Fisheries Research Using Digital Tablets in Myanmar

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Abstract

The present paper introduces a new method for data gathering using digital tablets in the field. The method is part of a fisheries study aimed at identifying migration patterns and breeding sites of key commercial fish species in Myanmar. The research is based on systematic and structured gathering of local knowledge along a 1,000 km long segment of the Ayeyarwady River, from the southern Delta to the northern Central Dry Zone. Digital tablets are used to convert local indigenous knowledge into data. The system developed includes two modules: i) Android-based tablets with digital questionnaires for data collection on the field, and ii) a Back Office application for questionnaire management and data compilation. The tool allows data collected from different tablets to be uploaded through a ftp server and combined into a single matrix ready for analysis. In addition, the survey software can be updated in real time on the individual tablets. The system bi-passes the time-consuming manual data entry process, data become available for analysis immediately after the last survey, and the cost is similar or lower than that of manual data entry. Time- and cost-efficiency along with road-tested reliability makes this approach an effective one for field research in developing countries where there is good telephone network coverage.

Keywords: digital tablet, Android application, remote data entry, database systems, field research, fisheries management, natural resources.

Introduction

The ACIAR-funded project *"Improving Research and Development of Myanmar's Inland and Coastal Fisheries"* (short name: MYFish) aims at building the capacity of Department of Fisheries in Research and Development, characterizing the fisheries sector and identifying new approaches to increase productivity, efficiency, sustainability and equity in the Myanmar fisheries. The Fish Migration study is one of the studies facilitated under MYFish. The migratory Hilsa fish (*Tenualosa ilisha*) is a major resource in the Gulf of Bengal and the stock of this species is shared between multiple countries. This anadromous species breeds inland, where it ascends up to 1,200km up rivers for spawning (Karamchandi, 2012). Identifying breeding sites and main inland migration routes in each country in order to implement

adequate management measures is critical for the sustainability of the resource. The Fish Migration study undertook the identification of Hilsa main spawning grounds in the Ayeyarwady Delta and along the Ayeyarwady River. The extent of its migration is studied through a systematic and structured gathering of local knowledge, using a questionnaire-based approach developed and tested in the Mekong (Baird 2007). Qualitative and semi-quantitative data gathering in Myanmar relied so far on paper-based questionnaires, with data subsequently entered manually in a computer database. Such method inconveniently requires a lot of time, is costly in labor and the duplication of operators increases the probability of errors in the final database (Marsh, 2005). However, recent progress in digital technologies has paved the way for more efficient approaches in recording data. The health sector was the first one using digital assistants, pen tablets and handheld computers (Spain *et al.* 2001; Green 2001, Main *et al.* 2004). Later on the marketing sector revolutionized the use of portable digital devices and initiated its conceptualization (Pace & Staton 2005; Wells *et al.*2013); nowadays digital tablets are also used in environmental sciences in developed countries (Peppard *et al.*2004; Gutowsky *et al.* 2013).

In the present paper we introduce a tablet-based application developed for scientific surveys and implemented by the Department of Fisheries (DoF) in Myanmar. The method has proven its comparative advantages: its time- and cost-efficiency and its road-tested reliability allowed Government fisheries research teams to save time and money while improving data consistency at the same time. The benefits of using this technology, already emphasized by the Asian Development Bank with reference to socioeconomics studies (ADB 2013) have been confirmed in the Myanmar context characterized by a quickly expanding mobile phone network.

Material and Methods

As part of the study of fish migrations along the Ayeyarwady River, a questionnaire was developed to survey local fishermen communities and capture their knowledge for a better understanding of Hilsa migration patterns and reproduction sites. The comprehensive survey was developed to collect biological information on Hilsa as well as 30 other target fish species of commercial interest. It included i) an identification by the interviewees of migratory fish species present in their location, and ii) questions about ecological parameters such as seasonal occurrence, seasonal size of catches or breeding areas, for each target species. The questionnaire was used with 160 fishermen in 32 different locations in the delta and along a 1000km long river segment.

A particular feature of this questionnaire is that it is in digital format: DoF surveyors used digital tablets on the field to ask questions, record answers and send data to a remote server. Thus, the digital survey system includes two modules: i) a tablet-based questionnaire, and ii) a Back Office application for questionnaire management and compilation of answers gathered. Each of those components is described below.
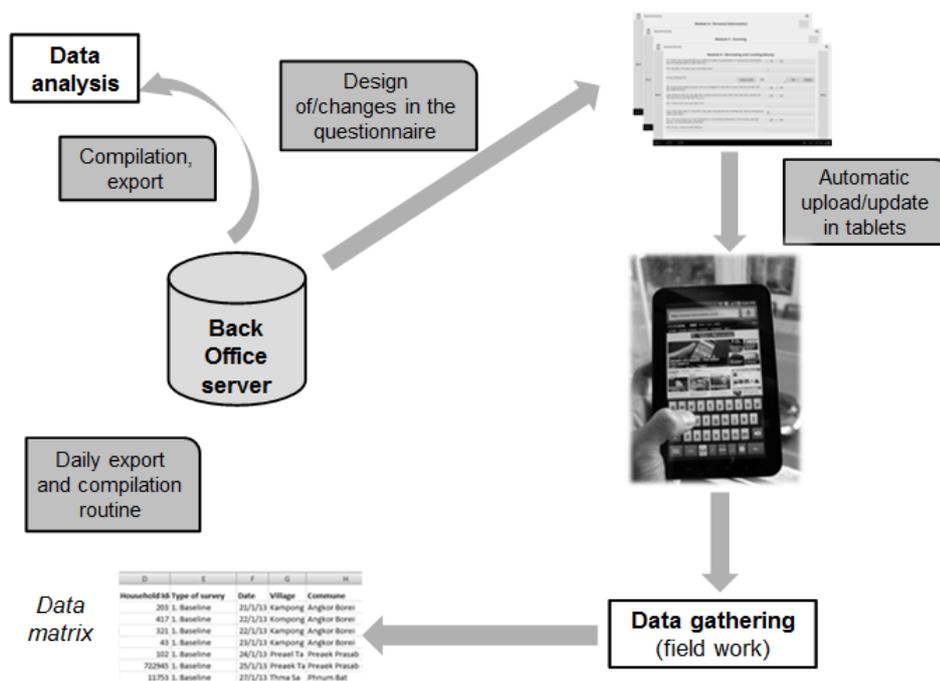
Fig.1. Overview of the system described.

The Tablet Application

The methodology was developed for a 10 inch (25 cm) screen Android-operated Samsung digital tablet. Designing a flexible application to handle the questionnaire was the main development challenge, especially given the need:
  - of an application able to process different questions in various order (e.g. coming back to a question A for complements after question B is answered);
  - to add, delete or modify questions remotely;
  - for a database model to handle a new type of question (e.g. based on experience with fishermen) without resorting to an update.

In terms of programming, the tables '*Question*' and '*AnswerQuestion*' are the core components (Wei 2012). Table '*Question*' includes all the questions asked and defines how the questionnaire is displayed. The specific fields of this table are:
  - '*TypeQuestion*': defining the display and storage of the question in the application;
  - '*ParentID*': linking any parent question to daughter questions, with no limitation in the number of levels (e.g. question on the size of Hilsa fish in January linked to the parent question on presence of Hilsa in January, itself linked to the question on Hilsa occurrence in the location surveyed);
  - '*LinkedQuestionID*': this feature allows the same subset of questions to be repetitively asked (e.g. questions about fish catch and fish size repeated for each species harvested and for each month of the year)

Table '*AnswerQuestion*' stores all the answers collected. The specific fields of this table are:
  - '*QuestionID*': relating a given answer to the corresponding question;
  - '*AnswerSurveyID*': relating a given answer to a given survey;

- '*ParentAnswerID*': linking, when the same subset of questions is repetitively asked (e.g. occurrence of Hilsa each month of the year), each subset of answers to a parent answer.

The questionnaire application was also designed to allow grouping in one table multiple data points (e.g. table Fisherman x Month x Fish yield), which is much more natural and user friendly than the default scroll-down list in which all combinations are successively listed (in that case Fisherman 1, Month 1, Fish yield; Fisherman 1, Month 2, Fish yield; etc). We managed to reduce the response time of the table option by optimizing the general performances of the whole application and by rethinking the way to display tables. Thus, tables can now be used in 3 different ways:
- As fixed tables, in which the number of rows is fixed;
- As dynamic tables, in which only one row is fixed but several rows can be added;
- As linked tables, related to a question that can handle multiple answers (e.g. a question listing all species a fisher knows) where the number of rows corresponds to the answers of the related question.

Designing a user interface able to adapt to the dynamic nature of the questionnaire (i.e. ability for the surveyor to enter the questionnaire in various sections, to skip or come back to a specific question) represented an important challenge; that challenge was addressed by using "fragments": these Android components confer dynamism to the code whereas the display is supported by some static *xml* layouts (Wilson 2013).
An additional function was developed, allowing the interviewer to display upon completion of the questionnaire a summary version of the questionnaire together with all answers. This allows the surveyor to review the answers, to fill gaps, and to amend possible mistakes before the corresponding final data set is exported to the Back Office.

The Back Office

The Back Office is the server-based software managing blank questionnaires and receiving filled questionnaires from tablets. More specifically, that Back Office must be able to i) update in each tablet the blank questionnaire possibly modified by survey designers, ii) automatically store and compile the data sets received from each individual tablet, and iii) export to scientists' computers, ready for analysis, the database of all questionnaires gathered (which is done in MS Excel format for user-friendliness). The communication, synchronization and compilation procedure developed is illustrated in Figures 2 and 3.

In order to avoid overloading the system with useless updates and be able to double-check revisions made to the questionnaire before sending them to the tablets, the updates are stored first in the Back Office. The user can then initiate the synchronization with the tablets when all revisions have been made and verified. During this synchronization, the tables defining the survey questions are uploaded in *csv* format, which is simpler, more effective and preferred for wider use. The newly generated blank questionnaires then automatically replace the former ones in all tablets.
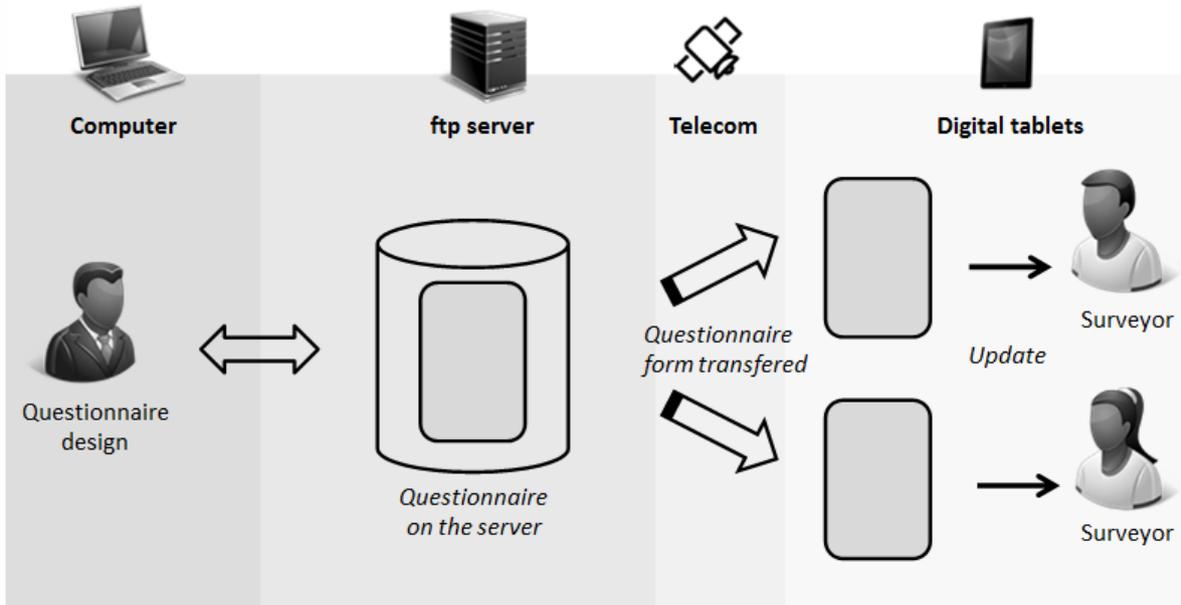
Fig.2. Synchronization: Updating questionnaire in each individual tablets from the Back Office.

When the surveyor triggers the export button, data are exported in *csv* format and transferred to an *ftp* server. Subsequently data are uploaded in the Back Office database. A combination of time and tablet identifiers is used to make sure that the same questionnaire, if exported twice, is not compiled twice in the Back Office. Converting multiple large *csv* datasets into a single Excel file matrix can be time-consuming in some cases (3,500,000 Excel cells required over 1 hour for compilation) so we addressed this limitation by programming a routine task running and compiling questionnaires every night (i.e. the whole set of data becomes available for analysis the morning after the last survey).
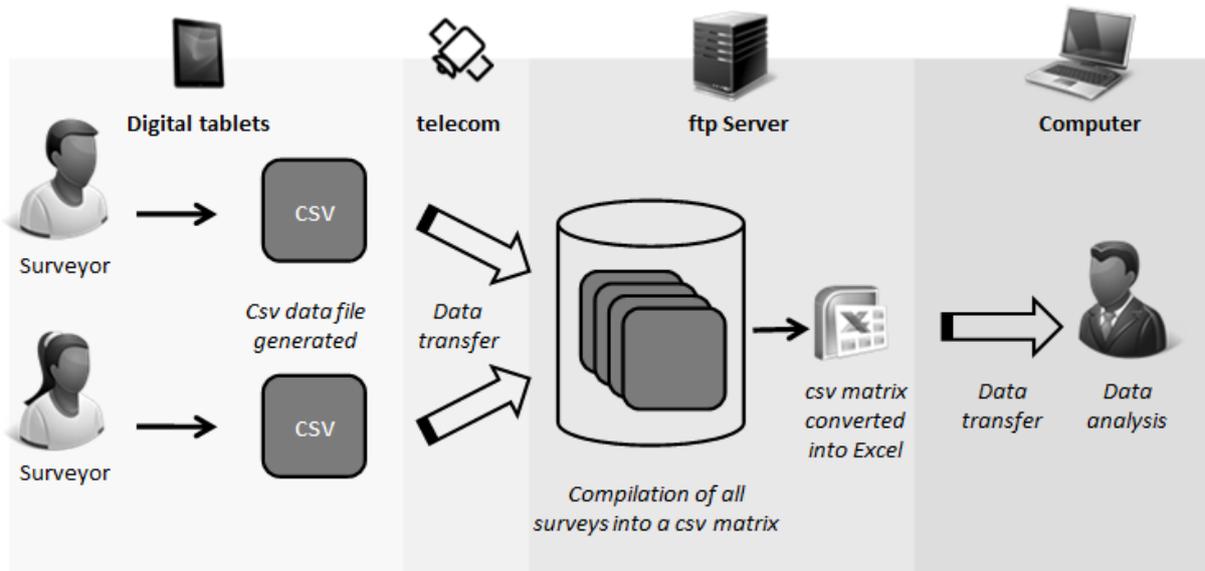

Fig.3. Synchronization: Exporting data from individual tablets and storing them into the Back Office.

Results and conclusions

The methodology described in this paper, used to collect information from 160 fishermen in 32 locations in remote Myanmar, has proven effective to reduce time and costs compared with manual data collection methods. In some of the places visited, there was no access to electricity but the battery capacity of the digital tablets allowed the surveyors to collect data day long while activating both the Energy saving and Flight modes on the tablets. During the night, the survey team could charge the digital devices using 220V electricity in places where it was available or 12V car batteries instead. Data collected were sent to the Back Office server using mobile telephone networks or Wi-Fi when available. A significant advantage of the system was the time and costs saved in entering data: for a similar study implemented by the same research team with the traditional paper-based data collection, nine weeks were allocated to data entry, with a database design and data entry budget slightly higher than the budget needed to purchase tablets and develop the application presented here. The fact that one step is saved in the data entry process (from verbal → paper → digital to verbal → digital) also reduces the chances of introducing errors in the final database. Another major benefit of using digital tablets was the capacity for the DoF team, unfamiliar with database management, to generate familiar Excel tables, and to review patterns and trends in data while details and memories from interviews were still fresh.

The present paper demonstrates the potential for using digital approaches to record interviews while implementing scientific surveys in countries such as Myanmar where infrastructure is limited but 3G networks are available. The fact that the methodology was adapted from a socioeconomic survey in Cambodia illustrates the adaptability of the tool which is not limited to a given type of study or discipline. Thus, the digital approach to data collection has already proven successful in various contexts and such methodology is recommended for research and also for monitoring and extension in rural environment.

Acknowledgements

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