



M-fisheries prototype: Innovating towards evidence-based planning and decision-making in marine fisheries management

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Abstract

Kenya's marine fisheries sector has the potential for increased growth. However, fisheries managers in Kenya currently face the challenge of poor, missing or aggregated catch data. This paper explores Information and Communication Technology (ICT)-based solutions in the fisheries sector. The study adopts exploratory research design. It reports a review and analysis of two ICT-based solutions in the fisheries sector, conducted in the year 2020. From the analysis, the study proposes the development of M-Fisheries Prototype, as an answer to the challenges of the two reviewed solutions. The prototype introduces an SMS/USSD app for data collection. The SMS/USSD app aligns to the mobile-rich but internet-poor context of the fish landing sites, as it addresses the challenges of the other mobile-based systems that only require the use of smartphones. These challenges include infrastructural accessibility, technical usability and internet data costs.

Keywords: M-Fisheries; Fisheries Management; Blue Economy; ICT4D; ICT4Fisheries

1. Introduction

One of the key renewable resources in the Western Indian Ocean (WIO) region is fisheries. Capture fisheries provide about 80% of the total income, of 70% of Kenya's coastal communities (Malleret-King et al., 2003). Over 80% of production in the marine fisheries in Kenya is by small-scale artisanal fishers, while the rest (20%) is landed by industrial and semi-industrial fishers. There are 197 fish landing sites along Kenya's coast, with the fishing capacity constituting about 3,000 small-scale fishing crafts and over 13,000 fishers (Government of Kenya, 2016). The small fishing crafts are dominated by wooden dugout canoes, dhows (mashua) and out riggers, of which less than 10% is motorised (Kimani et al., 2018).

1.1. Statement of the Problem

Kenya's fisheries sector has the potential for increased production, particularly in the marine fisheries. For the purposes of development planning and to support the sustainable management of fisheries, timely data and information on the status of fishery stocks and associated ecosystems is critical. Consistent data collection is however considered challenging due to limited resources, which affects the certainty of stock assessments (Kimani et al., 2018).

UNDP (2018) and Okemwa et al., (2018), recommend the implementation of multidisciplinary research to solve the need for evidence-based decision making in the fisheries sector. Kimani et al (2018b) also recommend the need to promote a consistent catch monitoring program for small-scale prawn fishery in collaboration with county governments and Beach Management Units (BMUs) to provide the data to assess the status of the stock. This could also be scaled to

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cover the whole marine fisheries. BMUs consist of fishers, fish traders, boat owners, fish processors and other beach stakeholders.

Currently, catch data in Kenya is generally poor or missing from the national evaluations (Kimani et al., 2018). Therefore, development of an integrated system for the collection of accurate fisheries landings data, as well as market and socioeconomic information, is recommended, to facilitate accurate determination of the value of the sector, including trade, value addition and contribution to national food security and national economy. They further recommend that, within fisheries management plans, there should be mechanisms to involve the fishers, including BMUs in data collection and surveillance at sea to promote voluntary compliance.

The challenge of poor or missing catch data is further confirmed by results from our preliminary interviews with the fisheries managers (directors of fisheries departments at the county governments of Mombasa and Kilifi, an officer from the Kenya Fisheries Service (KeFS) and BMU officials from Mtwapa BMU in Kilifi County). The fisheries managers are in dire need of data analytics to inform their planning and interventions towards the sector.

Objective of the Study

The goal of this study was to explore Information and Communication Technology (ICT)-based solutions in the fisheries sector. The aim was to draw lessons and inspiration with the specific objective of proposing the development of an ICT-based prototype for collecting and reporting marine artisanal landings and related data.

Justification

The resultant prototype was envisioned to contribute towards strengthening of monitoring and control systems. This was in line with fisheries development management in the agricultural sector of the economic pillar of Kenya's Vision 2030. Proper evidence-based planning and decision making in marine fisheries management would contribute towards achieving food security and nutrition

2. Methodology

This study adopted the exploratory research design. This paper reports the review and analysis that was conducted on two select ICT-based solutions in the fisheries sector. The aim was to have an in-depth review of solutions while drawing lessons and insights on what worked and what needed improvement. This was to lead towards the development of an ICT-based prototype for collecting and reporting marine artisanal landings and related data. This paper was part of a broader study and empirical data was not collected and analysed at that stage.

3. Results

Information and Communication Technologies (ICTs) have been used across the global fisheries sector for different purposes. Applications such as Global Positioning System (GPS) have been used for navigation and location finding, mobiles for trading, information exchange and emergencies, radio programming with fishing communities and web-based information and network resources.

3.1. ABALOBI

ABALOBI is a mobile app suite that includes electronic catch documentation and traceability platform, a marketplace for sea food and a digital transactional system (ABALOBI, 2020). In 2015, ABALOBI started co-designing technology with small scale fishers, seeking approaches for fishers to collect reliable data, and to benefit from the use of such data in terms of improved accounting and fisheries management. In 2017, they built the first prototype. The platform facilitates electronic payments directly to the fishers, with full transparency on the returns they receive.

Despite ABALOBI's successes thus far, it has experienced the following challenges in **smartphone penetration**, **technology uptake** and **internet data costs**:

- ABALOBI app only works on smartphones. It therefore leaves out a majority of fishers who do not own a smartphone, but just basic feature phones.
- Despite ABALOBI app being free for download, some fishers still struggled to use it because most of the fishers had limited exposure to ICTs and smartphone usage.

- The working of the ABALOBI app fully depends on the internet. The cost of internet data was a challenge for the individuals, therefore, logging of data came with a price which was significant for some of the fishers.

3.2. Enhanced Fish Market Information Service (EFMIS)

The Kenya Marine and Fisheries Research Institute (KMFRI) developed Enhanced Fish Market Information Service (EFMIS). EFMIS was an ICT pilot project based on the mobile phone and implemented in Lake Victoria fisheries from 2009 to 2013. The objective of the project was to enhance fish trade and incomes for fisher communities through improved access to market information through a convenient, fast and cheap media (Abila et al., 2013).

The data would be recorded once or twice a day at the fish landing sites and inland markets, and relayed to the data centre via Short Messaging Service (SMS). The data would be manually retrieved by six KMFRI personnel and then populated into a Microsoft Excel sheet, indicating the market name, time, date, fish species, quantity landed, price, number of trucks and weather information (dry or wet). Users would then access the information by sending a query using SMS and get an automatic reply. The market information would also be disseminated through monthly electronic bulletin to stakeholders. From our preliminary interview with the Head of ICT at KMFRI, EFMIS is not currently in service.

In light of the management challenges that our project seeks to address, EFMIS exhibits the following gaps:

- Human intervention is still needed at the data centre, to populate the SMS data onto MS Excel sheet. This second level data entry could introduce errors to the data.
- The MS Excel sheet is not accessible to the various stakeholders.
- The data captured is not comprehensive enough to inform varied management decisions. It would be useful to couple the catch data to specific fishers or traders and have additional data points such as type of vessel, type of fishing net etc.
- A uniform monthly bulletin would not be equally useful to all stakeholders (fisheries managers, BMU officials, BMU members, researchers, donors and other stakeholders), because, they are interested in different data points and would therefore require different presentation of reports.

4. Discussion

4.1. M-Fisheries Prototype

The proposed innovation is the 'M-Fisheries Prototype', an ICT-based prototype that integrates three technologies (SMS app, Unstructured Supplementary Service Data [USSD] app, and Web app). The prototype seeks to address the challenge of inconsistent collection of catch data and poor, missing or inaccurate fisheries landings data, so as to empower marine fisheries managers and other stakeholders to conduct evidence-based planning and decision making. It will significantly improve the current state-of-the-art implementations of ICTs (for example ABALOBI and EFMIS) that are trying to address similar challenges in the marine fisheries sector, by addressing their gaps.

The SMS and USSD apps will be used by the BMU members (fishers, fish traders, BMU agents at the landing sites) to keep daily logs of the artisanal landings and related data (e.g. fish species, quantity landed). They will enter the logs during landing at the landing sites, with the prototype automatically capturing the time of landing using the message delivery time. Based on their registration number at the BMU, the catch data will automatically be linked to their bio data, fishing gear, vessel data, landing location etc. The SMS and USSD apps will be available in both English and Swahili (the predominant language used by the BMU members at the Kenya coast).

We propose the BMU-facing components of the prototype to use the SMS and USSD technologies because these technologies are a solution to the constraints facing BMU members (**limited smartphone penetration, limited exposure to smartphone usage, high costs of internet data, delicate nature of smartphones within the landing site environment and limited coverage of 3G and 4G networks within landing sites**). These technologies are supported by any basic mobile phone, which majority of the BMU members already own, and know how to use.

The SMS and USSD technologies can also allow transfer of the cost of the messages from the BMU members to the marine fisheries managers. This can encourage usage of the prototype because there will be no costs to the BMU members. The technologies are also an affordable way for fisheries managers to continuously collect catch landing data since only the messages are charged.

The web app will be available for use mainly by the marine fisheries managers and other stakeholders, for presentation of real-time analytics and visualisations of marine catch and related data. As the BMU members enter their daily catch logs, the same information will automatically be available to the web app, in real-time. The web app will also enable trend analysis and any other customised user-defined reports to be generated by the users (marine fisheries managers and other stakeholders), based on available data.

The web app is proposed for use by the marine fisheries managers because they offer more functionalities (ability to provide real-time analytics and visualisations) compared to the SMS and USSD technologies. The marine fisheries managers are also not constrained with similar challenges (smartphone penetration, technology uptake and internet costs) as the BMU members. Figure 1 shows a graphical representation of how the different users will interact with the M-fisheries prototype, including the expected outcomes and impact. This is our conceptualisation of the different components of the prototype.

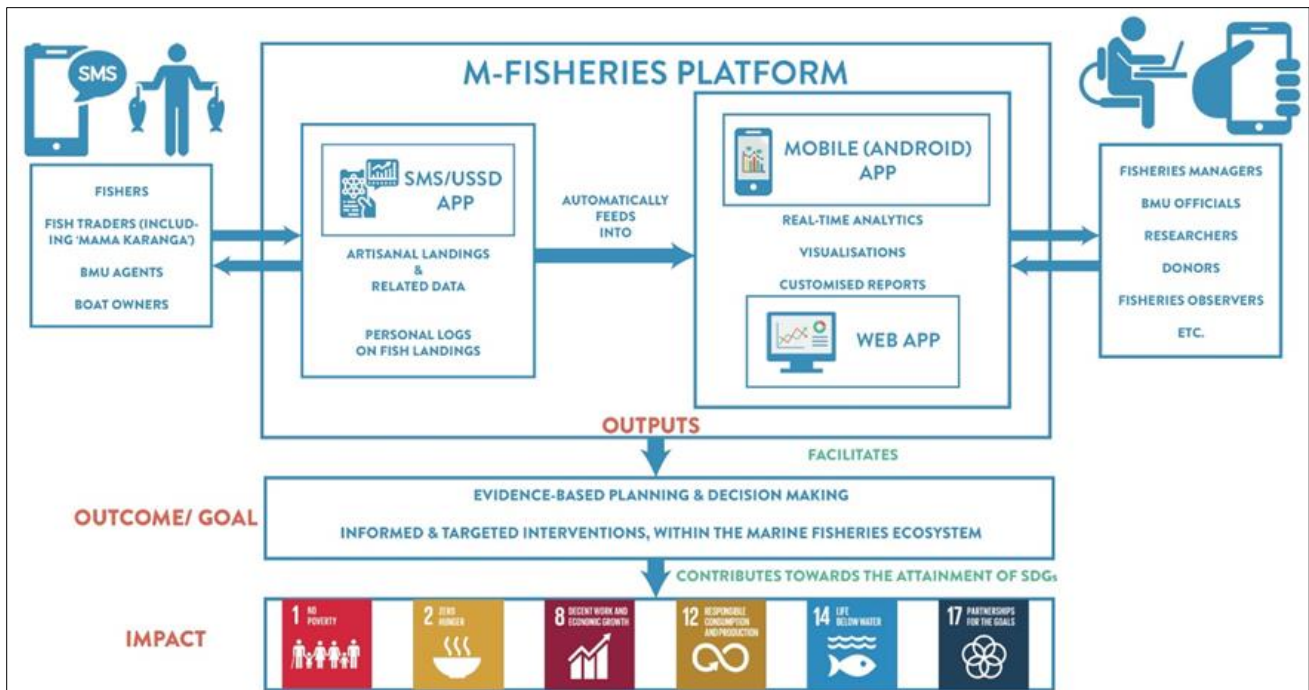


Figure 1 Graphical representation of how different users interact with the prototype

4.1.1. How M-Fisheries Prototype will address the Identified Needs/Challenges

Marine fisheries managers in Kenya currently face the challenge of poor or missing catch data. Collection of accurate fisheries landings data and stock assessments is challenging due to limited resources (Kimani et al., 2018). Marine fisheries managers critically need timely data and information on the status of fishery stocks and associated ecosystems, for purposes of evidence-based decision making, development planning and support of the sustainable management of the sector (UNDP 2018; Okemwa et al., 2018).

The SMS and USSD apps will address the challenge of collecting catch landings data. All the fishers within BMUs will individually log their daily catch data via SMS or USSD, thus addressing the challenge of poor or missing data. The apps will also provide affordable data collection costs unlike employing data enumerators at the landing sites, because the only cost incurred will be the daily message costs, which will be borne by the fisheries managers. Accuracy and reliability of the catch data will be addressed through triangulating the data logged in by the individual fishers and those logged in by the BMU officials at the landing sites.

The web app will address the timely examination, identification and discovery of trends and patterns inherent in the catch data that were collected using the SMS and USSD apps. The web app will present the data in visual form using charts and graphs, making explicit the trends, patterns and maps in the data. This representation will provide useful insights to help marine fisheries managers to understand the magnitude of the data in order to draw conclusions. The insights and conclusions will aid the managers in making evidence-based decisions and development plans.

4.1.2. How M-Fisheries Prototype Improves the Nearest State-of-the-Art

The SMS and USSD apps address the challenges faced by ABALOBI, involving strict usage of a smartphone for collection of catch data by the fisher community, in the following ways:

- Unlike ABALOBI, the apps will be supported by any basic standard phone, which is what majority of the BMU members own.
- The basic standard phones are also hardy and more suitable for the landing site environment, compared to smartphones. They are not sensitive to touch and are still functional even with wet or sandy fingers. The basic standard phones also keep electricity charge for longer, compared to smartphones, therefore they are more ideal in the landing sites, majority of which do not have connectivity to the electricity grid.
- Majority of the landing sites are not covered by 3G or 4G network needed by the smartphone and Android app. However, they still have 2G connectivity which works well for the SMS and USSD technology and the basic standard phone.
- The SMS and USSD apps do not require internet data costs. Irrespective of who uses the apps, the technologies allow the costs to be transferred to the other party. Therefore, the costs could be borne by the marine fisheries managers or development partners as opposed to the fisher community, thereby increasing the uptake of the apps.
- The SMS and USSD technologies are similar to those used for mobile money. Most Kenyans are familiar with how the technologies works, largely because of their usage of MPESA. This will address the challenge of limited exposure to ICTs and smartphones by the fisher community

On the other hand, the web app addresses the challenges posed by EFMS and related systems in the following ways.

- They eliminate human intervention after catch data has been entered by the SMS and USSD apps.
- They are more accessible in an open data portal, where different stakeholders are able to plug in, as opposed to an inaccessible MS Excel sheet.
- They allow different users to generate customised trend analysis and reports, which are more useful. They also allow access to real-time analytics and visualisations which are beneficial during evidenced-based planning and decision making.

5. Conclusion

From the review and findings of this study, the proposed M-Fisheries Prototype has the potential to demonstrate how to address the challenge of poor or missing catch data. It will do this by empowering individual fishers to keep logs of their daily catch landings in an affordable, reliable and user-friendly manner. It is also envisioned to demonstrate how marine fisheries managers could address their need for timely examination and analysis of catch data. It will present the data in visual form using charts, graphs and maps, making explicit the trends and patterns in the data. These insights will help the managers in making informed, evidence-based decisions, development plans and management policies, which will lead to better managed marine fisheries resources in the short and long term.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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