Efficient Inland Fisheries Data Collection Made Easy: the DACOFA Way

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The role of inland capture fisheries in ensuring adequate nutrient supplies and food security could not be surmised, especially that information on the actual contribution of inland fisheries to the socio-economic development of many countries is unfortunately not readily available. Inland fisheries activities are notably small-scale, making it difficult to compile the relevant data, much more their continuous production trend which is necessary for stock assessment. At times when such data is available, the information tends to be scattered, ending up with data that are not useful and scientifically, could not be utilized. As a result, evaluating the importance and value of inland fisheries remains one of the biggest challenges for its development, since the data available is not sufficient enough for any analysis. The SEAFDEC Inland Fishery Resources Development and Management Department (SEAFDEC/IFRDMD) therefore, takes on an important responsibility not only of collecting existing data on inland fisheries production but also in addressing the gaps in information collection and the research needs related to fish stocks in inland waters. Although, an increasing number of databases support the development of indicators for data collection about the inland fisheries sub-sector, choosing the appropriate management option that is applicable for the Southeast Asian region should be taken into consideration. Therefore, alternative approaches on data collection are necessary to improve the situation. As means of promoting an effective system of data collection on inland fisheries, SEAFDEC/IFRDMD introduced the web-based mobile application which is envisioned to be capable of efficiently collecting the data on inland capture fisheries in the Southeast Asian region. This application is known as DACOFA, which is short for "Data Collection for Fishery Activities."

For many countries around the world, inland fisheries are important for poverty alleviation, food security, gender empowerment, cultural services, ecosystem functions, and biodiversity (Funge-Smith & Benneth, 2019), and also for the well-being of their peoples, rural community livelihoods, and national economies (UNEP, 2010; Cooke *et al*., 2016). More often than not, the importance of inland fisheries is either not quantified or is undervalued, and as a result, inland fisheries are largely overlooked in policy discussions. Globally, the sustainable development agenda have in fact, focused mainly on the marine environment (FAO, 2018). In the Southeast Asian countries, the role of inland fisheries is not only for enhancing the peoples' livelihoods but also increasingly in providing recreational services, biodiversity conservation, and eco-tourism, as what is the trend nowadays. Therefore,

in order to demonstrate the importance of the inland fisheries sub-sector, it is necessary that monitoring of the production and management is improved in order to demonstrate the increasing contribution of the sub-sector to food security which has recently become a major global concern (Suuronen & Bartley, 2014).

The future of inland fisheries development is linked with the successful management of the wide inland resources such as rivers, swamps, lakes, and other wetlands (UNEP, 2010), making it crucial to ensure that management of the inland fisheries is placed on a larger environmental and socio-economic scale. Considering that data and information are the basis for proper management, these should be properly monitored and collected. It is common in tropical watersheds that fish landings could go completely unreported and the amount of catch is oftentimes estimated from unreliable information sources, clearly contributing to the severely incorrect production data from inland capture fisheries. In many cases, the amount of catch reported is only an underestimation because the fisheries production from many small tributaries and water bodies is generally overlooked (Vehanen *et al*., 2020).

Data Collection on Inland Fisheries: issues and concerns

Aside from being small-scale, activities in inland fisheries are highly seasonal with their highest peak taking place during flood receding periods or at the end of the rainy season. These features should be considered when collecting the data and analyzing the production statistics on inland capture fisheries. As a matter of fact, these factors must have been overlooked resulting in the inadequacy or incompleteness or untimely statistics data and production trend from inland capture fisheries. Furthermore, the inland fisheries sub-sector has been given better attention only very recently compared to the practice in the past when more importance was put on the marine fisheries sub-sector.

Catch statistics and related information on fisheries are some of the fundamental data that could provide a better picture of the present situation of the fisheries as well as that of the condition of the fishery resources. Such data are useful for the decision-makers in establishing the most appropriate fisheries management policies and measures towards achieving the sustainability of the fisheries.

For many Southeast Asian countries, the importance of catch statistics from inland capture fisheries is not well understood and less evaluated, which could be because such data are fragmented and discontinuous, contributing to the alarming bleak condition of the overall status of the region's small-scale fisheries. In fact, the majority of inland fishing activities are not licensed, operated at a semi-commercial or subsistence level, and are widely dispersed along the numerous inland water bodies (FAO, 2010). Moreover, the numbers of fishers are large as these include the occasional fishers, and vary significantly during the different seasons, resulting in inconsistencies of information in terms of the catch size and composition, and types of gears used, among others. Furthermore, as the catch usually comprise multi-species of fish that go immediately to various market channels, information on the catch is not properly recorded (Muthmainnah *et al.*, 2019) as there are no centralized landing ports or major markets where data could be easily collected. Oftentimes, the catches are purchased on the spot or bartered locally by buyers or in most cases these are brought directly by fishers to the local markets. Also, large portions of the catch are brought home by fishers for household consumption and for traditional post-harvest processing into fermented and salted fish for direct consumption.

Development of DACOFA

Recognizing the urgent need to gather valuable data and information on inland fisheries from each ASEAN Member State (AMS) to understand the real situation of the region's inland fisheries, and to identify the key issues that hinder the sustainable development of the region's inland fisheries, SEAFDEC/IFRDMD has been considering all possible approaches for the efficient and effective system of collecting data from inland capture fisheries. This resulted in the development of an application-based system on Android mobile phones that had been established mainly for collecting data on inland capture fisheries in the Southeast Asian region. SEAFDEC/IFRDMD considered the use of mobile phones with Android operating system for convenience and ease in running the application, and for the affordability of these types of mobile phones.

The development of the data collection application, which is known as the system of Data Collection for Fishery Activities or DACOFA, started in 2019 and was timely launched on 27 January 2020 during the inauguration of the SEAFDEC/IFRDMD Building by the Minister of Ministry of Marine Affairs and Fisheries (MMAF) of the Republic of Indonesia, *Dr. Edhy Prabowo*. One of the main advantages of this data collection application is the possibility of gathering data while the enumerators are on-the-go or in locations where Internet connection is unreliable. Offline forms would allow the fishers to store a backup of their data on their mobile devices and upload the data once an Internet connection is available, and automatically, the data will be recorded on the IFRDMD Database.

Overview of the Implications of DACOFA

At the onset, SEAFDEC/IFRDMD recognized that achieving the sustainable utilization of the inland fishery resources should be addressed first before considering the several concrete management measures. Therefore, it has become necessary to understand the various aspects of inland capture fisheries in the region, which also requires massive capacity building of the stakeholders in inland waters. In addition, it had also become necessary to identify the critical issues regarding the fish stocks in order to achieve the sustainable use of the freshwater fishery resources. Thus, mapping of the historical research activities and its findings had been carried out through desk studies, and the information compiled would serve as baseline data that could be used to fill the gap between achieving a science-based water resource healthy index that could be used in improving any conceptual fisheries management plan.

Therefore, data collection which entails the gathering of relevant and accurate data using the simplest way possible had been considered of utmost importance. In fact, collection of field data is the root or the primary step of the entire field management process. In addition, DACOFA which has been developed as a method of collecting data with software application or web-based application could receive real-time information and data, which could be accessed by the SEAFDEC/IFRDMD staff from their respective offices. By using this mobile application compared to paper-based forms, the number of data to be collected could be greatly increased, giving option for the data collectors to best suit the purposes. Nonetheless, before using this application, the users should be trained on the best practices for the data collection on how to successfully capture such information from remote
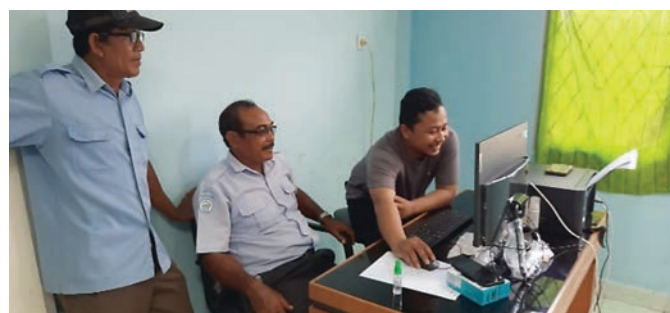

Figure 1. Training of data collectors conducted by staff from IFRDMD Data Center

areas. In this regard, the staff from the Data Center as well as researchers from SEAFDEC/IFRDMD had been conducting such training courses (**Figure 1**).

Figure 2. Trainees assisted by IFRDMD staff, making use of their android mobile phones installed with DACOFA application, for inputting fisheries activities data from Patratani Village, South Sumatra, Indonesia

Since July 2020, SEAFDEC/IFRDMD has pilot-tested the use DACOFA in collecting data on inland capture fisheries from Patratani Village, South Sumatra, Indonesia. The DACOFA Application had been installed on the smartphone devices of the enumerators (**Figure 2**). Subsequently, the application could already be accessed from the Google Play Store.

The DACOFA Application Menu

After the application is installed on smartphones, the enumerators or data collectors can choose the language options at top right of **Figure 3a**: there are two language options, *i.e.* Bahasa (IND) and English (ENG). Then input the USER NAME and PASSWORD that has been given by the administrator, and then click the "SIGN IN" option. After clicking "SIGN IN", there are four option components: VIEW DATA, INSERT DATA, PRIVACY POLICY, and the back-red icon" (**Figure 3b**).

The information of each option comprises the following:
1. VIEW DATA: This function will show all the data that have been saved or inputted into the system
2. INSERT DATA: This function will show the form for collecting the data
3. PRIVACY POLICY: This function will show the explanation about this application
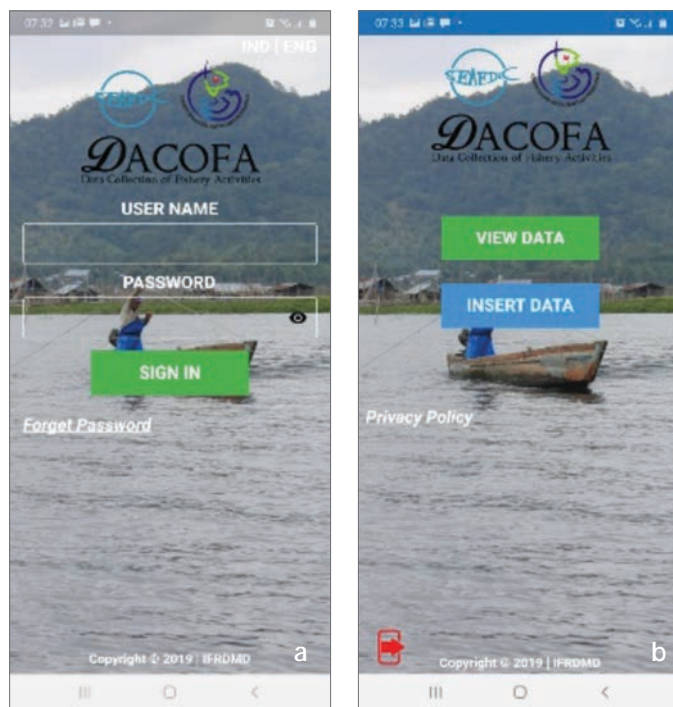
Figure 3. The DACOFA application menu:
a. Language options; b. Main page

4. Back-red icon: This function will show the notification to exit from this application

To input data by the enumerator, in this case, called the USER, the procedure below should be followed:
1. Push the "INSERT DATA" option. Then, the screen will show the form which contains: date, fishing gear, others, mesh size, units of fishing gear, country, province, district, location and operation type (**Figure 4**)

Figure 4. Inputting data on the DACOFA application menu
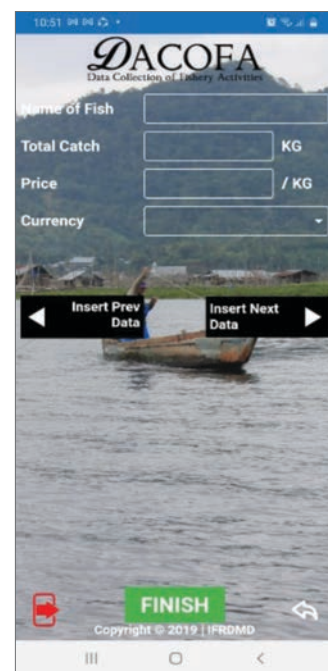
Figure 5. Information on price of fish on DACOFA

2. Fill up the data form completely
3. "OTHER" options: if there is no explanation or information, please input the punctuation hyphen "-".
4. Choose "OK" button after inputting of data is completed, and the screen will go to next page which contains the information on name of fish, total catch, price of the fish, kind of currency, and the button for looking for the previous data or the next data
5. Fill up the data form completely; and if there is no information on the fish price, please input the number zero "0" (**Figure 5**).
6. Choose the "INSERT NEXT DATA" button if the user wishes to input another information
7. Choose the "FINISH" button after completing the inputting of data
8. Lastly, user will be shown to the main page after choosing the "FINISH" option

After inputting the data, comes the validation of the data. The procedure for validating the data in the DACOFA application is as follows:
1. Choose the "VIEW DATA" on the main page
2. The inputted fishery data will appear based on date of entry (**Figure 6**).
3. Three options are available: "EDIT", "DELETE, and "VALIDATE". If there are no revisions or data cancelations, please click "VALIDATE" (**Figure 7**), and finally, the data will be saved in the SEAFDEC/IFRDMD Database.

Challenges in the Application of DACOFA

During the trial and pilot testing of DACOFA, some challenges had been encountered while collecting data using the smartphones. Considering that the operation of DACOFA application makes use of a smartphone and is dependent on an Internet link, the stability of Internet links and facilities in the desired area should be established.

Nowadays, the use of smartphones for communication is prevalent even in developing countries. The growth in smartphone usage even in some of the poorest and most remote communities has allowed for the application of new innovations. However, the personal ability of stakeholders to input the data also determines the success of any data collection. Generally, fishers engaged in inland fisheries come from the marginal communities and mostly received inadequate education. As mentioned by Pauly (1990), fishers are often presented or perceived as the "poorest of the poor," and their poverty is viewed as a consequence of their being over-dependent on fisheries and consequently overexploiting their own resources. In this regard, SEAFDEC/IFRDMD has been supporting and training the stakeholders on the implementation of an up-to-date technology to enable the fishers to improve their skills in data collection, and be able
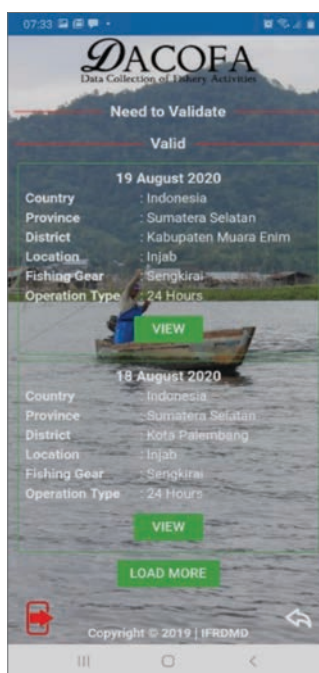

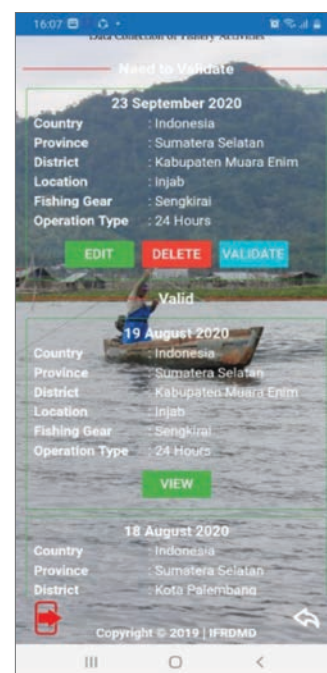**Figure 6**. Data displayed on DACOFA menu

Figure 7. The data shown on screen before being saved in the IFRDMD Database

to report the desired information properly since the current paper-based reporting systems are also not practical and sustainable.

Way Forward

Data in research is always bound, and that it should be reusable, searchable, and accessible. Therefore, such data should be collected and stored securely. Mobile data collection has been recognized as the best choice for efficiently reaching any research objectives. Furthermore, these mobile data collection applications' efficiently opens a chance for adaptive work-time, especially in the new-normal period after the pandemic crisis. The enumerators could enter the data with care and continue performing faster data analysis. This application is also suitable for monitoring the overexploited fish commodities, especially those not properly recorded. This way, the unsustainable utilization of such fish commodities could be addressed.

Acknowledgement

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