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Step-by-step guide to conducting digital surveys for aquaculture performance assessment

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Step-by-step guide to conducting digital surveys for aquaculture performance assessment

Authors

Kelvin Mashisia Shikuku,¹ Jerome Delamare-Deboutteville,¹ Kai Ching Cheong,¹ Nhuong Tran,¹ Partho Debnath,¹ Shimaa Ali,¹ Laura Khor,¹ Mona Dverdal Jansen,¹ David Verner-Jeffreys,⁴ Ling Yee Khor,¹ Manfred Zeller,³ Yee Mon Aung³ and Mohan Vishnumurthy Chadag¹

Authors' Affiliations

- ¹ WorldFish
- ² Norwegian Veterinary Institute
- ³ University of Hohenheim
- ⁴ Centre for Environment, Fisheries and Aquaculture

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Contact

WorldFish Communications and Marketing Department, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia.
Email: fish@cgiar.org

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Summary

The WorldFish objective for sustainable aquaculture within the CGIAR Research Program on Fish Agri-Food Systems (FISH) focuses on enabling enterprises to progressively enhance production of aquatic foods in a more efficient and sustainable way. This is achieved by using domesticated, selectively bred, healthy fish reared on sustainable feeds in gender-inclusive production systems that have low carbon footprints with limited adverse environmental impacts. Focus on these areas will have the highest probability of achieving productivity gains while avoiding adverse economic, social or environmental impacts.

Genetics research within the Sustainable Aquaculture (SA) flagship of FISH is toward producing and disseminating elite genetically improved tilapia, carp and catfish strains to farmers in Asia and Africa in order to reduce poverty, improve food security and nutrition, and generate employment.

Understanding how the elite strains perform in different production systems, how they are affected by diseases, farmers' management practices, and the overall productivity of the system(s) requires different kinds of context-specific information from different geographies, economics, social and agro-climatic conditions. Carefully designed population-based surveys are often used to gather such information. WorldFish aims to develop and implement comprehensive surveys in different geographies using digital systems to create big data around the performance of genetically improved strains. This document provides a step-by-step guideline in designing and field implementation of digital surveys in aquaculture. To demonstrate the process, two specific and successfully field-tested examples have been provided.

In collaboration with its research and implementing partners, the University of Hohenheim, the Norwegian Veterinary Institute (NVI) and the Center for Environment Fisheries and Aquaculture Science (CEFAS), WorldFish has designed online mobile phone data collection tools for farmer surveys that generate data needed for (1) an integrated assessment of tilapia epidemiology and health economics and (2) an integrated assessment of aquaculture systems performance. This document provides guidance for field implementation of both types of surveys. It is organized in four main parts. The first two parts apply broadly to efforts targeting successful preparation and implementation of the surveys. The first part describes the procedure for recruiting the field team, providing training and pretesting the surveys. The second part provides guidelines for using mobile data collection tools—in this case, Open Data Kit (ODK).¹ The third and fourth parts present the two aforementioned field-tested farmer surveys, as examples. The first three parts have accompanying online training modules developed on the learn.ink² platform.

Introduction

FISH is an integrated, multidisciplinary research program designed to develop and implement research innovations that optimize the individual and joint contributions of aquaculture and small-scale fisheries to reducing poverty, improving food and nutrition security for health, and sustaining the underlying natural resources systems and ecosystems services on which both depend. The Sustainable Aquaculture flagship of FISH develops and delivers gender responsive and inclusive innovations in aquaculture breeding and genetics, aqua feeds, fish health and nutrition, and aquaculture systems. The focus is on enhancing aquaculture productivity and sustainability for millions of small-scale fish farmers. A step-by-step guide is needed to conduct digital surveys for aquaculture performance assessment across two key areas: (1) tilapia epidemiology and health economics and (2) aquaculture systems performance. This is an important contribution to support integration across the three research clusters in the SA flagship of FISH: genetics (elite strains), health and feed (husbandry practices) and aquaculture systems (system performance).

Why collect data?

Studies have highlighted that adopting selected genetically improved fish strains increases yields and hence income, improves nutrition, reduces poverty and makes associated environmental gains. However, contexts are increasingly changing, necessitating the need to understand on-farm performance of aquaculture systems, in general, and improved fish strains, specifically. With farming intensification and widespread trade in live aquatic animals, fish are becoming increasingly susceptible to pathogens that, if not controlled, could cause serious production losses. Some of these pathogens include the epizootic ulcerative syndrome (EUS), a fungal-like pathogen affecting over 70 wild and farmed freshwater and estuarine fish species, including carps, catfish and tilapia in North America, Africa, Asia and Australia. They also include bacteria, such as *Streptococcus agalactiae*, *Aeromonas hydrophila*, *Edwardsiella ictaluri*, *Flavobacterium columnare* and *Francisella* sp., as well as viruses, including tilapia iridovirus, infectious spleen and kidney necrosis virus (ISKNV), and tilapia lake virus (TiLV). With recent (re)emergence of diseases, there is growing global interest in fish health and biosecurity. Understanding fish epidemiology and health economics is necessary to sustain small-scale and industrial aquaculture in the future to ensure the supply of safe, nutritious and affordable aquatic foods to nourish populations.

However, reliable benchmarking information on production systems and management is missing yet crucial to inform interventions in aquatic food systems. Currently, there is limited baseline data on fish epidemiology and health economics, which hampers surveillance and disease control efforts. One possible explanation for this is that existing data collection approaches are not harmonized for systematic applications. Digital innovation in data collection offers an opportunity to address this gap. Open-source digital tools are becoming increasingly available along with better and cheaper mobile phones and improved internet connectivity. A systematic approach to collecting data for benchmarking is important to allow comparability between studies and across regions.

What type of data?

Digital tools for farmer surveys can collect a wide range of data on farm characteristics (e.g. location, size, production type, water source etc.), pond preparation and stocking of species (e.g. numbers, weight, and length at stocking and harvesting), biosecurity measures, source and use of inputs (e.g. seeds, feeds, chemicals, antibiotics, fertilizer, etc.) and the performance of genetics under varied conditions to better understand genetic-environmental interactions. These tools can collect information related to production cycle (e.g. stocking and harvesting time), labor use (disaggregated by gender, age, education), economics (costs, benefits and profitability), and separating losses caused by poor management practices from those caused by diseases.

How data is collected?

Platforms such as ODK are an enabling open-access and easy to program tool ideal for farmer surveys. The digital surveys are implemented by trained enumerators who are preferably subject matter specialists or who get a good understanding of the survey through pre-survey training. This step-by-step guide is intended to provide a foundation to build the required skills. The way the tools are designed allows for quality control checks by minimizing inconsistencies during data collection while creating an automatic pipeline for data analysis.

Whom is this guide for?

The target audience for this step-by-step guide and the associated survey examples includes researchers, both within and outside WorldFish, national partners including universities, aquaculture extension specialists and government and nongovernmental field officers. All of them can use the tools with producers following a systematic scientific approach in collecting reliable data to identify risks, understand performance of aquatic systems and develop targeted interventions to support sustainable aquaculture development. While the focus of the guide is on ODK, the ultimate goal is to create a community of practice around usage of digital tools in aquaculture. ODK is a pathway to pave the way for wider adoption by competent authorities to set their own digital strategies to safeguard fish production against diseases, strong biosecurity strategy and better governance. National risk analysis, surveillance, disease reporting and preparedness and responsible intranational and international movements of live aquatic animals will ensure good biosecurity implementation at farm, region and state levels. While those digital tools are primarily used for research purposes (e.g. building baselines/benchmarking), the intention is to tap into digital transformation in Africa and Asia to create a platform for multistakeholder interactions on performance of aquaculture systems.

The digital strategies can be adapted and contextualized to the needs of the respective countries. This will require a suite of local information and communication technological changes (e.g. mobile applications to communicate with farmers, establishing surveillance programs for disease, and real-time and accurate data collection).



Farmers learning from project's extension agent. Khanpur, Bagerhat, Bangladesh.

1. Part 1: Preparation for field work to implement farmer surveys

1.1. Organization of the field team

A field team is generally composed of enumerators, at least one field supervisor or team leader (TL), a field assistant or guide, and a driver. One vehicle should be assigned for each team with a local driver.

(**Note:** the number of teams will depend on the scale of the study—the number of regions covered and farms per region to be surveyed.)

1.2. Enumerator and supervisor recruitment guidelines

The recruitment of well-qualified enumerators to conduct the interviews is crucial to ensuring quality data collection. Enumerators need to be experienced and qualified in the following:

- collecting data through quantitative questionnaires
- engaging farmers in open-ended semi-structured questionnaires, including listening, processing and probing for more detailed answers, as well as synthesizing and recording the storylines farmers tell in detail
- subject matter specialization with adequate knowledge of aquaculture farming systems and procedures, fish health management practices and fish disease diagnostics
- good written skills
- communicating in the local language.

1.3. Roles and responsibilities of field team members

1.3.1. Field supervisor/team leader

The TL is responsible for the overall management of the field teams, ensuring team discipline and motivation and, ultimately, the completion of field activities within the stipulated timeframe and production of high quality data.

Because TLs double as data quality editors (DQE), they should be directly responsible for data quality. To meet these responsibilities, the TL/DQE should carry out the following tasks:

- Ensure that the logistic arrangements and materials for field work are sorted out before departure to the field.
- Engage with relevant authorities beforehand (at least 1 day before an interview) to ensure that the survey can be carried out in every enumeration area.
- Make sure that the sampling procedure and the selected sample are adhered to throughout the survey period.
- Ensure that those and only those farmers listed are interviewed.
- Be directly in charge, and physically stay with the interviewing sub-team at the beginning of the survey and intermittently throughout it to allocate work, monitor and evaluate the performance of enumerators and correct any identified errors while the team is still in the field.
- Monitor the use of field equipment to make sure that all are kept in good working order, and report problems promptly to the study's principal investigator (PI).
- Organize and lead daily field reviews or retraining meetings for all team members so that mistakes are identified and corrections made in time.
- Retrieve and review questionnaires from enumerators for completeness, clarity and consistency immediately upon completion of interviews so that immediate corrections of flagged errors are made before the team leaves the field for the day.
- Use the TL's checklist to take stock of each field day's work to identify and keep a record of farmers who have not been interviewed, as well as reasons for such omissions and to schedule callbacks.

- Make sure that completed questionnaires are uploaded and shared with the research team daily.
- Present a field report to the PI for each enumeration area highlighting any events that were different from the plan, specific comments about the performance of the team of enumerators, justification for farm replacements, and any observations pertinent for the interpretation of the data from the farms surveyed on that day.

The TLs should participate in workshop training for enumerators before data collection begins. Each TL is responsible for implementing data collection smoothly by managing logistics on the ground, overseeing the enumerators in the field, and troubleshooting where needed. The TL must be able to speak the local language. The TL has an important role to play in adequately entering the farm and introducing the team and the purpose of the survey to the owner of the farm. This person has to engage actively throughout the data collection process to ensure smooth implementation and high quality data standards.

Enumerator management is critical for the successful implementation of the data collection process, as well as for data quality assurance. The TL has to engage closely with the enumerators, provide support and supervision in the field as needed and manage any concerns that may arise during the data collection process. The TL has to ensure that enumerators stay motivated throughout the process, countering any symptoms of enumerator fatigue appropriately. This person needs to monitor enumerators, carry out surprise visits and actively manage the enumerators to adhere to high standards of interviewing.

1.3.2. Enumerators

Enumerators are in charge of collecting farmer data using mobile phone tablet questionnaires according to the procedures provided in the training. They need to have good communication and literacy skills, as well as patience under time constraints, and they should always strictly follow the designed procedure. Enumerators report directly and immediately to the TL in each team when facing any sort of issue or doubt during an interview. Their responsibilities are as follows:

- Attend the required number of days allocated for training.
- Participate actively during training and raise questions.
- Understand the concepts behind the questions so that they can be translated into the local languages without losing their meaning.
- Refer to this manual as a reference and guide.
- Read the guidelines carefully and make sure to understand the survey objectives.
- Introduce and explain the survey objectives and the overall interview procedure to the respondents.
- Obtain approval for conducting an interview from the respondent after briefing.
- Follow the steps according to the questionnaire design, making sure that all questions are answered.
- Do not skip any questions and do not engage in guesswork if in doubt. Instead, consult the TL immediately.
- Maintain a neutral and impartial manner when conducting the survey.
- Conduct multiple interviews per day as assigned by the TL at each selected location.
- Complete interviews with all farmers in the assigned area.
- Check the completeness of the interview, and confirm that the data has been saved after each session.
- Take note of any errors during the interview, and report them to the TL on a daily basis.
- Provide feedback and raise any concerns and challenges faced during the interviews to the TL.
- Quickly review and satisfactorily respond to any comments and queries raised by the TL/DQE on the questionnaires. This includes revisiting the farmer to clarify issues as the TL/DQE may instruct.
- Maintain the quality of data collection as much as possible through diligent work and by conducting oneself professionally.

- Deliver the mobile phone tablets with completed questionnaires to the TL at the end of each day.
- Make sure that the mobile phone tablets are fully charged before the following morning.
- Take care of the mobile phone tablets to avoid any damage.

1.3.3. General qualities and skills of enumerators

The primary objective of any data-gathering activity is to get accurate and complete information. It is to the enumerators' advantage if they can create a friendly atmosphere in such a way that they make a good impression on a respondent at the start of an interview. They can do this by being polite (at all times), presentable (with regard to appearance) and well-mannered to win the trust and confidence of the respondent.

Enumerators should be neutral, attentive and interested in the answers that the respondent provides throughout the interview. Behave respectfully, use eye contact throughout the interview and avoid unnecessary discussions on issues that may antagonize the respondent. In addition, they should not answer their mobile phones during the interview.

Enumerators should ask all the applicable questions in the questionnaire. Even if they think they already know the answer to a question, this may not be the respondent's answer. Some questions will require enumerators to synthesize and write down the story that the respondent is telling them.

Enumerators should never suggest answers to the respondent. Occasionally a person's answer may be confusing or unclear. If enumerators find that the person's answer is unclear or not satisfactory, they should probe for more information. Try to be efficient and use time well; it is not necessary to always have three answers for questions that allow multiple responses. Probing should be balanced with efficient use of time.

Enumerators should never change the wording or sequence of the questions. If the respondent requires clarification or explanation, enumerators can give it but only after the question has

been asked in the standard form. However, it is acceptable to have the respondent tell a story that can be used to answer multiple questions. Enumerators should do their best to be familiar with the survey so that they know what information can be used to answer which questions, and they should pay attention to the provided answers.

Enumerators should pay attention to all skip patterns in the survey and must not ask a respondent a question that should be skipped based on their previous answers. The mobile phone tablet should be programmed to guide enumerators accordingly, so it is important that they pay close attention.

In addition, enumerators should strive to develop the following qualities and skills:

- Quickly establish and maintain a connection with respondents to gain their trust and confidence. This is the most fundamental step to obtaining full and honest information. Practicing the following strategies is useful to build connection:
 - Dress appropriately, being careful not to offend local standards of modesty and not to let enumerators' dress code attract any attention from the respondent.
 - Approach the respondent confidently and convey a professional attitude.
 - Try as much as possible to be warm and friendly. Facial expressions and body language, such as postures and gestures, are very important.
 - Be friendly but not too personal.
 - Do not rush into formalities. Look around and quickly start with some small talk about a topic of common interest. Children are always a good topic. Sincere compliments are always welcome, and tacit expressions of regret are helpful if enumerators come at a busy time.
 - Names are important to human pride. Learn them before an interview and call respondents by their own names. Enumerators should use a sample list to help them remember respondents' names.

- Find and conduct the interview from a quiet place, with minimum distractions. Interviews held from the roadside with frequent passers-by, in the midst of other family members, in the presence of an authority figure or in similar conditions will not be successful.
- Start the interview with a brief explanation of what the interview is about and how it will progress.
- When the interview starts, find a good pace for your interview—neither too slow to bore nor too fast to annoy. Be respectful and non-judgmental. Do not rush the participant or guess about their answers. Listen carefully, wait and let them answer fully. Again, be mindful of your body language.
- Control and keep the interview on track, and obtain detailed information. Ask the respondent to clarify anything that was said too quickly or inaudibly. Repeat or rephrase your question if you think the respondent did not understand the first time, or read back the respondent's answers to confirm accuracy. If the respondent is asking too many irrelevant questions that are interrupting the pace of the interview, politely ask the respondent to remember to ask any questions after the interview.
- Prepare adequately before the interview takes place. Use the checklist to ensure you have all you need on a daily basis before setting off for fieldwork. Arrange and place the field equipment, supplies and materials where you can easily see and retrieve them during the interview.
- Record information legibly on the tablet. It is unlikely that you will be around to clarify unreadable data during data analysis, as this will be done by other teams and possibly long after the end of data collection.
- Always review and check the survey questionnaire on the tablet for completeness before leaving the respondent.
- Thank the respondent and other farmer members for their participation and patience. Give them a chance to ask any questions and answer as best as you can. Refer questions you cannot answer to the TL.
- Enumerators and other staff must keep information confidential. In order to do this enumerators should follow these procedures:
 - Identify participants by survey ID number (same as farmer ID and individual ID) when you talk to other staff about your work.
 - Do not permit any unauthorized person, including your own family members, to see the completed interview forms.
 - Keep the mobile phone tablets in a secure place until they can be given to the TL.
- Do not discuss the information that the participants give you with anyone but the TL.

1.3.4. How to handle data collection problems

During data collection, enumerators may encounter problems along the way. If they come across difficulties not covered here or in any part of the manual, they should not hesitate to contact their TL for assistance.

If the respondent refuses to cooperate, the importance of the survey should be stressed. If all else fails, enumerators should ask for their supervisor's assistance.

Enumerators should be flexible about returning at another time if the respondent is interested in being surveyed but is unable to complete the survey at that time. Ask respondents about their availability and record this information. Every effort should be made to return to the farmer at one of the convenient, available times provided during the first visit. For the surveys presented here, make arrangements ahead of time to secure the participation of the respondent.

The respondent must be a farm member, ideally the owner of the farm or someone representing him or her, who can provide accurate information about the farm and its operations. Farm members include the people who work together on the farm during the production cycle. Those who work somewhere else and only come to visit, provide services or bring money are not considered farm members.

1.3.5. Submitting the completed questionnaire

At the end of each day, mobile phone tablets should be submitted to the TL. However, before submitting the tablets, enumerators should thoroughly review and check the questionnaires for inconsistencies. The TL shall likewise review the completed questionnaires for completeness and consistency of the entries. If TLs find any data quality related issues after reviewing a form, they should report the comments by uploading them to the research team together with the completed form for further review. The research team should incorporate all the comments from the TL, the country's team and the PI and then send the feedback to the TL before more interviews can be conducted the next day.

It is important that the respondent be the same person throughout the questionnaire. It is necessary to avoid having different respondents—for example, in the event that enumerators need to return to a farm to fill out any missing information or resolve inconsistencies. The TL should make sure that all farms are properly accounted for and that instructions in this manual are properly followed for each surveyed farm. If there are inconsistencies in the questionnaire, or the questionnaire is incomplete, the next day should be reserved for calling back respondents to complete the questionnaire. It is the responsibility of each enumerator to take good care of the mobile phone tablet. They should always make sure the tablets are fully charged the night before the survey.

Every survey day, the field team should have a short meeting before setting out for the interviews. The TL is responsible for providing the schedule of the day, assigning the role of each member in the team and providing accurate feedback to each enumerator according to data quality review done by the research team. Data quality should be checked daily by the research team from all the data uploaded by the TL. The project team should run a STATA do-file (or other script) to check the completeness and look for any inconsistencies in the data. The project team should pass on any feedback and guidance on improvement for each enumerator to the TL, who should then brief and clarify directly with the enumerators during the daily meetings.

1.3.6. Sample mobilization and field schedule

1.3.6.1. The sample list

The TL should have a complete list of farmers selected for the interviews. A separate list should be provided to the TL for replacing farmers who could not be reached even after three callbacks. Only those selected should be interviewed.

The TL should visit farmers and community leaders in advance to inform the respondents of the planned visits. While the enumerators are doing interviews, TLs can use the time to visit or call the next farmer to confirm the time of the visit. During this visit, the supervisor should confirm that the sampled farmers are available for interviews on the planned day. If there is a need to call a respondent back, the supervisor should record this information. Inform respondents ahead of time that a team will be visiting them for interviews, and politely request the cooperation of the respondents to participate in the survey. Mobilizing for interviews ahead of time will help minimize wasting time looking for respondents, which will improve planning and increase efficiency. The supervisor should work closely with local community leaders to correctly identify farmers and mobilize the respondents for interviews.

1.3.7. Conducting farmer interviews

1.3.7.1. How to start and progress through the interview

Instructions for each question should be provided as computer-assisted personal interviewing questions on the tablet. If respondents are away, please wait until they come back if they are expected at the farm shortly.

Interview techniques:

- Tell respondents that you are interested in their opinions and what they have to say.
- There is no right or wrong answer.
- Pay attention to your body language and remain engaged in the interview.
- Respect the opinion of the respondent.
- Consider any comment seriously and positively.

- Politely divert the respondent's attention from unnecessary responses that could take time.
- Do not abruptly stop the respondent or barge in rudely.

1.3.7.2. Introduction and consent by the main respondent

- The first few questions are about identification information. These details should help to identify each farm. The TL is responsible for providing this information to enumerators ahead of time. The survey ID is the number coming from the farmer list that was generated in advance. It must be unique for each farmer. This is a vital initial activity. It must be done to ensure that you work with the right sample.
- Identify an appropriate respondent for the interview. Ideally, the respondent should be the farmer head or spouse. If nobody (suitable) is around to answer your questions, you are required to revisit the farmer at least three times. You may inform the TL only after you have done everything you can to talk to the farmer.
- At the beginning of each farmer interview, read out the introduction and consent confidentiality statement. You need to own the statement for the respondent to be confident in you. This must be done before you start the interview.
- Introduce yourself as a member of the organization that you work for.
- These interviews target the farmer. In a farmer's absence, the spouse or any other responsible adult in the farm household is allowed to handle the interview. Record whether the main respondent consents to the interview. Repeat the confidentiality statement if another farm member joins the process.
- Ensure the respondent understands that the information provided will be used, but make sure that the name of the farmer or the location of the farm does not appear in the information published.
- If a respondent refuses consent, stop the interview immediately. The respondent can also opt out of the interview at any time. Thank respondents politely for their time if consent is

refused. The questionnaire has to be submitted to the TL, who will then randomly sample another farmer for the enumerator.

- Be honest about the length of the interview in terms of amount of time.
- Respondents may have expectations, and it may be tempting to promise them gifts to ensure their cooperation. It is critical to be clear that there are no benefits involved.
- Avoid promising payments or gifts to respondents. This is not at the discretion of the survey team. Instead, the enumerator has to build confidence and explain the survey in a manner that raises the respondents' interest.
- Respondents may ask if you have local permission to conduct the interviews in their zone. You can assure them that the district authorities and local leaders have granted your organization permission.
- Please remember that you are not to mention a long-term program, because respondents tend to tell you what you want to hear. You may explain that this information will be used to better understand farming practices—that we want to listen to the respondents' stories about their farming practices and problems they face. This improved understanding may be used to plan potential future partnerships with farmers and to identify potential information needs in the farming community.

1.4. Objectives of training

Training for implementing the farmer survey has the following objectives:

1. To familiarize the field teams with the objectives of the survey, the methodology of the survey, and the reasons why this level of standardization is required.
2. To ensure that enumerators and field supervisors have an in-depth knowledge and understanding of each question in the survey questionnaire. This is more than being familiar with the questions; it implies knowing what is being asked, why it is being asked and how it should be asked.
3. To ensure that enumerators and field supervisors are familiar with and comfortable to use the ODK, the mobile data collection platform of choice.

4. To explain the roles and responsibilities of each member of the field team and how a chain of responsibilities has been established to help ensure data quality.

Training includes the following activities:

1. Opening remarks, introduction of participants and an overview of the performance assessment project.
2. Discussion of the roles and responsibilities of different members of the team.
3. Introduction of the basic function and operation of the survey device and the ODK tool.
4. Discussion of entry procedures to ensure that the required protocol is followed in the field. This includes entry into the village and the introduction of the survey to the respondents, in particular, as well as the importance of reading the consent statement before starting the interviews.
5. Studying, discussing and using the questionnaire under classroom conditions. Demonstrations by the TL or competent members of the team on how to conduct the interview will be planned as part of the process of familiarization with the questionnaire. Role playing, where enumerators take the place of interviewees and interviewers, will be organized, witnessed and followed along by members of the field using their tablet and will be discussed to improve the ability of the enumerators to carry out interviews.
6. Using the sampling procedure on prepared village and farmer listings. Each enumerator should carry out at least two interviews, while field supervisors should upload the data and send it to the research team.
7. Practice in the field during which enumerators and supervisors can put into practice the process of farmer selection, geo-referencing of farmers, interviewing and report writing. This experience and collected data must be discussed and lessons drawn from after the field visit.



Photo credit: Halilub Haque/Worldfish

Hatchery worker spreading feed in hapas.

2. Part 2: Open Data Kit (ODK) tool basic operation

All the devices should come preinstalled with the ODK Collect/KoBo Collect application along with the questionnaire form.

On the device's homepage, tab on the ODK Collect icon to open the application (Figure 1).

Main menu

A main menu will appear upon starting the app. The description of each selection is as follows:

Fill Blank Form: Contains an empty questionnaire. Used to start a new survey.

Edit Saved Form: Contains all saved questionnaires. Used to continue an incomplete survey.

Send Finalized Form: To send saved and finalized questionnaires. The team leader uses this to upload finalized questionnaires to the server at the end of each surveying day.

View Sent Form: Contains all the sent questionnaires. Used to double-check that all the finalized questionnaires have successfully uploaded.

Get Blank Form: To get blank forms from the server.

Delete Saved Form: To delete saved questionnaires.

If the ODK Collect application and form have not been installed, please refer to the instructions below.

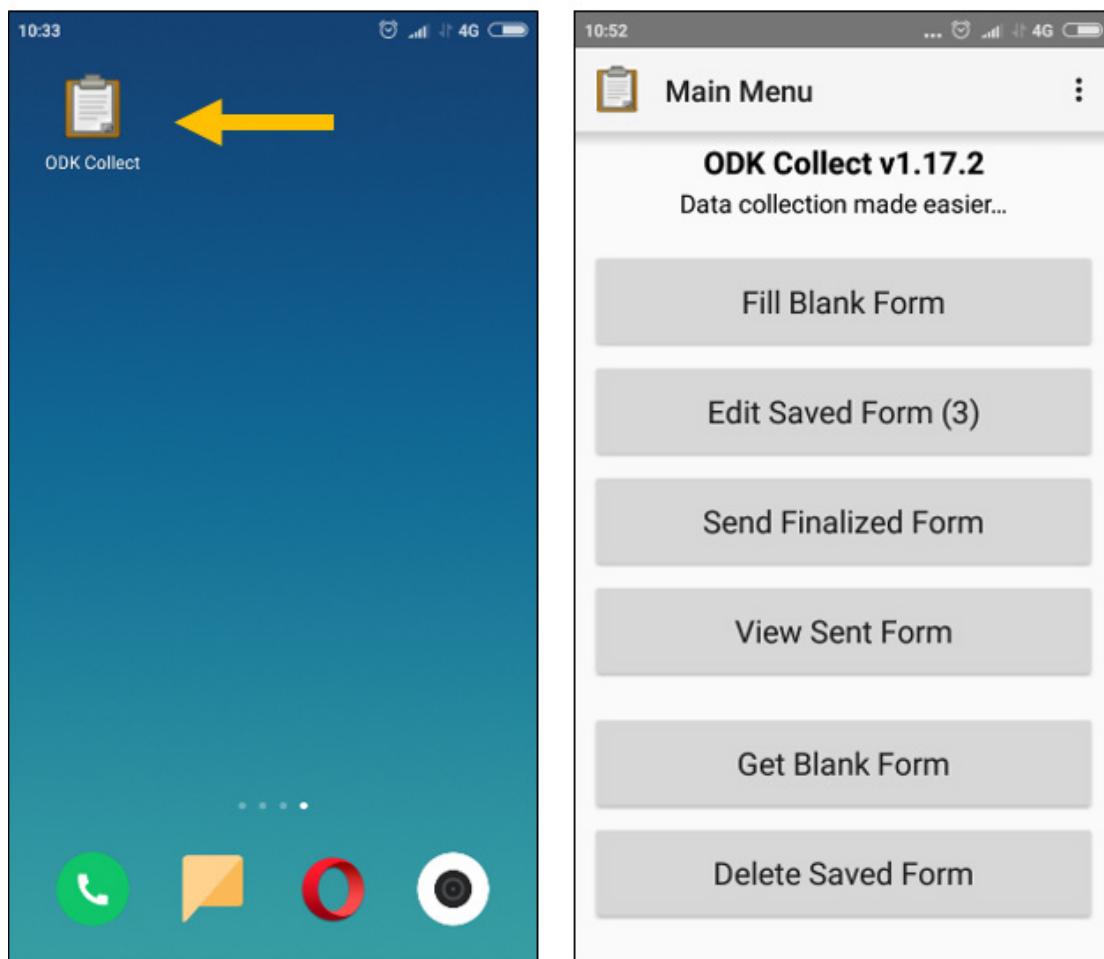
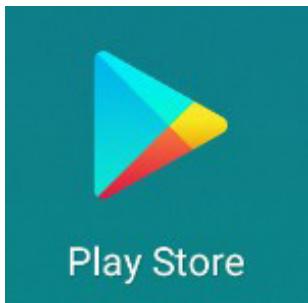


Figure 1. The ODK Collect app on the homepage of the device (left) and the main menu of ODK Collect (right).

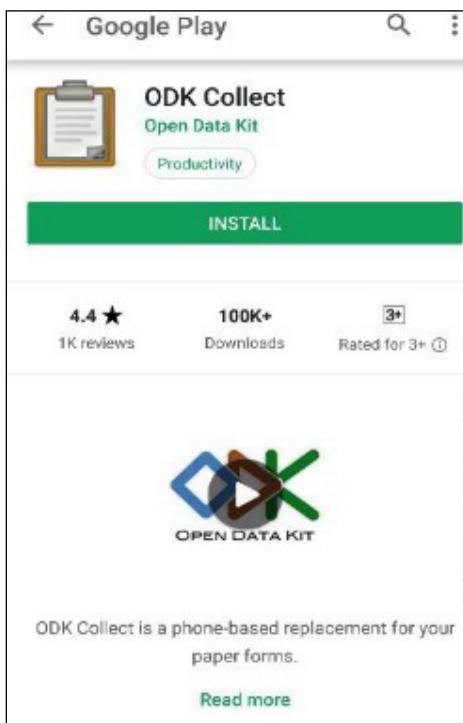
2.1. ODK Collect installation and form download

To install ODK Collect and download a form, please refer to the instructions below.

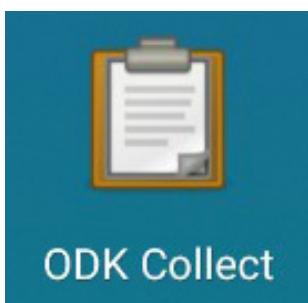
1. Launch “**Play Store**” by selecting the icon.



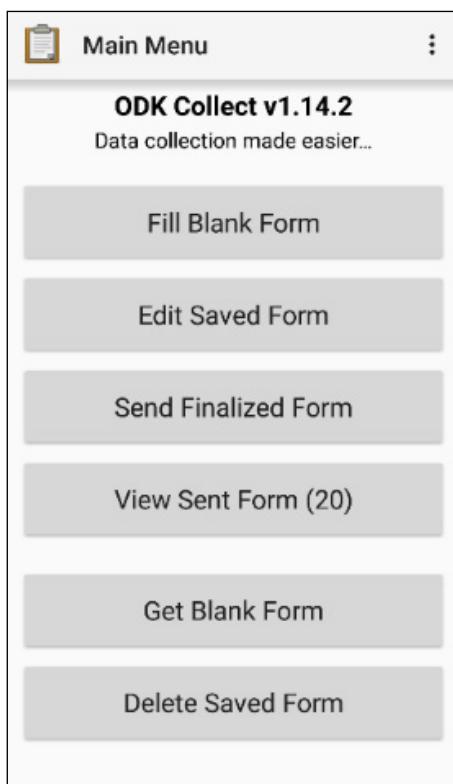
2. Search the app named “**ODK Collect**.” Select “**Install**” to download and install the app.



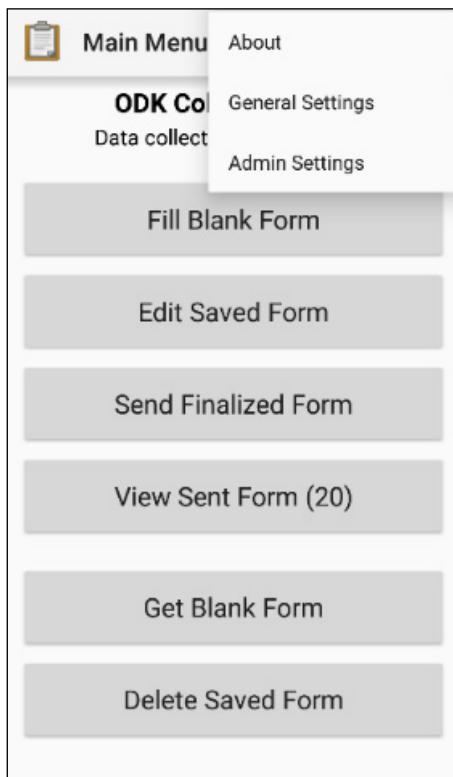
3. Launch the “**ODK Collect**” by selecting the icon.



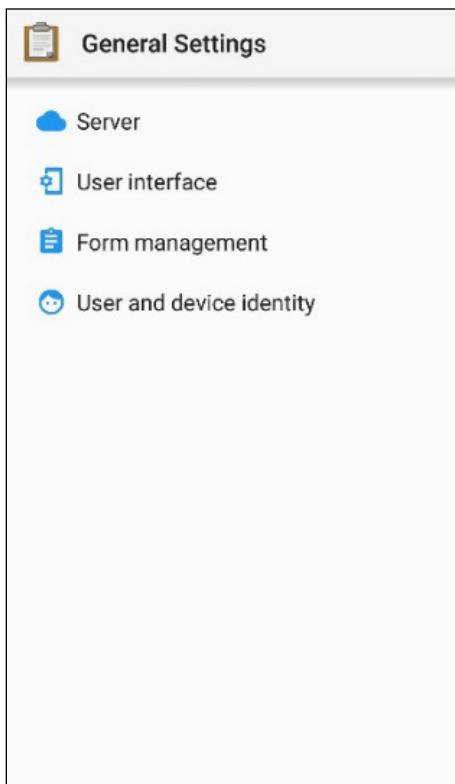
4. The “**ODK Collect**” home screen will be shown.



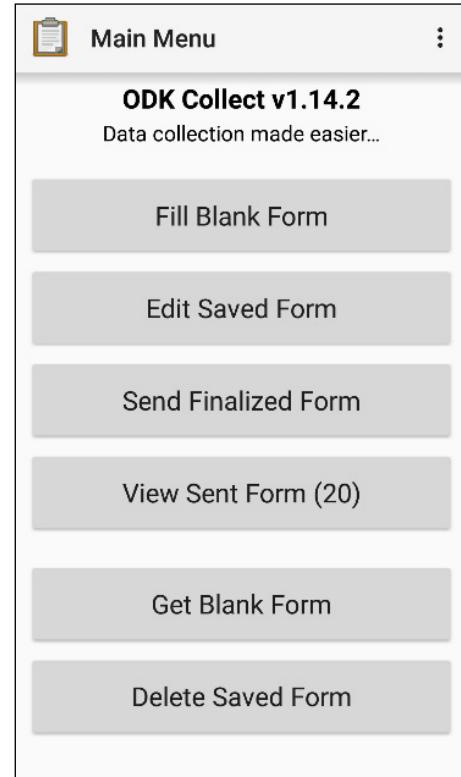
5. Select the menu icon in the top right corner (3 dots) and select “**General Settings**.”



6. Select "Server."



8. Select "Get Blank Form."



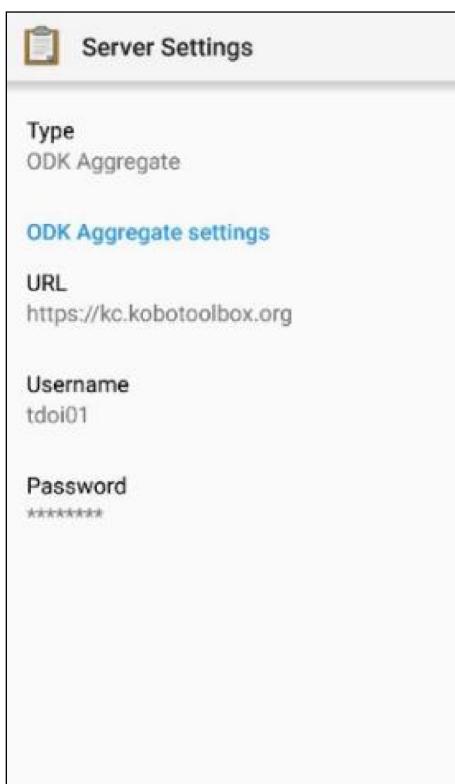
7. Enter settings for the specific project:

Example

URL: <https://kc.kobotoolbox.org>

Username: **tdoi01**

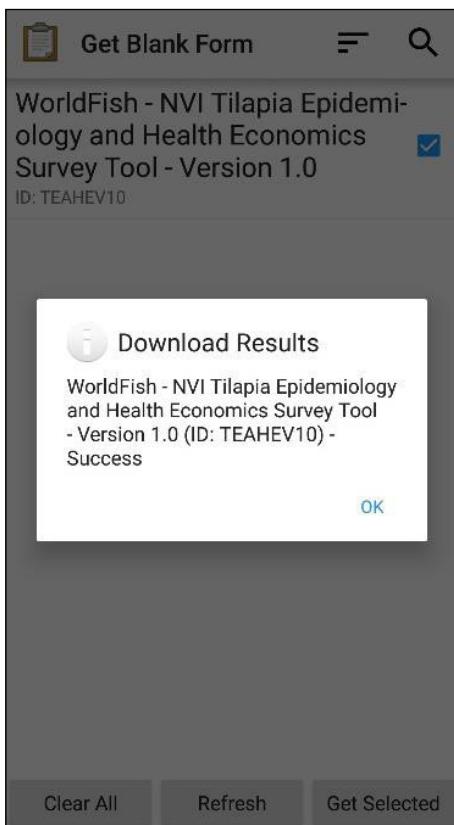
Password: **xxxxxx**



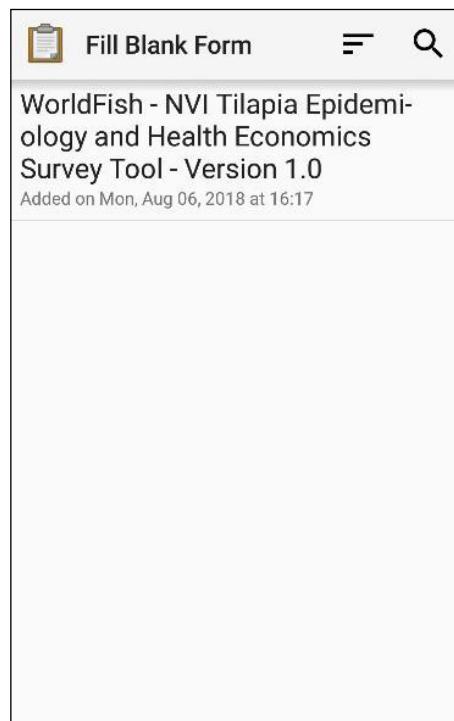
9. Select the form by checking the check box. Then select "Get Selected" to download the form.



10. The app will show a message once the form is downloaded successfully.

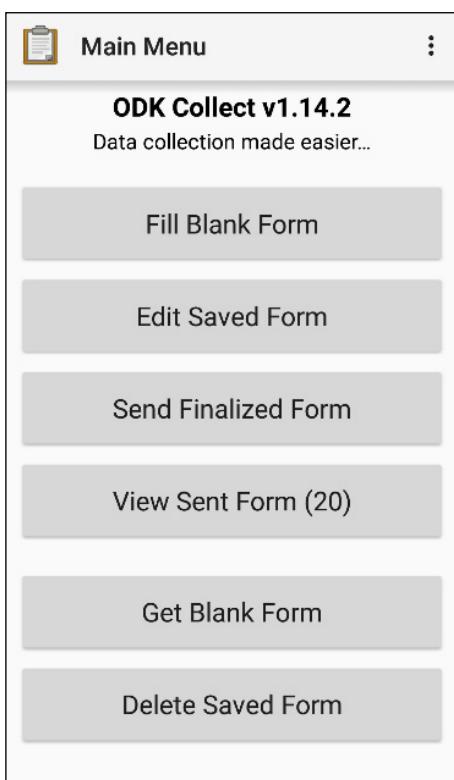


12. The downloaded form will be shown. Select the form to start entering data.



(Important: if you have been using a previous version, please refer to step 8 above to get a new blank form and select the latest version from the list.)

11. Select “**Fill Blank Form**”.



2.2. ODK Collect data entry and submission

To enter data and submit a form online, please refer to the instructions below.

The basic layout and functions of the tool:

- *Swipe right* to go to the previous question.
- ← *Swipe left* to go to the next question.
- 💾 Partial save of the questionnaire. Questionnaires can be saved at any time during the survey. **REMEMBER TO SAVE** before you close the questionnaire when pausing the survey. Saved questionnaires can be viewed and edited from the **Edit Saved Form** tab on the main page.
- 👉 Jump to a question or view all the questions. Viewing all the questions and collected answers. This can be used for checking collected answers and the completeness of the survey.
- * Question that cannot be skipped; required questions.

Examples of the different types of questions in the questionnaire are given in Figure 2.

1. Integer number
Example: Types of crops

17:31 On-farm Impa... ⌂ ⌂ ⌂ ⌂

AGRICULTURAL LAND

How many different types of crops did the households grow in the 2018 cropping seasons?

5

1 2 3 -
4 5 6 —
7 8 9 ✕
, 0 . ↶

2. Decimal number
Example: Weight

11:09 On-farm Impa... ⌂ ⌂ ⌂ ⌂

River > Cycles for River (1)

*** How much of the fish harvested for Tilapia in River in the 3rd cycle was sold for cash?**

150.6

1 2 3 -
4 5 6 —
7 8 9 ✕
, 0 . ↶

3. Text
Example: Name

11:17 On-farm Impa... ⌂ ⌂ ⌂ ⌂

SECTION A: GENERAL INFORMATION AND IDENTIFICATION DETAILS

*** Name of the respondent**

Firstname [space] Middle name(optional) [space] Last name

Saiful Kanchon Choudhuri

to the and for in is
q w e r t y u i o p
a s d f g h j k l
z x c v b n m ✕
?123 , ⌂ English . ↶

4. Single selection
Example: "Yes" or "No" questions

10:09 On-farm Impa... ⌂ ⌂ ⌂ ⌂

*** Do you accept to provide information?**

No
 Yes

5. Multiple selections
Example: Types of expenditures

17:31 On-farm Impa... ⌂ ⌂ ⌂ ⌂

AQUACULTURE

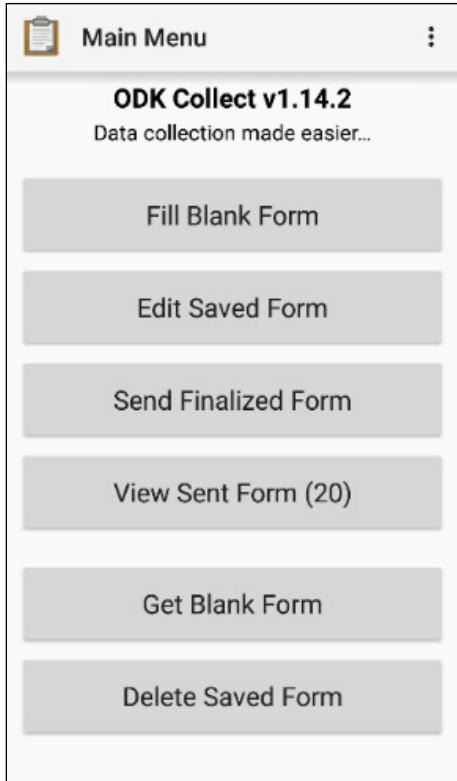
*** Tell me the three main ways that you spent the money that your household earned from selling fish**

School fees
 Furniture
 Pay hospital bill
 Pay rent
 Pay dowry
 Leisure
 Land preparation
 Buy farm inputs
 Pay loan
 Buy food
 Buy other HH items

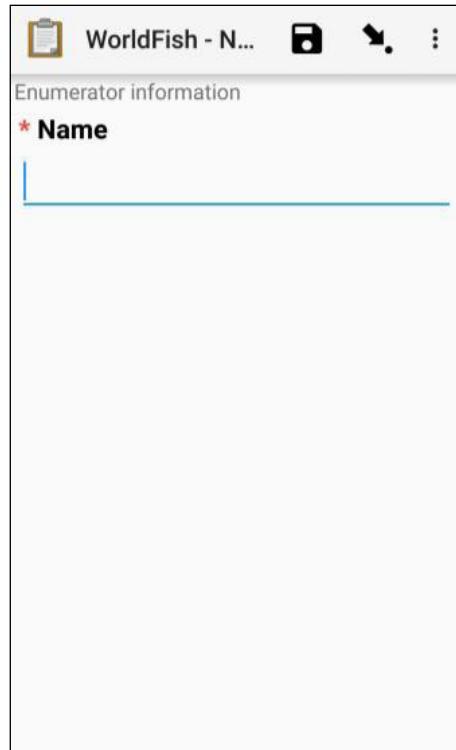
Figure 2. Examples of different types of questions in the questionnaire.

To start a new survey:

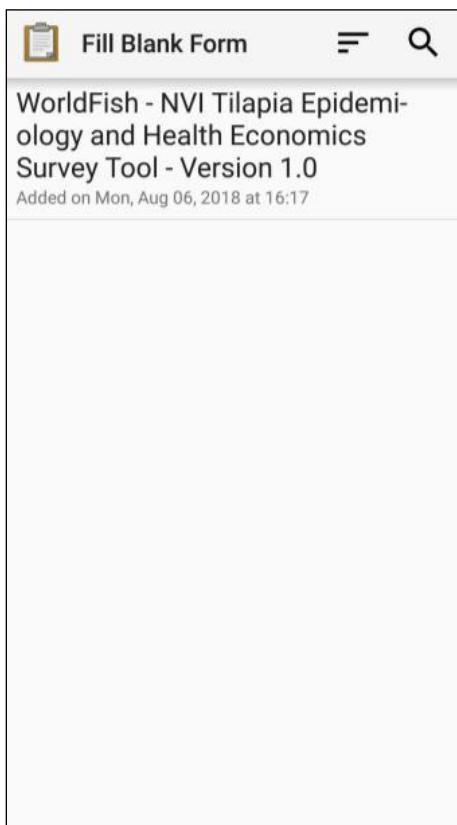
1. Select "**Fill Blank Form**" tab.



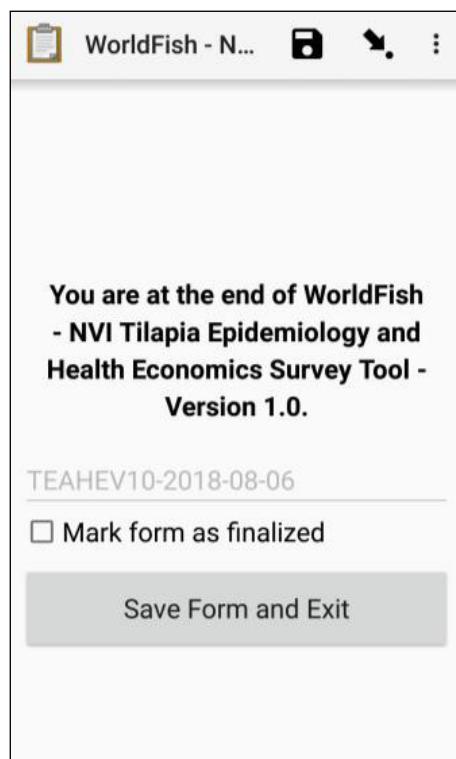
3. For example, enter enumerator's name into the textbox. Swipe left to move to the next question. Swipe right to move to the previous question.



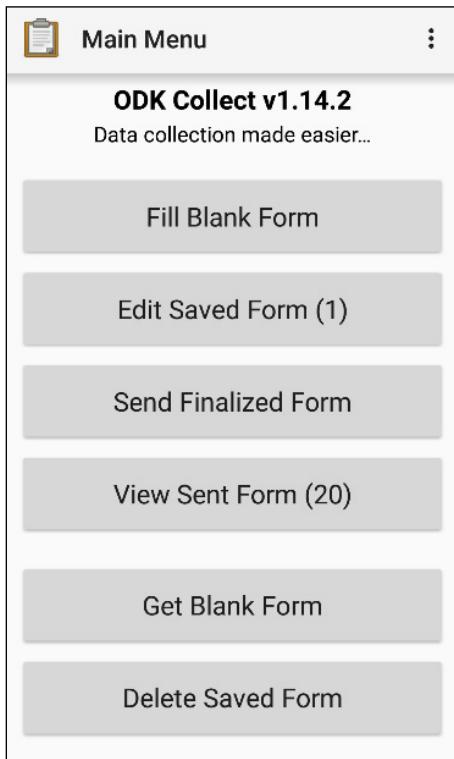
2. Select the form to start entering data.



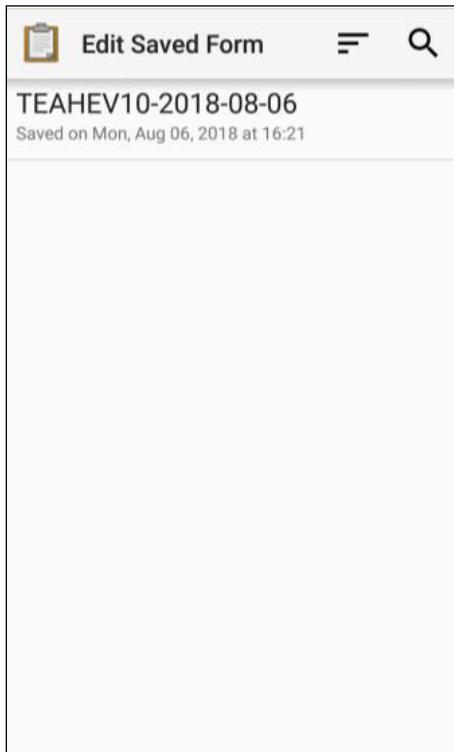
4. At the end of the form, the app will save the form with the format "**TEAHEVXX-YYYY-MM-DD**". Check the checkbox "**Mark form as finalized**" if there are no more changes. Uncheck the checkbox to save the form as a draft version. For this example, uncheck the checkbox and select "**Save Form and Exit**" to save the form as a draft version.



5. To reopen the draft form, select “**Edit Saved Form (1)**.” The number in the brackets shows the total number of draft forms saved.



6. Select the draft form name to reopen the draft form.



7. The app will show all the entered data of the draft form. Select “**Go to Start**” to edit the entered data. For this example, select “**Go to End**” to go to the last screen of the draft form.

The screenshot shows a draft form titled "WorldFish - NVI Tilapia Epidemiology and Health Economics Survey Tool - Version 1.0". It contains the following fields:

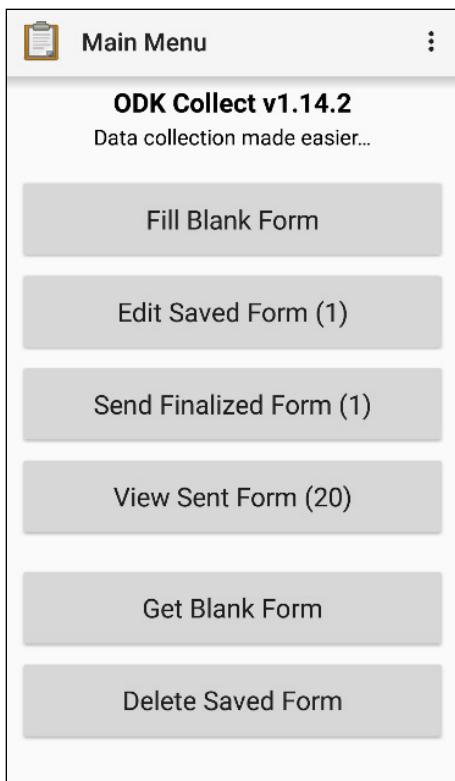
- Name:** A (with a red asterisk)
- Email:** A (with a red asterisk)
- Mobile number:** A (with a red asterisk)
- Consent to anonymised data being used in studies on tilapia production and health:** OK (with a red asterisk)
- Country:** Bangladesh (with a red asterisk)
- Administrative level 1:** Barisal (with a red asterisk)
- Administrative level 2:** Barguna (with a red asterisk)

At the bottom are three buttons: "Go Up", "Go To Start", and "Go To End".

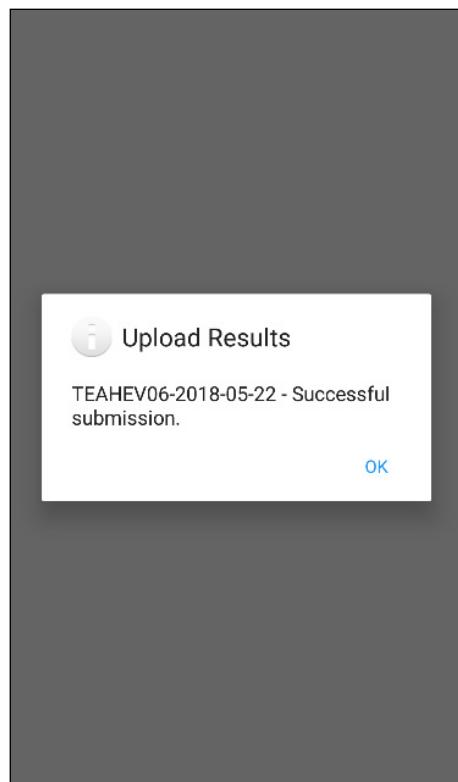
8. Check the checkbox “**Mark form as finalized**.” Select “**Save Form and Exit**” to save the form as a finalized version.

The screenshot shows the final step of the draft form process. It displays the message: "You are at the end of WorldFish - NVI Tilapia Epidemiology and Health Economics Survey Tool - Version 1.0." Below this, it shows the draft form name "TEAHEV10-2018-08-06" and a checked checkbox labeled "Mark form as finalized". At the bottom is a large button labeled "Save Form and Exit".

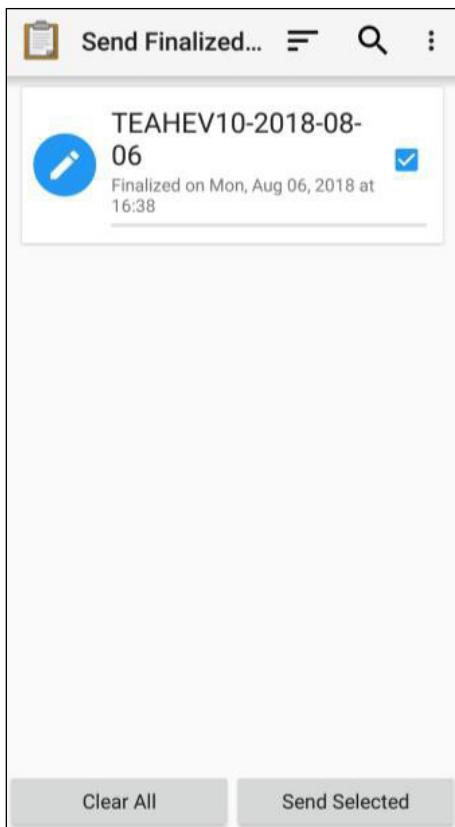
9. To submit the finalized form to the ODK server, select “**Send Finalized Form (1)**.” The number in the brackets shows the total number of finalized forms pending for submission.



11. The app will show a message once the form is submitted successfully.



10. Check the finalized form. Select “**Send Selected**” to submit the finalized form.



3. Part 3: Survey for integrated assessment of tilapia epidemiology and health economics

WorldFish, in partnership with the Norwegian Veterinary Institute (OIE Reference Center for Aquatic Epidemiology) has designed an integrated assessment online questionnaire (survey tool) for tilapia epidemiology and health economics. Initially, it is meant to be used in WorldFish focal and scaling countries. The tool was predesigned and pretested in the ODK Collect application of the Kobo mobile data toolbox platform to collate fish population-level information in a centralized database. The survey tool is designed to collect data on disease prevalence, baseline and abnormal mortality, background information from a production site, its workforce, production parameters, key economic indicators and operational procedures (e.g. pond preparation, biosecurity measures), health management practices (e.g. use of chemicals or antibiotics), and existing diagnostic services. The ODK is compatible with Android devices. Enumerators are trained 2–3 days before visiting a farm or hatchery in pairs. Data collection is conducted offline using mobile phones or tablets that allow completion of multiple surveys without the need of an internet connection. Data can be uploaded at internet connection points allowing enumerators to revise entered data at convenient times before submitting surveys online.

This survey tool is envisaged to support the following:

- Study disease in population.
- Demystify disease causation in tilapia and quantify losses.
- Identify factors associated with disease ponds (risk factors) and factors associated with healthy ponds (best management practices) at the population level.
- Help to move beyond the single pathogen, single disease and single pond approach.
- Better understand disease emergence and spread in global tilapia aquaculture.

Population-based analysis gives the required statistical power for the evidence generated and can be integrated into national aquatic animal health management plans. Epidemiology, combined with rapid and presumptive diagnostics, provides evidence to make responsible real-time health management decisions.

For release to a wider audience in new countries, the existing tool needs slight modification to suit local contexts, such as the names of the local fish species and subregions. As part of the FISH CRP, WorldFish intends to roll out this tool for assessing tilapia epidemiology and health economics in all of its focal and scaling countries in Asia and Africa, where tilapia farming contributes significantly to livelihoods, local economies and nutrition.

3.1. The questionnaire, question by question

Section 1: Enumerator information

Please enter the name, email and mobile number of the enumerator conducting the survey.

Section 2: Consent

Enumerators need to clearly explain to respondents that any data collected during the survey is strictly confidential. Every farmer's identity, as well as any information related to farming operations, will be kept anonymous—only the person or organization conducting the survey will have access to it. Official reports should not include any specific mention of the identity of the farmer or the location of the farm. For farms undergoing outbreaks at the time of the survey, ask for permission to take photographs of any clinical signs of the outbreak when collecting biological samples. Permission is also needed to take photographs of potential labels farmers are using for any commercial feeds, chemicals, antibiotics or probiotics. No photographs should be able to identify the farm or any persons on the farm; the only photographs permitted are close-ups of dying or dead animals with clinical signs of disease and photographs of commercial product labels.

A survey or farmer ID is a unique identifier for each new survey that allows enumerators to access it later for revision if necessary. Each enumerator is given a unique letter for the entire duration of the project. This letter is followed by a unique number and the date when the survey is performed [format: A000X_year month day]. For example, if enumerator 1 is given the letter A and the enumerator's first farm visit is on November 25, 2019, the survey ID is A001_2019 11 25.

Section 3: Location

For the current version (v1.4), the list of countries includes Bangladesh, Cambodia, Egypt, Ghana, India, Malawi, Malaysia, Myanmar, Nigeria, Sierra Leone, Solomon Islands, Tanzania, Timor-Leste and Zambia. Selecting a specific country will automatically generate a list of the different regions and districts available. For new countries not in the list, region and district names will need to be manually entered in the source file.

Section 4: Units

Available currency options are loaded based on country selection. For example, selecting "Bangladesh" will load "BDT – Bangladeshi Taka" and "USD – United States Dollar" into the list. Enumerators and respondents still need to decide whether answers to economic questions will be in an international (USD) or local currency, so it is important to select the appropriate one. Enumerators and respondents need to agree on the correct unit of measurement for the surface area (e.g. acres, square meters, hectares, decimals). If a respondent's answers are in any other local units, enumerators must convert them into one of the units allowed in the survey. Each new currency not listed will need to be added manually to the file source code.

Section 5: Farmer and production system information

This section is for collecting information on the farmers and their farms that are being surveyed. Enumerators should include the name of the farmer/farm, farm address and details of the person being interviewed, such as gender, age, education and contact information.

Note that for "first year of activity," there are multiple options; just scroll up or down to select the right year.

There are also questions on the number of employees, both male and female, and how many are working full or part time.

Note that for the "farming system" section, a homestead or backyard pond is one that is in direct contact with human habitations, while a commercial farm is a larger operation, whose main purpose is generating profit.

The next few questions of this section focus on getting data on the total number of the ponds or cages, total size of the farm, water spread area and pond type, such as earthen or concrete.

"All-in all-out system" means that a farmer stocks at a specific time of the year (e.g. March) and harvests the entire crop later in the year at a specific time (e.g. August) followed by a fallow period when the pond is emptied (e.g. September–December) before the next farming cycle. The unit of measurement here should be per production cycle. As opposed to all-in all-out system, farms on a continuous cycle operate their ponds for years without drying them, so the unit of measurement here should be yearly.

To standardize data collection between enumerators and across farms, it must be clearly defined whether input and output information in this survey is for a completed production cycle or the last completed year (not ongoing and incomplete production). This will apply to both all-in all-out systems (break between production cycles) and for continuous production.

The following is an example defining 12 months of completed production (2018):

A farmer starts an all-in all-out production cycle in January 2018. He prepares all his ponds until the end of February followed by the first stocking for the first production cycle starting early March and harvests his first production cycle at the end of July. That same farmer restocks in August and harvests his second production cycle at the end of December. In this case, then the past 12 months of a completed production cycle run from January 2018 to the end of December 2018. The same would apply if that farmer was on a continuous production cycle. The enumerators for that farmer would need to define that 12-month period with the farmer.

For the following sections, enumerators will need to continue to collect information for that same time period as defined above for the all-in all-out system question: feed and fertilizer, stocking information, water quality, biosecurity, baseline mortality records or dead fish handling, unusual tilapia mortality and economics.

Section 6: Water management and practices

This section is for gathering information on the main water sources used for farming tilapia, such as surface water (municipal town water), ground water (via bore), irrigation canal, nearby farm water, river water, rainwater and lake water. Questions focus on the management of the water sources, such as replacing or adding water to ponds and the number of days per culture year that the water is replaced or added (percentage per day).

Section 7: Stock type

In this section, enumerators should start by collecting information about the species or strain of tilapia cultured on the farm, such as GIFT Nile tilapia, Abbassa Nile tilapia and Akosombo Nile tilapia. Determine if the fish are monosex or mixed sex, as well as where the fingerlings are sourced from—whether they are coming from a hatchery or nursery (include name and location), from the farmer's own stock, from the wild, from a middleperson or with incoming water. Also, find out how the tilapia fingerlings reached the farm: Did the hatchery deliver them directly? Did the respondent collect them directly from the hatchery? Are there intermediaries (middleperson) involved? Did they come from the farmer's own stock or fish introduced with incoming water? Information on the culture type (e.g. monoculture versus polyculture), as well as the cropping pattern, is also important. For tilapia monoculture, the cropping pattern options will be either only tilapia, farming shrimp then tilapia, farming tilapia then rice, or another combination. For polyculture, a list of co-cultivated species will appear. If necessary, please select multiple co-cultivated species, such as grey mullet, common carp and Indian carp, and indicate their overall percentage compared to tilapia. If a particular co-cultivated species is not in the list, select other (describe) and enter the common and scientific names. Enumerators can select both monoculture and polyculture if farmers are using both culture types on the same farm.

Section 8: Feed and fertilizer

(**Note:** for feed and fertilizer information, enumerators must collect data for that same time period as defined above for the all-in all-out system question). If respondents are using different commercial feeds, enumerators must enter the names of the feed companies and products. If respondents are using multiple feed types, list the relative quantity and cost for each. Collect information on the nature of any vegetable and animal products used for domestic scraps; the same goes for any ingredients used in homemade feed. In polyculture systems, estimation and differentiation of "total feed used" and "total feed cost" of commercial, domestic scraps or homemade feed consumed by tilapia from other species is difficult. Here enumerators must collect information on the total feed used and the cost for the entire farm regardless of the species.

For monoculture systems, the feed conversion ratio (FCR) is a powerful indicator for fish farmers because it allows them to estimate the amount of feed required in a growing cycle and, especially, for their overall profitability. The FCR indicates two things: (1) feed quality and feed management, such as how well the individual doing the feeding is able to judge when to stop feeding to avoid waste, and (2) how efficiently a fish species uses and converts nutrients from the feed into weight gain. The FCR is a ratio of the feed given (kilograms) per weight gain (kilograms) of an animal. An FCR below 1 is a good indicator of high-quality feed and stewardship and is usually found during the early life stages of fish.

If farmers are using different fertilizers, enumerators should indicate each fertilizer type, whether it is organic, inorganic or other (describe). Describe the source, the quantity used and the cost of the manure (e.g. poultry and cow) for any organic fertilizers. Similarly, describe the type, quantity used and cost of any inorganic fertilizers.

Section 9: Stocking information

(**Note:** for stocking information, enumerators must collect data for that same time period as defined above for the all-in all-out system question.)

This section is for gathering information on the number of times farmers stock fish on their farm per production cycle (all-in all-out system) or per year for continuous production.

Enumerators must include all information pertaining to a farm (e.g. number of production cycles per year for an all-in all-out system or number of times tilapia are stocked on the farm per year for a continuous cycle) if the data is collected for a 12-month period.

Please enter the date (year-month-day) when tilapia were stocked, number of tilapia stocked, cost per seed, average size (centimeters), average weight (grams) and average stocking density (number per cubic meter). A farm may have one pond or several ponds, so the lowest and highest stocking densities are only applicable if a farm has more than one pond. If a farmer has restocked more than once, all the above information for each restocking event must be entered.

Section 10: Shared water body

This section is for collecting as much information as possible on shared water bodies between farms, including the distance (meters) to the nearest farm upstream or downstream of the river or the distance (meters) to the closest farm if the shared water body is a lake. Any collaboration in place between farms sharing the same water body on disease control should be described.

Section 11: Water quality parameters

(**Note:** for information on water quality parameters, enumerators must collect data for that same time period as defined above for the all-in all-out system question.)

Monitoring water quality regularly is critical, though most farmers will not be able to record any of the parameters, such as the dissolved oxygen or pH level of their ponds, because of a lack of access to appropriate equipment. If a farm has experienced mortalities, enumerators should ask the respondent to give the worst average water parameters (e.g. dissolved oxygen, temperature, ammonia, pH and salinity) within the 2-week period before onset of the outbreak. Inquire about the average water parameters during normal farming conditions. For farms that have not experienced abnormal mortalities, collect the water quality parameters under the worst farming conditions as well as during normal farming operations. Provide as much information as is available. This section will not be possible to complete if water parameters are measured but not recorded or not measured at all. Capture

additional explanations in the “other relevant water quality information” section.

Section 12: Biosecurity

This section is for gathering information on biosecurity protocols at the time of stocking, including vehicle “tirebatch” disinfection upon entry into the farm, fish disinfection, disposing of water used to transport fingerlings, no biosecurity protocol in place or any other type of protocols not listed.

Enumerators must collect information regarding what goes into the farm after the main stocking, especially for any restocking, whether any biosecurity measures are being used between production cycles (e.g. drying pond, liming pond, cleaning nets) and the duration of the fallow period, if applicable. Also, collect information if equipment or staff are being shared between one or more farms and ask about general on-farm internal biosecurity measures, such as vehicle disinfection, footbath, and hand or equipment disinfection. Ask if any service providers—such as harvesters, pond excavators, feed suppliers, veterinarians and Department of Fisheries officers or similar representatives—have visited the farm and if any of these biosecurity measures are being applied for their arrival and departure. For the final question, indicate any altered biosecurity measures implemented after a disease outbreak.

Section 13: Baseline mortality records and handling dead fish

(**Note:** for information regarding baseline mortality records and handling dead fish, enumerators must collect data for that same time period as defined above for the all-in all-out system question.)

This section aims to collect information on the normal average baseline mortality for average production at a farm. Enumerators need to describe how employees usually record fish mortalities on the farm or in neighboring wild environments—whether they maintain paper records, computerized records or no records at all. Indicate how frequently dead fish are removed from the farm—whether never, occasionally, daily or several times a day, every 2–3 days or weekly. Enter any methods used for disposing of dead fish, such as buried on or off the farm, burned, collected for discarding, discarded in a water body, sold for animal feed or fed to other animals

on the farm. Also, ask respondents if the baseline mortality on their farm is usually a major concern. If yes, include a detailed explanation.

Enumerators must spend sufficient time on this section, because critical information could arise on how diseases might be spreading within and between ponds.

Section 14: Treatments

(**Note:** for information regarding any treatments, including vaccines, chemicals, antibiotics and probiotics, enumerators must collect data for that same time period as defined above for the all-in all-out system question.)

Vaccination

This section collects information on the use of vaccination in farmed tilapia. Surveys in most countries will likely reveal either no vaccination or very limited use or access to tilapia vaccination. If respondents indicate partial vaccination of their stock or population, enumerators should pay special attention to the proportion or number of fish vaccinated (e.g. 100%, 75%, 50%, 25% or 10,000, 100,000 fish) in relation to the total stock. Indicate the route of administration, such as immersion, injection or orally mixed with feed. Include the name of the person or company producing and selling the vaccine, vaccine brand and which diseases the vaccine protects against. For the total cost of vaccination, it is important to know whether the input value is per production cycle (all-in all-out system) or on a per year basis (continuous farming). Include whether the fish were fewer than 3 months of age or older when vaccinated. At the end of this section, include additional details, if possible, such as if the fish were vaccinated before arriving on the farm or directly on the farm before stocking.

Chemical treatments

This section collects information on the number or type of chemicals used on a particular farm, how each chemical was applied (e.g. in feed, water or during the fallow period), and the treatment dosing rate, such as the mass of chemical per volume of water or day, the mass of chemical per kilogram of feed per day, or the mass of chemical per square meter per day. Enumerators need to collect information on the total amount of each chemical used for the same time period as defined above for the all-in all-out system question

(previous 12 months of completed production) such as the volume (liters) or amount (kilograms) used on the farm per year. Also, ask about the frequency and duration of the chemical treatment per year (e.g. three times a year during 1 week), when the chemical was applied (e.g. January and June 2018), why that particular chemical was applied and which diseases or problems were treated. Ask respondents who advised them on the use of that particular chemical and on the origin of each chemical being used. Enumerators also need to ask if the respondent thinks the chemical was effective or not and get a detailed explanation.

Antibiotic treatments

This section collects information on the number or type of antibiotics used on a particular farm, how each antibiotic was applied (either in feed or in water), and on the treatment dosing rate, such as the amount of medicated feed applied per kilogram of feed (percentage of bodyweight per day, or mass per liter of water per day). Enumerators need to collect information on the estimated quantity (kilogram) used per year for each antibiotic, as well as the frequency and duration of the antibiotic treatment per year (e.g. once a year for 10 days, during morning and afternoon feed rations), when the antibiotic treatment was applied (e.g. June 2018), why that particular antibiotic was applied and which diseases or problems were treated. Ask the respondents who advised them on the use of that particular antibiotic and on the origin of each antibiotic being used. Enumerators should also ask if the farmer thinks the antibiotic was effective or not and get a detailed explanation.

Probiotic treatments

This section collects information on the number or type of any probiotics used on a particular farm, how each probiotic was applied (either in feed or in water) and on the treatment dosing rate, such as the amount of probiotic applied per kilogram of feed (percentage bodyweight per day, or the amount of probiotic per liter of water per day). Enumerators must collect information on the estimated quantity (kilograms) used per year for each probiotic, as well as the frequency and duration of the probiotic treatment per year (e.g. for 3 weeks just after each stocking, during morning and afternoon feed rations), when the probiotic treatment was applied (e.g. 3 weeks in January 2018), why that particular probiotic was

applied and which diseases or problems were used. Ask respondents who advised them on the use of that particular probiotic and on the origin of each probiotic being used. Enumerators should also ask if the respondent thinks the probiotic was effective or not and get a detailed explanation.

Section 15: Unusual tilapia mortalities

(**Note:** for unusual tilapia mortalities information, enumerators must collect data for that same time period as defined above for the all-in all-out system question).

In contrast to section 13, this section aims to collect information on unusual or abnormal mortalities. Enumerators must inform respondents that this question covers unusual mortalities for both on-farm and wild fish. If respondents have not experienced unusual mortalities, whether on their farm or in nearby wild environments, then this question leads to section 17 on economics.

For on-farm mortalities, enumerators must collect information on the date of the most recent onset of increased mortalities. Ideally, this should include the exact date (year-month-day), total number of ponds or cages affected and which tilapia stocks were affected, whether newly introduced, older fish or all stocks. If co-cultivated species also experienced mortalities, listed the name of the species as well as the species that died first and the nature of the mortality, whether it was sudden, gradual, occasional or multiple events. Also, note the duration of the mortalities, such as within a day or within a week. In the case of continuous production, determine whether the outbreak is over or still continuing, along with the percentage of total mortalities. Ask respondents if they observed any variation in mortalities between ponds or cages and, if so, indicate the lowest and highest levels, and record the average, minimum and maximum weight of dead tilapia. Include any observations of significant stress factors (e.g. transportation stress, handling stress, grading stress, treatment stress, weather stress and water quality stress) that might have happened 2 weeks prior to the onset of mortalities. Describe the nature and duration of each stress as well as any evidence of pond-to-pond spread of mortalities. The final parts of this section allow enumerators to add other information on mortalities and any treatments. Describe any unexplained mortalities

and information on mortalities that respondents experienced in previous production cycles. Ask respondents if they applied any treatment following unusual mortalities, which ones and whether the treatment was effective or not. Include a detailed explanation. If the treatment was advised, details are needed; if not, ask farmers how did they decided to use it.

Section 16: Disease and laboratory investigation

(**Note:** for disease and laboratory investigation information, enumerators must collect data for that same time period as defined above for the all-in all-out system question.)

This section aims to collect valuable information on prominent clinical signs observed. Some of the most common ones include lethargy, loss of appetite, ocular alterations (such as eye exophthalmia or opacification), skin erosions with hemorrhagic lesions, skin discoloration, open wounds, abdominal distension or swelling, scale protrusion or detachment, anaemia with abnormal gill paleness, fin rot and abnormal behavior, such as swimming at the surface, swirling or gasping for air. It is a good idea for enumerators to spend time describing these clinical signs to respondents and to record any particular ones that they recall from the disease outbreak. As examples, enumerators can show respondents pictures of the major clinical signs in tilapia provided for the survey. Note that the pictures can be used to describe similar clinical signs occurring in other fish species as well.

Ask respondents what the samples collected were for, such as histology, polymerase chain reaction, bacteriology, virology, immunology, blood chemistry, serum for enzyme-linked immunosorbent assay or parasitology. If they recall the nature of the samples collected during the outbreak investigation, indicate which ones from the list of options, such as water, sediment, whole fish, brain, gills, blood, anterior kidney, posterior kidney, spleen or eyes. Other samples could be worms, insects, frogs, cow dung, etc.

If the cause of the mortalities has been determined, then record the diagnosis and the laboratory conducting the analysis, whether it is a private independent laboratory, in-house

laboratory, university laboratory or another service provider. In addition, include the name of the individual who took the samples on the farm and the name of the laboratory conducting the analysis and doing the final reporting. If the samples were collected directly by the farmer, please make sure to record that information with as much detail as possible.

In addition, and independently of the disease investigation that would have been carried out by a health professional, collect information from respondents on the assumed cause of mortalities. These could include heavy rainfall, water temperature, water pollution or even a particular bacterial or viral infection (such as *Streptococcus agalactiae* or TiLV) based on previous experiences.



Nursery worker spreading feed at a research pond for the rohu genetic improvement program.

Section 17. Economics

(**Note:** for economic information, enumerators must collect data for that same time period as defined above for the all-in all-out system question.) In this section, enumerators collect information on total tilapia production (convert metric tons to kilograms), estimated loss of tilapia production (kilograms) and the expected farm gate price of lost tilapia per kilogram as a result of baseline and abnormal mortalities. Indicate where fish are sold (e.g. own consumption, local market, regional market, export), as well as the type of retailing (e.g. larger stores, own outlets, intermediaries). Include the estimated average cost for each kilogram of tilapia produced.

Determine whether there are any costs associated with restocking as a result of tilapia loss (baseline mortality or unusual mortality), sanitation, biosecurity, disease screening, chemotherapeutics, veterinarians or consultants, disease investigation and disposal of dead fish. Ask respondents if they have generated a profit in the past 12 months of completed production. Also, ask them if they have insurance to cover baseline mortalities or large losses, and describe the nature of those policies if they are available. Indicate the impact level (e.g. negligible, low, moderate, high, severe) that the baseline mortality or disease outbreak has on worker job security, lost opportunities (e.g. family access to schooling and health services), the reputation of the farm and impact on trade. Be sure to describe any impacts mentioned. Include any additional financial information (e.g. major investment, bank loan) in the last comment box of this section.

Section 18. Feral/wild tilapia mortality

In this section, enumerators should ask respondents if they recall any unusual mortalities happening in wild tilapia. If none is reported, the survey is over. For feral/wild tilapia mortalities, collect details (e.g. mobile number, email and occupation) on the individual or institution reporting the case, if available. Indicate the date of first observed mortality, the nature of the water body where it took place (e.g. river, estuary, reservoir or lake), name of the nearest village and the names of the tilapia species and any other species affected. Indicate the nature of the mortality, whether it was sudden, gradual or occasional. Ask about the duration of the wild mortality event and whether it happened within a day, week, month or more

than a month. Record the average weight (grams) of dead fish, number of dead animals and if the individual reporting the case took photographs of any clinical signs. Record as much information as possible on potentially important environmental abnormalities (e.g. heavy rain, low water quality, high water temperature) before or during the wild mortalities. Finally, indicate the likely impact wild tilapia mortalities have on the business and on the household of the respondent. At the end of this section, enter any other relevant information pertaining to wild mortalities.

Section 19: Other relevant information

Add any additional relevant information about tilapia farming not covered in previous questions.

Section 20: Supporting photographic evidence

(**Note:** this section is for mortalities and labels for feed, chemical, antibiotics, probiotics, etc.)

In this section, enumerators can take photographs of clinical signs of moribund and dead fish if mortalities are occurring at the time of the survey. Also, take photographs of labels for any commercial feed, chemicals, antibiotics, probiotics used, making sure to capture as much information as possible. Note that photographs must be high quality (good focus) and show valuable information. No photographs should be able to identify the farm or any persons on the farm.

Section 21: Additional notes

This is where enumerators can input all their handwritten notes.

Section 22: End of survey

- Thank the respondent at the end of the interview.
- Request the respondent to sit in or near their home for a few more minutes to make sure you have recorded everything correctly.
- Let the respondent know that you may need to ask a few more questions.
- Check that all pages of the questionnaire have been filled out.
- Record any information about the farmer or respondents that the study coordinator needs to know.

4. Part 4: Survey for integrated assessment of aquaculture systems performance

4.1. The questionnaire, question-by-question

Core modules

General information and identification details

A01–02. The tool has been programmed to automatically record the date of interview, as well as the time the interview begins.

A03–A08. Enumerators begin by selecting the answers to these questions from a drop-down list and then writing the unique household identification number (HHID). Each household has a unique identifier which is available on the household listing form. The supervisor will provide this information before you proceed to the household. Please do not change this identification information—only the supervisor can change this information. In that case, the project's PI will be informed immediately about the change and the reasons for the amendment. Record the HHID as given by the supervisor—do not change the HHID. Clearly write down the name of the respondent. The respondent is the person you will interview. That person is the one who is able to provide responses to the questions about the fish farm as well as the household. It is important to interview the same person from start to end for the purposes of follow-up. Write down the respondent's phone number. This information is useful especially if the study is designed to have a follow-up.

A12. From the drop-down list, select your (enumerator) name.

Introduction and consent

The consent statement has been written to include the introduction. Read the consent statement aloud and allow the respondent to make an informed decision whether or not to voluntarily participate.

Ask what the respondent's role is in the fish farm and then select one from the list. Again, ask if the respondent is the primary decision-maker for

daily farm operations. If the respondent's role is "manager," questions related to the household roster may not be applicable.

In some cases, fish farms may be co-owned or joint-invested by multiple owners. Enumerators should try as much as possible to interview the joint managers or owners together. Someone might have applied fertilizer or feed or any other input without informing the other. It is also likely that the other person may not know how much exactly was applied by his co-investor. It is important to avoid as much as possible underestimating or overestimating costs and revenue. For the rest of the information, record the details of the person with the largest share of investment in the pond and write in the comments about this situation so that it is taken into account during the analysis. If during the interview the respondent mentions a co-managed pond, record the details of the other person involved (farmer details, assets, risks, information, credit, etc.) and interview both of them together—but only for information related to the pond that they share.

Household composition

This module contains basic information about the respondent, such as name, sex and age, as well as information about the household.

In this survey, a household is defined as people who live together and share meals and resources for at least one cycle per year. This may include non-blood family members who stay and eat with the family (laborers, servants, lodgers), but they must meet both requirements—living together for one season and sharing food. Members who live somewhere else and only come to visit and bring money are not considered household members.

C01. Record the first name and last name of each household member separated by a single space. If it is appropriate to also record a middle name, then add this after the first name. Make sure the

respondent is a member of the household. The household head and/or spouse should be the main respondent (or another adult knowledgeable of household activities). The household head is the member of the household whose authority is acknowledged by other members and who makes most of the major decisions.

C02. Relationship to the household head:

How is each of the household members related to the household head? Pay attention to the codes—some household members may not be blood relatives.

C03. Age: Age of the household member. In some cases, you may first ask for the year of birth then calculate their age in completed years. You may also have to refer to important historical events and probe for the year of birth.

C04. Sex: Record the sex of the household members. For the respondent, do not ask, but instead observe and record the sex.

C05. Marital status: Record the marital status of each household member. Please note that if a member's relationship to the household head is "spouse," then marital status cannot be "single."

C06. Education: Level of formal education completed excludes nursery school or pre-unit and should include all education (vocational training, university, college and master's programs). Enumerators should discuss how this question should be phrased to capture all the necessary information. Note that it asks for the highest level of formal education completed. If a member is in the process of completing a certain level of education, please write the last completed year.

C07. Chronic illness: Households with a significant proportion of its members chronically ill may be disadvantaged and more vulnerable to poverty than those without sick members. Furthermore, resources may be diverted from productive activities to caring for the sick. For the purpose of the survey, chronic illness is considered as a condition whereby a household member was very sick and so could not engage in any active work. Chronic illness usually occurs for a prolonged period of time.

Aquaculture production

Aquaculture experience and facilities

D01–D02h. Aquaculture experience: Ask respondents to recall the year they started fish farming. Then ask whether the household is currently practicing aquaculture. Next, ask if there was a period of time when the household stopped practicing aquaculture since the household started practicing aquaculture for the first time. Use this information to answer D01–D03. Proceed to ask the type of fish farming practiced (D04). Pay attention to the codes and note that the respondent may indicate another type of farming not specified there. In that case, write the answer clearly in D04 other. Then ask about the types of fish species farmed. Does the household practice monoculture or polyculture? Ask respondents whether they culture more than one species of fish in the same pond or facility. Enumerators should explain the practice of integrated agriculture/livestock aquaculture: for example, dike cropping, combining agriculture and aquaculture production in the same land, using inputs and or by-products from agriculture for aquaculture production or vice versa. Next, specify the form of integrated aquaculture practiced. Finally, ask about the total amount of land owned by the household in the study's reference period and the proportion that was used for fish farming. Pay attention to the unit of land. Note that respondents may misreport the amount of land owned if they lack trust in the motive of the survey and the enumerator—for example, if they fear that land will be taken away or that the government will impose a tax on their land. Carefully and clearly explain the objective of the survey.

D02i. Perceived/desired unconstrained land allocation:

This part is helpful to understand farmers' intentions and perceived importance of aquaculture relative to other activities. It therefore asks, "If the household could freely redesign how its current land is used, what are the proportions it would use for the different activities?"

In D03 enumerators begin by asking for the number of cycles that were stocked and completely harvested during the study's reference period. Do not jump to questions first when coming to this section. Instead, introduce and explain the section before proceeding. Read the

introduction aloud to the farmers. Tell them you are asking about fish farming activities for the cycles and ponds or facilities that were stocked and harvested completely during the reference period. Please be clear that nursery ponds that are only used for nursery purposes are not being targeted. Nursery ponds are only for raising fingerlings to a larger size after which the fish are then removed and transferred to grow-out ponds. In some cases, a nursery pond may also be a grow-out pond. After the fingerlings have been distributed to other grow-out ponds, some will remain in the nursery pond and eventually grow out and be harvested. If this is the case, this type of nursery pond should be counted as a grow-out pond and information about it should be captured. For each cycle, ask for the species of fish stocked.

Then for each fish species, ask the following:

- number or pieces of fingerlings stocked
- weight (grams) at stocking
- average length (centimeters) at stocking
- price of fingerlings
- quantity harvested
- weight at harvesting
- quantity consumed (recorded in the same unit as quantity harvested)
- quantity sold (also recorded in the same unit as quantity harvested)
- price per unit of fish sold
- the form in which the fish were sold
- the main buyer
- distance (kilometers) to the point of sale
- main mode of transport to the point of sale
- the proportion out of total production that was neither consumed nor sold because of postharvest losses.

Feed use and cost

This information is cycle specific. Enumerators should first introduce the section. Next, ask for all the types of feed applied during the specific cycle. For each type of feed, probe for the source, distance (kilometers) to the source, quantity applied, price per unit of feed (for bought feed), the main mode of payment (cash, credit, both), the

cost of transporting feed from source to farm, and the percentage of protein in the feed. Please note that these questions may be asked at different stages of fish growth (e.g. juvenile, fingerlings, table fish). Also note that respondents may use their own vehicle or motorbike to transport feed. In that case, please record the cost of the fuel used. In cases where the farmer hired a car or motorbike, record the cost and ask if they bought fuel. Information about the percentage of protein is usually indicated on the bag. Ask the respondent for the bag or package that contained the feed.

Fertilizer use and cost

This information is cycle specific. Enumerators should first introduce the section. Next, ask for all the types of fertilizer applied during the specific cycle. For each type of fertilizer, probe for the quantity applied (be keen to specify the unit), the price per unit bought and the cost of transporting the fertilizer.

Chemical use and cost

This information is cycle specific. Enumerators should first introduce the section. Next, ask for all the types of chemicals (e.g. lime, oxygen tablets, antibiotics, growth hormones) applied during the specific cycle. For each type of chemical, probe for the quantity applied (be keen to specify the unit), the price per unit bought and the cost of transporting the chemical.

Water exchange and sediment disposal

In this section, enumerators ask whether or not the respondent replaces the water in the pond or facility and, if so, the frequency. Then ask for the rate of water replacement and about sediment disposal.

If the respondent uses a pump for water replacement, although adding and discarding water can happen simultaneously, ask the farmer how many hours (x) it takes to operate the pump each time. Then ask how many hours (y) are needed to fill the pond from empty using that same pump. Divide the pond's depth by "y" then times "x" to get the depth (feet or meters) of how much water is replaced.

Labor use and cost

This information is cycle specific. Enumerators should first introduce the section. It is divided into three main types of labor: family, hired part-time and hired full-time. For each type of labor, ask about all the types of fish farming activities undertaken in each cycle (e.g. pond preparation, grading and stocking, feeding, fertilizer and chemical application, harvesting, selling). For family labor, ask (for each activity) which household members work. Again, note that household members may or may not be relatives. For each household member, ask for the number of days worked, the number of hours worked in a typical day, and also for the wage rate, separately for men and women. (Information about part-time and full-time labor has been disaggregated into male and female labor.) If the respondent estimates labor in a piecework rate, this must be converted to a daily or hourly wage.

Additional expenses in aquaculture production

Beyond feed, fertilizer, chemicals and labor, there may be other expenses incurred by the farm household. Such expenses may include the cost of renting land, purchasing equipment and hiring a consultant or manager. It is important to find out whether these additional expenses were incurred for specific species of fish or whether they were general expenses for all species, as well as the cycle in which the expense was incurred and what the total cost was.

Fish mortality rate

This part collects information about fish mortality during the 5 years preceding the survey. It specifically asks for the causes of mortality in each year, actions taken to cope with or address the mortality, species of fish lost because of abnormal mortality and an estimate of the amount and monetary value of fish lost as a result of abnormal mortality. Clinical signs are used to guide the enumerator and the respondent in case the cause of abnormal fish mortality is disease. Enumerators must be sure to describe what abnormal mortality means for each respondent. Abnormal mortality generally means a loss of fish that makes the farmer worried. An example of this would be if a farmer loses 5% of his fish at once; however,

if the 5% is lost, say, over a span of 9 months, it should not be considered as abnormal mortality. Abnormal mortality can also mean a loss of fish that starts and increases in intensity, leading the respondent to worry about the situation.

Other questions

Farmers' perceptions and adaptation to climatic shocks

Like diseases, climatic stress is also a shock to aquaculture production. In this section, enumerators should ask respondents for their perceptions of climatic shocks and the adaptation measures implemented in their aquaculture to increase resilience. Ask for current adaptation, but also planned future adaptation. It is common for farmers to adopt and disadopt innovations, so it is necessary to assess farmers' adoption and disadoption of adaptation strategies and probe for reasons.

Food consumption and other consumption

Beyond productivity impacts, aquaculture may affect the food consumption and well-being of households. This section begins with enumerators asking respondents to describe a typical food year for their household. Ask respondents to indicate months when they tend to source food from their own farm and months when food is sourced from outside the farm (e.g. from the market or through borrowing). Respondents should also describe months when they tend to have sufficient food for their households and months of food deficit. Next, ask respondents to indicate the different food groups that their household members consumed in the past 7 days. This information is used to compute the household's dietary diversity score. Next, ask respondents whether they ate fish in the 7 days preceding the survey and, if so, which types. For each type, ask for the form in which the fish was eaten, the number of days out of the past 7 in which that type of fish was eaten, the source of the fish, and the members of the household who ate it.

It is also necessary for enumerators to capture expenditures on durable and less durable items. Expenses for the latter are measured for the previous month before the survey, whereas expenses for the former are estimated for the past 12 months.

Food safety and willingness to participate in aquaculture certification

Enumerators should ask about the respondent's perceptions on food quality or safety in fish, sources of information on food safety, current awareness and participation in aquaculture certification for safety, willingness to participate (for those unaware of aquaculture certification) and perceived benefits and disadvantages of participation in aquaculture certification.

Information and credit

Access to credit is important to ease liquidity constraints in aquaculture production. This section captures demand for credit and whether such demand is actually met. In addition, enumerators must ask respondents to indicate whether any member of their household participated in an aquaculture production group and the types of services received. Such a group can be a commercial fish farming company, community-based production group or union, an NGO or a government project. Finally, ask respondents whether any members of their household received information about expected weather conditions that was useful for managing their fish farming activities.

Risk preferences and attitude

People behave differently in different situations. Farmers' adoption behavior may be affected by their preferences for risk. Using a scale from 0 (not prepared to take risks at all) to 9 (fully prepared to take risks), enumerators need to ask respondents to rate their willingness to take risks. Make sure to show the respondent the risk-scale chart.

Housing and assets

Housing: This section collects data about housing characteristics. From the list, enumerators should select the material used for each part of the house, including roof, walls and floor, and specify which materials are not available in the selections. Ask the respondent if the house has a toilet and what type it is. Next, ask what the water source is for drinking and domestic and the distance in walking minutes to it. Then ask the type of cooking fuel used in the household and specify whenever there is other type. Lastly, ask the respondent about the type of lighting in the household.

Assets: This section collects details about assets that the household owns. Read out clearly from the list and tick all assets that the respondent mentions. Please specify other assets that may be missing from the list provided, and then follow up with a series of questions for each asset. Ask the respondent the amount owned for each asset.

Subjective wealth, well-being and happiness/aspirations

This part asks respondents about their perceived subjective wealth and well-being as well as personal aspirations.

Getting GPS coordinates

After the last question in the questionnaire, enumerators need to ask to record the GPS coordinates of the household by clicking the Start GeoPoint button. Make sure the GPS sensor of the device is turned on, and move outdoors if the device cannot detect the satellites. Wait for the device to detect the satellites until the GPS accuracy is less than 50 m (preferably 10 m), then click Save GeoPoint. Explain to the respondent that you are taking the location of the household while waiting for the GPS to load.

Finishing the interview

- Thank the respondent at the end of the interview.
- Request the respondent to sit in or near their home for a few more minutes to make sure you have recorded everything correctly.
- Let the respondent know that you may need to ask a few more questions.
- Check that all pages of the questionnaire have been filled out.
- Record any information about the farmer or respondents that the study coordinator needs to know.

5. Concluding remarks

In this document, two examples are used to demonstrate the design and implementation of digital surveys in aquaculture. The document shows that there are core modules that are common in both surveys and indeed in many surveys within aquaculture. There are also specific modules that tend to be unique in each survey or research area. We acknowledge that some questions may be present in both surveys under the specific module sections and that if implemented jointly, there would be duplication. There is a need to identify questions that are similar in both tools to avoid repetition, especially when both surveys are administered on the same respondent. At the same time, we recognize the need to allow flexibility in designing the tools, especially for researchers who would want to implement the surveys separately. As a potential next step, the authors will work toward identifying similar questions in the specific modules section and harmonizing the framing of questions. The examples provided here illustrate how the surveys can be implemented separately.

Notes

- ¹ Although we make reference to ODK, the steps described here can be generalized to other digital survey tools (e.g. Survey CTO, CommCare, etc.).
- ² Learn.ink (<https://app.learn.ink/>)

Appendix I. Field survey checklist

- Letter of authorities (TL only) ID badge
- ID badge
- Team member and list of important contacts
- List of farmers (sample) to be interviewed
- Mobile phone
- Tablet
- Power bank
- Notebook and pen for drawing farmer/farm map and taking notes
- Sample list
- Map (TL/field assistant)
- Spare device (TL/field assistant)
- Paper version of questionnaires (in case of device malfunction)



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PROGRAM ON
Fish
Led by WorldFish

About FISH

The CGIAR Research Program on Fish Agri-Food Systems (FISH) is a multidisciplinary research program. Designed in collaboration with research partners, beneficiaries and stakeholders, FISH develops and implements research innovations that optimize the individual and joint contributions of aquaculture and small-scale fisheries to reducing poverty, improving food and nutrition security and sustaining the underlying natural resources and ecosystems services upon which both depend. The program is led by WorldFish, a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.