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OUR FUTURE PILOT¹

GUIDE NO. 2

Participatory Mapping:

Creating Knowledge for Coastal Spatial Planning in Vietnam

Toolkit for Participatory Coastal Spatial Planning at the District Level



¹ This pilot was developed and implemented through the Tenure and Global Climate Change (TGCC) Program.

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Acronyms and Abbreviations

aGPS	Assisted Global Positioning System
CSV	Comma-separated Values (file type)
DPI	Dots per Inch
GB	Gigabyte
GLONASS	Global Navigation Satellite System
GPS	Global Positioning System
ID	Identification Number
PCRA	Participatory Coastal Resource Assessment
TGCC	Tenure and Global Climate Change
USAID	United States Agency for International Development

Toolkit for Participatory Coastal Spatial Planning at the District Level

The Government of Vietnam is highly interested in improving coastal forest management, especially for mangrove forests. Decree 119/2016/ND-CP, approved by the Government of Vietnam in August 2016, focuses on policies for the sustainable management, protection, and development of coastal forests to support adaptation to climate change.

The *Our Coast – Our Future* pilot project² promotes the design of coastal spatial scenarios and a spatial implementation plan as part of a participatory coastal spatial planning process that enables the adoption of a holistic approach to coastal forest management. By working with coastal communes, the creation of a district-level spatial implementation plan enables coordination and consensus over how to manage the coastal landscape to achieve the sustainable management of coastal forests.

The development of coastal spatial scenarios explicitly considers the relationship between forest rehabilitation and management, and multiple other uses of the coastal landscape for infrastructure, livelihood support, and income generation. By identifying the complementarities and conflicts between these different current and future interests in the coastal landscape, an integrated coastal resource management approach can be set into motion.

This **Toolkit for Participatory Coastal Spatial Planning at the District Level** promotes a tenure-responsive form of coastal spatial planning by identifying ways to improve the sustainability of coastal natural resources focusing on issues of access, use, management, and exclusion rights to specific resource areas. Once a spatial implementation is developed, the stage is set for creating a collaborative approach to mangrove management with key local stakeholders. Altogether, this provides an effective way of improving the sustainable management of vital coastal resources such as mangrove forests.

The **Toolkit for Participatory Coastal Spatial Planning at the District Level** is composed of three parts:

- a. *Guide No. 1: Participatory Coastal Resource Assessment: Developing Commune Coastal Profiles in Vietnam.*
- b. *Guide No. 2: Participatory Mapping: Creating Knowledge for Coastal Spatial Planning in Vietnam.*
- c. *Guide No. 3: Building Coastal Spatial Scenarios in Vietnam: Supporting Planning in Coastal Landscapes at the Local Level.*

These guides are available in both Vietnamese and English languages.

² This pilot was developed and implemented through the Tenure and Global Climate Change (TGCC) Program. See: <https://www.land-links.org/project/tenure-global-climate-change-vietnam/>.

I. Introduction

I.1 Purpose: Mapping Vietnam's Coastal Landscapes at the District Level

In Vietnam, many organizations and communities have worked with the local government to increase mangrove forest areas and build a coastal buffer that protects their coastlines. These efforts to expand mangrove areas have been largely successful. Mangroves support local aquatic productivity and help with both adaptation and mitigation measures in the face of climate change. In the face of growing global and national recognition of the importance of mangrove forests, the Government of Vietnam issued the Decree No. 119/2016/ND-CP in August 2016 in order to provide policies on sustainable management, protection, and development of coastal forests to support adaptation to climate change.

In designing approaches to protect and increase coastal forests such as mangroves, it is essential to develop an integrated and inclusive approach to mangrove forest management that considers unique characteristics not involved with terrestrial forest management. The complexity of mangrove and other coastal forest ecosystems requires a careful understanding of not only the ecological dynamics but also the diverse types of resource uses communities make within such landscapes as well as how they are managed. In the *Our Coast – Our Future* pilot project, *Guide No. 1* of the **Toolkit on Participatory Coastal Spatial Planning at the District Level** helps communities and the local government carry out a Participatory Coastal Resource Assessment (PCRA) so that an analysis of the resource types, conditions, users, and governance and tenure arrangements can be developed. This knowledge is presented in the form of a Commune Coastal Profile, which provides a detailed understanding of the current conditions within the coastal landscape in order to develop spatial visions and scenarios for the future. Some of this knowledge is best collected and visualized in a geospatial form so that the question of who is using which resources in specific locations becomes clearer.

Guide No. 2 focuses on this participatory mapping component. A set of digitized maps are prepared on identified themes to support the participatory process for identifying a set of spatial scenarios for the future. Where such digitized maps can be prepared, they become part of the Commune Coastal Profile created with the help of *Guide No. 1*. Based on the knowledge generated from *Guides No. 1 and 2*, the next step focuses on how to develop an overall spatial vision and scenario for the local coastal landscape. This involves identifying a range of alternative spatial scenarios from which one spatial scenario is selected for developing a spatial implementation plan. This is covered by *Guide No. 3: Building Coastal Spatial Scenarios in Vietnam*.

By following these three sequential guides, the best way to manage the local coastal landscape through a holistic understanding of the interactions between different livelihoods, economic development, and forest conservation needs can be identified. Through such an integrated approach, the likelihood of implementing successful interventions is increased. Such a coastal spatial planning process also provides the framework within which the design of mangrove management can be carried out.

While Vietnam has been actively engaged in marine or coastal spatial planning at the provincial level, the task of developing detailed, district-level management plans for coastal areas works best by drawing on the multiple forms of knowledge of local residents and stakeholders at the commune and district levels through a participatory approach. This engagement is important for four reasons: 1) local community knowledge is interlinked with remote sensing knowledge about the coastal landscape, 2) future visions and scenarios for the coastal landscape scale are developed through participation from all affected coastal resource user groups, 3) implementation of interventions becomes effective through active decision-making among all stakeholders, and 4) local data collectors are trained so they can continue to collect information that helps to monitor and update progress in the future.

This document (*Guide No. 2*) provides step-by-step information on creating a set of digitized maps through a participatory, low-cost, and rapid process for obtaining key information on the resource types, conditions, users, and governance and tenure arrangements within the coastal landscape at the commune and district levels. Where it is possible, gender-differentiated information is also collected. The aim is to ensure all key groups of users and managers of the local coastal landscape are involved in contributing to the collection and validation process of the geospatial data.

1.2 Mapping for the Commune Coastal Profile

For communities living in coastal bays, the local environment not only supports their livelihoods but also provides a cultural space within which generations of families have grown up. There is often a deep sense of appreciation for the local waters and mangrove forests that form part of their home. Mothers have taught their children to glean within the mangroves and mudflats, and fathers have taught children to fish by traps, nets, or boats. As the economy changes, dependencies on the local resources will adjust over time; some will engage in seasonal migration for work in larger cities, some will look for local wage labor opportunities, and others will develop their own new businesses. Women will increasingly become owners or workers in new commercial enterprises such as aquaculture, fishing, and clam farming.³ As the transition in economic and ecological conditions takes place, coastal spatial mapping and planning can help ensure that the economic and environmental benefits local communities enjoy today and in the future can be properly supported.

In any given coastal landscape with coastal forests such as mangroves, there are multiple types of users drawing upon varied aquatic and land-based natural resources to maintain their food needs and generate income. The coastal forests and their associated ecological areas such as mudflats, seagrass beds, and reefs contribute to ecological wellbeing and the richness and diversity of the local resource supply. Mangrove forests, for example, not only protect the coastal infrastructure and lands from storms and sea-level rise, but also provide the nutrients and habitat for a wide range of

³ See two briefs prepared by the *Our Coast – Our Future* project: a) Why gender matters in sustainable coastal resource management within Vietnam's coastal mangrove forests, and b) Positive steps towards gender equality in participatory coastal spatial planning. Case of Tien Lang district, Haiphong, Vietnam. Available at: <https://www.land-links.org/project/tenure-global-climate-change-vietnam/>

aquatic species such as fish, shrimp, crabs, and worms that form part of the local diet and provide income-generation opportunities.

Expert knowledge alone cannot allow us to understand this complexity of coastal landscapes. The people who live in the area and who regularly glean, fish, and raise shrimp have detailed knowledge of the changes over time both during an annual cycle and over the course of years. In order to improve livelihoods and protect coastal forests, the condition of the resources as well as the governance and tenure arrangements involved in managing these resources needs to be understood. Participatory mapping is a process that relies on low-cost, rapid, and accessible ways of collecting data from local residents in order to prepare a set of digitized maps on specific identified themes.

Once this geospatial knowledge is available, the process of deciding on both the future coastal spatial scenarios over the next few years and the longer-term vision can begin. There are many questions to consider while developing coastal spatial scenarios, including: To what extent should aquaculture pond areas be allowed to expand? In which areas can mangrove forests be extended? How should the disputes between clam-farming operations and fisherfolk be resolved? And how can growth in mangrove areas support eco-tourism? Once a scenario is selected and has been agreed to, the details of how to manage mangrove forests or organize clam farming can be focused on so that an integrated approach is set into motion. Maps form an essential component of the knowledge base for making such decisions about the future.

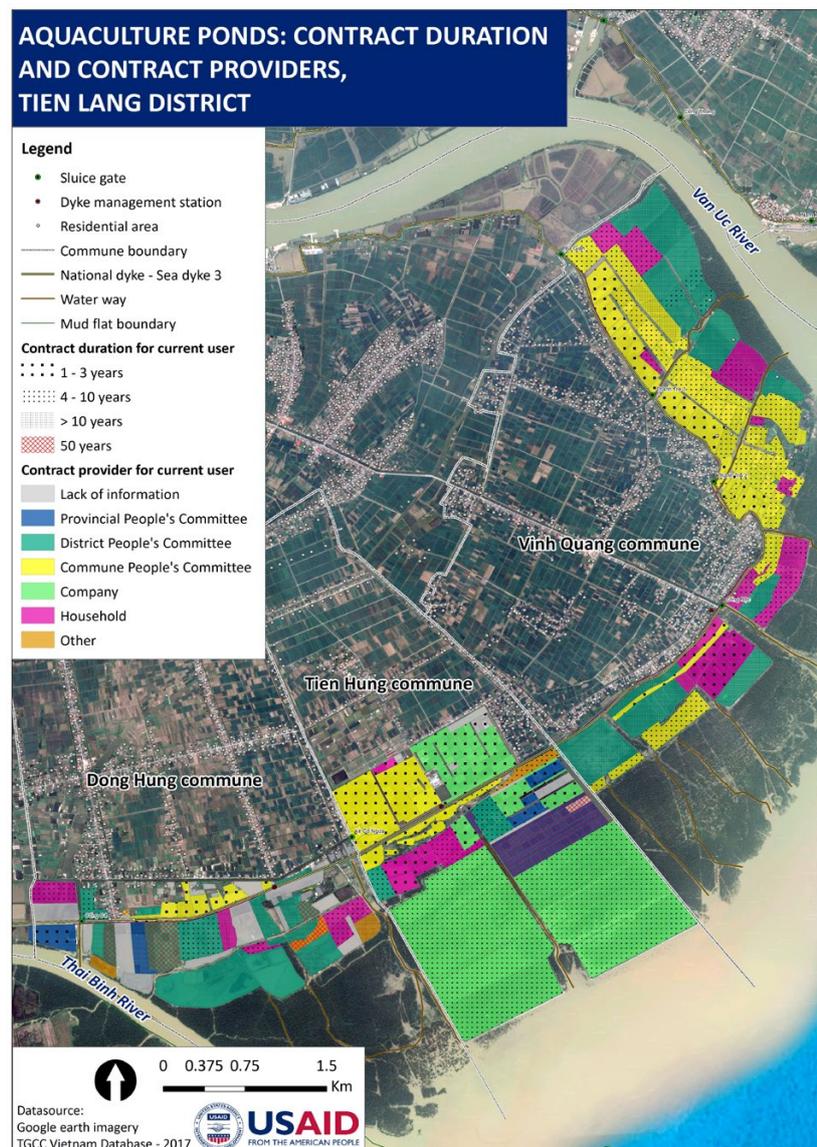


Figure 1: A digitized map showing the location of aquaculture ponds and the contract conditions across Tien Lang district's coastline

I.3 Key Components of Local Participatory Mapping for Coastal Landscapes

Most people living within communes have seen the formal maps available at the commune and district levels that contain basic information about the administrative boundaries and key features of the landscape. To manage the coastal landscape (particularly the mangrove forests) sustainably, more detailed information is needed about the location of the diverse types of natural resources and their condition, different types of users, and various governance and tenure arrangements that affect the design of an integrated management approach for effective resource regulation.

The geospatial dimensions of this information can be collected through a participatory mapping approach where local residents and key stakeholders become part of the data collection team and provide information on prevailing coastal conditions. Participatory mapping is a decentralized approach that provides rich data to support coastal resource planning and mapping. Importantly, it relies on near real-time data. Such a participatory local approach has been shown to be a cost-efficient approach for creating multiple layers of spatial data on the key characteristics of coastal landscape conditions.

This guide shows how participatory mapping utilizes mobile tools, such as global positioning system (GPS)-enabled tablets, and open source software in order to quickly and cheaply collect data through engagement of key resource users and managers to obtain a wide range of geospatial data. The collected geospatial information reflects the unique social and cultural understanding of the local landscape among residents.

The preparation of a set of digitized maps through a participatory mapping approach requires careful thinking about the types of maps that need to be prepared; how data is collected to create such maps; how data collectors are to be trained; and how data will be analyzed, validated, and presented. Effective facilitation of each of these steps is critical for the successful completion of each step so that the process can produce reliable data.

I.4 Filling in the Picture: Types of Data to be Collected

At the outset of the participatory mapping process, it is important for the core team to work together with local district and commune governments, mass organizations, local resource users, and other relevant stakeholders to identify what kind of data is necessary for developing a coastal spatial implementation plan for their district. In essence, the digitized maps produce a supplementary set of geospatial data that fills out the picture created through the PCRA process (by using *Guide No. 1*), and ultimately become a part of the Commune Coastal Profile.

A facilitated set of meetings with each of these local groups can help collate the key themes that maps should cover. These can then be distilled down to a finalized set of digitized data and maps to be prepared. It will be important to determine the geographical boundaries for the maps, including deciding, for example, if the area in front of sea dikes will be covered and how far out

from the coast the map will cover. In addition, it is necessary to identify which types of spatial and non-spatial data (such as photographs) will be collected for the creation of each map.

To guide this discussion, it is suggested that the individual maps cover the following key themes:

1. **Broad coastal resource types:** aquaculture ponds, mangrove areas, mudflats, fishing by net areas, fishing by boat areas, and clam farming.
2. **Mangroves and coastal forests:** details of areas covered by older and younger mangrove forests (natural and planted) and proposed rehabilitation areas.
3. **Pollution and conflict areas:** areas where conflicts exist between specific types of resource users, such as conflicts between boat fisherfolk and clam farmers or between gleaners and aquaculture pond owners.
4. **Set of maps on aquaculture ponds:** a range of maps covering a sub-set of data can be created, such as: a) production type (extensive or intensive); b) pond owner (commune, district, province, or outsider); c) pond contract holder (commune, district, province, or outsider); d) contract issued by commune, district, or provincial government; e) duration of contract; f) ponds under one contract holder; g) type of buyer of pond products (commune, district, province, or outsider); h) income level for pond; i) source of investment; j) permanent laborers per pond; k) female permanent laborers per pond; l) short-term laborers per pond; and m) female short-term laborers per pond.
5. **Fishing by boat:** a range of maps covering a sub-set of data can be created such as: a) number of boats per owner; b) boat power; c) number of fishing nets per boat; and d) fish catch trend per boat.
6. **Fishing by hand:** a range of maps covering a sub-set of data can be created such as: a) number of persons fishing in a given area; b) catch in terms of kilogram per unit of time; and c) number of days for fishing by hand per month.
7. **Clam farming:** a range of maps covering a sub-set of data can be created such as: a) area of clam farm; b) contract issued by commune, district, or provincial government; c) number of share-owners in a clam farming company; and d) harvest level (unit per time period).

1.5 Key Resources Needed for Participatory Mapping

Before deciding on whether to carry out the participatory mapping, it is important to understand the range of resources needed to complete all the steps involved successfully. The following provides a good indication of the key resource components needed to carry out the participatory mapping work at the commune and district levels.

1.5.1 People Resources

The process of participatory mapping is coordinated by a core technical team made up of a geographic information system (GIS) technician and a mapping facilitator. Each of these team members plays a distinct role: the GIS technician supports the design of the data collection

CURRENT CONDITION AND PROPOSED REHABILITATION OF MANGROVE FOREST, TIEN LANG DISTRICT

Legend

- Sluice gate
 - ★ Dyke management station
 - Residential area
 - Commune boundary
 - National dyke - Sea dyke 3
 - Water way
 - Mud flat boundary
 - ▨ Rehabilitation area
 - ▨ Weak survival of mangrove
- Mangrove forest**
- < 2m
 - > 2m
 - Channel/water way
 - Mangrove nursery



Datasource:
 Google earth imagery Z17
 TGCC Vietnam Database - 2017



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Figure 2: A digitized map showing the current condition and proposed rehabilitation areas for mangrove forests in Tien Lang District

process (including questionnaire design), the collection process itself, the processing and analysis of data, and the finalization of the set of digitized maps. The mapping facilitator helps organize the key groups of people involved in each of the steps for preparation of the maps, particularly by training data collectors then ensuring the accuracy of data collected in the validation stage.

In addition to the core team, the local data collectors (local government staff and community members) will interview key resource users within the landscape and obtain answers for the questionnaire to link non-spatial data (e.g., management practices, type of contracts, production yield, etc.) to the spatial features (e.g., boundaries of shrimp ponds, locations of gleaning, etc.). It is important to ensure that data collectors are technically proficient and understand the resource use issues within the coastal landscape. For this reason, it is useful to pair an older person, who has broad knowledge of coastal resources, with a younger person, who is usually more technically proficient in operating technology such as tablets.

1.5.2 Material Resources

There are two key types of material resources needed to undertake the participatory mapping process. One is concerned with the technical elements such as tablets, software, computers for processing GIS data, mobile projectors, and cameras. Another is related to the logistical elements of training data collectors, conducting data collection, and validating maps. To support this process, resources include arranging rooms for meetings and acquiring materials for facilitation, transport vehicles (motorbikes, boats, etc.) for data collection, bags for gear needed to collect data, and smaller items such as notebooks and pens.

1.5.3 Financial Resources

This is a critical element of project preparation. In addition to hiring the core team, the costs for hardware and software related to data collection and processing will form a large component of the total project cost. In addition, the costs for meeting rooms, training, data collection (including meals), and final validation workshops will all need to be factored in while preparing a budget for the participatory mapping work.

1.5.4 Time Resources

If the commitment of the local government staff and key resource users is strong, then the process can be undertaken in a relatively short space of time. The key issue is determining the set of maps needed as final products, and the time needed for training and data collection depending on the area to be covered by the maps.

The next section sets out the step-by-step process needed to prepare the digitized maps for coastal spatial planning.



Data collector interviewing a gleaner during the participatory mapping data collection in the field.

2. Step-by-Step Participatory Mapping

There are six key steps involved in creating the identified set of digitized maps (see Figure 3).

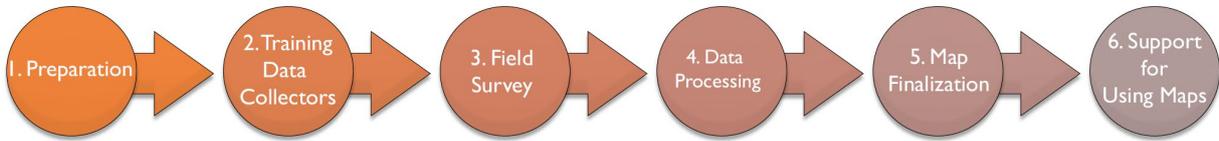


Figure 3: Step-by-step participatory mapping process

These six steps involve:

Step I: Preparation

Objective: To prepare the hardware, software, questionnaire, and base maps needed to carry out the participatory data collection.

Process: The preparation step identifies the right mobile hardware and software tools to help support data collection by local government staff and community members. [Technical Appendix for Step I: Preparation](#) provides guidance on hardware (tablet and computer) and software selection for carrying out participatory mapping data collection and processing. In this guide, information is provided regarding the use of the application GeoODK (Open Data Kit) for data collection, two options to support GIS data processing and map creation (ArcGIS and QGIS), and a range of other software needed for questionnaire development, data aggregation, and data conversion.

Once the hardware and software decisions have been made regarding the overall technical specification of the system for data collection, processing, and representation, the next step is preparation of the questionnaire. Draft questions should be prepared in conjunction with key



Training on use of GeoODK application in Tien Hung commune.

government officials, mass organizations, and key types of resource users. This set of questions then needs to be converted into a questionnaire format appropriate for the software chosen to collect data. [Technical Appendix for Step I: Preparation](#) provides guidance on how to prepare a questionnaire in Excel and then convert it into XForm for use in GeoODK.

In conjunction with developing the questionnaire, decisions need to be made on how the area to be covered will be divided into specific survey units that each data collection team will cover. The [Technical Appendix for Step 1: Preparation](#) provides guidance on how to create sub-units in the form of spatial polygons for survey purposes. During the PCRA process, a paper map was created with key data on habitat types, resource types, risks, and infrastructure. These maps need to be digitized and integrated into the base map so that this preliminary information provides a contextual understanding for developing the set of detailed digitized maps. [Technical Appendix for Step 1: Preparation](#) goes through the specific steps needed to carry out this conversion of data from paper map to digital map.

Step 2: Training Data Collectors

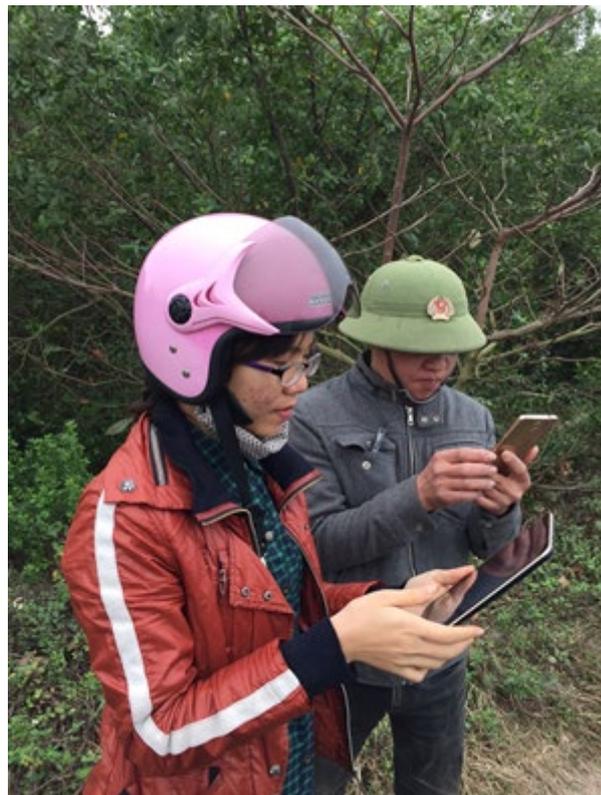
Objective: To provide training to data collection team members who can include local government staff, members of mass organizations, and representatives of key resource user types in the commune's coastal landscape.

Process: All team members will receive training on how to use data collection equipment and how to carry out field interviews to collect the data necessary for preparing the maps. The [Technical Appendix for Step 2: Training Data Collectors](#) sets out the training provided to team members on understanding how to use GeoODK applications to collect spatial and non-spatial information and how to administer the questionnaires during the field survey.

Step 3: Field Survey

Objective: To collect data efficiently from field-based interviews that will be used to create the full set of identified maps.

Process: In order to ensure that there is complete coverage of the coastal landscape area of interest, it is important to carefully design the data collection process in terms of data collection team number and members. The [Technical Appendix for Step 3: Field Survey](#) provides guidance on the key dimensions of field survey work that must be identified prior to the commencement of data collection.



Data collection in Tien Hung commune., Tien Lang district.

Step 4: Data Processing

Objective: To process the data obtained from the interviews in the field so that it can be analyzed and geospatially represented with the help of Excel and GIS software.

Process: Each of the categories of data identified in the questionnaire need to be processed and analyzed. The [Technical Appendix for Step 4: Data Processing](#) provides step-by-step information on how to process and analyze data in order to create a draft map for each of the key themes.

Step 5: Map Finalization

Objective: To validate the contents of the full set of digitized maps created through the participatory mapping approach.

Process: Although maps are created with information collected in the field, it is necessary to validate the draft maps with those who helped to create them. Through workshops and, where necessary, further field visits, the draft maps will need to be validated so they can be finalized and used for a range of purposes including coastal spatial planning. Organizing workshops within each commune will involve presenting the maps organized by theme. The participants can then be divided into small groups to work on validation of each set of maps on specific themes.



Display of the range of digitized maps created from the participatory mapping process.

Once revised, they can be provided to key government offices and local leaders for further use. These maps will also be used in the next step focused on developing spatial scenarios. This is covered in *Guide No. 3: Building Coastal Spatial Scenarios in Vietnam: Supporting Planning in Coastal Landscapes at the Local Level*. As needed, these maps can be updated over time so that they continue to accurately reflect the details of the local coastal landscape resources, users and governance arrangements.

Maps and information are verified through:

1. Field visits: The project GIS specialist returns to the field to verify any unclear location and/or information.
2. Workshops/meetings: At least one meeting per commune and one workshop per district are needed. Workshop and group discussion meetings are held to validate and revise maps/information both at district/commune level and with national/international experts. In these meetings: (1) participants are guided by the core technical team how to read the map, legend, and the information on the maps; and (2) participants should provide comments if they disagree with the map/information to ensure agreement on mapping revisions in each commune.



Group work to verify maps.

Once the maps are finalized based on this validation process, they are ready for dissemination and use. A set of sample maps is provided in the section [Sample Maps from the Participatory Mapping Approach](#) in the appendices.

Step 6: Support for Using Maps

Objective: To strengthen the capacity of relevant district and commune-level offices in using the maps and spatial data.

Process:

1. Develop a detailed guide to introduce list of outputs and data, as well as a step-by-step guide for basic functions.
2. Design a training program to provide basic knowledge and skills to implement the participatory mapping activities, to include:
 - a) General session
 - o A run-through of all processes and tools used in the project;
 - o List of project outputs and data;
 - o Instructions on how to access data and products; and
 - o Examples of how the data generated by the project can be used for management and decision-making purposes.
 - b) Technical session (including guidelines, examples, and exercises):
 - o Installation of GeoODK on smartphones/tablets and QGIS software on laptops;
 - o Examples of how to use GeoODK for data collection and develop basic questionnaires;
 - o Exercise on basic functionality (e.g., importing, editing, updating spatial data, and preparing maps) in QGIS/ArcGIS; and
 - o Data management systems for project results.

A set of targeted trainees are selected from relevant agencies including the Province People's Committee, District People's Committee, Commune People's Committees, Women's Union, and other agencies based on the following criteria: (i) knowledge of tablet and computer use; (ii) willingness to learn new tools; and (iii) basic understanding and knowledge of GIS and mapping data.



Discussion of key issues and problem areas during data collection for participatory mapping.

3. Next Steps

Once the full set of maps has been finalized and made available to key local stakeholders, they will be available for supporting a range of local needs. By training local map users in data collection, processing, and map creation, they will be able to update maps over time to continue to inform local-level planning and management needs. These maps can be used broadly to develop spatial scenarios and visions, but they can also be used for specific projects such as aquaculture sector projections and planning or developing mangrove management approaches that involve zoning areas into older and younger mangrove forests and areas in need of rehabilitation.



Aquaculture pond in Tien Lang district.

The availability of geospatial data of this kind can spark interest in using them for emerging needs such as developing plans for ecotourism development, new infrastructure projects, or new clam-farming areas at the commune and district levels. As such, this type of holistic and integrated information provides a platform for meeting a range of local needs and can be used to enhance provincial data collection.

Technical Appendices

Technical Appendix for Step I: Preparation

Part I. Hardware

This part lists the necessary hardware equipment and provides recommendations.

A. Tablet as a tool for data collection

A tablet is a high-performance tool for data collection and recording with many advantages such as affordability (~\$150/unit), minimum time required for data entry, support for diverse types of information/data, automatic transfer of data via wireless internet connections, and a user-friendly interface. Survey forms can be designed in a number of tablet applications and can include fields for question-and-answer data as well as voice/video recording, photography, location coordinates, and time. The survey forms used in the *Our Coast – Our Future* project, and detailed here, were designed using the GeoODK application, which is only available on Android devices.

When selecting a tablet for survey data collection, the following criteria must be considered:

- Operating System: Android.
- GPS function: GPS/GLONASS (Global Navigation Satellite System, to identify position without internet). If the tablet only has aGPS (assisted GPS) technology, a SIM card with 3G/4G mobile network accessibility will be required.
- Screen: 5-inch display or larger.
- Camera.
- Storage: 16GB (gigabytes) or more.
- Availability for purchasing.

B. Computer

A number of software programs and applications can be used to conduct the survey and spatial planning, including QGIS, ArcGIS, GeoODK, GeoODK Briefcase, GeoODK's Mobile Data Conversion Kit, and Microsoft Excel (see details in the following section in this document). The selected computer must meet the following requirements to ensure smooth operation of the GIS software and display of high-resolution satellite imagery.

Recommended specifications for a computer configuration are listed below:

Specification	Requirement
CPU speed	2.2 GHz minimum; Hyper-threading or Multi-core recommended
Platform	x86 or x64 with SSE2 extensions
Memory/RAM	Minimum: 4 GB Recommended: 8 GB
Display properties	24-bit color depth Also see Video/Graphics adapter requirements below.*
Screen resolution	1024x768 recommended minimum at normal size (96 dpi, dots per inch)
Disk space for software	Minimum: 4 GB Recommended: 6 GB or higher
*Video/graphics adapter	64 MB RAM minimum; 256 MB RAM or higher recommended. NVIDIA, ATI, and Intel chipsets supported 24-bit capable graphics accelerator Be sure to use the latest available drivers.

Part II. Software

This part lists the needed software packages and provides step-by-step instructions on how to install them.

A. GeoODK Collect for Android

Obtaining a field survey application for collecting geo-referenced and non-spatial information is a crucial step of this methodology. GeoODK (Figure 4) has been used in Vietnam in various fields of natural resources management, for example in the forest monitoring system used for Payment for Ecosystem Services by the Vietnam Forest Development and Protection Fund. GeoODK is a freely available, open source application that allows users to collect and store georeferenced data, as well as a suite of tools to visualize, analyze, and manipulate ground-collected data.



GeoODK Collect

GeoODK Productivity

3+

You don't have any devices

Figure 4: GeoODK icon

Main functions in this project:

- Collecting and storing geo-referenced data as well as non-spatial data.

Installation of the application (Figure 5):

Using Android tablet, open CH play > Search “GeoODK Collect” > Select Install > Select Accept

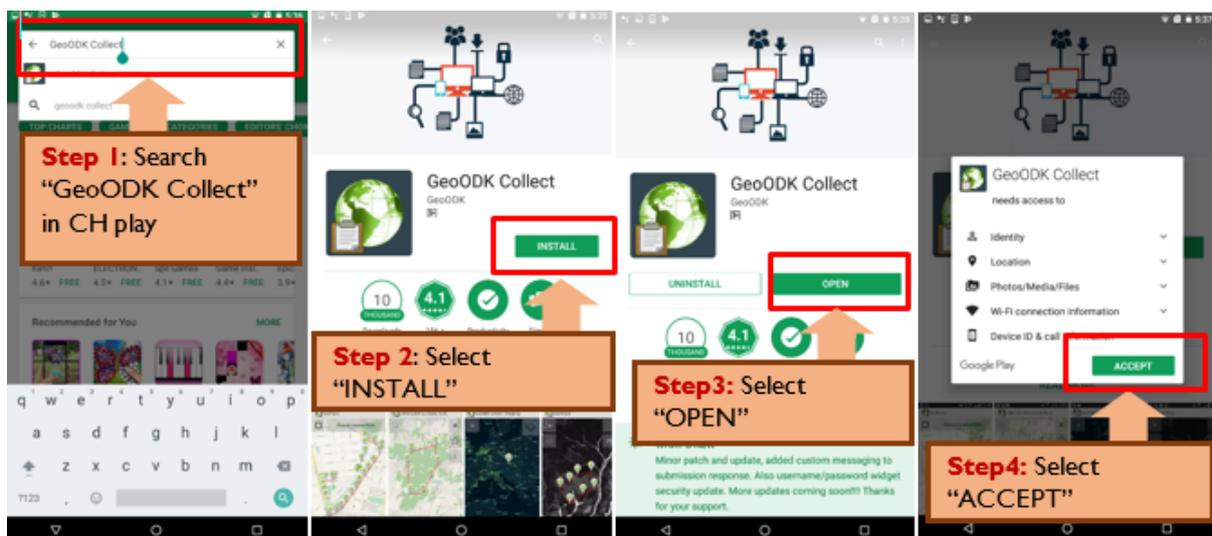


Figure 5: GeoODK Collect installation steps

B. ArcGIS

ArcGIS (Figure 6) is GIS software for working with maps and geographic information. It offers a wide set of tools for mapping, compiling geographic data, performing spatial analysis, data visualization, as well as data management solutions. ArcGIS is the most commonly used commercial GIS software.

ArcGIS is available for download at: <http://www.esri.com/>.

Main functions in this project:

- Create maps.
- Analyze mapping information.
- Support spatial planning.

Please be advised that the cost of ArcGIS could be high, but there are also free, open-source alternatives that can be used (see section for QGIS below).

C. QGIS

QGIS (Figure 7) has been used widely in Vietnam for different applications, including disaster risk mapping, land use/land cover mapping, and forestry management. QGIS (Quantum GIS) is a cross-platform, free, and open-source desktop GIS application that supports viewing, editing, and analyzing geospatial data. QGIS supports both raster and vector layers in multiple GIS formats including shapefiles, coverages, personal geodatabases, dxf, MapInfo to PostGIS, and other formats. As an open source application, QGIS features useful extensions which have been developed and updated regularly. QGIS integrates with other open-source GIS packages, including PostGIS, GRASS GIS, and MapServer.

QGIS is available for download at: <http://www.qgis.org/en/site/>.

Main functions in this project:

- Create maps.
- Analyze mapping information.
- Support spatial planning.

D. ODK Aggregate using Google Engine

ODK Aggregate provides a ready-to-deploy server and data repository to:

- Provide **blank forms** to **ODK Collect/GeoODK Collect**;
- Accept finalized forms (submissions) from ODK Collect and manage collected data;
- Visualize the collected data using maps and simple graphs;
- Export data (e.g., as comma-separated value [CSV] files for spreadsheets, or as KML files for **Google Earth**); and



Figure 6: ArcGIS icon by ESRI



Figure 7: QGIS software icon

- Publish data to external systems (e.g., Google Spreadsheets or Google Fusion Tables).

ODK Aggregate can be deployed on [Google's App Engine](#), enabling users to quickly get running without facing the complexities of setting up their own scalable web service.

ODK Aggregate is available for download at: <https://opendatakit.org/use/aggregate/>.

Main functions in this project:

- Provide data storage.
- Visualize the collected data using maps and simple graphs.

E. ODK Briefcase

ODK Briefcase is a Java application developed to easily gather and aggregate data from ODK Collect without the need for internet connectivity. ODK Briefcase is also an alternative for those who do not want to setup an ODK Aggregate server or other ODK-compatible servers indicated above. ODK Briefcase can therefore either be a complementary tool to an ODK Aggregate server particularly during periods of poor internet connectivity or as a replacement for ODK Aggregate altogether.

ODK Briefcase is available for download at: <https://opendatakit.org/use/briefcase/>.

Main functions in this project: Export data to CSV format.

F. Mobile Data Conversion Kit

GeoODK's Mobile Data Conversion Kit is a desktop application that aims to convert the CSV data from the ODK Aggregate system. Often there is a need to view the data in GIS software like ArcMap, QGIS, or Google Earth. This software will allow for the conversion of CSV exported data into a format that can be handled in the above GIS software programs. Also, this application can download images taken during the survey from the system.

Mobile Data Conversion Kit is available for download at: <http://geoodk.com/downloads.html>.

Main functions in this project: Convert CSV exported data to Shapefile and KMZ file.

G. Microsoft Excel

Microsoft Excel is a spreadsheet program included in the Microsoft Office suite of applications. Excel spreadsheets present tables of values arranged in rows and columns that can be manipulated using both basic and complex arithmetic operations and functions. It features calculation, graphing tools, pivot tables, and a macro programming language called Visual Basic for Applications.

Microsoft Excel is available for download at: http://www.webopedia.com/TERM/M/microsoft_excel.html.

Main functions in this project: Data analysis such as pivot table and calculation.

Part III. Preparing the Field-Based Survey

Preparing a field survey for collecting geo-referenced and non-spatial information by using mobile tool (tablet) is a crucial step of this methodology. A field-based questionnaire is created within a table in the GeoODK application. Part III provides details on how to create a field-based survey, what application to use, and conversion tools.

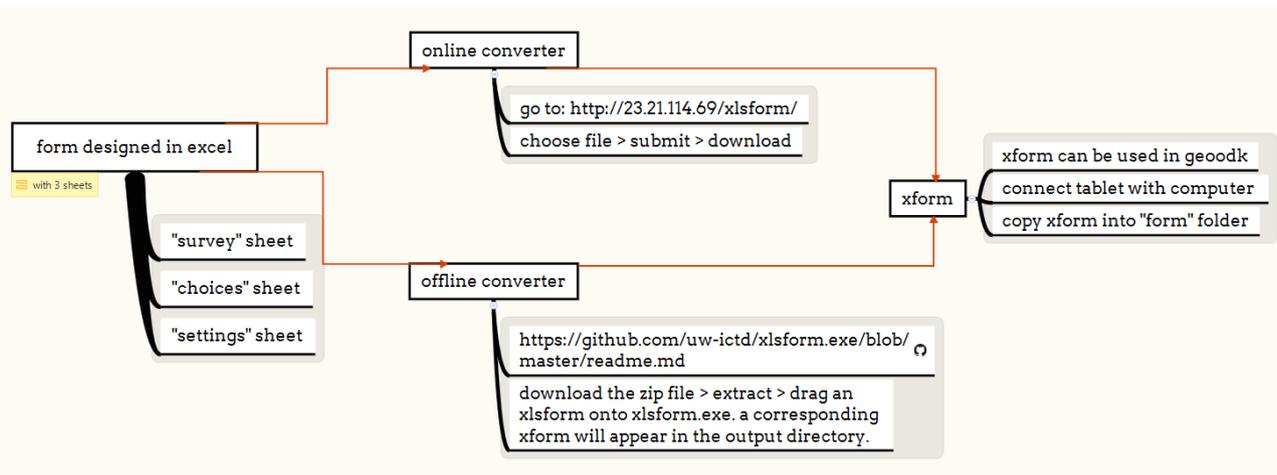


Figure 8: GeoODK form creation process

A. Creating the Questionnaire Forms for GeoODK application

Forms can be designed first with Excel and then XLSForm will convert it to an XForm that can be used with GeoODK tools (Figure 8). XLSForm is a tool to simplify the creation of forms. We can convert the form with online or offline tools.

A sample form Excel file can be downloaded at: http://geoodk.com/xlsform_format.html. Creating a questionnaire form involves the following steps:

Step 1. Develop basic format of questionnaires in Excel

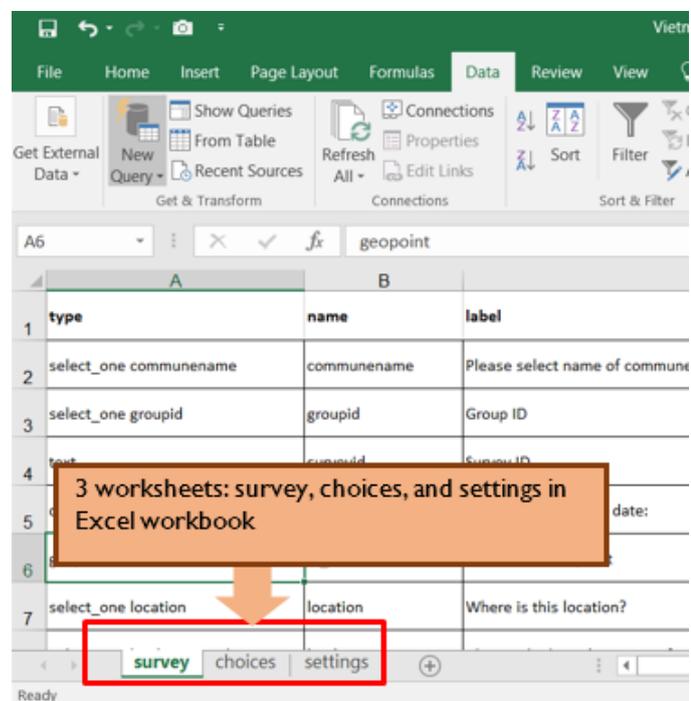


Figure 9: Three worksheets: survey, choices, settings

Questionnaires are designed in an Excel workbook. Each workbook must have three worksheets: survey (questions), choices (answers), and settings (Figure 9). Each worksheet has a set of required columns that must be present for the .xls file to be valid. Additionally, each worksheet has a set of optional columns that allow further control over the behavior of each entry in the form, but are not essential to the specification. Every entry must have values for each necessary column, but any of the optional columns may be left blank from entry to entry.

- **Survey:** This sheet will include all the survey questions, type of questions, label, and other instructions which ODK will interpret once the form has been uploaded (see Figure 10).

Column	Description
type (required)	ODK recognizes a set of question types, like single select (Yes or No questions), multi-select, text, numbers, and even photos and geographical locations. You can also use grouped or repeated questions.
name (required)	This column will be the headers for the responses. The name should be related to your question. Names should be unique and must not have spaces. Names may only have letters, numbers, and/or underscores.
label (required)	This is basically how your survey questions will appear on your mobile device. You can type this in whichever format (e.g., “What is your name?”, “Age”, “Date today”).
hint	As the name implies, this is where you can give your respondents a hint on how you want your question answered.
appearance	This column determines how your question or groups of question will appear on your mobile device. Questions can be grouped together using the code field-list per group of questions.
constraint	This column is used to set restrictions for numerical questions. If you would like to have a minimum or maximum value of numerical answers, you can put in a constraint (i.e., ≥ 0 and ≤ 1000).
constraint message	If you have a constraint, this column allows you to show an error message if the responder fails to follow the constraint.

Column	Description
relevance	The entry in the 'relevant' column is a true or false XPath expression. When the expression evaluates to true, the question will be asked, otherwise it will be skipped.
required	Put in Yes across the question which you want the respondent to answer.
calculation	For questions requiring numerical answers, ODK gives you a chance to do calculations. $\{name_of_calculated_field\}$ is the expression used to perform a calculation. Under this column, you can request ODK to perform simple calculations for you.

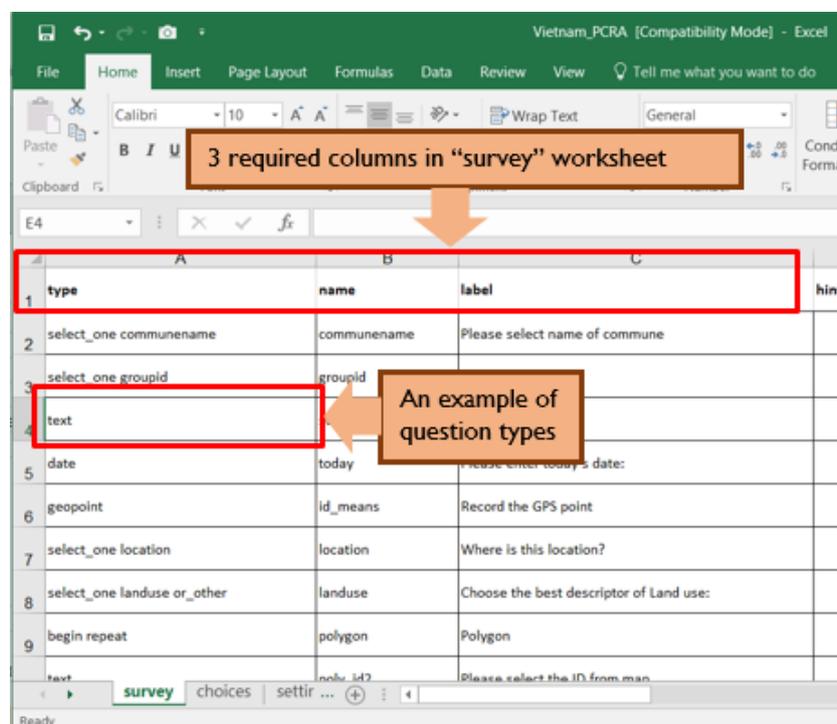


Figure 10: Required columns in "survey" worksheet

Column	Description
media	You can also make questions that show the user an image, a video or an audio file as a way of asking a question. In order to do this, you will need to put the media in /geoodk/forms/formname-media folder on your phone, and reference their filenames from xlsform in a media column.

Column	Description
label	It is easy to add multiple languages to a survey. You simply have to name your label::language1 label::language2 etc., and your surveys will be available in multiple languages.

GeoODK Collect supports a number of simple question types: this type will be entered in “type” column.

Text	Text input.
integer	Integer (i.e., whole number) input.
decimal	Decimal input.
select_one [options]	Multiple choice question; only one answer can be selected.
select_multiple [options]	Multiple choice question; multiple answers can be selected.
note	Display a note on the screen, takes no input.
geopoint	Collect GPS coordinates.
geoshape	Collect Polygon coordinates.
image	Take a photograph.
barcode	Scan a barcode, requires the barcode scanner app is installed.
date	Date input.
datetime	Accepts a date and a time input.
audio	Take an audio recording.
video	Take a video recording.
calculate	Perform a calculation; see “calculates” below.

- **Choices:** This sheet will include all the choices that will be used for single or multiple choice questions from your Survey sheet (see Figure 11).

Column	Description
List_name (required)	This serves the same purpose as your Type column in the survey sheet. This is your main reference in single-select or multiple-select questions in your survey sheet.
Name (required)	This is similar to your Name column from the survey sheet. This must be unique and is related to your choices Labels. You can use letters, numbers, and/or underscores for the choices names.
Label (required)	This shows how your choices will appear on your device.

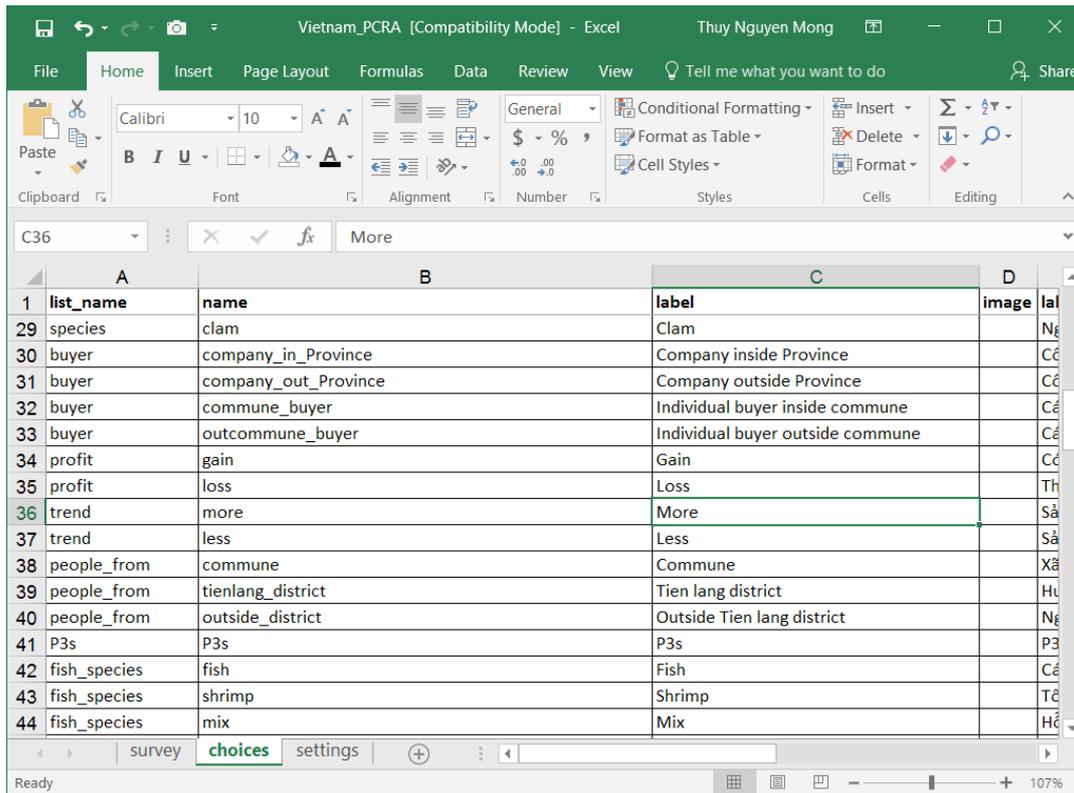


Figure 11: “Choices” worksheet

- **Settings:** This sheet will determine how your sheet will be viewed in your mobile device (see Figure 12).

Column	Description
form_title	This is how the name of your form will appear in your form list.
form_id	ODK creates an ID for each of the forms that you create. Make sure that your form_id is unique.

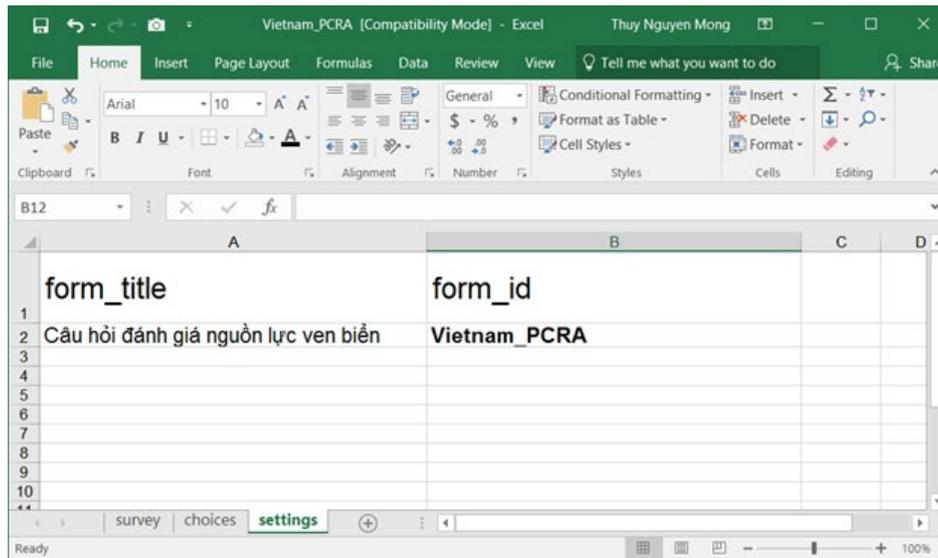


Figure 12: “Settings” worksheet

Step 2. Convert Excel to XForm to be used in GeoODK

To introduce the questionnaire forms into the GeoODK interface to be used on the tablet, the XForm should be converted from Excel format. This step can be done on a computer either online (see 2.1 below) or offline (see 2.2 below).

2.1. Convert Excel to XForm online

A computer with an active internet connection can convert the Excel form into an XForm online. To do so, please follow these steps (see Figure 13):

- Go to: http://geoodk.com/xlsform_converter.html.
- Convert to XForm: Select “Convert Excel to XLSForm” > Choose the Excel file > Select Submit > Click Download to download Xform.

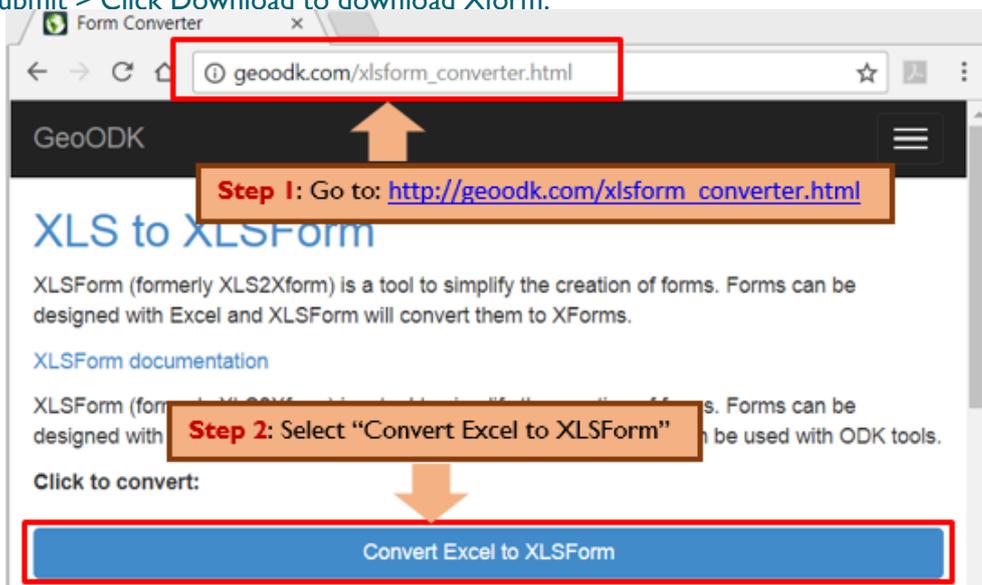


Figure 13: Open online conversion tool

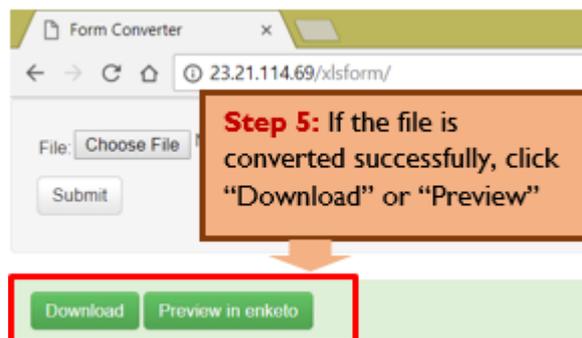
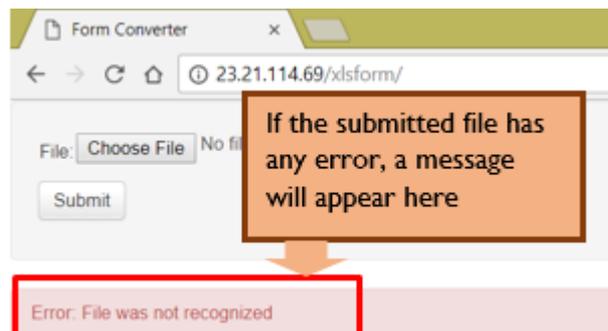
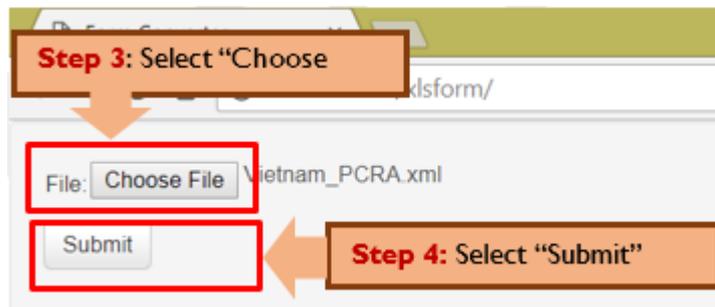


Figure 14: Select file and submit

2.2 Convert Excel to XForm offline

A computer without an internet connection can convert the Excel form into an XForm with the correct software. To do so, please follow the steps in Figures 15 and 16.

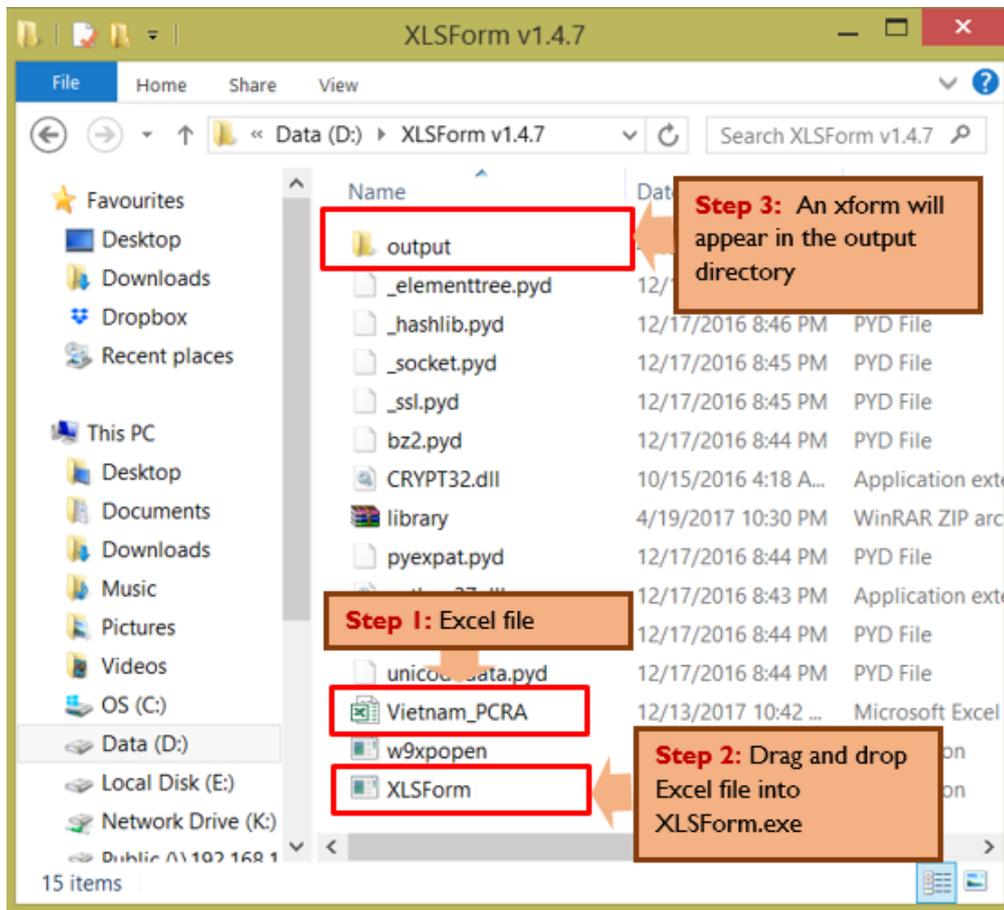


Figure 15: Offline conversion tool

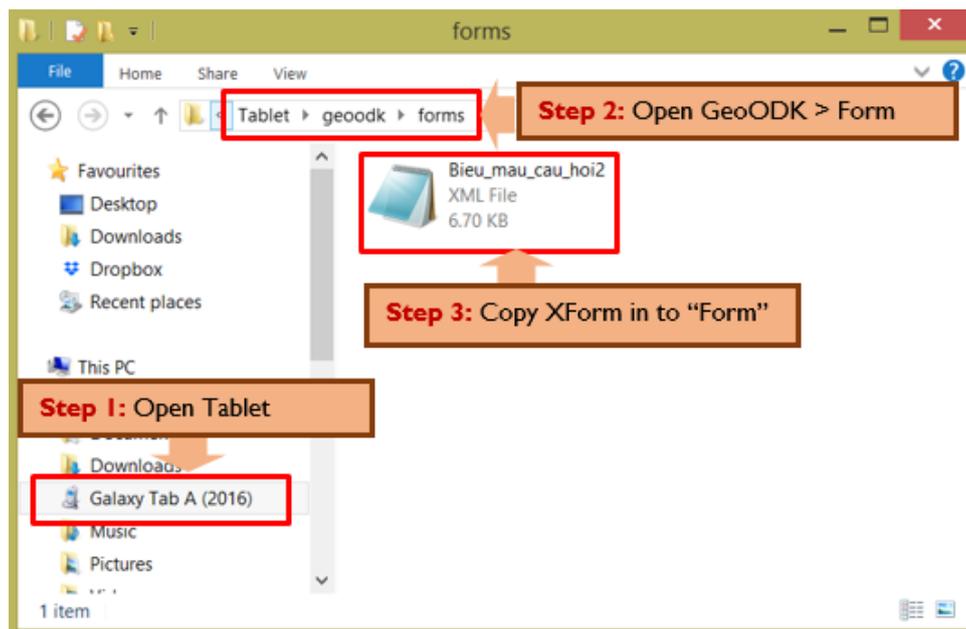


Figure 16: Copy Xform into tablet

- Download the offline converter tool at: <https://opendatakit.org/downloads/download-info/xlsform-for-windows/>.
- Extract the zip file.
- Drag an XLSForm into xlsform.exe. A corresponding xform will appear in the output directory.
- Xform in output folder is ready to use for GeoODK application.

Step 3. Copy Form to Tablet

Connect your tablet with the computer using a cable > Open tablet internal storage > Open “geoodk” folder > Copy the downloaded XForm to the “forms” folder within the “geoodk” folder (Figure 16).

B. Example Questionnaire Content

For the *Our Coast – Our Future* project, a questionnaire was developed to collect general information and specific data for each sector on coastal resource uses. It was tested during the pilot survey and used in group discussion with commune members. Additional questions can be developed based on the needs and context.

Sectors covered in the project were:

- i. Aquaculture ponds;
- ii. Farming field;
- iii. Fishing by boat near shore;
- iv. Fishing by hand; and
- v. Mangroves.

A sample list of questions is shown below:

Question	Answer
General Information	
Please select name of commune	Select one:
	Tien Hung
	Dong Hung
	Vinh Quang
Please enter today's date:	Select date
Record the GPS point	Record the GPS point
Where is this location?	Select one:
	Field
	Not field
Choose the best descriptor of land use:	Select one:
	Aquaculture ponds
	Farming field

Question	Answer
	Fishing capture field by boat near shore
	Fishing capture field by hand
	Mangroves
Aquaculture Ponds	
Please select the ID from map	Type Polygon ID on map
What kind of production type is utilized in this pond?	Select one:
	Intensive Production
	Semi-intensive Production
	Extensive Production
Who is the contract holder of this pond?	Select one:
	Commune Household
	Outside Commune Household
	Company
From whom do you contract the pond?	Select one:
	Provincial government
	District government
	Commune government
	Company
	Household
Who is the primary owner of this pond?	Select one:
	Provincial government
	District government
	Commune government
	Company
What kind of land use contract?	Select one:
	Redbook
	Fixed Term Lease Contract
How long is the contract	Select one:
	50-year contract
	20-year contract
	10-year contract
	5-year contract
	2-year contract
	1-year contract
Date of contract signature?	Type starting year
How many hectares?	Type pond area (ha)
What kind of species are you farming?	Multiple choices
	Shrimp
	Fish

Question	Answer
	Crab
	Clam
What is the key production time frame for each species?	From month to month
Who will buy production from this pond?	Multiple choices
	Company inside Province
	Company outside Province
	Individual buyer inside commune
	Individual buyer outside commune
Total annual investment in this pond? (million VND)	Type number
Total annual income from this pond? (million VND)	Type number
How many permanent laborers are involved in this aquaculture work?	Type number
How many women?	Type number
How many short-term labor days are involved in this farming work?	Type number
What percentage of this is labor done by women?	Type number
Clam Farming	
Field ID	Type field id from list
Who is the contract holder of this field?	Select one:
	Commune Household
	Outside commune household
	Company
From whom you own or contract this field?	Select one:
	Provincial government
	District government
	Commune government
	Company
	Household
How many households are investing with you?	Type number
What kind of land use contract do you have?	Select one:
	Redbook
	Fixed term lease contract
How long is the contract?	Select one:

Question	Answer
	50 year contract
	20 year contract
	10 year contract
	5 year contract
	2 year contract
	1 year contract
Date of contract signature?	Type starting year
How many hectares?	Type pond area (ha)
What kind of aquatic species are you raising?	Multiple choices
	Shrimp
	Fish
	Crab
	Clam
What is the production period?	From which month to which month
Who will buy the production?	Multiple choices
	Company inside Province
	Company outside Province
	Individual buyer inside commune
	Individual buyer outside commune
Total annual investment in this production site? (million VND)	Type number
Total annual income from this production site? (million VND)	Type number
How many permanent laborers are involved in this farming work?	Type number
How many women?	Type number
How many short-term labor days are involved in this farming work?	Type number
What % are women?	Type number
Fishing by Boat Near Shore	
Where do you come from?	Select one:
	Commune Household
	Outside commune household
	Company
How many boats do you have?	Type number
Total boat power?	Type number (CV)
How many fishing nets?	Type number
What kind of species do you catch?	Multiple choices
	Fish
	Shrimp

Question	Answer
	Mix
Who will buy your fishing catch?	Multiple choices
	Company inside Province
	Company outside Province
	Individual buyer inside commune
	Individual buyer outside commune
Fish catch trend in recent years?	Select one:
	More
	Less
What is the explanation for the trend?	Type response
Total number of fisher laborers involved?	Type number
Number of fisher women laborers involved?	Type number
Fishing by Hand	
Where do you come from?	Select one:
	Commune Household
	Outside Commune Household
How do you access the fishing by hand area?	Select one:
	Open access
	Limited access
	Forbidden access
What tools do you use for catching?	Multiple choices
	Fix fishing net
	Fishnets
	Bamboo trap
	By hand
What kind of fish species do you catch?	Type
How many kg of fish and other aquatic species do you catch per time?	Type number
Who buys your fish and catch?	Multiple choices
	Family consumer
	Individual buyer
How many days per month?	Type number
How many members of your family are involved in this work?	Type number
Do you know how many people are catching with you in this area?	Type number
Mangroves	
Who is assigned to protect this mangrove area?	Select one:

Question	Answer
	Household
	Coastal border guard
	Community
	Commune people's committee team
What kind of protection contract?	Select one:
	Redbook
	Fixed term contract
How long is the fixed term contract?	Type number in years
Contract signature date	Type Date
What are your benefits from this protection contract?	Multiple choices
	Forest wood
	Protection fee
	Aqua product
	Honey bee
	Others
What types of mangrove species are present?	Multiple choices
	Kandelia species
	Rhizophora species
	Sonneratia species
	Others
How high are they?	Select one:
	Less than 2 m
	Greater than 2 m
When were mangroves planted?	Select one:
	Less than 1 year ago
	1 - 5 year ago
	5 - 10 year ago
	10 - 20 year ago
	Greater than 20 year ago
Where are they located?	Select one:
	Inside pond
	Outside pond
Do you think we should plant more mangroves in this area?	Select one:
	Yes
	No
Explain more	
Take a picture showing the landscape	

Part IV. Creating Survey Zones for Each Team

The entire area to be mapped is divided into separate survey zones, identified with polygons in the digitized maps to be created. Each team covers a range of different survey zones. Each zone covers one type of land use, such as an aquaculture pond, a part of the mangrove forest, or a part of the mud flat. Using satellite images, areas of shrimp ponds and mangroves are digitized (a Google Earth satellite image is imported into GIS software and a polygon is manually drawn for each side of the shrimp pond and mangrove area) and a unique identification number (ID) is allocated to each polygon shape in GIS software (Figure 18).

The ID is important because after the survey is conducted, the ID for each polygon will be automatically linked to the survey interview form. See Figure 18 for an example of a diagram showing the survey zone polygons in Vinh Quang commune.

This zoning map with polygons is presented on a map and discussed with the data collectors during training. During the training, data collectors will decide how to allocate the survey zones amongst themselves and determine a suitable time for conducting the survey (depending on tidal patterns). A survey plan is finalized during the training.

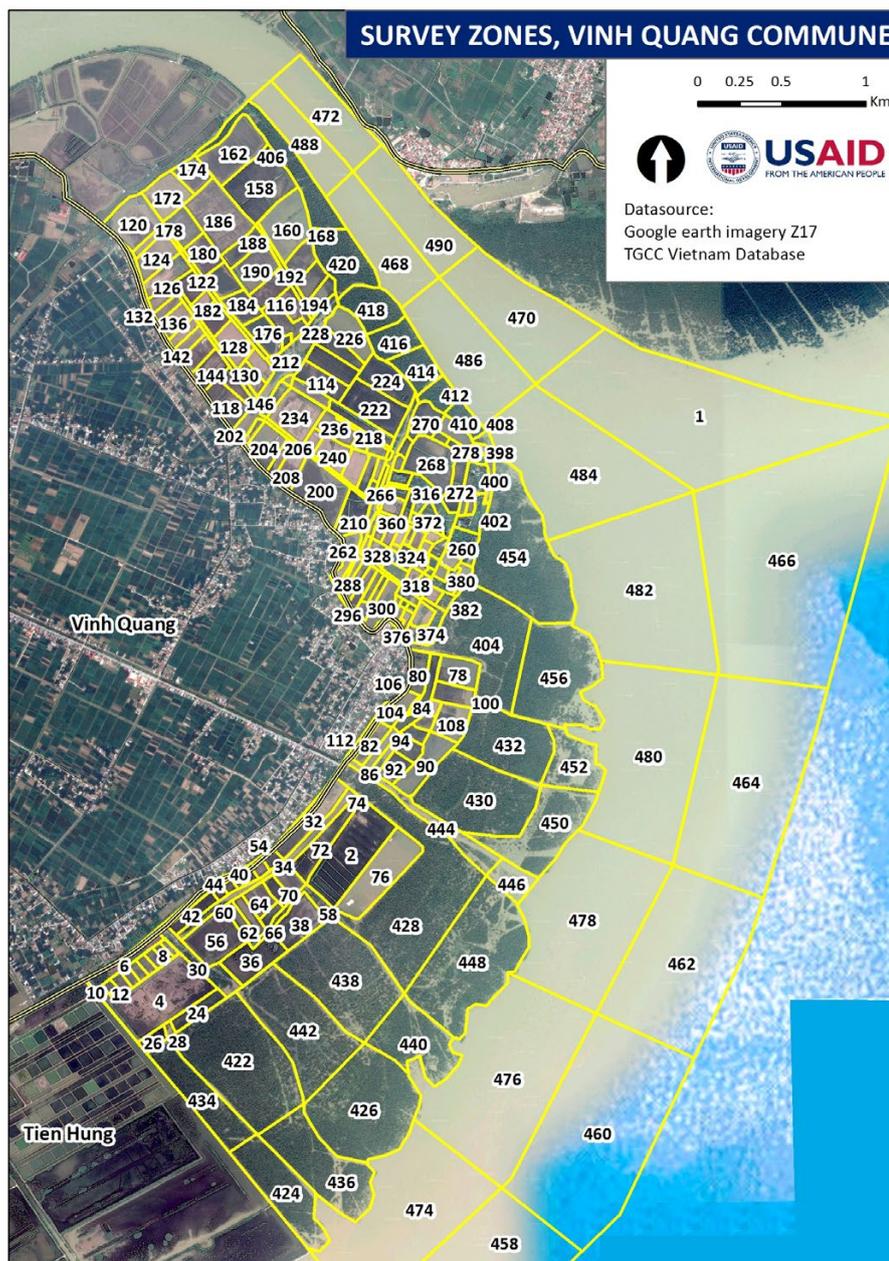


Figure 17: Diagram of survey zone polygons, Vinh Quang commune

Data collectors are provided with a printout of the map in A1 size to support their survey process, and each survey group decides on the order for conducting the survey.

How to get satellite images online:

It is possible to get high resolution satellite images with some GIS software (e.g., QGIS, ArcGIS). The software provides base maps as part of its map services. This requires an internet connection:



Figure 18: ID for each polygon

- In QGIS: Select Web > OpenLayers plugin > Google Maps > Google Satellite.

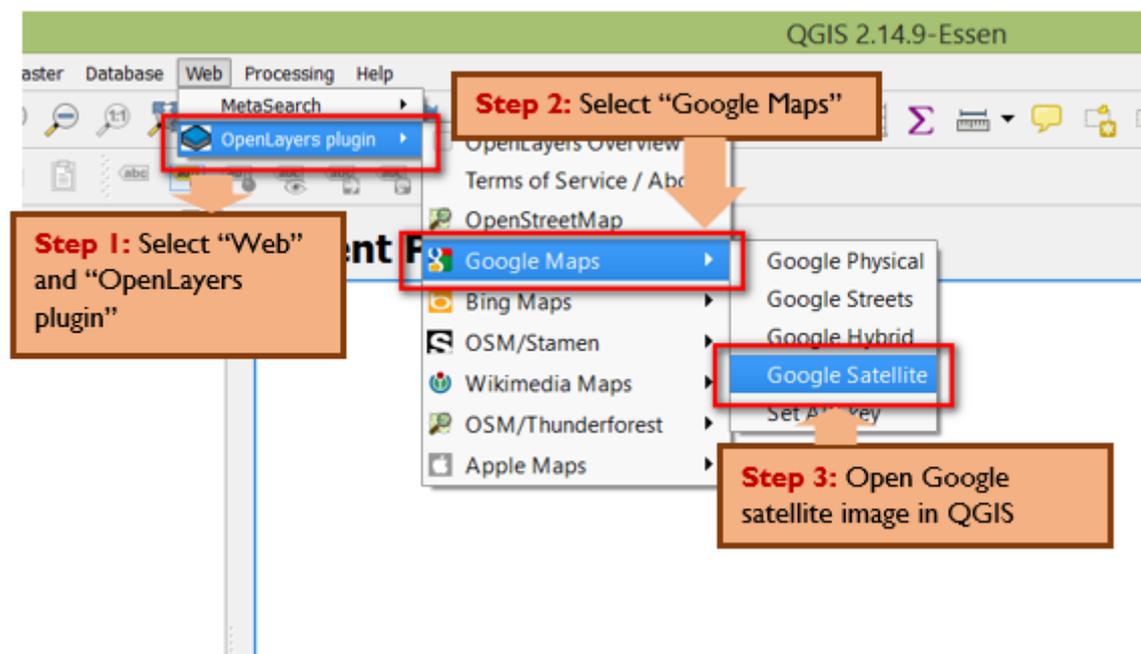


Figure 19: Open satellite image in QGIS

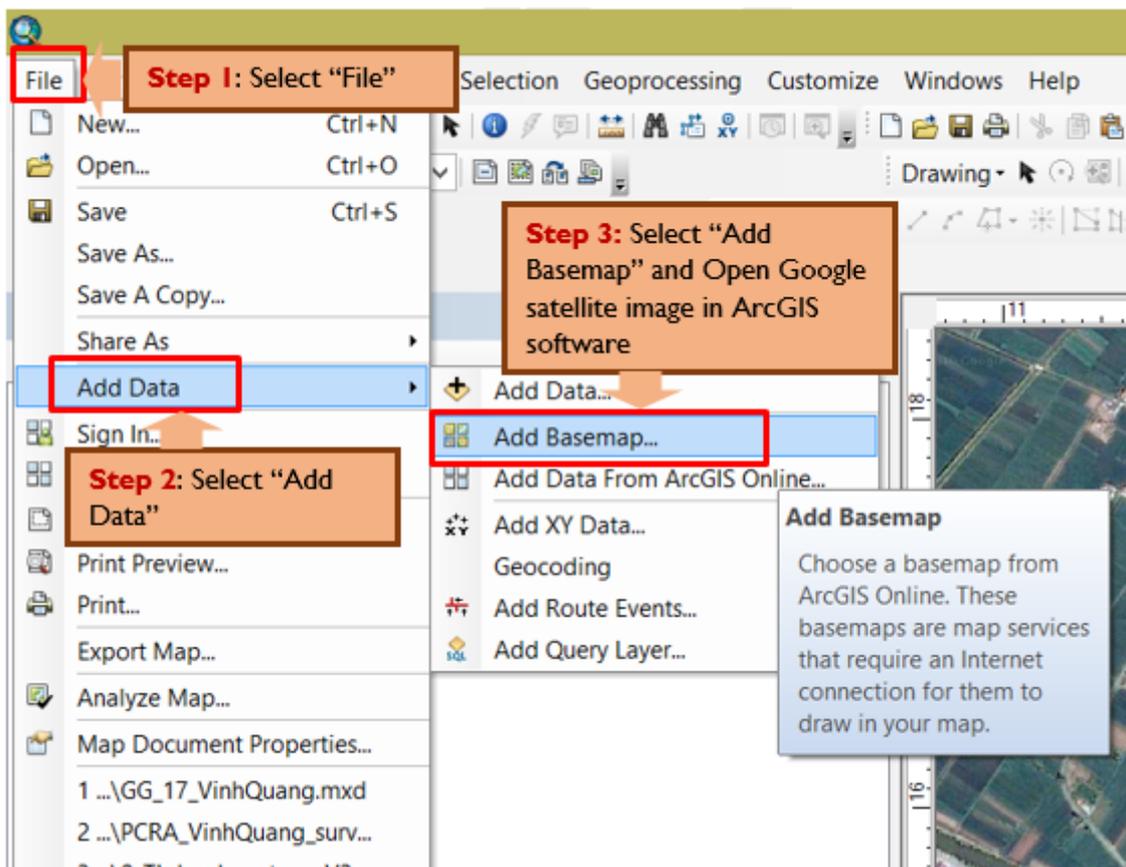


Figure 20: Open basemap in ArcMap

Part V. Converting the Participatory Maps Produced During the PCRA Workshops to GIS Format

The paper maps that were produced during the PCRA mapping exercise (See *Guide No. 1: Participatory Coastal Resource Assessment: Developing Commune Coastal Profiles in Vietnam*) need to be digitized in GIS format (Figure 21). Additional spatial data such as updated forest inventory and infrastructure (e.g., settlements, sluice gates, dike systems, roads, and river channels) can be collected from the government and overlaid with the digitized information.

This spatial information forms the basis for creating maps that present the current status of local resources and will be used during the spatial planning process.

The maps of coastal resources should contain the following information:

- General features (such as roads, government buildings, sea dike, schools, religious buildings, and community halls) and administrative boundaries.
- Habitat areas: Mangroves (old forest), newly planted mangrove seedlings (new forest), seagrass, rocky shoreline, mudflats, estuary, marine waters, boat passages and channels, and terrestrial areas.
- Resources: These are specific resources harvested or grown in the different habitat areas. These can include aquaculture pond shrimp, open shrimp collection, crab collection, clams, fish species, and honey production.
- Resource uses: These are areas allocated for specific uses such as: gleaning areas, fishing landing or gear sites, fish drying areas, standing fish net areas, protected areas, sacred areas, or rehabilitation areas.
- Issues/conflict over resources: This information covers issues such as coastal erosion, cyanide fishing, blast fishing, pollution, weak survival of mangrove seedlings, poor production in aquaculture ponds, heavy storm surge damage, and conflict over resource use.

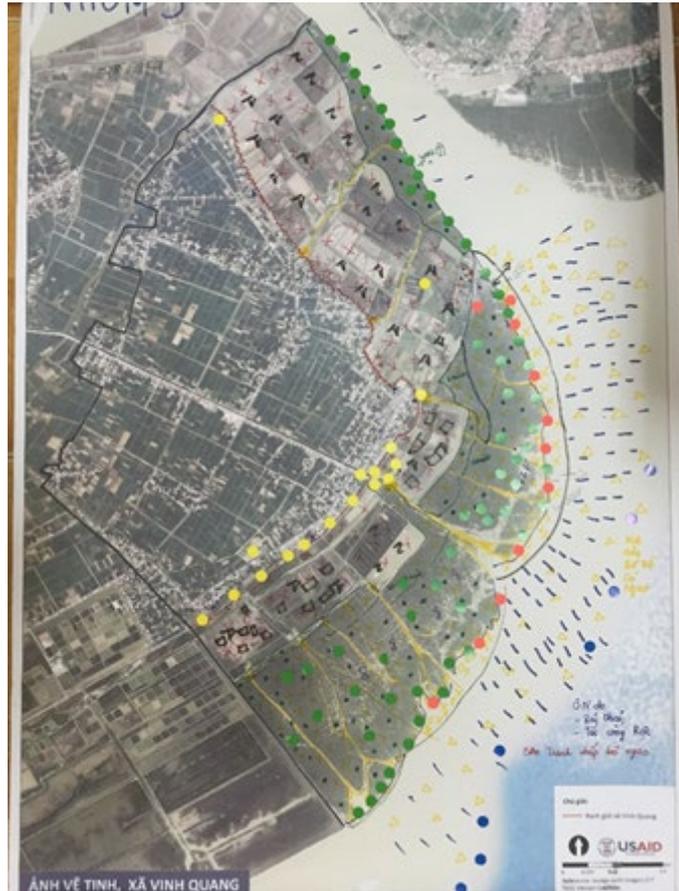


Figure 21: One of the paper maps created during the Vinh Quang PCRA workshop

Technical Appendix for Step 2: Training Data Collectors

The training process is a combination of indoor (1.5 days) and outdoor (half day) exercises with intensive supervision by the core technical team. After the training and practical work, commune staff and active community members will have the necessary knowledge to use tablet applications and paper maps and collect data.

Training Content

Expected results of the training:

- Collectors are capable of using GeoODK application for spatial and non-spatial data collection;
- Questionnaire contents are well understood by all collectors; and
- Collectors are able to facilitate field interviews with local people.

Content:

- Preparation for field surveys (software, hardware, checklist checking);
- Steps to use the GeoODK application for data collection;
- Questionnaire content;
- Development of survey plan; and
- Hands-on practice by using GeoODK to collect spatial and non-spatial information.

Part I: Training on Questionnaire Content

- Pre-test the questionnaires (piloted to test): The survey tool is finalized after a test pilot in the field.
- Guide the data collectors to question and fill-in questionnaires in GeoODK from the respondents by going through question-by-question.

Part II: Develop Survey Plan for Each Type of Resource Users

Survey groups are formed and each group discusses the following issues for two land use categories within the survey plan: location, the best time for interview, tools to prepare, difficulties, etc. Survey plans should be presented to the whole group to get feedback and agreement.

Part III: Practicing

- a. **Mini-game used in training:** A mini-game should be used to test collectors on information presented in the training session (Figure 22).

MINI-GAME: ANSWER THE QUESTION BY GROUP

What functions do you need to check before you go out?

When you check GPS function, where do you find the accuracy number?

How many pictures can you save for one interview?

If a pond owner has three ponds, how can you record the ID?

If a pond owner has three ponds, do you type in the total area of ponds or the area of each pond?

Figure 22: Mini-game used in training

- b. **Indoor testing:** Two groups practice with each other and take turns to give questions and answers within a half day, and the core technical team checks their results on the tablet.
- c. **Field testing:** Groups can go out to practice for 2 hours; they should do 3 or 4 interviews and come back to the room to give their feedback. The core technical team should follow groups in the field to observe and provide guidance/support.

Part IV: Field Survey Technique

When the training is completed, the following steps will be performed in the actual survey:

Step 1. Preparation before going to field

Hardware checklist:

- Tablet – touch screen is functioning and tablet is in working condition.
- GPS – make sure it works and has sufficient accuracy/satellites in use (Figure 23).
- Camera – make sure camera application can take and save photos.
- Battery and charger – make sure you have 75% of battery before you go out (3 hours coverage).
- Storage – make sure there is minimum remaining storage of 3GB (Figure 24).

Software checklist:

- Use the Android tablet.
- See if GeoODK Collect application is installed on the tablet.
- Confirm that questionnaires are loaded on the tablet.
- Make sure you have the base paper map (optional).

Checklist for collectors:

- Motorbike.
- Clothes appropriate for fieldwork.
- Raincoat, plastic bag for tablet.
- Drinking water and some food.
- Received from project: Two people will receive one set of these:
 1. Tablet (need to sign it out) – inventory ID provided; name, address, and mobile phone are provided when signing tablet equipment out.
 2. Paper map with survey diagram.
 3. Paper list of ponds and interviewees, notebook, and bag to carry it all.

Step 2. Data collection in the field by GeoODK application using tablet

The example from our project survey is used below to show the order in which the survey steps are conducted.

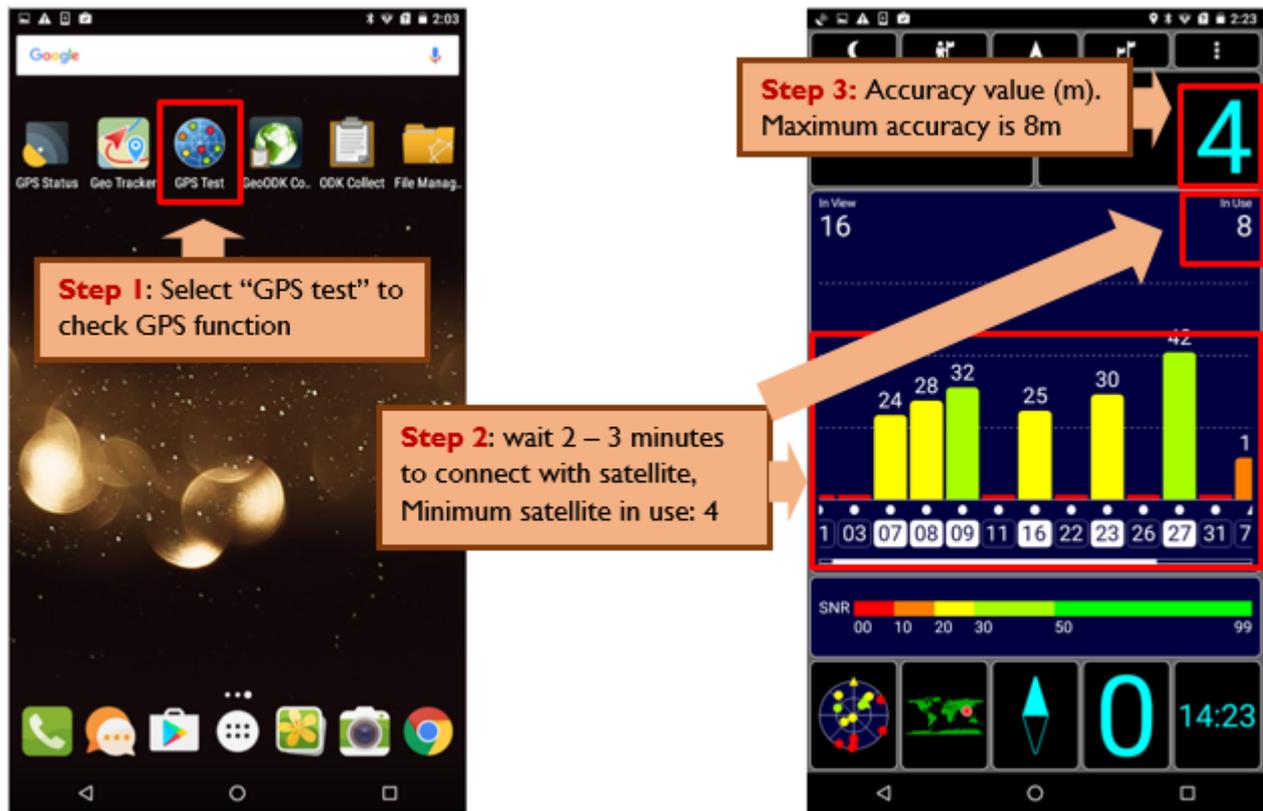


Figure 23: GPS function check

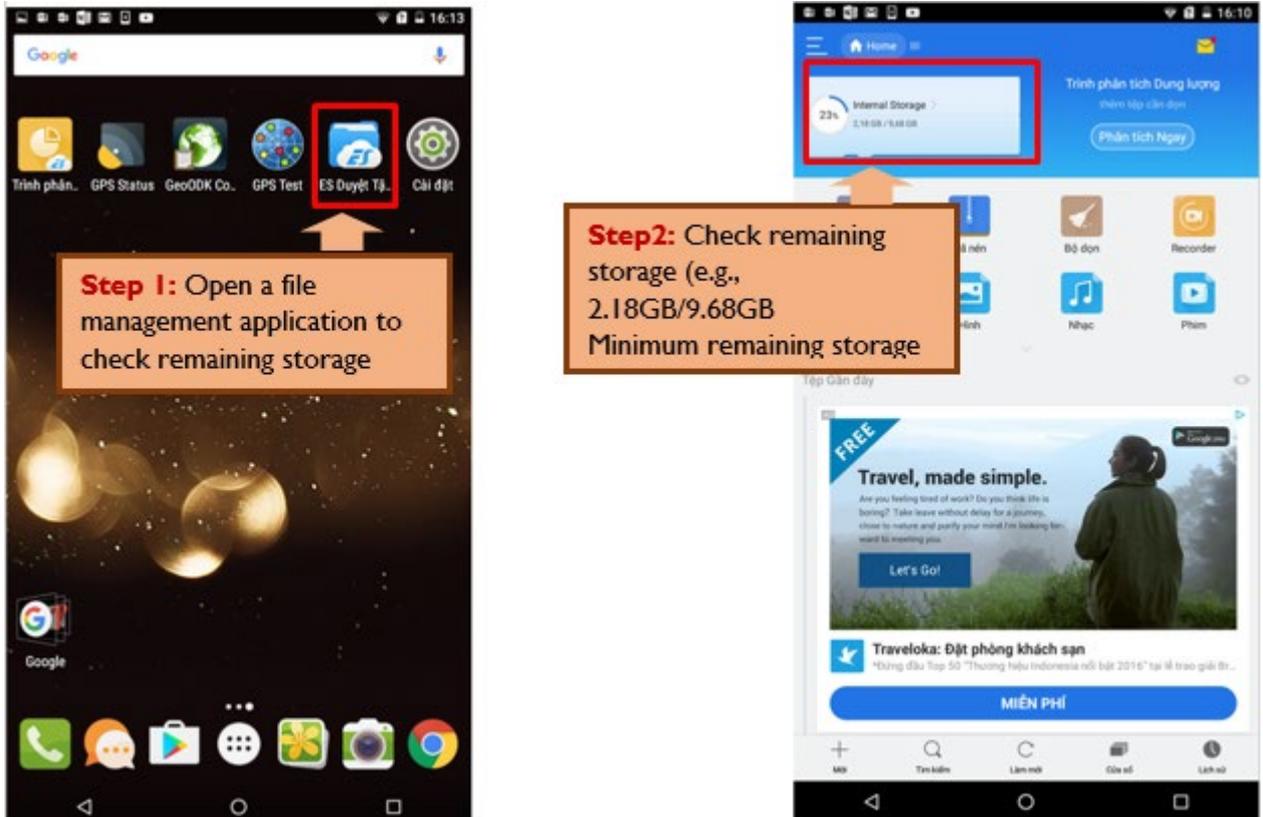


Figure 24: Checking for remaining free storage

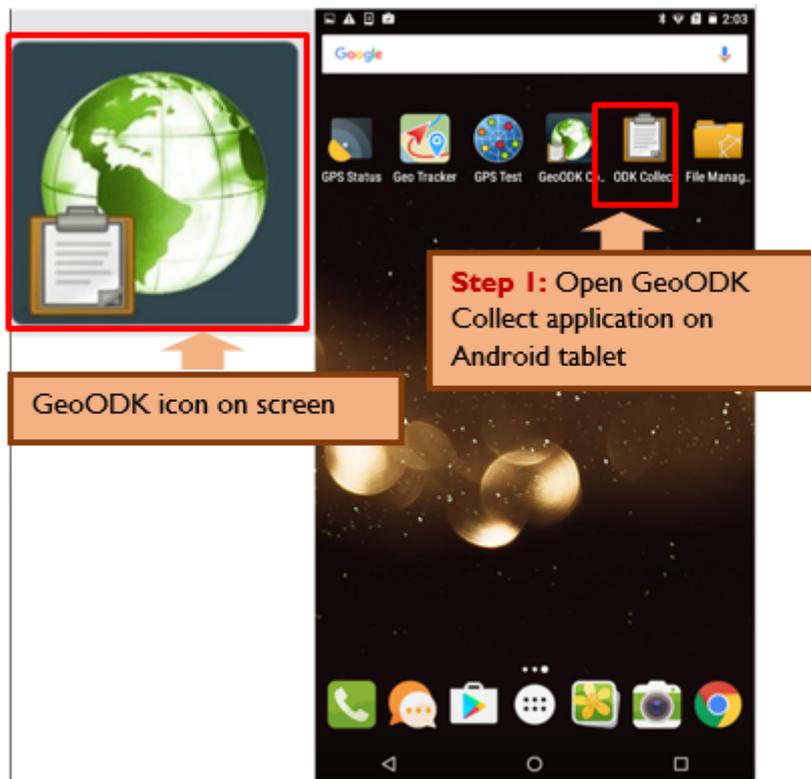


Figure 25: Select GeoODK application on the tablet screen

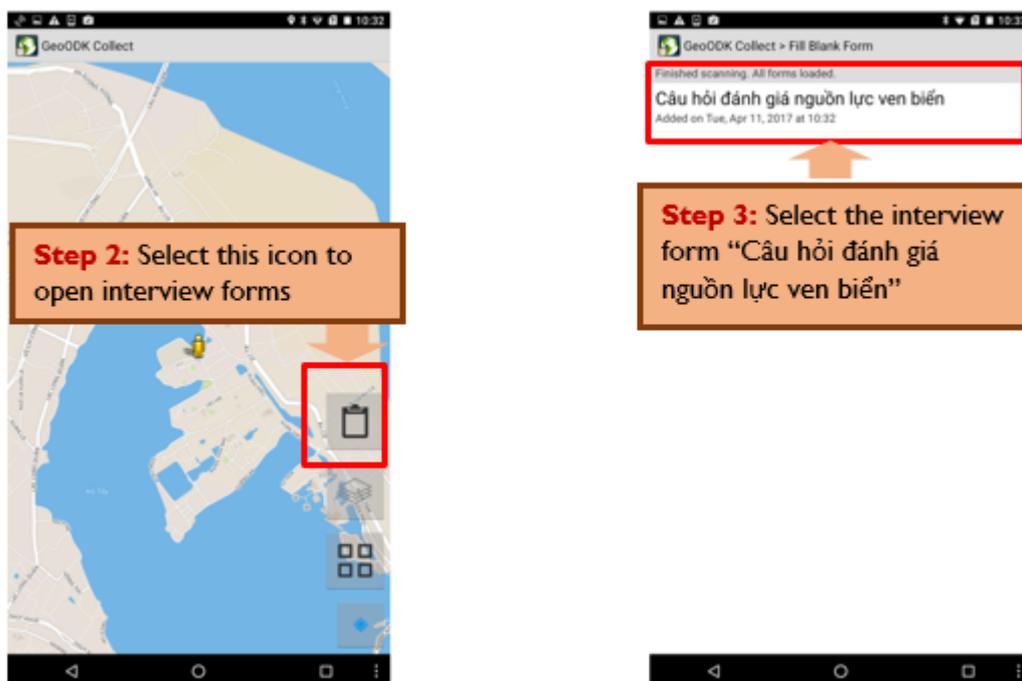


Figure 26: Select interview form



Figure 27: Change language settings

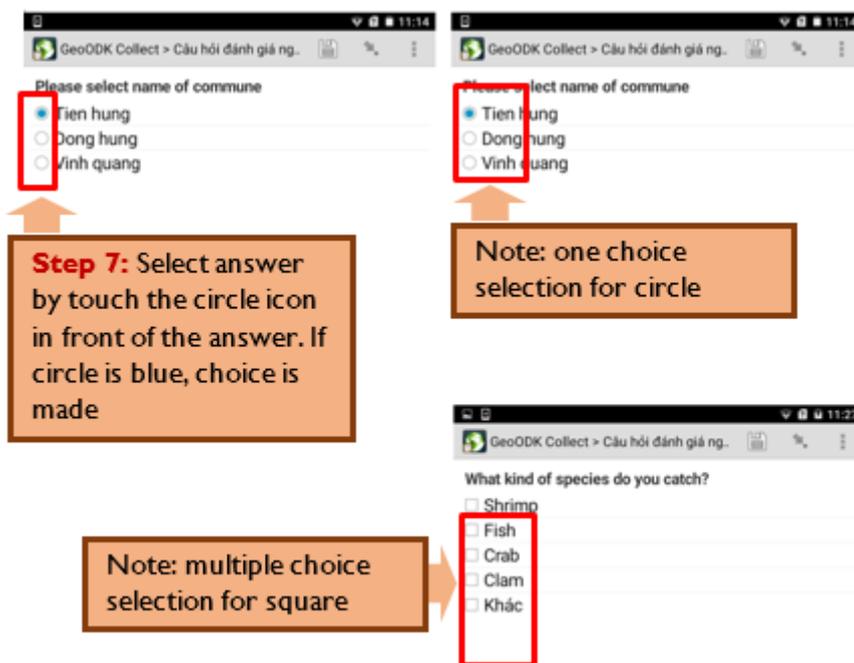
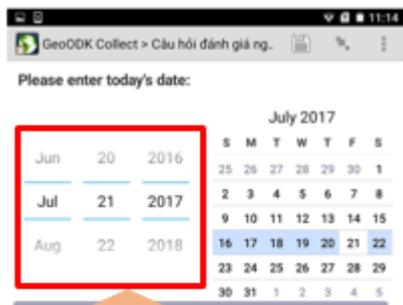
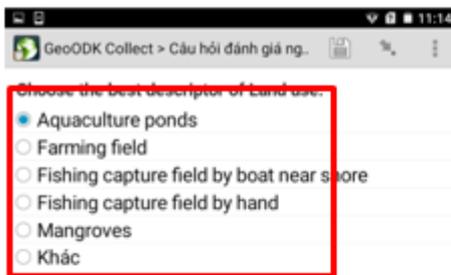


Figure 28: Select answer: one choice vs. multiple choice

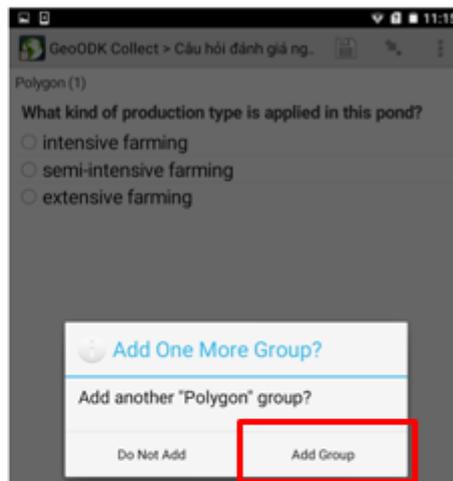


Step 8: Choose date on calendar to answer, default value is survey's date

Figure 29: Select date



Step 9: Select land use type or resource user



Step 10: Add group to type Polygon ID

Figure 30: Select type of land use or resource user, add polygon

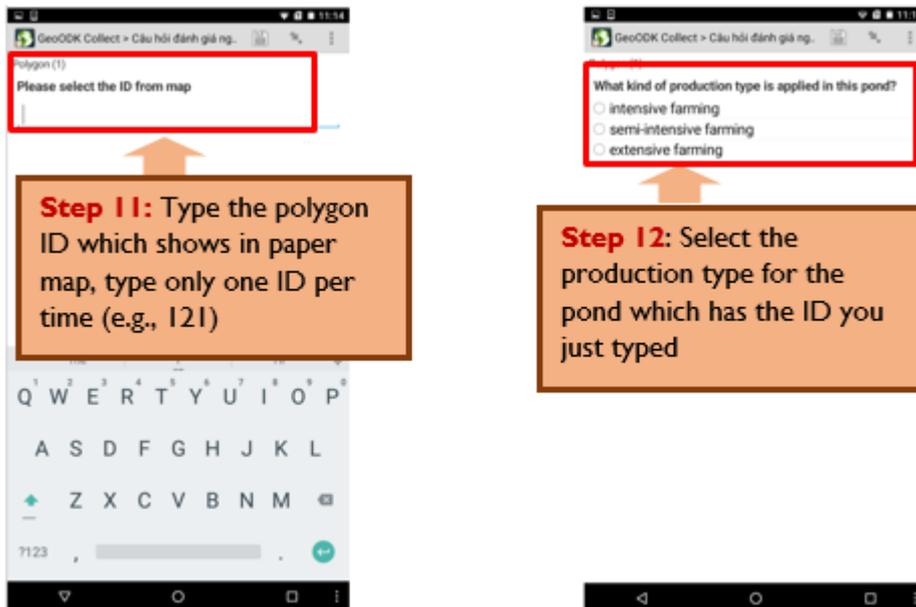


Figure 31: Add polygon ID

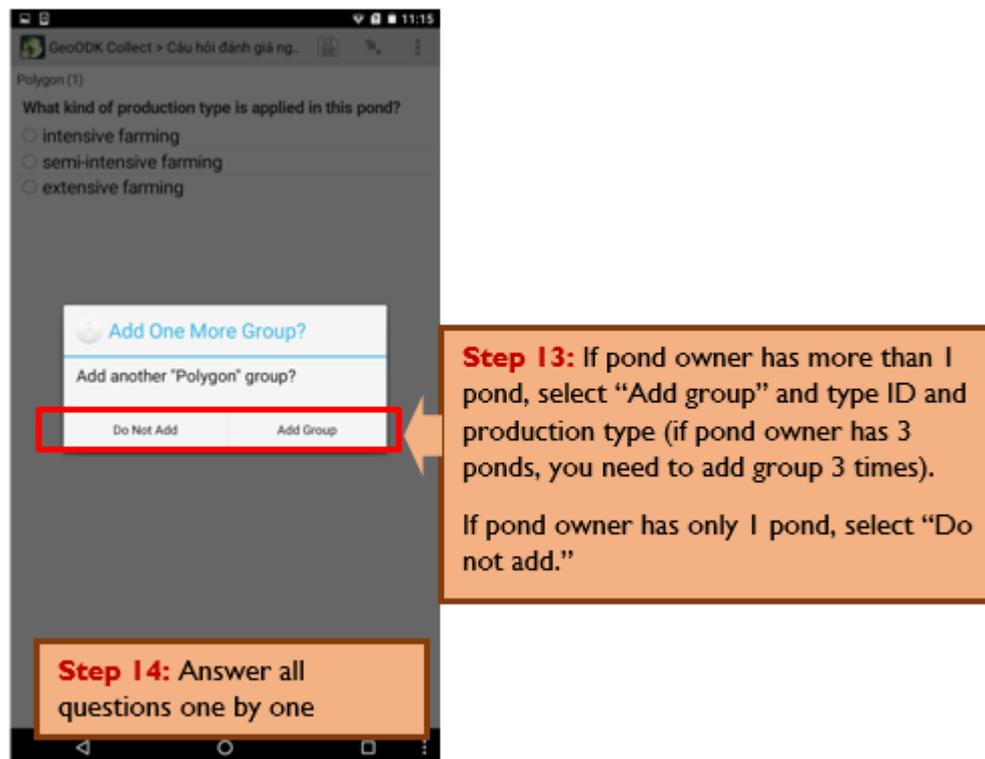


Figure 32: Add another polygon

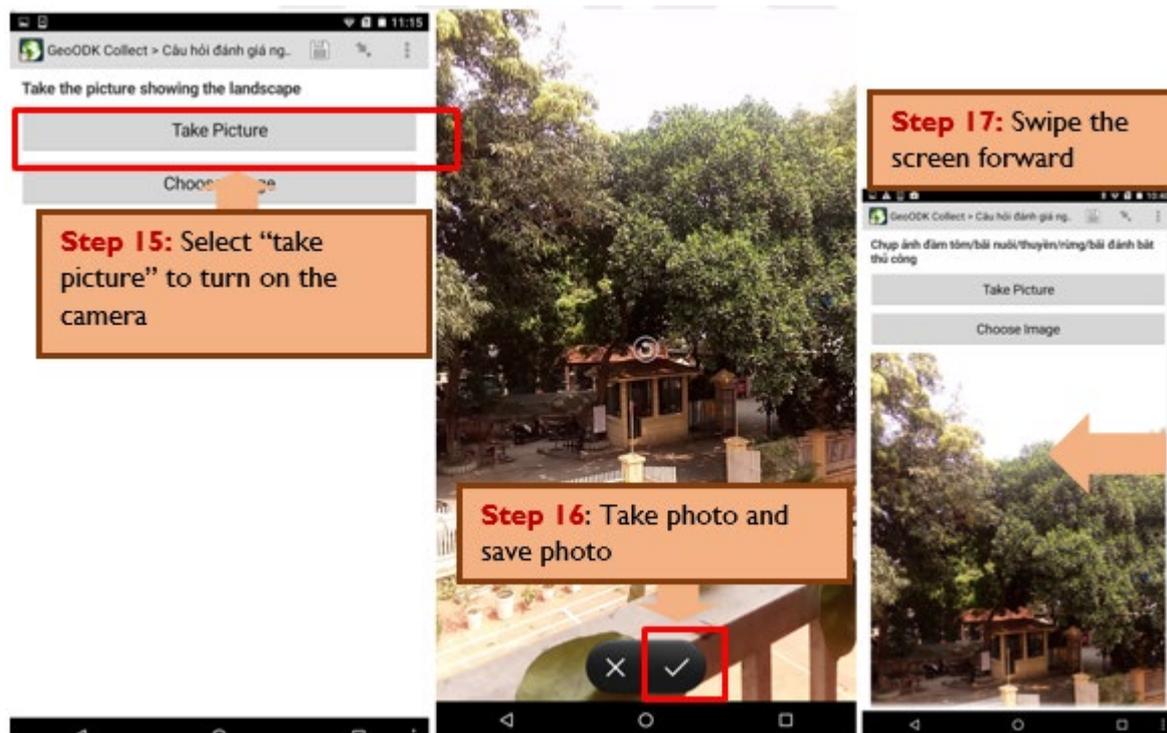


Figure 33: Take picture

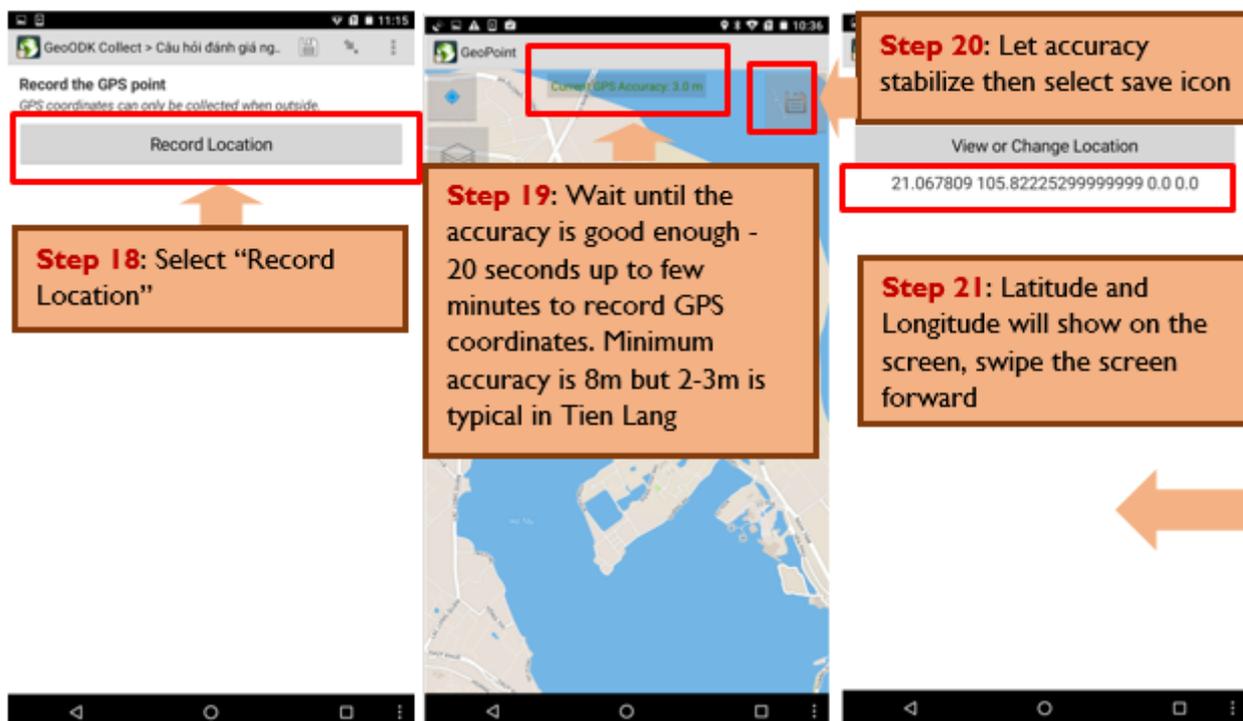


Figure 34: Record location

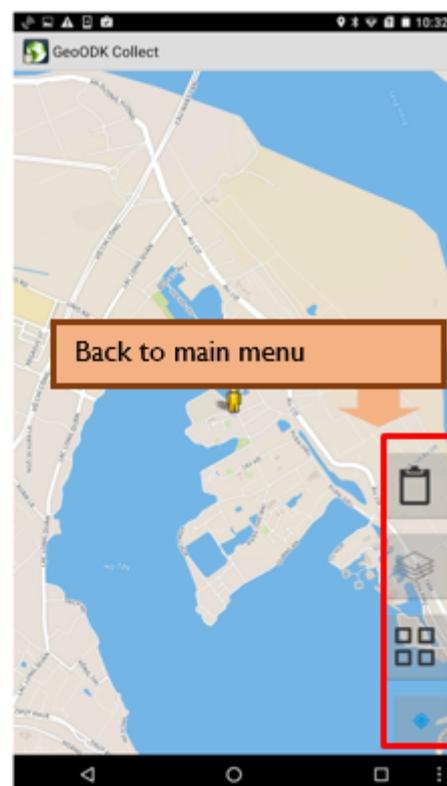
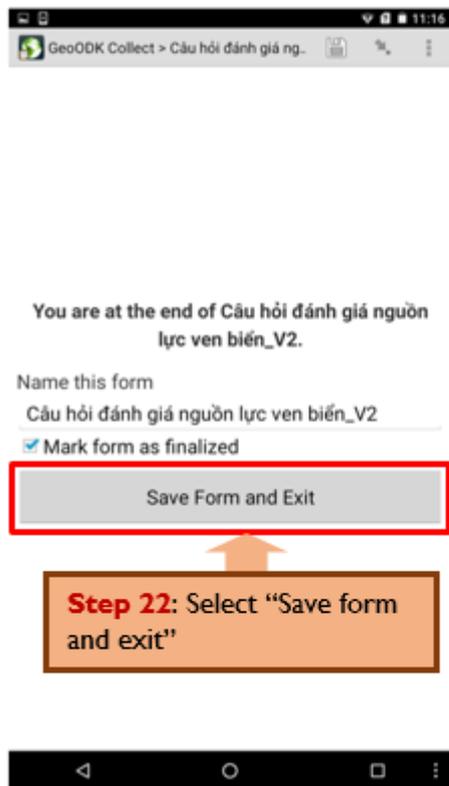


Figure 35: Save form and exit

Technical Appendix for Step 3: Field Survey

The survey team consists of two members. One member enters the survey information and asks clarifying questions during interviews. The other survey member, who should have a good understanding of the area and issues, can build trust during interviews. Survey teams should include:

- Young people (aged 20–35), who are often fast learners of new techniques/tools.
- Mid-aged people (aged 35–50), who tend to have a deeper understanding of the area and be familiar with interviewees.

This helps simplify the interview process and assure the accuracy of entered survey information. If a shrimp pond owner is absent or not interested in being interviewed, this can be noted and a general visual interpretation can be done. Each group has a Group ID which can be entered in the questionnaire form.

The core technical team and collectors should have a debrief meeting at the end of each day to review data collection progress, identify any challenges, discuss solutions, make necessary adjustments, and define which activities need to be prioritized.

Data collection in the GeoODK application should follow the step-by-step process provided in the previous section on hardware checking, software checking, and checklist for collectors (see [Technical Appendix for Step 2: Training Data Collectors](#)).

The spatial survey is conducted with resource users using the tablet to supplement information collected during the PCRA process. The following data collection parameters are suggested:

- Sample size: 200 surveys/commune.
- Duration: 2–3 days/commune.
- Team: 6–9 teams/commune.

Technical Appendix for Step 4: Data Processing

Both non-spatial and spatial data collected during the survey need to be transferred from the GeoODK application to Excel format for further processing and analysis in Excel and GIS software (ArcGIS or QGIS) for the final development of maps.

Step 1: Export data from GeoODK to appropriate formats for processing in GIS software

1.1 Copy data in all tablets to only one GeoODK folder for each commune:

It has the same structure as GeoODK in an Android tablet; the subfolders are:

- Form;
- Instances;
- Media; and
- Metadata.

1.2 Use ODK Briefcase to export data to *.CSV and media files

- Open ODK Briefcase v1.4.10.
- Set up result folder: Choose Settings tab > Select location for exporting files (Figure 36).

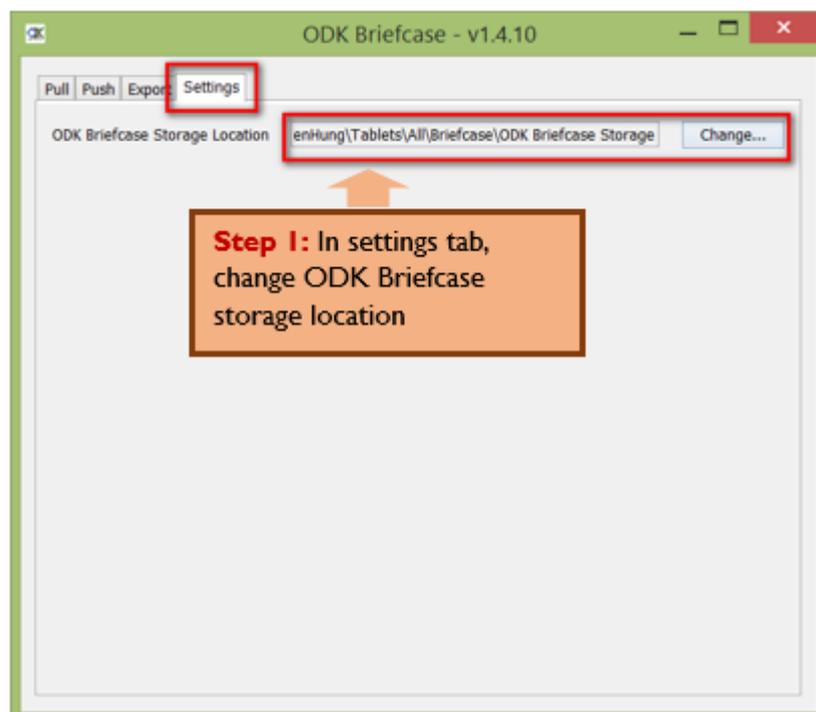


Figure 36: Settings tab of ODK Briefcase

- Pull data from ODK Directory: Select Pull tab > Select Custom Path to ODK Directory > Choose ODK Directory > Select Form > Pull (Figure 37).

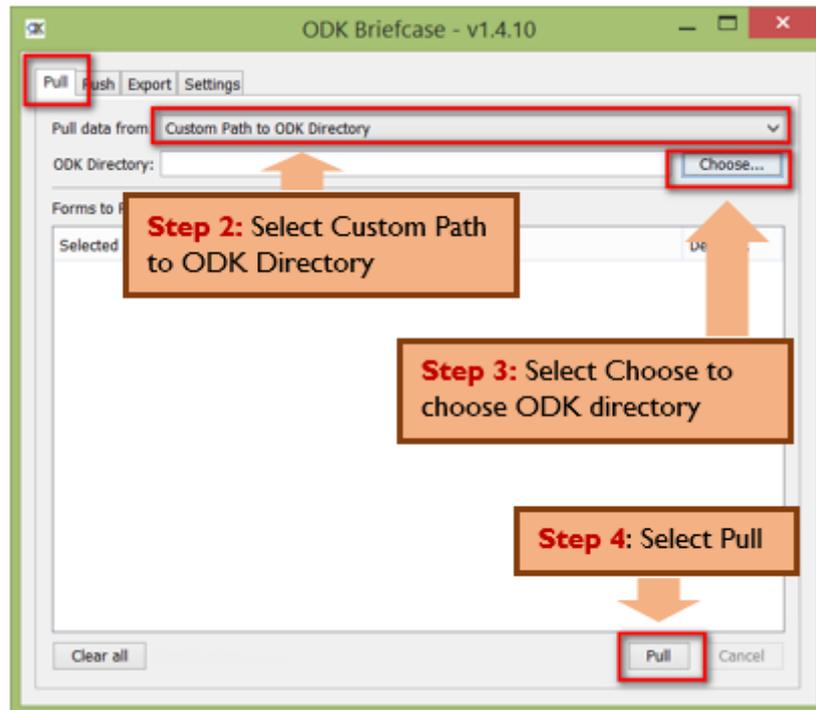


Figure 37: Pull tab of ODK Briefcase

- Export data to CSV file and media files: Select Export tab > Select Form > Choose export directory > Export: (i) Interview result CSV file: with all information; (ii) Polygon CSV file (Figure 38).

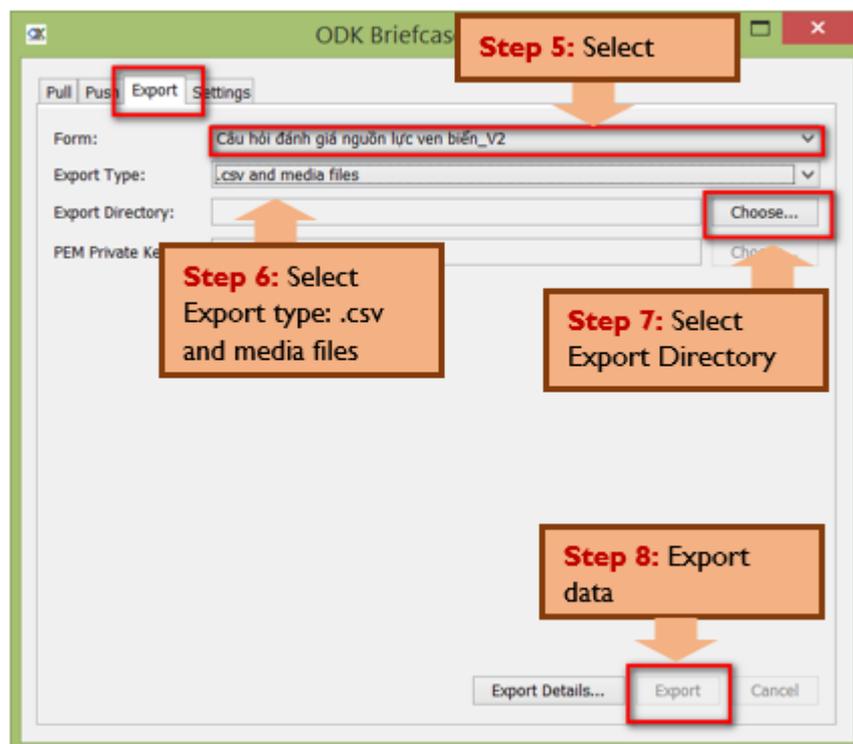


Figure 38: Export tab of ODK Briefcase

Step 2: Data clean-up

- Open CSV file (*.csv) in Notepad, save as to a text file (*.txt) then import to Excel file (*.xlsx). We should import file from a text file to ensure this process does not cause any errors with Vietnamese text.
- Remove error interview results (missing Polygon ID, blank all information, etc.).
- Correct any errors.
- Each interview form receives a unique number in the database.
- Divide survey results into different tabs in the Excel workbook and save as *.csv for further processing (Figure 39).
 - Aquaculture pond.
 - Fishing by hand.
 - Fishing by boat.
 - Clam farming.
 - Mangroves.
 - Others.



Figure 39: CSV result files

Step 3: Example of processing data

This section provides an example of processing survey data for different sectors surveyed in the *Our Coast – Our Future* project.

3.1 Aquaculture pond sector processing

- Join Aquaculture pond ID in export file with ID in Survey Diagram Shapefile (or other type of Polygon file).
- Calculate area for each pond using survey diagram shapefile in ArcGIS/QGIS software > Export to Excel file.
- Calculate pond area for each pond owner: use pivot table function in Excel to calculate in the exported Excel file.
- Calculate investment value for each ha/year.
- Calculate income value for each ha/year.
- Calculate number of labor/ha/year (permanent labor, short-term labor days).
- Calculate percentage of female labor (permanent labor, short-term labor days).
- Create maps with ArcGIS/QGIS based on Aquaculture pond shapefile with all information: Base map: high resolution satellite imagery.

- Use the Pivot table function in Excel to summarize results for each question/answer, for example:
 - How many hectares are using intensive production type/extensive and farming intensive production type?
 - How many hectares are managed by Commune/District/Provincial People's Committee?
 - How many hectares utilize a Fixed-term Contract/Red Book?
 - Investment of pond: millions/ha/year.
 - Income of pond: millions/ha/year.

3.2. Mangroves sector processing

Mangrove forests are already delineated in the existing data in the National Forest Inventory (updated every 5 years/cycle in the Vietnam context) and digitized based on high-resolution satellite imagery in QGIS or ArcGIS software. However, during the survey, additional spatial information is collected (e.g., new plantations that have not been shown in the satellite images). During this step, all new information is merged to reflect the current extent of the mangrove forest.

Mangrove forest area/information will be defined from different sources:

- Digitized mangrove area based on high resolution satellite imagery (use OpenLayers Plugin/Google Maps/Google Satellite in QGIS software).
- Updated National Forest Inventory data in 2016.
- Information and data collected from the survey: Protection Contract, Benefit from Protection Contract, Type of Mangrove Species, Height, and Year of Planting Work.
- Information from group discussion and exercise with satellite base map: Rehabilitation Area, Weak Survival of Mangroves, Seeding Area, and Year of Planting Work.

3.3. Fishing by boat/fishing by hand/clam farming/other sectors processing

Use the latitude and longitude data in the exported CSV file to create shapefile with points and all information in ArcGIS/QGIS software.

- In ArcGIS> Select File > Add Data > Add XY Data > Select CSV file > Specify latitude/longitude fields > Choose Geographic coordinate system GCS_WGS_1984 (Figure 40).

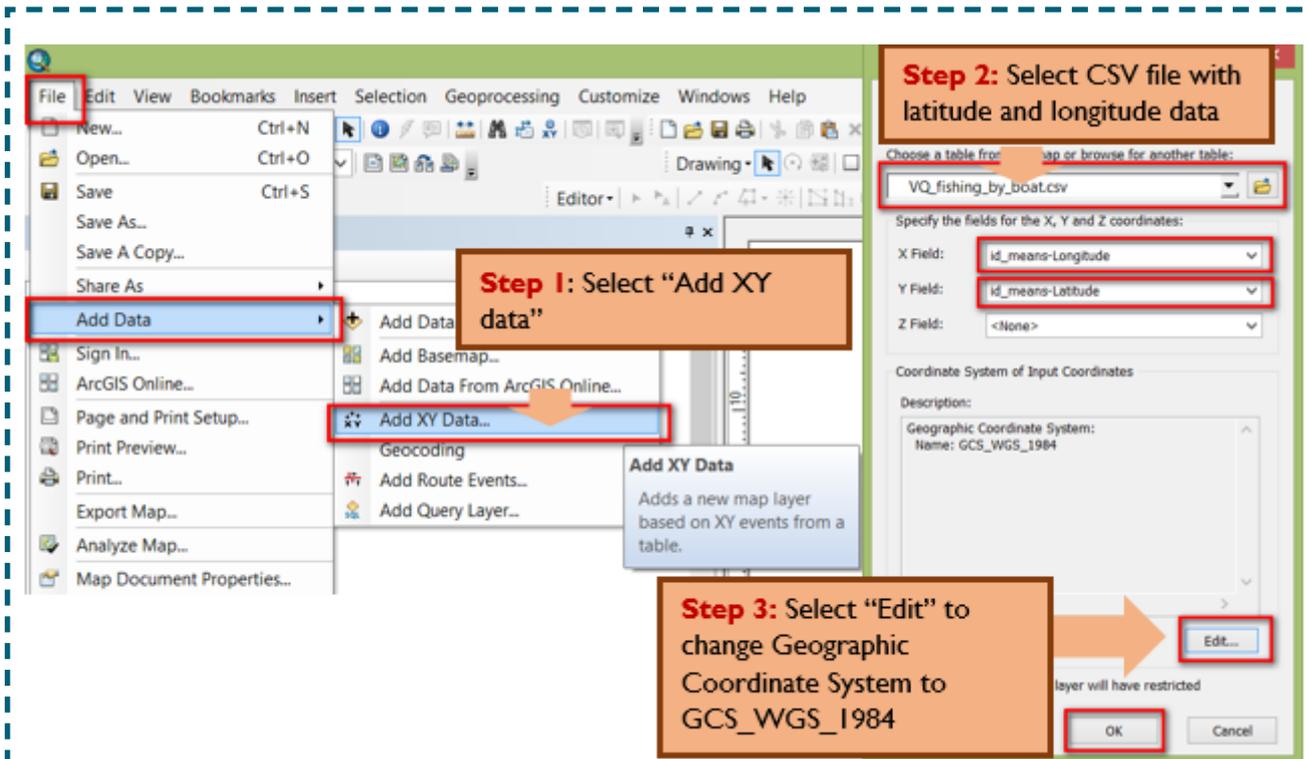


Figure 40: Add XY data in ArcGIS

- In QGIS: Layer > Add layer > Add Delimited Text layer > Select CSV file > Select file format: CSV > select X field, Y field columns > Choose Geographic Coordinate System GCS_WGS_1984 (Figure 41).

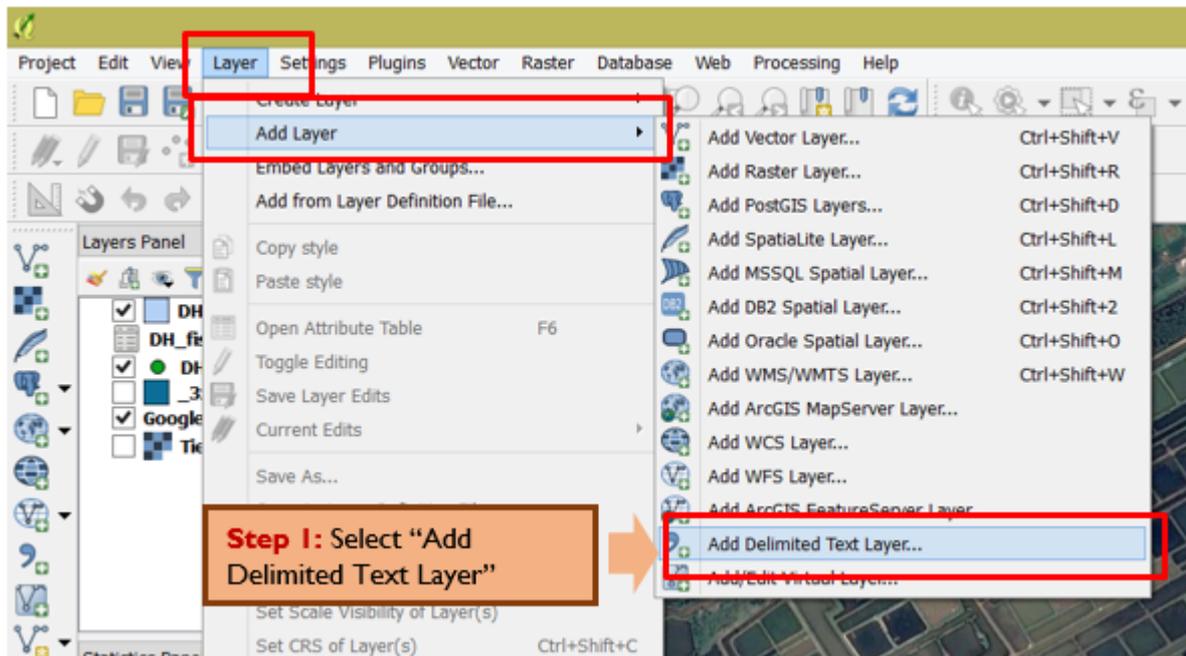


Figure 41: Add delimited text layer in QGIS

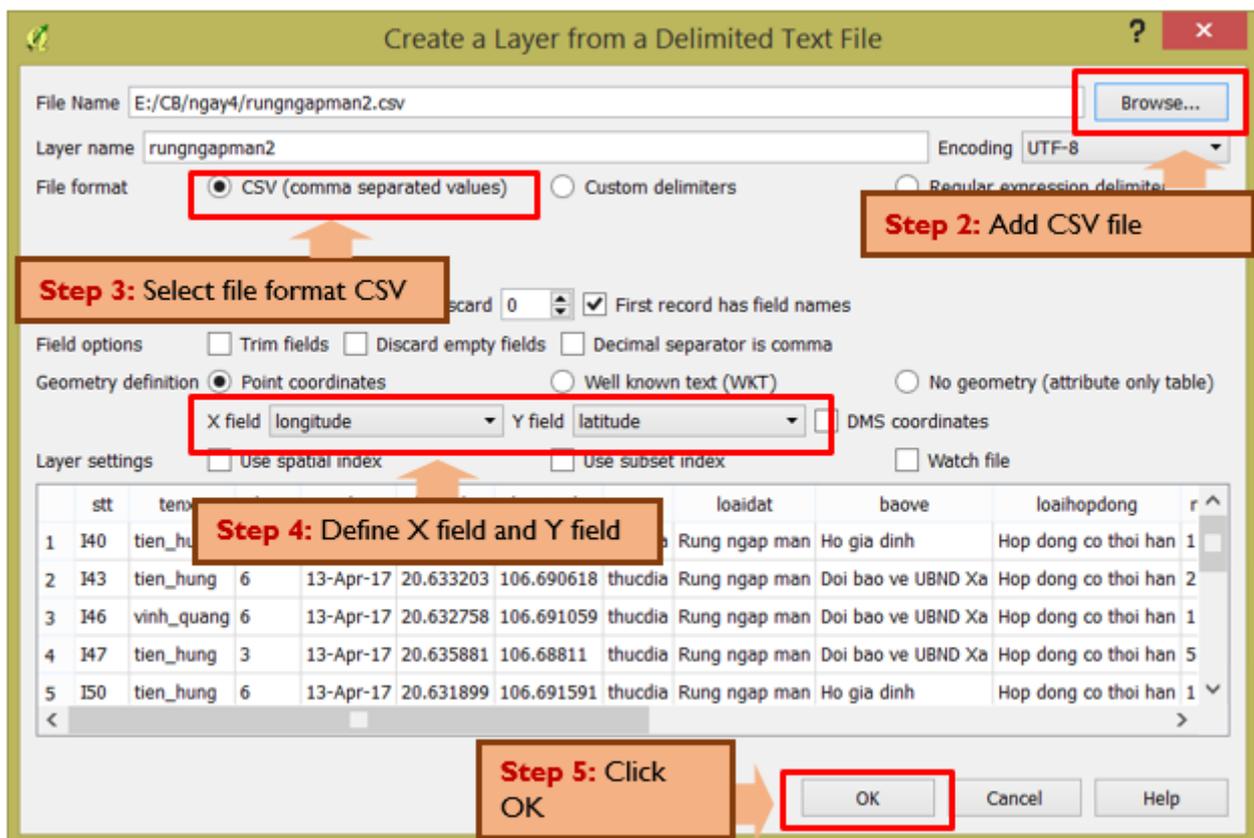


Figure 42: Add CSV file

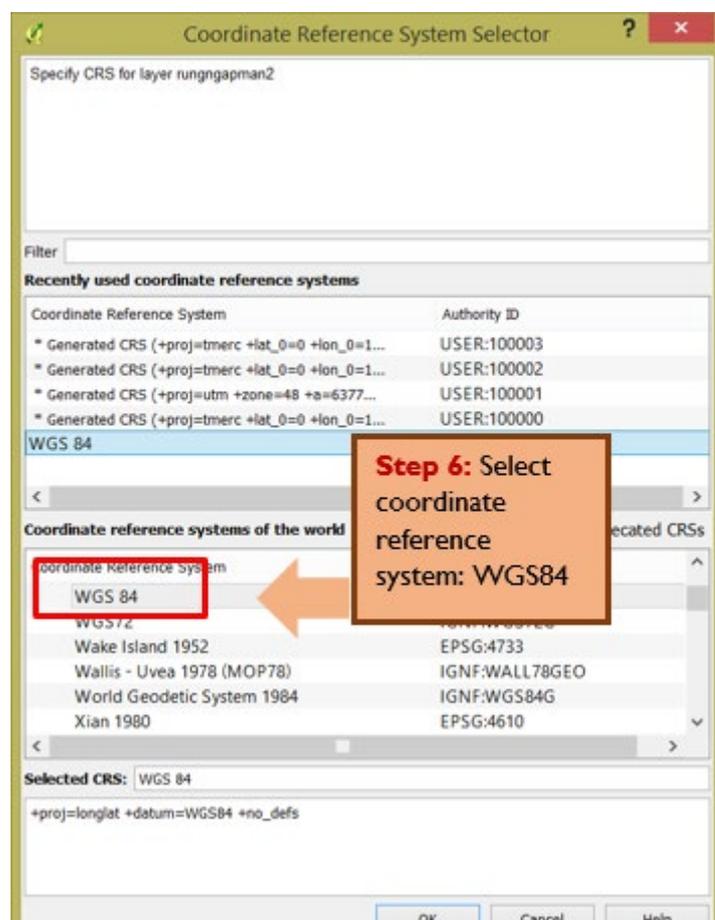


Figure 43: Select coordinate reference system

Step 4: Creating a map with ArcGIS/QGIS software

To visually present the results, all spatial data can be displayed on a map and printed for further use by the commune and district government.

The following standard features should be present on the map:

- Title;
- Location frame;
- Scale;
- Legend;
- North orientation;
- Author(s)/Publisher(s)/Data source/Year of publication (if required); and
- Logo.

The map can be created using GIS software. An example of how to add these features on a map with ArcGIS/QGIS is shown below:

- With ArcGIS: select Insert to add (i) Data frame; (ii) text, (iii) legend, north arrow, scale bar, scale text, logo (Figure 44).

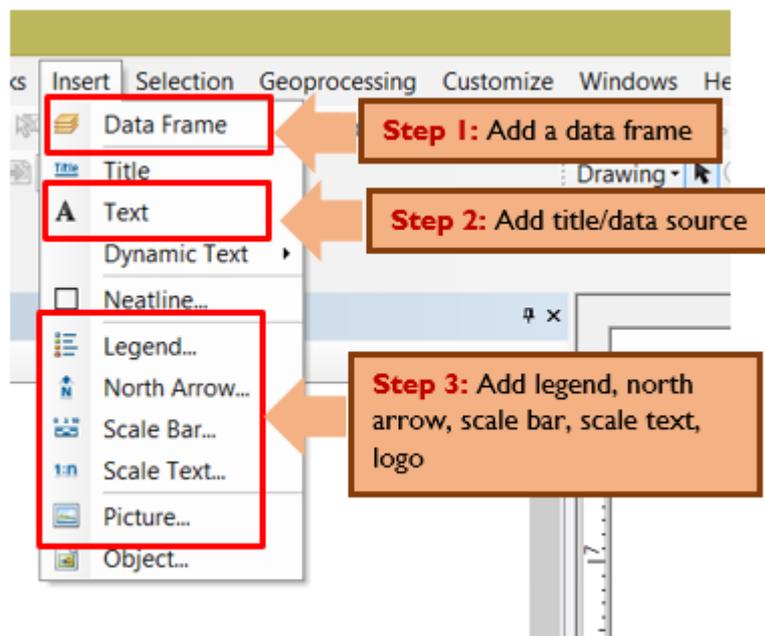


Figure 44: Add standard features to maps in ArcMap

- With QGIS: Add new print composer > add map and other features (Figure 45).

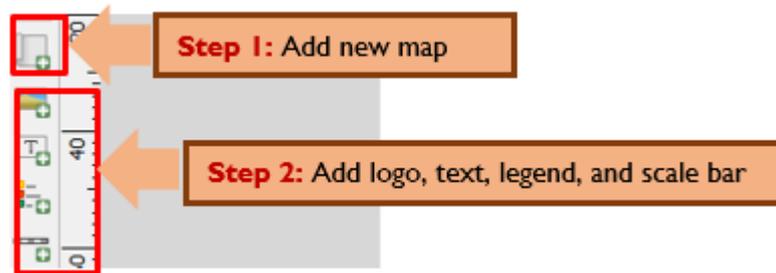


Figure 45: Add standard features to maps in QGIS

Maps exported to printable formats:

Maps can be exported to PDF, JPG, or any other picture format with minimum resolution of 220 dpi for A3 paper or 300 dpi for A1 paper. Photography paper or normal paper are usually used for printing maps.

Sample Maps from the Participatory Mapping Approach



AQUACULTURE PONDS: CURRENT USER AND PRIMARY OWNER, TIEN LANG DISTRICT

Legend

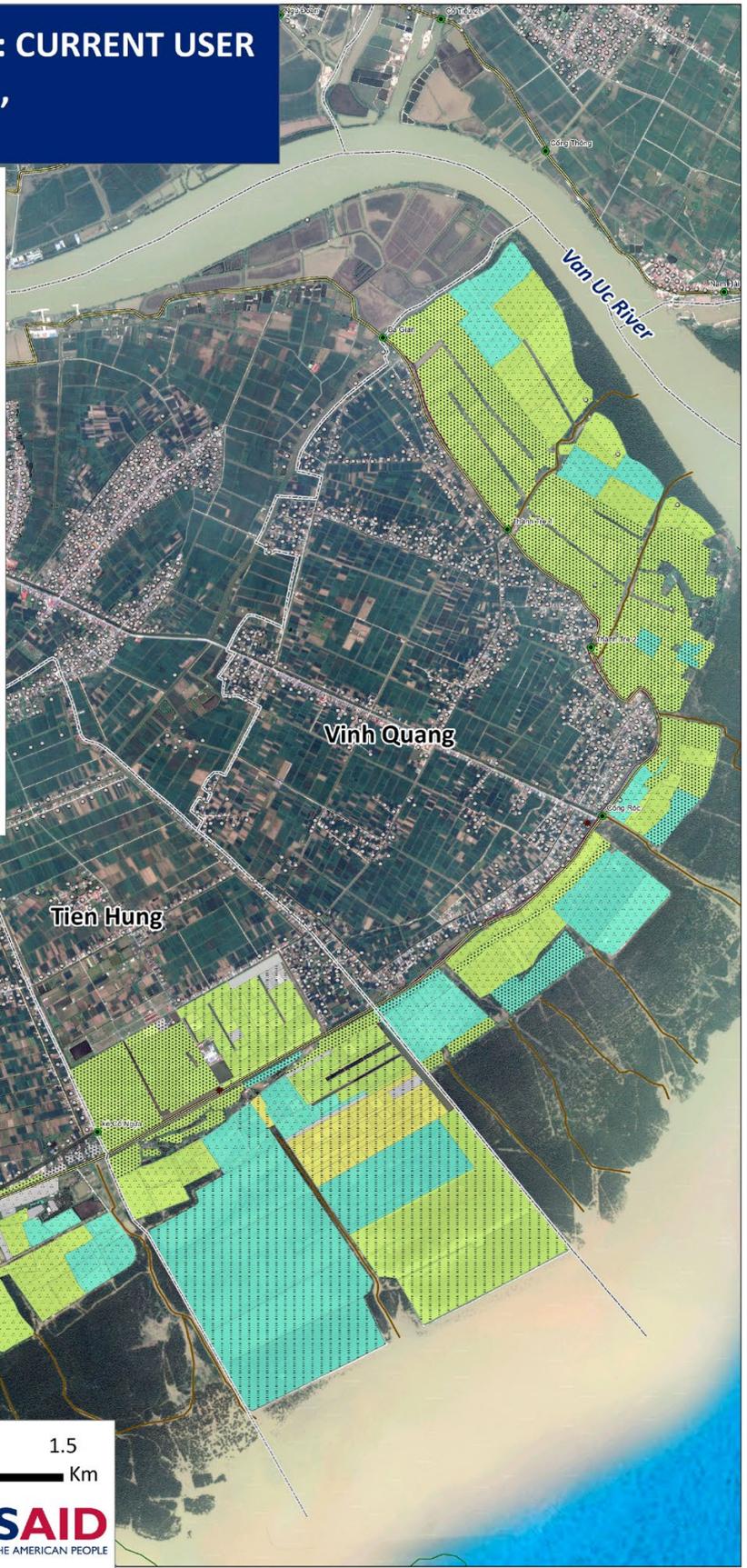
- Sluice gate
- ★ Dyke management station
- Residential area
- Commune boundary
- National dyke - Sea dyke 3
- Water way
- Mud flat boundary

Primary owner

- Provincial People's Committee
- District People's Committee
- Commune People's Committee

Current user

- Lack of information
- Commune household
- Company
- Outside commune household



0 0.375 0.75 1.5 Km

Datasource:
 Google earth imagery
 TGCC Vietnam Database - 2017

AQUACULTURE PONDS: CONTRACT DURATION AND CONTRACT PROVIDERS, TIEN LANG DISTRICT

Legend

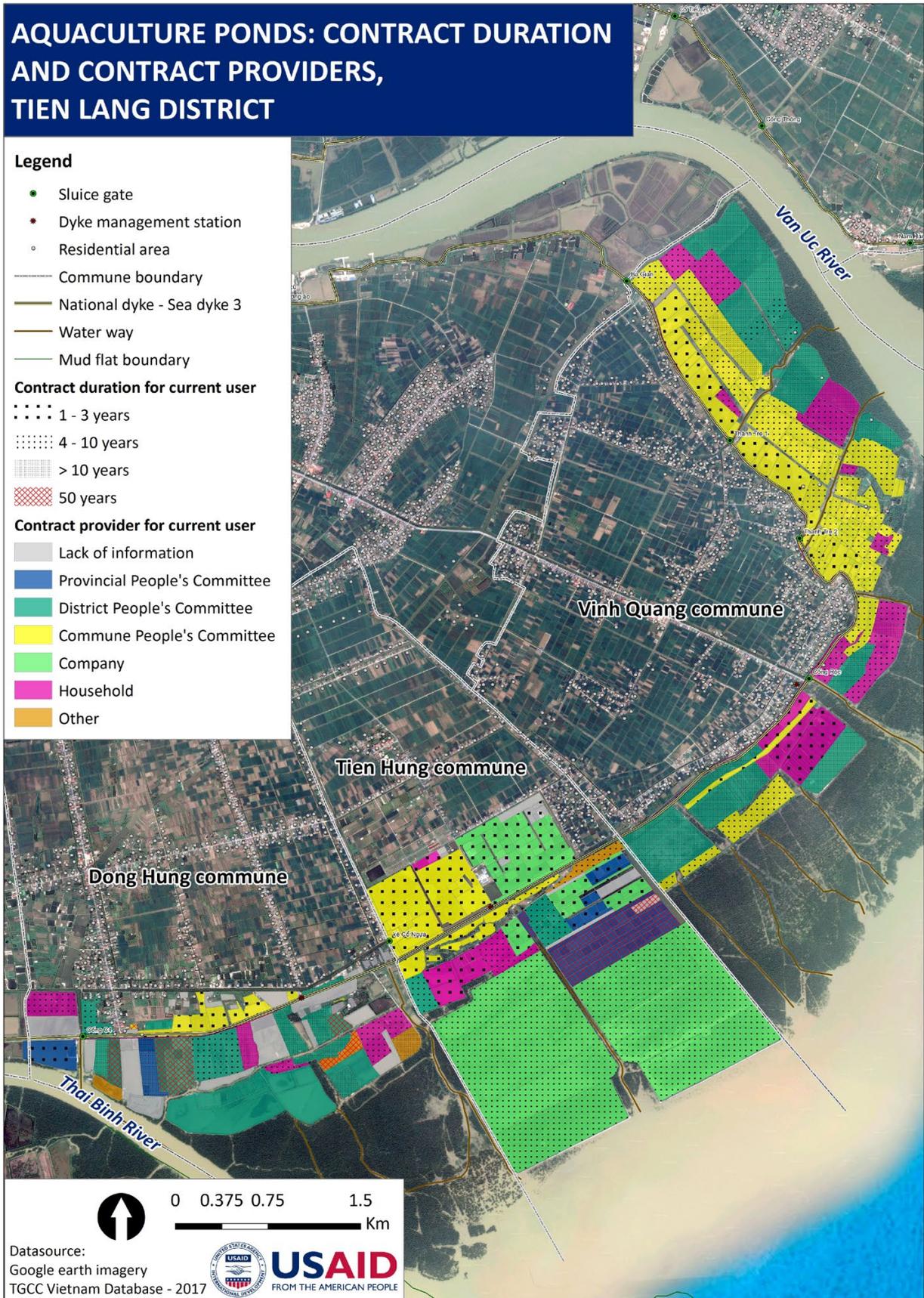
- Sluice gate
- ★ Dyke management station
- Residential area
- Commune boundary
- National dyke - Sea dyke 3
- Water way
- Mud flat boundary

Contract duration for current user

- 1 - 3 years
- 4 - 10 years
- > 10 years
- 50 years

Contract provider for current user

- Lack of information
- Provincial People's Committee
- District People's Committee
- Commune People's Committee
- Company
- Household
- Other



AQUACULTURE PONDS: INVESTMENT AND INCOME, TIEN LANG DISTRICT

Legend

- Sluice gate
- ★ Dyke management station
- Residential area
- Commune boundary
- National dyke - Sea dyke 3
- Water way
- Mud flat boundary

Investment (mio.VND/ha/year)

- Lack of information
- < 50
- 50 - 200
- > 200

Income (mio.VND/ha/year)

- Lack of information
- 0
- < 50
- 50 - 200
- > 200



BOAT OWNER SURVEY RESULT, TIEN LANG DISTRICT

Legend

Boat power (HP)

 < 10

 11 - 30

 31 - 110

 Sluice gate

 Dyke management station

 Residential area

 Commune boundary

 National dyke - Sea dyke 3

 Water way

 Mud flat boundary

XX Number of boats



0 0.5 1 2 Km

Datasource:
Google earth imagery
TGCC Vietnam Database - 2017



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FISHING BY HAND AREA, TIEN LANG DISTRICT

Legend

- Sluice gate
- ★ Dyke management station
- Residential area
- Commune boundary
- National dyke - Sea dyke 3
- Number of working-days per month**
- ☆ 5 - 7
- ★ 8 - 21
- ★ 22 - 30
- Number of people catching fish**
- < 25
- 26 - 50
- 51 - 100
- Water way
- Mud flat boundary
- ▨ Fixed net area
- ▨ Fishing by hand area
- Mangrove forest**
- < 2m
- > 2m

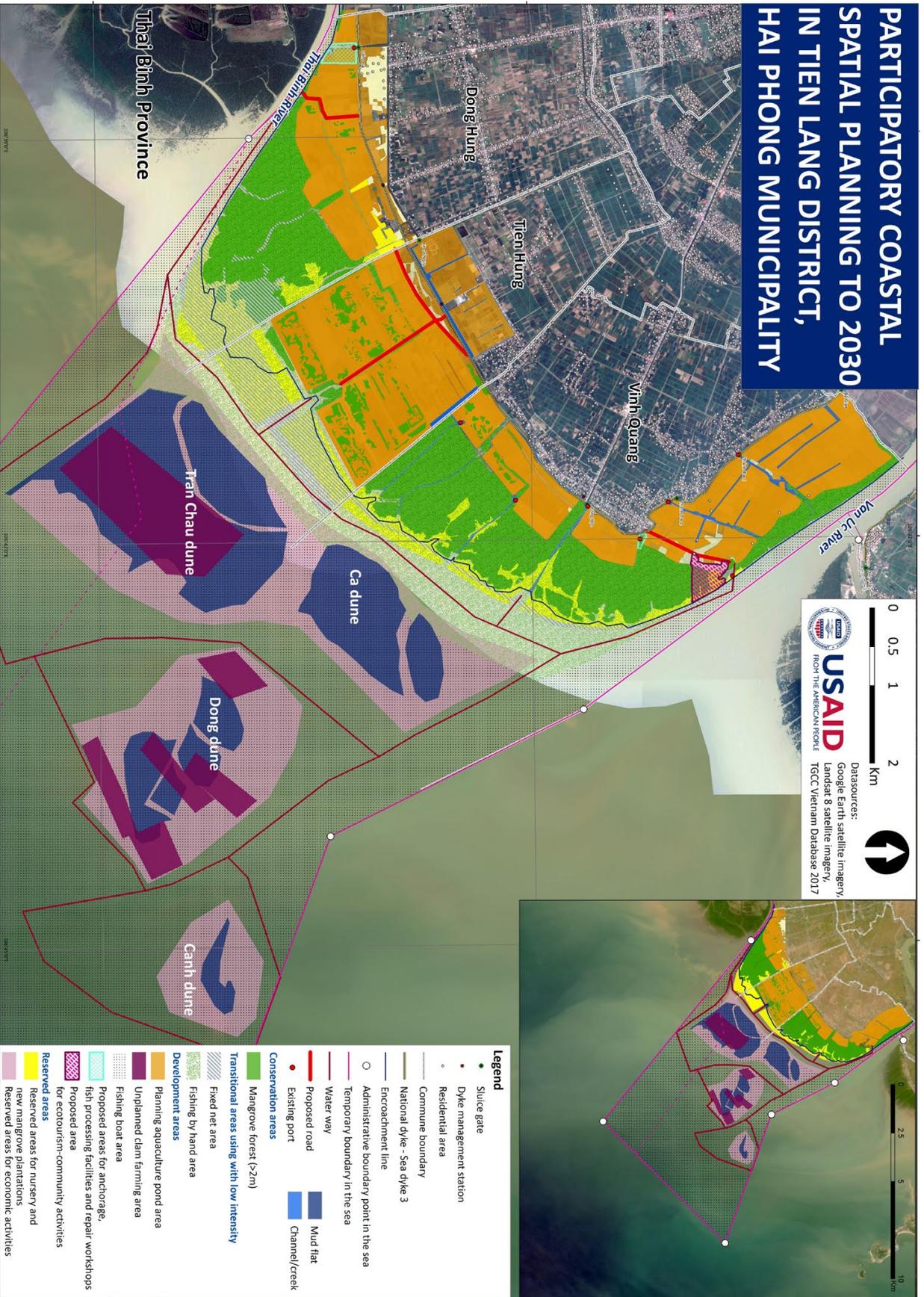


0 0.5 1 2 Km

Datasource:
 Google earth imagery Z17
 TGCC Vietnam Database - 2017

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