of both qualitative and quantitative nature, and they were divided in three categories: traceability, technology and borrowing. In more detail, the questions aimed to establish the current state of traceability, sentiment towards sharing traceability data, the state of borrowing and personal finances of fisherfolk and the technical readiness towards digital traceability data production. A survey template can be found in Annex B.

The surveys were conducted at two local venues: Sablayan in Occidental Mindoro and Malilipot in Bicol. WWF Philippines personnel translated the survey questions to local languages,Tagalog and Bicolese, and transcribed the responses to survey forms in English.

The survey was conducted on an afternoon during the high season of artisanal tuna fishing, and this may have affected the sample size. If a fisherman was absent and could not be interviewed directly, we interviewed their wives instead. Fishermen's wives are typically up-to-date and in charge of household finances.

There were a total of 32 responses with 17 responses from Bicol and 15 responses from Occidental Mindoro. The respondents formed a diverse group of people who participate in fishing activities directly or indirectly; fishermen, fishermen's wives and boat owners. The sample size of 32 respondents translates to around 17.3 percent margin of error for the population size of 5500 fisherfolk with 95 percent confidence level. A summary These summaries of responses is given below.

Findings

Gulf of Bicol/Lagonoy

Fifteen out of seventeen respondents at BicolOn responded to questions about traceability. The collected data ranges from using a WWF specified catch log to a subset of the catch log with custom attributes such as fishing gear used, grade of fish determined by casa or fish aggregating devices (FADs) used. All respondents who produced data (15 out of 17) recorded it on different types of paper based formats. This data was received either by WWF Philippines or local government units.

Fisherfolk at Bicol expressed different types of concerns about sharing catch data. Answers ranged from no concerns to conditional sharing of data if there's an incentive for it, to recognizing the importance of data sharing in order to fulfil regulatory requirements and to help the government to estimate the size of the fish stock. The majority of respondents (16 out of 17) were willing to share date if they would be compensated for it.

On questions about technology, more than half of the respondents (10 out of 17) have an Android smartphone at hand (see figure 2). Almost half of the respondents (8 out of 17) respondents, have access to the Internet.

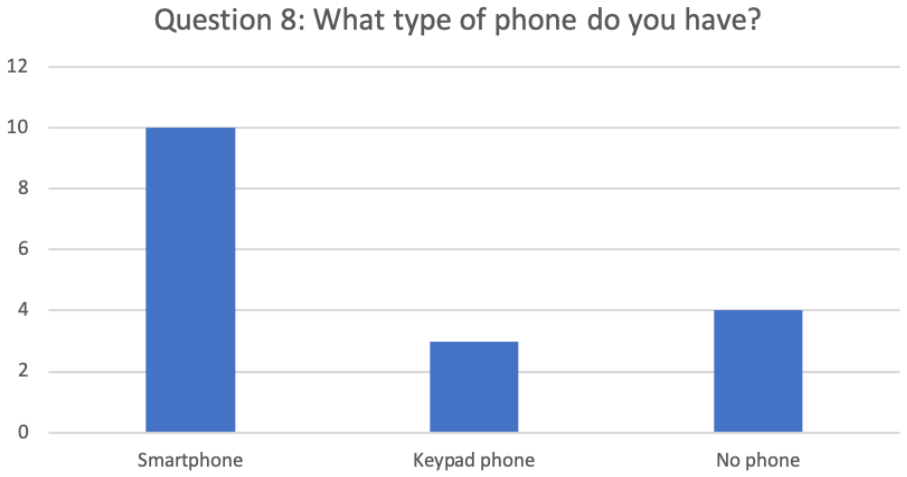

Figure 2. Types of phones used by respondents

On questions related to borrowing, some respondents gave answers as a range for the borrowed amount and for the average income. In such cases, the arithmetic average and the median were calculated on the basis of the minimum and maximum value in the ranges provided.

More than two thirds (12 out of 17) of respondents answered that they regularly borrow money. The borrowed amounts varied between 100 PHP to 150 000 PHP, with the median amount being 5000 PHP and the average amount being 16650 PHP for lower range and 17 600 PHP for higher range. The respondents' reported income varied between 1500 PHP and 30 000 PHP per month. The average monthly income varied between 6650 PHP and 7590 PHP, depending on the low or high season. The median income varied between 5000 PHP and 6000 PHP between the low and high seasons.

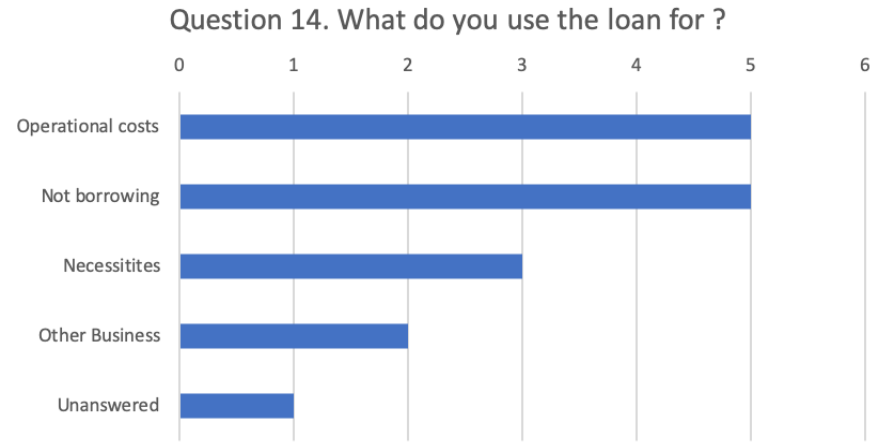

Figure 3. The most common reason for borrowing money.

The most common reason (see Figure 3) for borrowing money was to cover operational costs of fishing. This was followed by loans for necessities such as fulfilling basic needs, acquiring medicine and funding side businesses such as sari-sari stores and pig farming.

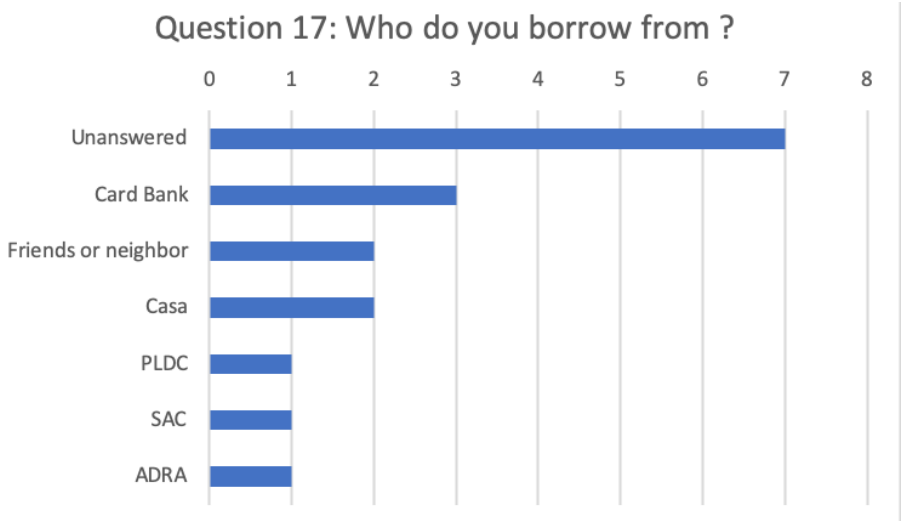

Figure 4. The source of borrowing.

Respondents identified different sources of borrowing (see Figure 4), including friends and neighbors, NGOs, rural banks and casas. A few (three respondents) reported that lenders require collateral to be eligible for the loan. The required collateral varied from a percentage of the loan to physical collateral such as home appliances or the fishing boat. Interest rates for the loans varied from zero (in case of borrowing from friends) up to 20 percent per month when borrowing from microlending operators.

Majority of the respondents (14 of 17, see Figure 5) stabilise their income during yellowfin tuna's off-peak season by fishing for other species, by working other professions or by running other businesses.

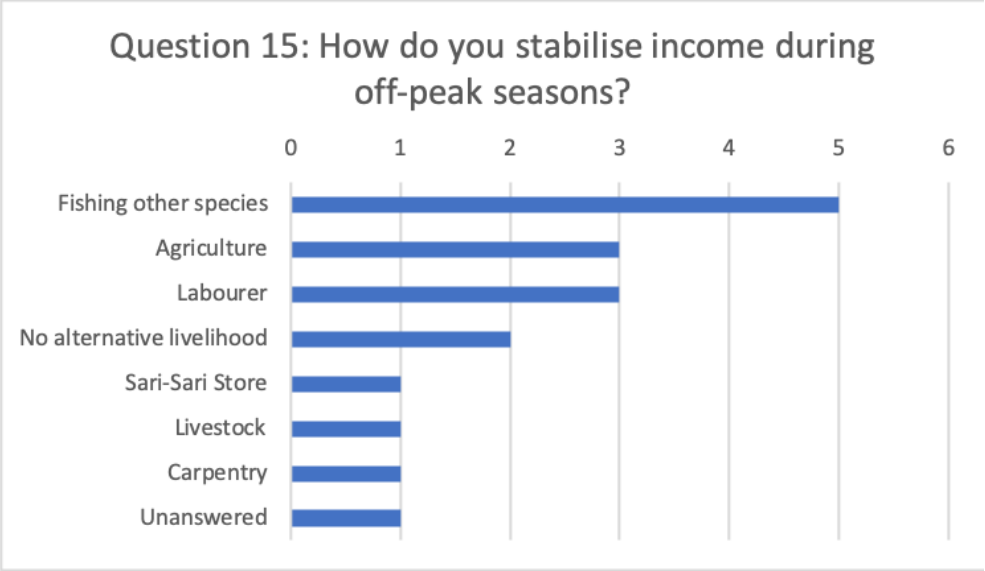

Figure 5. The means to stabilise income during the off-peak yellow-fin tuna fishing season.

Roughly two thirds of the respondents don't have a bank account (Figure 6). Respondents with a bank account had it in one of the following banks; Card Bank, Landbank, BPI, BDO or Rural Bank of Guinobatan. Majority of the respondents (14 out of 17) were able to identify

or mention at least one borrowing platform or an instance which could offer financing if needed (Figure 7).

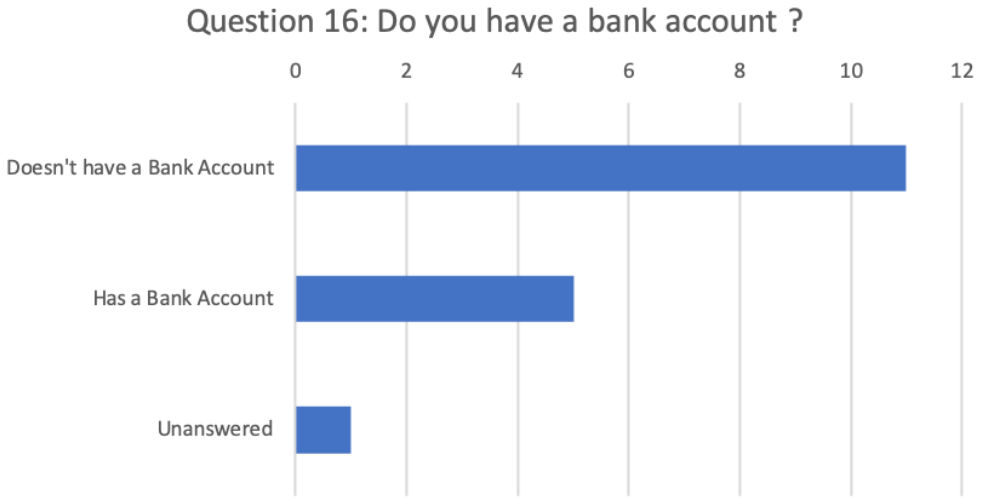

Figure 6. The availability of a bank account.

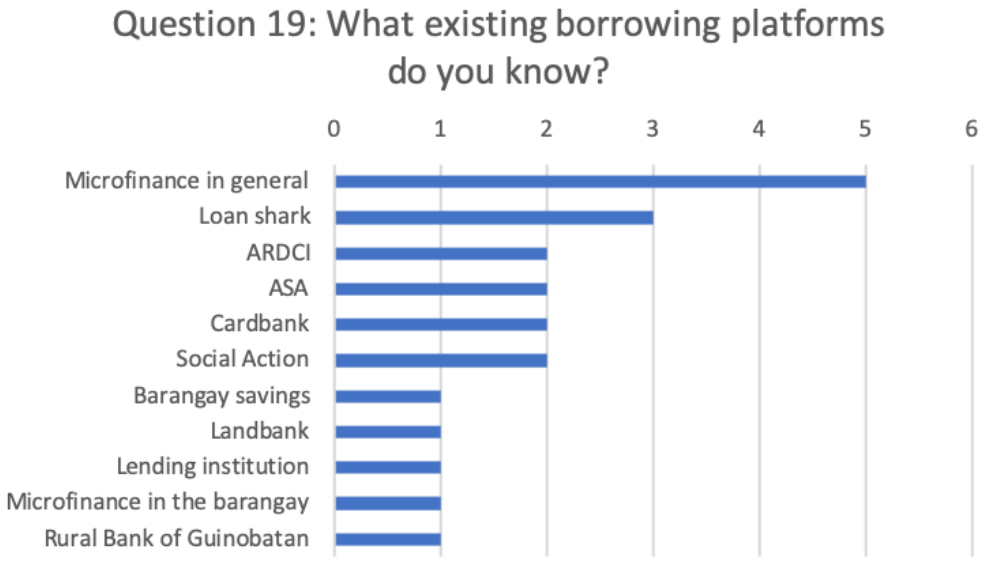

Figure 7. Existing borrowing platforms that the respondents are aware of.

Occidental Mindoro

At Occidental Mindoro, fifteen respondents (including fishermen and fishermen's wives) were interviewed. Approximately half of the respondents (8 out of 15) participated in collecting traceability data. The data was collected in a variety of formats, including WWF Philippines fish catch report, local government units bluebook or a subset of fish catch reports attributes. All of the collected data were recorded on paper based formats. The collected catch log data was received either by WWF Philippines or by a local government unit.

Compared to Bicol/Lagonoy, the fisherfolk at Mindoro expressed somewhat different types of concerns about sharing catch log data. A third of the respondents expressed no worries towards sharing. The rest of the respondents expressed concerns related to helping local government unit to determine state of fisheries or supply chain of fish and concerns towards the use of collected and shared data outside the agreed scope.

On questions about technology, the majority of the respondents (14 out of 15) own a telephone, see figure 8. Eight respondents had an Android-based smartphone and six respondents had a keypad phone. Approximately half the respondents (7 out of 15) had access to the Internet either by a phone or tablet.

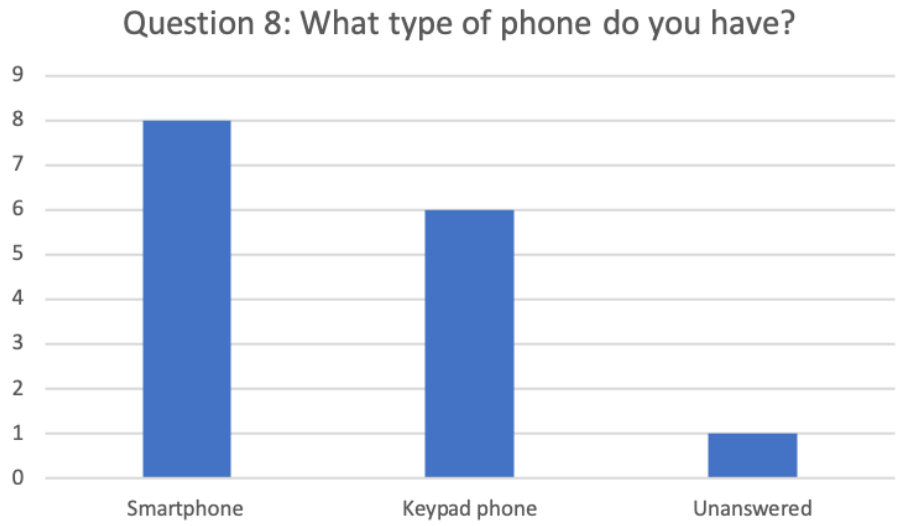

Figure 8. Types of phones used by respondents

On questions related to borrowing, twelve respondents answered that they regularly borrow money. Some respondents gave answers as a range for the borrowed amount and for the average income. In such cases, the arithmetic average and the median were calculated on the basis of the minimum and maximum value in the ranges provided.

The borrowed amounts varied between 500 PHP and 12 000 PHP for the range low and between 500 PHP and 15 000 PHP for the range high. The median amount of borrowed money varied between 5000 PHP for the range low and 7000 PHP for the range high. The arithmetic average of the amount borrowed over all respondents varied between 5600 PHP for the range low and 6600 PHP for the range high.

The average monthly income varied between 2000 PHP and 20 000 PHP during the low season and 5000 PHP and 20 000 PHP during the high season. The average monthly income varied between 9400 PHP during the low season and 10 500 PHP during the high season. The median income in the low season was 7500 PHP and 8000 PHP in the high season.

Around two thirds of nine respondents (9 out of 15) use the loans to cover operational costs for fishing, see figure 9. The rest of the respondents who borrowed money utilized it for different purposes, including personal, housing or basic needs.

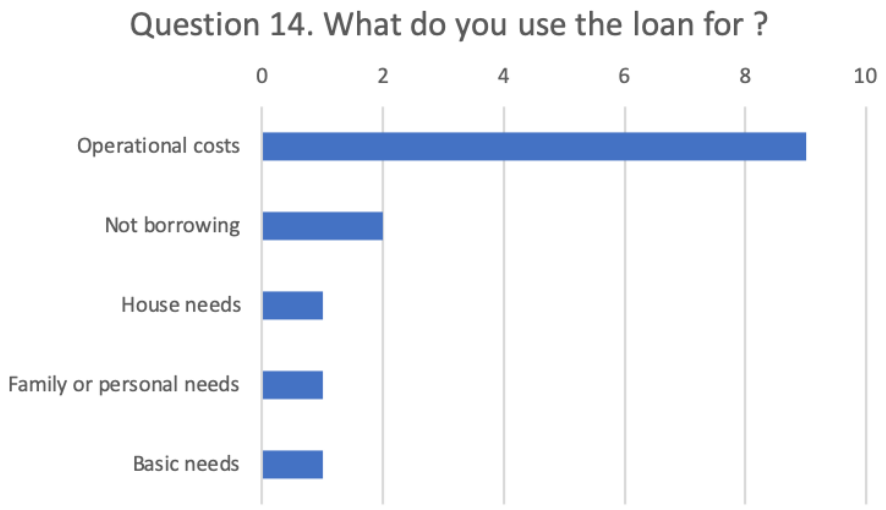

Figure 9. The most common reason for borrowing money.

All the respondents answered that they stabilise their income during off-peak season either by fishing for other species, running other businesses or by working in different professions.

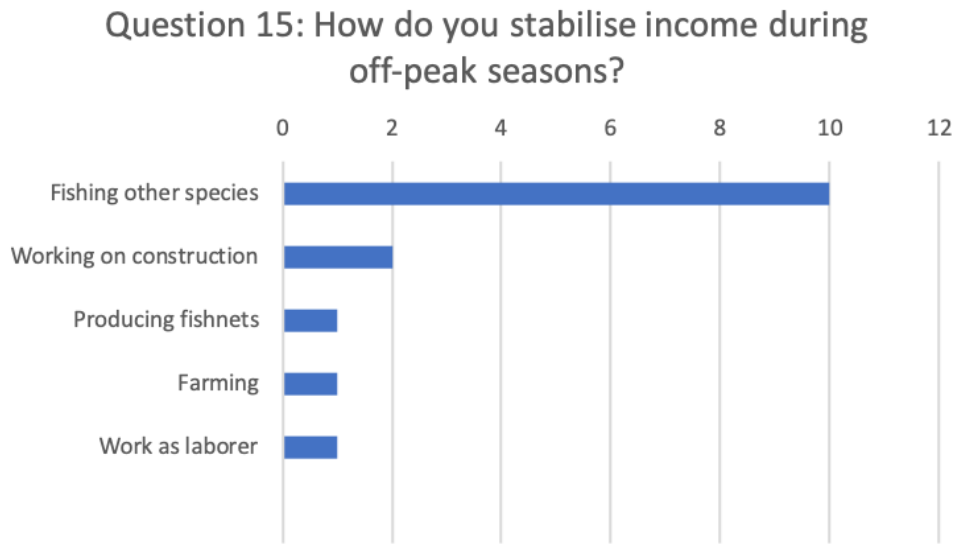

Figure 10. The means to stabilise income during the off-peak yellow-fin tuna fishing season

Only one third of the respondents (5 out of 15) have a bank account (see Figure 11). Such accounts were held in one of the following banks: Sablayan bank, Tammaran bank, UCPB or at CARD Bank. The rest of the respondents didn't have a bank account.

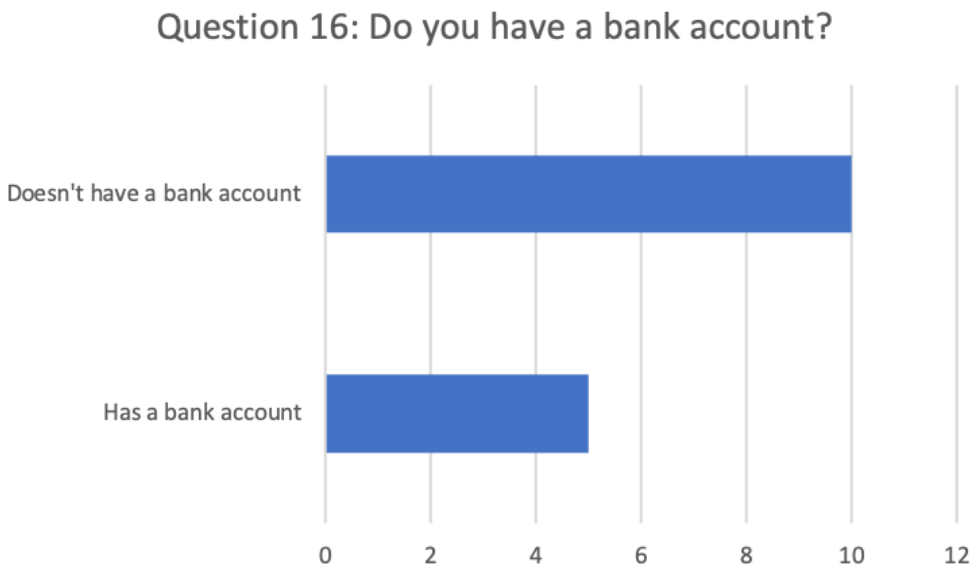

Figure 11. The availability of a bank account.

The respondents had different sources of borrowing, including relatives, boat owners, rural banks and casas (Figure 12). The respondents also identified different sources of loans, including Casas, rural banks and NGOs (Figure 13). The interest rate varied from zero interest (on loans from relatives) up to 15 percent of lump sum interest on principal for loans from a bank. None of the lending platforms or instances required collateral.

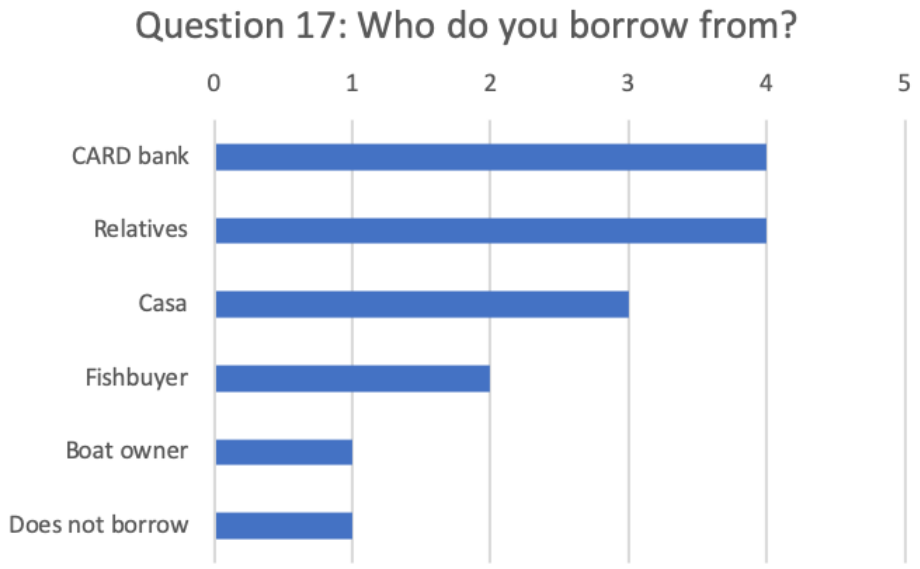

Figure 12. The source of borrowing.

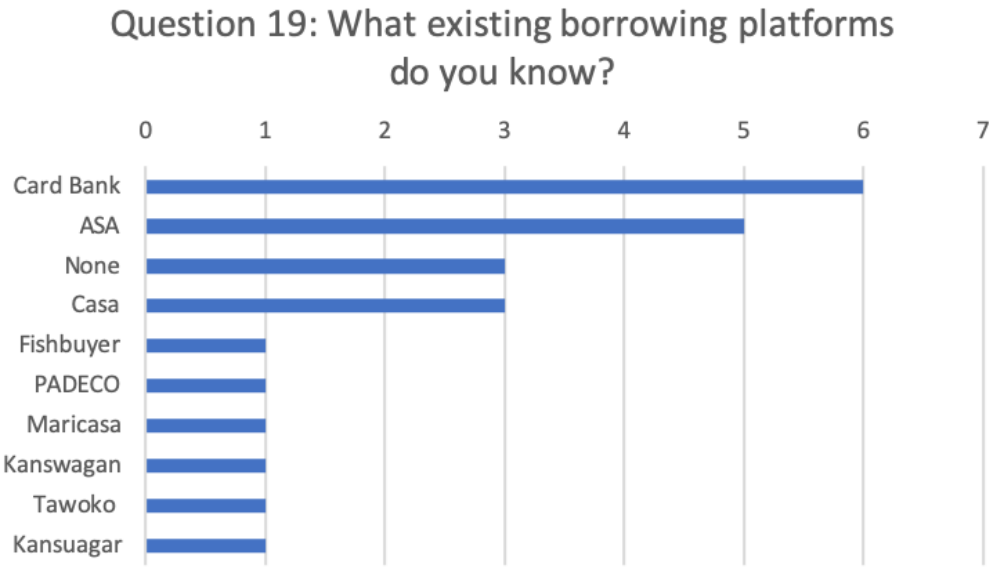

Figure 13. Existing borrowing platforms that the respondents are aware of.

Summary of the surveys

Based on the surveys, Fisheries Improvement Projects at Bicol and at Mindoro share some similarities. Respondents in these two FIPs have roughly similar technological capabilities and the same kind of aspirations towards sharing data. The fisherfolk at each of the locations also need to borrow money to fund their operations and lives, especially during the off-season.

There are some major differences between survey groups on the average income and the amounts of borrowing. The average income is approximately 40 percent higher in Mindoro than in Bicol. Conversely, the average borrowed amount is approximately 200 percent higher in Bicol compared to Mindoro. These figures may be affected by the sample size of the interviewees. However, the figures still serve as an indicator of fisherfolk's financial status and needs.

The survey reveals that the fisherfolk are interested in data sharing. They have technical capabilities such as smartphones and access to the internet. This means that they would be able to participate in pilot projects that require online connectivity or devices with access web-based services.

Blockchains and decentralized ledgers

According to IBM (2017) "...blockchain is a shared, immutable ledger for recording transactions, tracking assets and building trust." There are different types and implementations of blockchains but they all share some key characteristics; consensus, provenance, immutability and finality. For a transaction to be valid, all participants must agree on its validity – consensus. Participants know where the asset came from and how its ownership has changed over time - provenance. No participant can tamper with a transaction after it has been recorded to the ledger. If a transaction is in error, a new

transaction must be used to reverse the error, and both transactions are then visible - immutability. A single, shared ledger provides one place to go to determine the ownership of an asset or the completion of a transaction – finality. (IBM, 2017)

Ethereum is "...the world's leading programmable blockchain". It has a native cryptocurrency called Ether (ETH), a digital currency that can be sent to anyone in the world instantly. ETH is used to interact with applications built on Ethereum blockchain. ETH can be stored in digital wallets, i.e. specialized applications that make it easy to hold and transmit ETH. There are different wallet providers, including Coins.ph (2019) and MetaMask (2019). Such wallets support different platforms such as mobile phones and web browsers.

Ethereum is programmable and supports creation of new kinds of applications called decentralized applications (dApps). These applications are based on smart contracts that run on the Ethereum blockchain.

A smart contract can be thought of as a piece of self-executing computer code that can contain value, store information, process inputs, produce outputs. A smart contract is only accessible to the outside world if certain predefined conditions are met (Vitalik, Boger). The Ethereum smart contract platform is Turing complete. This means that smart contracts are computationally universal and programs can be written on them, they can be run and results can be received from them.

"A blockchain with a built-in Turing-complete programming language, allowing anyone to write smart contracts and decentralized applications where they can create their own arbitrary rules for ownership, transaction formats and state transition functions". (Buterin, 2014)

The proposed solution

In previous sections we have established the need and motivation for a solution which can tackle several challenges: improving seafood traceability, banking the unbanked and incentivizing the fisherfolk to produce traceability and trade data. These problems are non-trivial, and, frankly, wicked — "...problems that are often impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize" (Hassan, 2014 & Rittel & Wegger, 1973). Wicked problems can however be approached by designing and creating appropriate IT methodology, consisting of models, concepts and solutions that can effectively address the issues.

We propose a solution that combines blockchain technology, a data marketplace and data transfer capabilities from the Streamr technology stack (Streamr, 2017), a stablecoin and Know-Your-Customer capabilities from the Bank, and a single interface which gives fisherfolk access to microfinance and the ability to record, store and monetise catch data.

A simplified and high level service flow between the parties is described in Figure 14. In the proposed solution, the fisherfolk produce traceability and trade data which is directly monetised in a data marketplace where approved third parties such as researchers and enterprises can purchase it. The proceedings from the sales of the data are received directly by the data producers. Data is also indirectly monetised as is shared between financial institutions such as the Bank, who in turn provide a service for the fisherfolk in terms of access to microfinance.

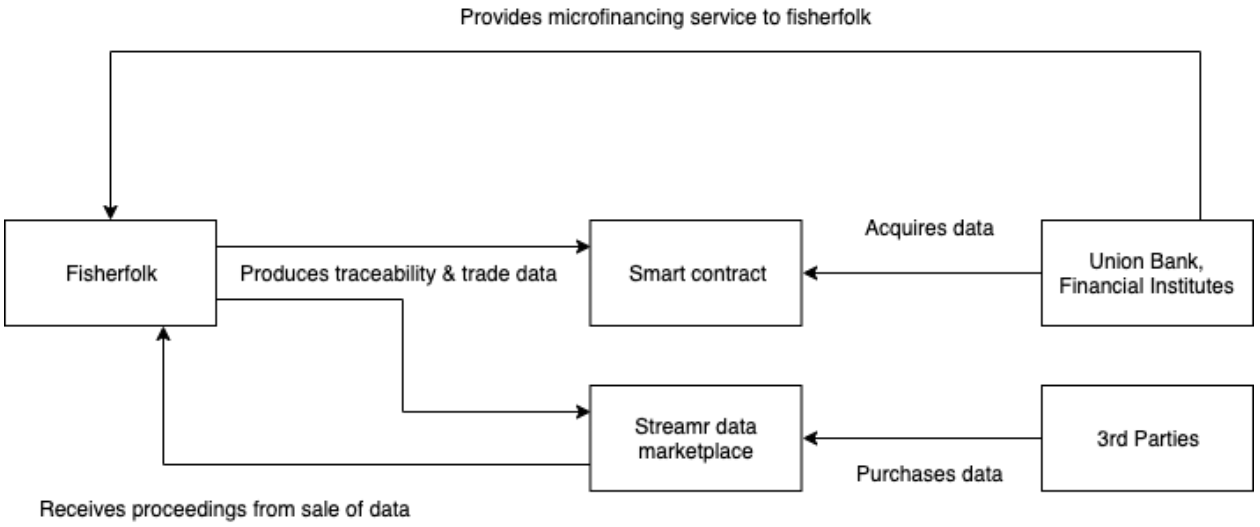

Figure 14. A high level service flow between the parties.

The fisherfolk are in the core of the proposed solution. They are responsible for contributing the traceability and trade data , and they are also the main beneficiaries of the data monetisation.

A representative user flow from the fisherfolk perspective is described in Figure 15. The user flow starts with a KYC process, where the fisherman identifies himself with a financial institution such as UnionBank. After the user has successfully passed the KYC process, he can be assigned a digital wallet from the financial institution.

In the next step, the fisherman creates a Tracey account. At the time of the account creation, Identifying information such as the name, fishing license and the registration number of the fishing vessel is gathered from the user. The fishermen are given the option to whitelist data buyers, and they can choose to which parties the data can be directly sold to. Information about the digital wallet is linked with the account to enable the user to track his performance and his journey towards the eligibility for microfinancing.

After the KYC and the account creation, the fisherman can start registering their catches. The collected data from fish catches follows a Key Data Element (KDE) list as compiled by

Global Dialogue on Seafood Traceability. The list in line with EU and US traceability requirements (GDST 2019a, 2019b).

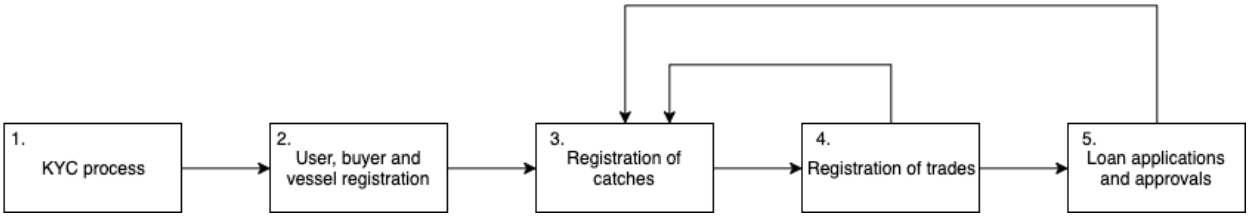

Figure 15. An example of a user flow.

When the fish is landed and sold, information about the trade such as the sales price, buyer identity, the quality of fish and a picture of purchase receipts are recorded to Tracey. The fisherman continues his fishing activities as usual and keeps registering catches and trades until he becomes eligible to apply for a loan. The eligibility for a loan is determined by financial institutions, and it is evaluated using credit score based on the fisherman's historical activities and performance.

The fisherman can apply for a loan once he becomes eligible for it. Once the application is approved, he can withdraw the loan to his wallet. The fisherman can follow his lending and payback process through Tracey. As the fisherman produces more catch and trade data and he satisfies the loan terms (such as the interest payments), he can improve the credit score and gain better terms for future loans (e.g. lower interest rates and larger loans).

High level technical architecture

The basic system design is based on public ethereum using smart contracts and ethereum wallets as means of identification and authorization. The ethereum wallet is linked to an identity by a third-party KYC provider such as Union Banks AKIN - a self sovereign identity solution providing digitized identity service.

Fishermen and validators are provided with an easy-to-use interface to interact with the system. Blockchain based and economic incentivization mechanisms encourage the usage and the generation of verified data.

Realtime data gathering and storage is handled by Streamr platform. Additional document storage is provided for signed metadata. A validation mechanism based on Ethereum identity is provided through the validator service.

Verified catch and trade data is made accessible to loan providers that can provide ERC-20 based stablecoin loans to borrowers identified by Ethereum public id.

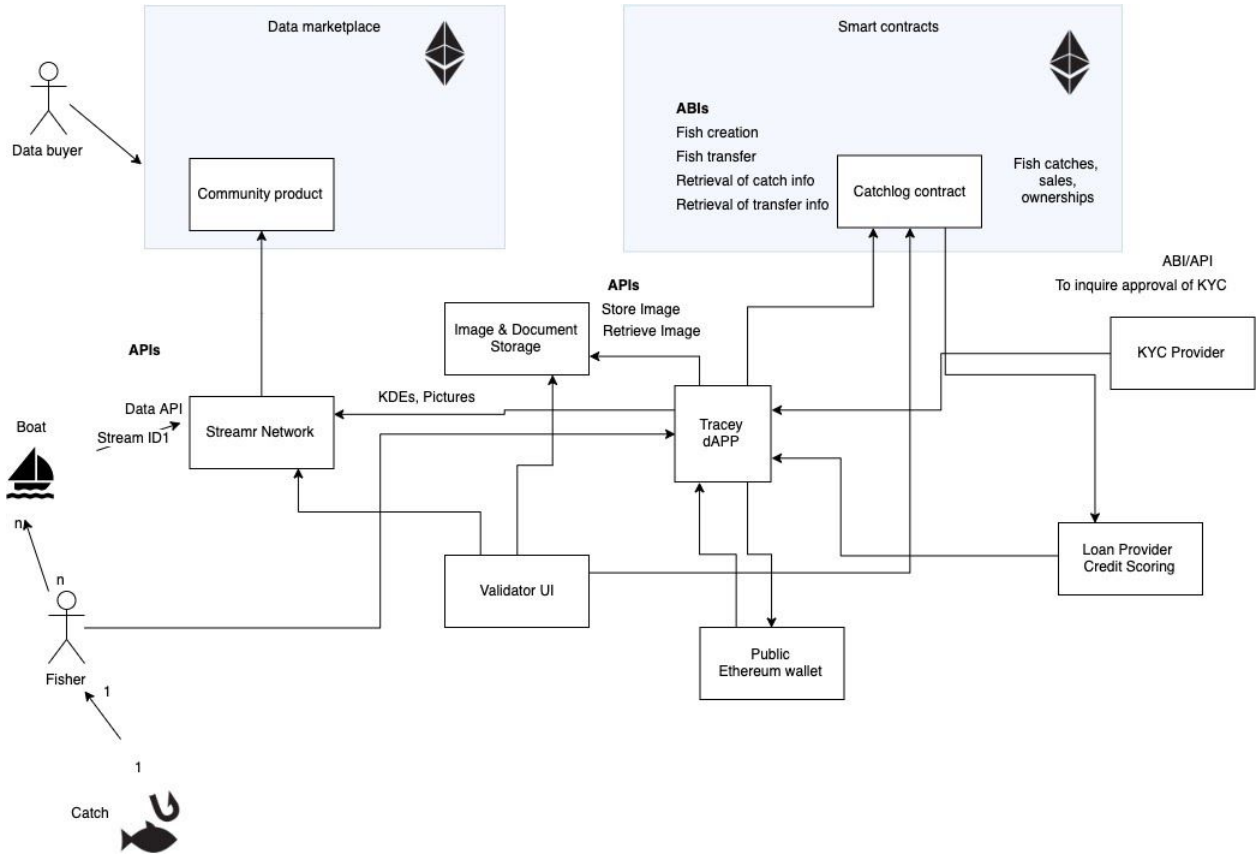

Figure 16. High level technical architecture of key Information Systems.

Authentication and authorization

Fisherman can create an account to use Tracey with Ethereum wallets keys. In general, authentication to interact with information system components in system architecture such as Tracey dApp, validator UI, and catchlog contract is based on Ethereum wallets public and private keys. Authorization is provided by referring Ethereum wallets identity against KYC service provider where user has proved and linked his identity with his wallet.

Other parties related to utilizing traceability and catch data, such as catchlog validators and loan providers are required to have a KYC approved Ethereum wallet identities. Ethereum wallets identity is used as credentials to access document storage, verify and approve individual catches and transactions. Information of verification results are stored to catchlog smart contract and to document storage. Verifiers are not able to remove other parties data or documents from smart contracts or from document storage.

Tracey dApp

Tracey dApp is used as a single interface on an android device by the fisherfolk to create an account with an Ethereum wallet, record catches and trade data to smart contract and to document storage. Tracey dApp user is able to make calls to smart contracts with his Ethereum wallets keys. Two types of functions are available, recording fish catch and recording of a trade.

A subset of key data element list is inserted to Tracey dApp on fish landing to record a successful fish catch. Additional data such as picture of paper catchlog may be added. Record of fish catch is signed by users Ethereum key to establish data provenance and stored to document database. A hash is created from recorded fish catch to document database and stored to smart contract with some of the key data element list data.

The amount of data stored to smart contract is kept at minimum as it incurs a cost. In the future versions of Ethereum blockchain the transaction costs are predicted to decrease which would enable economically increasing the amount of stored data to contract.

When fish is traded, relevant data such as price of fish, buyer information and receipt are signed and stored to document storage. Additionally a hash is created and stored to smart contract of a trade.

Verifier

A separate user interface is created for catchlog verifiers. Pre-approved verifiers that have completed a KYC process with an Ethereum wallet will be granted access to check and validate stored catchlog data on document storage. Verifiers will be able browse and tag or approve individual catches on document storage whichafter verification state is updated to the relevant fish catch on both document storage and smart contract.

Smart contract

An Ethereum smart contract is used as decentralized storage for catchlog and trade data. Only whitelisted users such as fisherfolk that have completed KYC with their Ethereum wallets are able to write to smart contract. A subsets of KDE list data of catchlog and trade data are stored with a reference hash to full information at document database to smart contract. Additional metadata such as Stream id to indicate real time data stream sensory data may be added to smart contract.

Document storage

Document storage takes place in a database which is used to store trade data and key data elements from catchlog as well as additional metadata (e.g. pictures of documents). Stored data and documents are signed with fishermans Ethereum wallets keys. There is a document storage API which is accessible with Ethereum wallets keys. Read and write access to document storage is granted on the basis of Ethereum wallets keys.

Streamr platform

Streamr platform offers tools for direct data monetization, data marketplace, the backend for the transmission of real-time data (i.e. Streamr Network). Sensory devices attached to fishing vessels can be integrated to produce real time data of fishing activities to Streamr datastreams. For example third party maritime transponders such as FAME transponder can be integrated at the third party platform or at device level to produce data to Streamr streams.These data streams can be monetized on a data marketplace by using Streamr's ERC-20 token (DATAcoin) to transfer value between data seller and purchaser.

Loan provider and credit scoring

Loan provider is provided access to the relevant trade data that is required to determine credit scores for fisherfolk. With pre-approved Ethreum wallet and its related keys a loan provider can inquire from smart contract fishermans trade history and state of trades to assess bankability of a loan applicant. Additionally lender provides an API where from loan applicant can check his bankability status and submit a loan application with Tracey dApp.

Future components

There are the future information system components that aren't included in the system architecture diagram. These include different types of user interfaces, methods for viewing previously recorded data and the means to examine the smart contract. Stakeholders may need the ability to look for information or to add new metadata about the fish catch as it moves throughout the supply chain. Separate user interfaces for different supply chain stakeholders could be implemented as tools which can establish traceability of fish product from bait to plate.

Ethereum

Ethereum blockchain has been chosen for the proposed solution as it provides synergies with project stakeholders. Both Streamr DATAcoin (a utility token) and UnionBank stable

coin operate on Ethereum blockchain. By using a common platform stakeholders can use their existing solutions to provide services for Tracey.

Additionally the premise of having verified digital identities tied to blockchain wallets and being able to verify and track supply chain goods enables new types of business models. For example, the consumer of product at the end of the supply chain could tip the producer of the goods in the start of the chain for participating in delivering a great tuna steak. Having a common platform to transfer value such as ETH on Ethereum blockchain would streamline the payment process of tipping from user to producer.

Potential pain-points

As mentioned above, discussions with the Bank and WWF identified several important pain-points. These include the following:

- Lending risk / borrower appetite of the Bank and actors, respectively, as the product progresses from “bait to plate.”
- Demonstrating traceability & verification throughout the value chain, not just between the first two actors.

The lending risk

The Bank is concerned about the lending risk associated with unbanked individuals in the beginning of the value chain. Two de-risking tools have been identified to address this risk, and will be tested during the Phase 3 pilot. These tools are described below.

Security deposit

During the pilot, the Fisheries Associations (FA) in Bicol and Mindoro will be requested to stake an equal sum of money to the total amount being loaned to the fisherfolk, in their respective locations. For example, the FA in Bicol might stake PHP 125,000, which means the Bank can then lend up to PHP 125,000. The deposit will be kept in a UnionBank time deposit account, and it will be required until such a time that the fisherfolk have demonstrated a reasonable history of creditworthiness. Any defaults on loan repayments would result in deductions from the deposit. It would be the FA's responsibility to collect the unpaid monies and replenish the deposit as required. For the purposes of the pilot, if the FA are unable to provide the necessary stake, an amount may be provided from the project budget.

A vouching system

In the Philippines, a vouching system is already widely used. It involves having a third party (which can be an individual or an organisation) guarantee the loan. This may however raise issues which have already ruled out the third option below. Given that one of the core objectives of the Tracey project is to remove the need for informal borrowing from middlemen, care must be taken to in the choice of the third parties.

The deposit mechanism is not a perfect solution because a capital downpayment or guarantee would be needed. Nevertheless, it is the preferred approach as it brings several benefits and helps the transition of the fisherfolk towards creditworthiness and the eligibility for institutional finance.

Traceability

To demonstrate the full end-to-end functionality, the capabilities of the Tracey app will be enhanced to incorporate all actors in the seafood value chain. These enhancements would be included in Phase 3 Pilot (see the Roadmap section for the timeline).

Verification

Manipulation or abuse of the data recording process to optimise positive creditworthiness scores may occur in the pilot or later in Phase 3 when Tracey becomes fully commercialised. Several actions will be taken to mitigate this risk:

- WWF-Philippines and the FA will conduct periodic audits to check the authenticity of the data which is captured in the Tracey App. Since the FA will have staked money in the UnionBank time deposit account, it will be in the best interests of the FA to ensure that borrowers are recording accurate data. Peer pressure by fellow members of the fishing community should encourage honesty and good behaviour when using Tracey.
- As the product moves through the value chain, actors receiving the product will have to verify that the data recorded in Tracey by the previous actor is valid and correct. Any adjustments to the data will be captured in the blockchain. Any anomalies in the data would be highlighted within Tracey and trigger a signal that the record cannot be considered in any credit evaluation.

Roadmap

This section presents and elaborates on the proposed roadmap for the project. Figure 17 depicts the work completed (black arrows) and the work planned and yet to be done (yellow arrows).

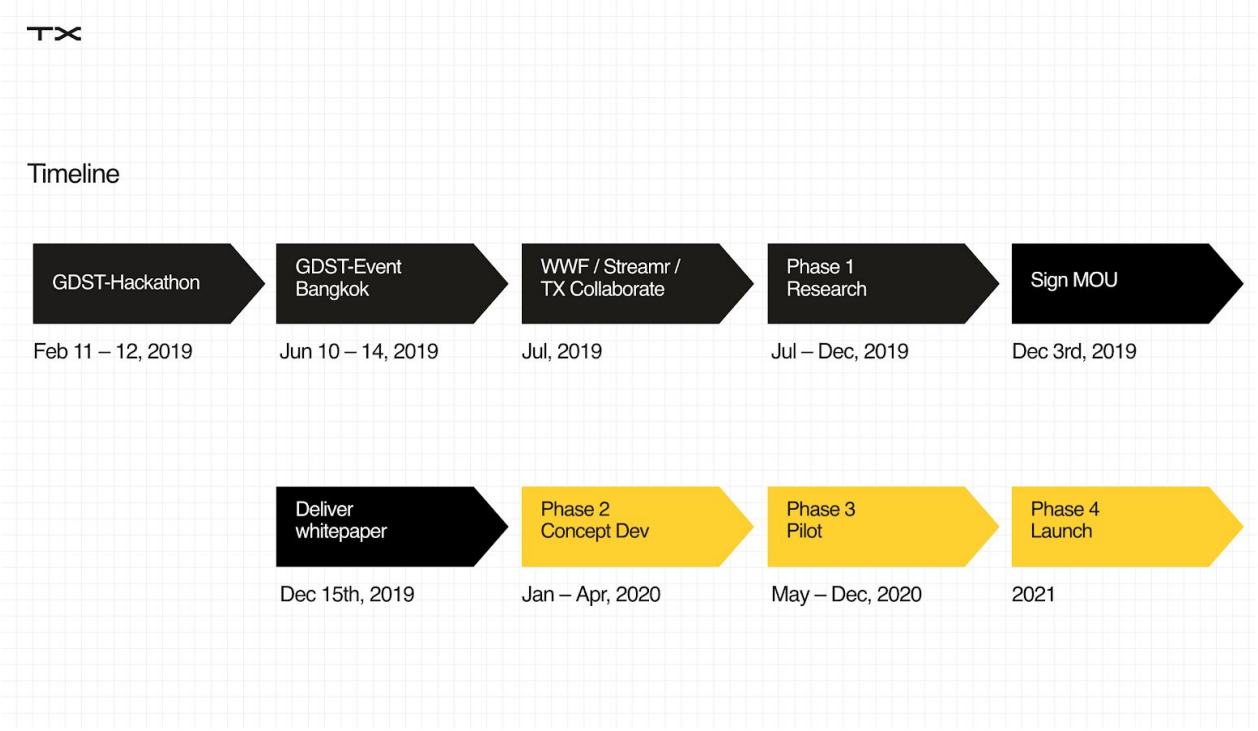

Figure 17. The Tracey project timeline

The immediate focus of the project is to test and pilot if fisherfolk in the Philippines can be incentivized to produce satisfactory traceability and trade data relating to handline yellowfin tuna fishing at the WWF Fisheries Improvement Project (FIP) sites located in Bicol and Mindoro. The data gathered by Tracey will be made available to the Bank for analysis and assessment of creditworthiness. Loans will be issued to test the full end to end solution. Described below is the work that was completed during phase 1 and the subsequent phases of work programmed.

Phase 1: White paper (completed)

Phase 1 has now been completed. The work consisted of scoping the attitudes and capabilities of fisherfolk in two different Fisheries Improvement Project (FIP) locations towards traceability, data monetisation and data collection. Designing and drafting high

level technical architecture to support the traceability data collection and monetisation. Creating an interactive UX prototype to demonstrate the workflow within Tracey. Introducing UnionBank to the project team to provide the e-wallet and KYC, lead the development of the lending components of the project and provide the physical lending during the pilot in phase 3. Producing this white paper and initial design of the pilot for Phase 3.

Phase 2: Design

This phase consists of the creation of the project delivery plan for Phase 2 and 3 as well as completing the full service design and UX design to the app and its backend.

Project Delivery Plan

Phase 2 will commence with the development of a Project Delivery Plan (PDP), which sets out the approach, main workstreams and w/stream leaders, programme, key milestones, risks, budget. The PDP will be developed in collaboration with Co-Founders through the Operational Working Group (OWG). The Executive Steering Committee (ESC) will sign off the PDP. More information is given on the role of the OWG and ESC in the Governance section of this document.

Service and UX design

The service and UX design of the Tracey app takes place with the participatory design methodology, in collaboration with the future end users of the app and its backend. The fieldwork for this is done in the Bicol and Mindoro communities selected for the pilot project. The work involves interviews, workshops and user studies with the locals, as well as preparation of design documents such as service paths, a stakeholder analysis, and wireframes and interactive prototypes of the user-interface.

The outcomes of the service design round are documents and prototypes that depict the Tracey app service process from the point of view of different stakeholder groups such as the fisher-persons, the community, the bank, WWF, buyers of the data, and all the actors along the value chain until the consumer. Compared to previous sketches of the service process in Phase 1, much more precision is required in this phase to tackle all possible situations that may be encountered in the use of the app.

The Tracey value chain will be expanded in this phase to capture all actors in the fisheries value chain. At each stage, a set of data points defined in the KDE list is used for the collection of data and its verification. The consequences that incorrect data has on creditworthiness is also defined.

The UX design documentation provides an understanding of how the Tracey app works on the level of the mobile phone and web browser interface. The design is made at this stage as a schematic (wireframe) version that lacks the final visual design. The UX design focuses on the mobile app and the fisher-person user group even though other frontends such as the bank backend will also be taken into account.

To get prepared for the MVP production phase, a roadmap is made for the app development. The scope of the MVP version is defined by listing the functionalities to be completed for the first app version to be launched.

Phase 3: MVP and the pilot

In this phase, the main activities include implementing the MVP and piloting the project at the two WWF FIP sites (Bicol and Mindoro) in the Philippines, the evaluation of the performance of the pilot, and capturing the recommendations from stakeholders prior to commercialisation in Phase 4.

MVP

MVP (Minimum Viable Product) stands for the first version of the Tracey app with all basic functionality, but possibly limited to only certain use cases and operations.

The MVP scope is defined in the previous project phase (Service and UX Design). It is suggested that the MVP production should take place in sprints of 2-4 weeks of duration. This project phase comprises the following tasks:

- Completion of the UI design including brand elements, based on the UX and service design prototype of the previous phase;
- Proof of Concept of critical technical questions (such as blockchain network architecture, use of e-wallet and stable coins, data monetisation, loan backend, etc) and how they are approached;
- A plan of the technical architecture;
- Devising the functionalities of the app in separate sprints each of which has its own limited scope and is managed as a miniature project in itself;
- QA testing to verify that the MVP version fulfills the requirements; and
- Backlog and a roadmap for further functionalities that are out of the scope of the MVP.

The final QA testing of the MVP version will take place in collaboration with the different end users (fisher-persons, bank officers etc.), with the aim to detect any erroneous assumptions made in the previous phase of user studies, or UX or service design issues that have arisen during the MVP implementation phase. Based on the QA and user testing round results, it is possible to make small improvements to the MVP (mainly on the UI/UX level) but larger changes are to be added to the backlog and implemented after the pilot phase.

The pilot

The pilot is envisaged to take place over a period of at least six months. It will begin with a mobilisation activity where WWF & TX will lead community engagement activities to onboard the fisherfolk to Tracey, QR code tagging, create e-wallets and undertake KYC. Training will be given on how to use the technology and the WWF local staff will be fully versed in the functionality of the App so they can hand-hold the fisherfolk through the process. We fully anticipate accidental misuse and errors logged in the early stages. This is a new technology for many individuals to become acquainted with. Therefore TX and WWF will have people on site for the first few weeks guiding people on how to use Tracey.

Six months should provide a reasonable amount of time for loans to be issued and repaid, which will test the full end-to-end functionality of Tracey. However, six months is not sufficient time to build up a respectable amount of data for ascertaining creditworthiness. Therefore to accelerate the process, WWF will provide historical data from the last two years of fishing activities at the two FIP sites. The Bank will be able to use this data to build their own data model for assessing an individual's credit worthiness. A maximum budget of PHP 250,000 will be set aside by the Bank for lending purposes.

As mentioned in the “Proposed solution” section, we will also test both the security deposit and vouching systems during the pilot. This will help us to evaluate the robustness of the de-risking tools in a live environment.

Evaluation and recommendations

At the beginning of Phase 3 during the planning activities, criteria will be agreed for measuring the success of the pilot and understanding what additional functionality might be needed prior to commercialization in Phase 4. These measures will take into consideration but are not limited to the following factors:

- Validity and reliability of data captured
- Functionality and usability of Tracey
- Creditworthiness and reliability of users

- ROI on loans issues - Cost Benefit Analysis (CBA)
- Usefulness of de-risking tools
- Adaptability and scalability

Phase 4: The launch and the commercialisation

Various options are currently being considered for the commercialisation of the Tracey App. This section will be completed in version 2.0 of the White Paper, at the end of Phase 2.

Phase 5: Roll out

After the technology has proven to be successful in the Philippines with UnionBank, the aim would be to provide access to other banks in the Philippines, and then expand the offering globally. WWF-Philippines is keen to see Tracey deployed as the preferred application for traceability data capture. Therefore the likely strategy for scaling internationally, would be to initially focus on locations where WWF has an existing presence on the ground with its FIP sites and can provide a similar type of support as they are giving to this project in the Philippines, through their local network of relationships.

Conclusion

This whitepaper looks at the wicked problem of how to incentivize fisherfolk to produce traceability and trade data. We have identified hypotheses that fisherfolk are able and willing to produce traceability and trade data if they are incentivized to do so. We've confirmed the hypothesis through a field survey and collected supporting information that can be used when designing a practical solution.

Survey results, a suggested solution (Tracey) and a project roadmap have been presented on this paper. We see that there's a need for a technical solution that enables the fisherfolk to digitize their catchlog data and monetize the trade and traceability data they produce. A technical solution would involve co-operation by multiple stakeholders but would also bring benefits to all of them, e.g. by opening new lending markets for financial institutions and enabling the collection of high quality traceability data for local government units and NGOs.

We recommend to pursue the next phase of designing Tracey and to pilot the solution as a way of gaining more knowledge of the feasibility of incentivizing fisherfolk to produce the desired data. In future phases we recommend to expand Tracey functionality to support all actors in the supply chain up until point of export. Work with BFAR to ensure domestic compliance of KDEs and usability of the information. During piloting, test option of lending to fisheries association as opposed to directly to the fishers to further de-risk the lending process. Identify international partner that could receive data from Tracey when purchasing fish and work with WWF-Philippines to develop commercial model and market penetration strategy with FIP schemes around Asia Pacific.

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Annexes

Annex A

WWF Philippines: “Change on the water. Incentivizing Fisherfolk through microloans.”

Annex B: Survey questions

Traceability

1. What data do you collect when a fish is caught? (show KDE List)

2. How is this data logged? Paper based? E log?

3. Who receives this data?

4. What concerns would you have about sharing this data?

5. Would you share your catch data if you were compensated for it?

Strongly Agree - Strongly Disagree

6. When are the peak and off peak fishing seasons? How long do they last?

Technology

7. I own a mobile phone
Yes / No

8. If yes:

What type of phone

__ Smartphone

__ Featurephone

9. Make and model of the phone
__

10. I have access to internet
Yes / No

11. If yes:

I use following devices to access Internet

__ PC

__ Tablet

__ Mobile phone

__ Other (what?)

Borrowing

12. What's your average monthly income?

13. Do you frequently need to borrow money? If so how much?

14. What do you use the loan for?

15. How do you stabilise income during off peak fishing seasons?

16. Do you have a bank account? Which bank?

17. Who do you borrow from? What is the payment back period and interest rate?

18. Do you have to give collateral when borrowing? What type of collateral?

19. What existing borrowing platforms exist? Do you use them?