Participatory Mapping at Kommuniboli and Falake Pilot Sites in Solomon Islands

- Guidance -

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We referred some articles such as IFAD(2010) and re-edited them for Solomon Islands.

Participatory Mapping Guidance for Solomon Islands

Through the MOFR-JICA's Project on Capacity Development for Sustainable Forest Resource Management in Solomon Islands, we found out some issues below:

1. MOFR does have a database about the natural resources and forest in its country but are quite outdated, especially in customary land, where the government has no power over these lands (Williams, 2011). And customary lands actually make up 90% of the total country area!
2. MOFR intends to update the data but updating data is time-consuming and expensive.
3. More than 80% of Solomon Islanders live in rural and remote areas without access to basic services such as electricity and tap water supply. And Solomon Islanders are in extensive poverty with 56.7% living on less than US$3.10 per person per day (World Bank Group, 2017).

In short, MOFR needs to collect and update data with less time and lower cost. But because the communities in Solomon Islands are too poor to enjoy basic services, let alone knowing how to plan and manage their natural resources with technology. According to the UNESCO Institute of Statistic (2021), fortunately, the literacy rate of adults of both genders aged 15 years old and older in 2009 is quite high, at 76.6%. Hence MOFR can empower them to be the stewards of their respective natural resources, while providing data to MOFR.

For the above reason, we intend to suggest MOFR to apply participatory mapping as a tool to manage forest and natural resources by empowering those literate Solomon Islanders throughout the country to do the job. Yes, it is an exchange between MOFR and Solomon Islanders. MOFR will provide knowledge, training and even lending some equipment needed to the community members so that they can collect data for MOFR. Of course, it is best if MOFR can help solve some of their problems, particularly in sustainable resources management in return so that the community would be excited to continue, and may cause a ripple effect through the word of mouth.

Summary Chart

① Project Design	② Pre-mapping	③ Mapping	④ Map Use & Decision Making	⑤ Evaluation
Assign roles & responsibilities ⇩ Set goals ⇩ Allocate budget & resources I • Budget for get to know community • Transport • Food • Accommodation ⇩ Know the communities • Build trust • Political situation • Culture • Lifestyle • Literacy • vulnerable group • Needs and issues	Community meeting I: Prepare community • Build trust • Learn the What, Why, How, Examples of participatory mapping • Discuss issues & risks • Obtain consent/ agreement Decide purpose Discuss & confirm mapping tools Identify implementers & training needs ⇩	Community meeting II: Determine legend Collect data: • Sketch mapping/ scale mapping • 3D mapping (optional) • Ground truth with GPS or other GPS enabled devices ⇩ Transcript data ⇩ Community meeting III	Community meeting IV: Support natural resources management with maps and discussion • Know resources location • Become aware of problems, challenges & potentials Facilitator may need to assist the discussion, and ensure no legal, management & safety issues Maps as tools of communication	<u>Community level</u> Community meeting IV or V: • Self-assessment* • Obtain feedback AND/OR Communities meeting: • Self-assessment* • Exchange ideas & values • Obtain feedback * Benefits of participatory mapping, failures and next steps needed <u>MOFR level</u>

• Participatory mapping effectiveness ⇩ Identify collaborators ⇩ Allocate budget & resources II • Budget for entire plan • Purchase equipment • Trainings • Transport • Food • Accommodation • Community members' stipends ⇩ Identify indicators/ criteria for monitoring change (direct/indirect to the project)	Provide training • Participatory mapping • Equality and inclusiveness • Tools • Facilitation (within community/ communities) ⇩ Purchase & prepare equipment	Analyze & evaluate new maps ⇩ Correct & Finalize map	• Must discuss about data authority Influence planning Other Uses	• Monitoring system with feedback mechanism to reflect & evaluate the achievement • Ensure community regularly consult project officers <u>Government level</u> • Contribute to policy development at district, regional or national levels ⇩ Post-project mapping

Note: May refer to (IFAD, 2010) for the suggested project checklist.

The Five Stages of Participatory Mapping

Each participatory mapping project is unique depending on the aim, the country's political environment and structure, the community's culture, history, politics, needs, issues and attitudes, to name a few. For these reasons, MOFR should be flexible in adapting the methodology of participatory mapping to the needs and requirements of each community. Therefore, MOFR may freely alternate, add or remove some of the steps below based

on the situation (Chapin, Lamb, & Threlkeld, 2005; IFAD, 2009; IFAD, 2010; Zerrudo, 2008).

Stage 1 is the stage if MOFR has to start the project from nothing. It was the planning stage whereby the JICA team had done before the project commenced (Section 5). Up to year 2020, the activities that the JICA team has done in Komuniboli and Falake were only at around Stage 2 and 3 and has not conducted both Stage 4 and 5 yet. Also, as you read, you may find out that we did not follow all the steps, and we did even remove, modify, add and even repeat some steps according to the needs. Thus, the steps below are for MOFR guidance only.

If you notice, Section 5 started with stating the objectives of the project, and the sub-objective 1 was to select the Pilot Sites in accordance with the Pilot Sites selection criteria, which could be considered as (S1.2) analyze the community situation. After determining the pilot sites, the JICA team and MOFR conducted a session of getting to know the two communities, Komuniboli and Falake, and signed a memorandum of understanding with the two communities (S2.1). Then, the JICA team directly provided training on GPS to collect boundary data (S2.5) so that a scaled satellite image map could be printed out for the scaled mapping. The JICA team conducted both sketch mapping and scaled satellite image mapping (S3.2) before providing another training on how to use Avenza Map installed in tablet devices for a more accurate data collection (S3.3). Of course (S2.6) was also being conducted but mostly by JICA Team from Japan. Then, the JICA team was responsible to transcribe field data onto new maps (S3.4). The printed maps were shown to the community members for validating and checking (S3.5), as well as acting as the foundation for the community members to learn how to read maps.

To achieve sub-objective 3, ie. to support and facilitate the Pilot Sites communities to develop Pilot Activities and implementation plans on SFRM, the community members were requested to create current land use (LU) map on the scaled satellite images while comparing with the maps they created with GPS and Avenza Map, and topography map for better accuracy. Then, based on the current LU map created, the community members started drawing, planning and zoning their future LU map before they determined their objectives and brainstormed for a list of activities to be conducted to achieve their objectives for each LU zone (S4.1).

Note: If you have no idea about the participatory mapping that we did in Komuniboli and Falake, please read Section 5.

Stage 1. Project Design

This is the stage which starts from the moment MOFR decided to conduct a participatory mapping until the start of formal project activities. In this stage, MOFR shall (S1.1) establish a working group to plan and design the project, (S1.2) analyze the community situation, (S1.3) identify collaborators/ partners, (S1.4) assign resources, and (S1.5) define monitoring mechanisms.

(S1.1) Establish a working group

The working group shall have a leader, secretary, treasurer, public relations officer, facilitator and a few committee members. It is better that everyone in the working group has experiences in participatory mapping for they would have to work with community members to collect data, which is not only useful for MOFR but also potentially useful for the community members. Although it is best to have one person assigned for each role, if there is a shortage of staff, MOFR can assign these roles to a few members only.

A leader oversees the entire project, assists other members in the working group, communicates with and even convince other government officers of higher status and local authorities, sponsors, and collaborators about the benefits and effectiveness of the project. The leader must also be able to work with the community members, communicate and negotiate with other relevant stakeholders. A secretary records meeting minutes, produce and keep required documentation and letters; a treasurer manages the account of the project, and make sure that money are enough for the entire project; a public relations officer assist the leader and the working group to deal with government officers, sponsors, collaborators, community, and even the publicity of the project; the facilitator mainly work with the targeted community by facilitating their meeting, though it would be best if the facilitator is capable in training new facilitators selected by the community; and the number of committee members depends on the size of the project for they are responsible to help the leader, secretary, treasurer, public relation officer, and the facilitator.

(S1.2) Analyze the community situation

This is the stage for MOFR to create awareness about the project among the community members as well. MOFR may first visit their local government officers such as the village leaders to learn about the targeted community. If possible, it is best that the facilitator or your team members live with the community members for some time to build trust and

personal relationships especially when none of your team is a member of the community itself or is familiar with the community to analyze the situation of the community. (Weyer, Bezerra, & De Vos, 2019; Damastuti & de Groot, 2019; de Paiva, 2017).

MOFR can assess the community preliminarily to identify suitable participatory mapping tools for the community based on the condition in the community (e.g., literacy rate and facilities available). At the same time, MOFR may informally interviewing the community members to better understand the community culture and lifestyle, internal politics to avoid potential conflicts, identify vulnerable members within the targeted community, community needs and issues, as well as whether participatory mapping can help (de Paiva, 2017; IFAD, 2010). MOFR may explain the objectives and importance of mapping work to them especially if they ask. This analysis allows MOFR to identify the main purpose of participatory mapping activities, potential mapping tools and methodology for cost calculation. However, please try to include as many community groups (e.g., youth, women, and elders) as possible.

If possible, MOFR may arrange so that your team visits the neighboring communities as well to understand their situation and identify their underlying issues too. If MOFR happen to find out that the neighboring communities are similar or are also having similar problems, MOFR may possibly think of integrating those communities into the project to save cost. Of course, depending on the purpose, some studies are able to include multiple groups within a community, and even multiple communities in a location at one time (Valencia-Sandoval, Flanders, & Kozak, 2010).

(S1.3) Identify collaborators/ partners

When you have analyzed and understood the situation, you can start identifying collaborators and partners from the local government, NGOs, consultant, and university, as well as fostering a good relationship with them.

(S1.4) Allocate resources

Although participatory mapping can cost less by involving more communities in the project at one time, financial planning is still a must. MOFR shall plan the budget at least twice throughout the project. The first directly after establishing a working group, mainly for the use of visiting the community to analyze the community condition and the second, after analyzing the community condition.

The project leader, especially the treasurer has to plan for the project budget.

Besides allocating resources for the staffs (general, technical and professional), community members (stipend or compensation), logistics (for project staffs to go to the project site and also traveling during ground truthing with the community members), accommodation, equipment (e.g. GPS, tablet, camera, etc.), food, training (for the staff, facilitators, and community members), evaluation (please refer to Stage 5), etc. (IFAD, 2010), the treasurer has to allocate a small amount of money for the 'rainy day', the unexpected costing and absolute emergency.

(S1.5) Define monitoring mechanism

Monitoring mechanism is a set of tangible baseline criteria and indicators which allows MOFR to measure the project impacts and changes qualitatively and quantitatively from the beginning to ensure the project is proceeding towards its goals. Qualitative indicators capture the changes perceived (e.g., how much a poor community is empowered) while quantitative indicators use numbers to measure. (e.g., the percentage of community members participating in the project). Both types of indicators can be combined to provide a more comprehensive understanding of the changes being assessed. Example is to use Likert Scale which allows individuals to express their attitude, whether they agree on a particular matter by measuring the intensity of their attitude on a continuum from strongly agree to strongly disagree.

The indicators shall be related to the community and overall project goals and shall involve three levels of stakeholders: the community, project's collaborators, and MOFR (Note: more explanation in Evaluation Stage). For examples (IFAD, 2010), the changes within individuals (e.g., skills and knowledge learned through the project enabled individuals to take up new roles in the community); changes within communities (e.g. a community now has cohesive, consensus-based management or a communication plan to guide future resource-related negotiation; and changes in a community's role in influencing a broader region (e.g. a map produced was used to influence the decision-making process of government for the community's advantage)

The possibility of a community/ tribe with a strong political background to successfully utilize maps for resources and influence is higher than those that are weak (IFAD, 2010) (the political background should have been identified in Stage 1.2, when the communities' situation was analyzed). Also, the indicators to measure the efficiency of the participatory mapping project must not focus on the outcomes or product but the process, such as the change in community cohesiveness, community building and

empowerment.

Note: It is similar to the Sustainable Development Goals (SDGs) developed and formulated by the United Nations (UN). For each goal, the UN provided a set of indicators as a guideline and measurement of success. Various organizations around the globe can identify the activities they can do to achieve their goals, and at the same time achieve the UN's SDGs, which can be measured through a set of indicators.

(Please refer to Stage 5 for more explanation.)

Stage 2. Pre-mapping

This is the stage before the real mapping work started. In this stage, MOFR shall hold the first inclusive community meeting or workshop to (S2.1) prepare the community, (S2.2) decide the mapping purpose, (S2.3) discuss and confirm mapping tools, (S2.4) identify participatory mapping implementers and provide required trainings. The (S2.5) purchase equipment can be done before the first meeting, partly before the first meeting and then after the meeting or when required.

Note:

- Engage the community members in the early stage so that they would have a sense of ownership over the project, hence, have a higher possibility to sustain the project for a longer term.
- Make sure to arrange the time period that is not overlapping with sowing and harvesting seasons or when they would be busy working for their livelihood.
- Compensate the local community members as much as possible.

(S2.1) Prepare the community

Gather the community members in a community meeting. MOFR may get the help from the local government and community elders, which have already identified in the S1.1 - 1.3. Do take note of the inclusiveness of the community group because being inclusive creates maps that represent the entire community views and interests better.

- In the meeting, provide the community sufficient information about participatory mapping (what are maps, how to create and use maps?) (Corbett & Keller, 2006)

- , the range of tools available (Refer to Stage 2.3 for more information), process to create map (time, effort and resources required) and the maps' potential uses (Corbett & Keller, 2006) (and whether the uses part of a larger project strategy of MOFR). MOFR may also share to the community the background or basic information of the study. For instance, if the project is about sustainable timber logging, MOFR may share about the importance of sustainable logging, and even the latest laws and policies of Solomon Islands.

Building trust is important to ensure the successfulness of the entire project. If the facilitator(s) has yet to visit the community during Stage 1.2 analyze the community situation, this meeting is a good opportunity for facilitator(s) to build rapport with the community members (IFAD, 2010).

The facilitator(s) and all stakeholders must identify and enunciate the potential risks relevant to this mapping project and engage the community members to discuss these issues. This is to prevent potential negative consequences such as the infringement of law because of the recorded community's traditional logging practice.

When the community understands both the opportunities and risks enough, they can decide whether they are willing to invest required time and energy into the project (IFAD, 2010). MOFR shall allow them to question and even argue about the project. Then, obtain their consent at this point, by having a black-and-white agreement.

Note: The community members may not have their own thoughts for they have no knowledge or experience in participatory mapping. Therefore, the facilitator plays an important role to engage the community members without bias.

(S2.2) Decide the mapping purpose

Although MOFR may have the purposes of the mapping project set, the community members may think that those purposes are not theirs, and may not even solve their present issues. Therefore, it is good to tell them that this is their project, and lead them to answers some of the questions below: (Source from Flavelle, 2002 in (IFAD, 2009)

- Why do we want to make a map?
- Who do we want to show it to?
- What are some of our most important land-related issues?
- What can we use the map for in the short term?

- What can we use the map for in the long term?
- Is there a predefined reason for creating the map?

Note: You may carry out this step in the same meeting as above, S2.1.

(S2.3) Discuss and confirm mapping tools

To ensure the community ownership of the project is taken care of, engage the community members in the discussion to confirm the type of tools to be used in the project. Of course, MOFR has to first select the type of tools to be used first based on the project fund, the skills and the ability of MOFR. Then, allow the community members to select the type of tools they wish to use based on their ability, ie. time and literacy rate. The various tools available are A) ground map, B) sketch map, C) scaled map with images, D) 3D model, E) GIS, F) Multimedia & Internet Map G) GPS and other data collection devices.

Note: You may carry out this step in the same meeting as above, S2.1 – 2.3. You may also find out the methods on how to use these tools in Stage 3.

A) Ground Map

Community involved in ground mapping activity in International Fund for Agricultural Development (IFAD) Mount Kenya East Pilot Project (MKEPP) @ MKEPP (IFAD, 2009)

Use Difficulty: Very simple
Equipment: Pebbles, stones, sticks, branches from nature
Cost: Very cheap/ no cost
Strengths:

- Non-literate people can join
- Results can be seen quickly and provide tangible outcome
- Best to start discussion

Weaknesses:

- Maps not geo-referenced
- Cannot provide quantitative information (eg. distance & direction)
- Created map may be destroyed easily by the nature (eg. wind and rain)

B) Sketch Map

@ B. Codispoti/ILC (IFAD, 2009)

Use Difficulty: Simple
Equipment: Large sized white paper (such as Mahjong paper), colored marker pens, pens, and sticky notes

Cost: Very cheap

Strengths:

- Results can be seen quickly and provide tangible outcome
- Best to start discussion

Weaknesses:

- Some non-literate people are excluded
- Maps not geo-referenced
- Cannot provide quantitative information (eg. distance & direction)

C) Scaled Map with Images

Scale-map mapping in Solomon Islands. @Khew E.H.

Use Difficulty: Simple

Cost: Cheap to expensive

Equipment: May need to purchase satellite images, computer with ArcGIS Pro (commercial version) or QGIS (free version) to create the scaled map, printer to print out, laminator to laminate or even fluorine film laminate, colored marker pens, sticky notes, and pens

Strengths:

- Easy for people who cannot read topography map
- Information can be incorporated into GIS easily
- Can provide quantitative information

Weaknesses:

- Need considerable time and energy to create
- May be difficult to access accurate and up-to-date scale map

D) 3D Model

Community 3D Mapping, Vietnam @G. Rambaldi/CTA (IFAD, 2009)

Use Difficulty: Difficult

Cost: Moderately expensive

Equipment: elevation data, white cement, cardboard, cutter, glue, foam board, marker, paint brush and colored paints.

Strengths:

- Easy to understand
- Time spend can encourage discussion of important spatial knowledge

Weaknesses:

- More effective for area with huge elevation difference
- Labor intensive
- Time consuming
- Difficult for storage and transportation

E) GIS

Using GIS software, Sabah, Malaysia @Rosli Jukrana

Use Difficulty: Difficult

Cost: Expensive (especially hardware)

Equipment: Computer (laptop or desktop) with ArcGIS Pro (commercial version) or QGIS (free version) installed.

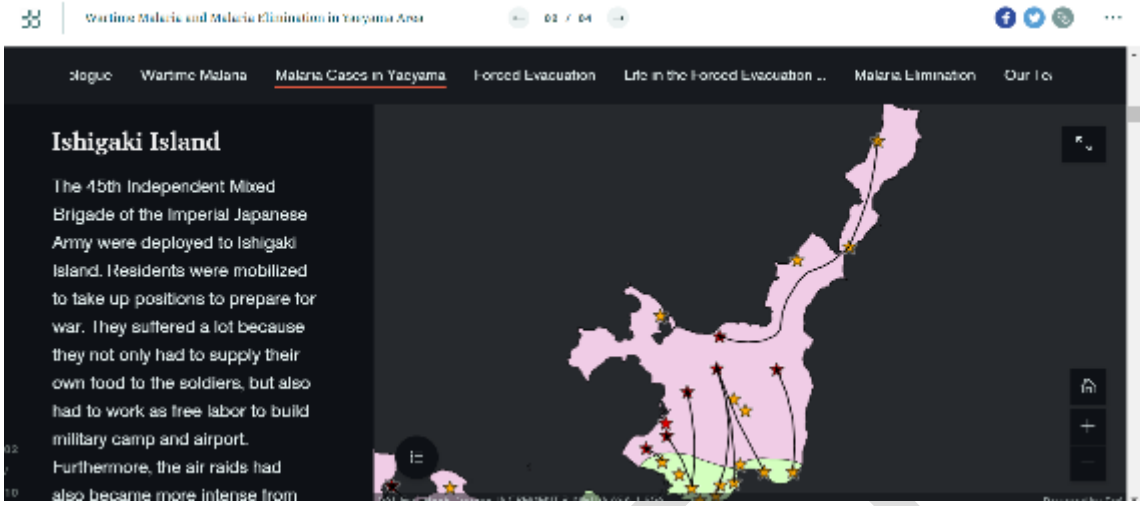
Strengths:

- Can store, retrieve, analyze and present spatial information
- Result maps look more professional
- Easier to influence land-related decision making

Weaknesses:

- Require continual updating of software and re-training
- Require long-term operating cost
- Technician must keep explaining what he/she is doing
- May not have electricity to support in some area

F) Multimedia & Internet Map (Crowd-sourcing)



History of Wartime Malaria in Yaeyama, Okinawa

https://arcg.is/1y0qHC

Use Difficulty: Moderate

Cost: Expensive

Equipment: Computer with stable internet connection,

Strengths:

- More comprehensive documentation because it can combine various of medias such as text, video, audio and images
- Allow communicating local knowledge in engaging format
- Certain online applications can be used for data crowd-sourcing

Weaknesses:

- Need knowledge of computer, video production, photographic editing and file management
- May not have electricity/ internet connection to support
- May not accessible for non-literate

G) GPS and other Data Collection Devices

Garmin GPS

Smartphone - Survey123

Use Difficulty: Moderate to Difficult

Cost: Cheap to expensive

Strengths:

- Information can be incorporated into GIS easily
- Can provide quantitative information

Weaknesses:

- Need knowledge of computer, GPS
- May not have electricity/ internet connection to support
- May not accessible for non-literate

(S2.4) Identify participatory mapping implementers and provide required trainings

MOFR shall get the community members to select a few persons-in-charge (or leaders) for the purpose(s) and tools decided in the first meeting. The selected people shall be at least knowledgeable about topics such as fishing, natural resources harvesting, and farming that they are responsible for. The facilitator should make the community aware of gender equality because women usually may provide knowledge and information different from men. If MOFR wishes that the project is sustainable in the selected villages, MOFR can have the community members to select one or two members within the community to act as their facilitators in the first community meeting. Of course, facilitators can also be identified from NGOs, local government officers, and/or other relevant stakeholders.

The selected facilitator should be able to (Weyer, Bezerra, & De Vos, 2019):

- Build trust by being clear and transparent
- Exercise patience and sensitivity when working with people from different cultural backgrounds.
- Explain ethical principles and informed consent to participants
- Take extreme care to explain all risks and processes, from participation to results dissemination in understandable language without jargon
- Dismantle misperceptions such as visiting researchers may be linked to a better life
- Have a thorough understanding of the local context, and building relationship within a community

(S2.5) Provide Training

Training for the persons-in-charge (or leaders) shall be based on their responsibilities. For instance, if the person-in-charge is responsible to collect data via GPS, GPS training shall be provided. As for the selected facilitator(s), training about participatory mapping and monitoring activities, tools and techniques, inclusive facilitation, negotiation and conflict management shall be provided. For both types of training, MOFR shall include a gender awareness component because participatory mapping is best to involve as wider groups as possible, including the vulnerable groups such as women.

It would be best if MOFR has an experienced facilitator to be part of the working group to lead, connect, facilitate, and supervise all the facilitators so that they could stay on path to the project goals. The facilitator shall also ensure all persons-in-charge and leaders report their work progress from time to time and provide them with support whenever issues arise.

MOFR can provide the same training for all of the community members together if they are willing to learn and if budget allows. To save training costs, MOFR can provide training for facilitators and persons-in-charge together, and/ or provide training to a few communities and villages simultaneously. Nevertheless, if budget permits, MOFR shall provide training periodically to sharpen present facilitators' skills, and allow them to interact, exchange experience and discuss issues they have in their respective communities. Periodical training is particularly important if the participating organization(s)'s staff turnover rate is high.

(S2.6) Purchase and prepare equipment

To save time, MOFR can purchase and prepare part of the equipment required for S2.1 to 2.4 above and perhaps also equipment for ground mapping, and sketch mapping tools such as large sized white paper, marker pens and sticky notes. Because MOFR has the computers with internet connection, MOFR can consider downloading satellite images, and print out for scale mapping too. The other equipment such as GPS can be purchased later after the first meeting with the community members if MOFR will go (Stage 3.3) ground truthing to verify and collect more accurate location data with GPS the other time.

Stage 3. Mapping

Mapping is the stage whereby MOHR begins to collect and verify data together with the community members to complete the final maps and achieve goals. Based on S2.3, there are many tools that can be used, and this is the stage whereby we will look into those tools in detail. A participatory mapping usually utilizes more than one tool to be more inclusive in achieving their goals.

A participatory mapping usually starts with (S3.1) identifying and determining legend, before carrying out (S3.2) sketch mapping or scaled mapping to have the community members to write and draw out their neighborhood, knowledge, experience, etc. Then, together with the experienced and knowledgeable community members selected by the community, the facilitator(s) and surveyors will go out to the site(s) to (S3.3) verify and collect more accurate location data with GPS. These GPS data will be (S3.4) transcribed onto new maps by the community members, MOFR, and/or external organizations such as the JICA team. The maps created will be printed out for (S3.5) the community members to analyze and evaluate before (S3.6) correction of the digital data to be made to finalize the map.

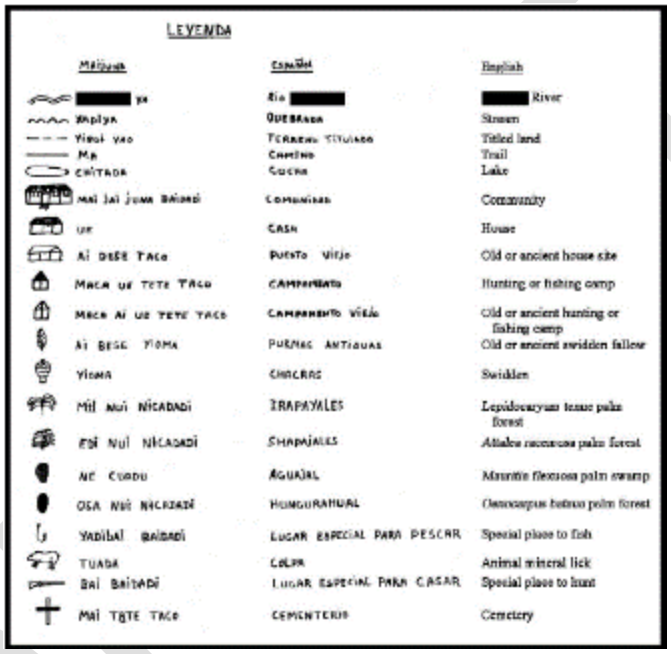
Note: Stage 3 is the stage whereby a good facilitator is highly required because the facilitator has to generate diverse views, reach a consensus on areas of contradiction and promote creativity and innovation (IFAD, 2010)). A recorder is also needed to record the conversation and discussions of the community.

(S3.1) Identify and determine legend

Identifying and determining legend is to create a list of symbols which represent and

describe the various features shown on the map. It also makes the process of sketch and scaled mapping easier because the community members can use the determined symbols to show some complicated and sophisticated stuff.

Considering some community members may not have idea about the use of legends, MOFR can provide some examples to initiate the discussion of identifying appropriate symbols such as forest (resources extraction sites, ie. timber, plants, animals), river (source of water, fishes, prawns), houses (community hall, elders' houses, school), farm (swine, chicken, goat, cows), religious site (taboo site, church), etc.



Example of legend in multi-languages (Gilmore & Young, 2012).

(S3.2) Ground Mapping, Sketch Mapping, Scaled-Mapping and 3D Modeling

At least a facilitator and a recorder are needed to conduct this step because the facilitator has too many things to oversee and handle, hence may be unable to recall all things during documentation.

The facilitator will have to create a conducive environment to encourage the participating community members to share and discuss their opinions, knowledge and experience. The facilitator may need to provide some ideas through questioning so that the participants know what to share. For examples, the facilitator may have to ask questions such as 'where do you usually get your food supply?', 'where do you usually fish?' etc.

Meanwhile, the recorder records the entire process, problems, and even discussion during the mapping process. The recorded information is important for the facilitator and MOFR to further improve the participatory mapping process, and even the entire project. The recorded information may be needed for reports and documentation too.

A participatory mapping usually selects only one tool out of the four tools below as the first step to start a discussion which may be helpful for data collection. Depending on the project's purpose, some may skip or repeat S3.3 and 3.4.

- **Ground mapping**
  - Use if there are many illiterate community members.
  - The facilitator ought to take note that the symbols used in legend shall not be too complicated because of the materials used are usually large in size, ie. pebbles, branches, etc.
  - The participants usually draw the map on a sandy ground with a stick or finger, and put pebbles and branches on the ground to represent certain features such as houses, farms, pools, and etc.
  - After the ground map is done, a recorder has to draw the ground map on a piece of paper or take a picture of the ground map so that the information created on the ground would not be lost.

- **Sketch mapping**
  - Better than ground mapping because it can be done indoors, hence, not affected by the weather.
  - Because it does not occupy too much space like that of ground mapping, the facilitator can consider to divide the community into groups (eg. woman, man, youth, and elders) so that the members will feel more freedom in sharing their knowledge and experience.
  - The participants usually draw the map on a large piece of paper (eg. mahjong paper) with colored marker pens. They can start by drawing a basemap, ie. the topography features such as river, land cover such as forest area, farm area, and residential area before adding points features such as school, houses, house of worship. They can also include the predetermined symbols in S3.1 in their map(s).
  - But to ensure the information given by each group is correct, each group has to

present their results so that a final sketch map which everyone agrees upon, can be produced.

- **Scaled-mapping**
  - MOFR has to first prepare the basemap. MOFR can download free or paid satellite images of the targeted area, create grids to scale the satellite image, and print out.
  - MOFR can print a large size map such as A0 by splitting the page across multiple sheets of A4 paper with the tiling option of Adobe Reader 10 and later or with other software. Then, MOFR can combine/ stick the A4 papers together into A0 sizes.
  - To repeatedly use the printed basemap, MOFR may fix acetate transparency film on the basemap so that the community members only draw and write on the acetate film.
  - The participants usually draw on the basemap with colored marker pens. They can start by drawing a basemap, ie. the topography features such as river, land cover such as forest area, farm area, and residential area before adding points features such as school, houses, house of worship. They can also include the predetermined symbols in S3.1 in their map(s).
  - But to ensure the information given by each group is correct, each group has to present their results so that a final sketch map which everyone agrees upon, can be produced.

- **3D modeling** (Corbett & Keller, 2006)
  - Looks good and suitable only if the topography is hilly.
  - It is time-consuming and rather complicated to use.
  - MOFR has to download the elevation data (contour) of the region, and increase the vertical exaggeration (Z scale) value to make the model look nicer.
  - Then, the facilitator will have to guide the community members (usually the young generation is more interested) to cut cardboard in the shape of the contour lines and pasted on top of each other to create a 3D model. Other features such as river basins will have to use slightly different techniques. Lastly, the participants can paint or use colored cement and add some accessories to make the model look real.
  - After setting up the model, the facilitator can facilitate community members' discussion and make them pointed out locations by using pushpins (for points),

colored string (for lines) and paint (for areas).

- This 3D model can be used to encourage the re-discovery and visualization of local community knowledge, as well as intergenerational dialogue. Because more man-power and longer time are needed, it can help build a greater sense of community cohesion.
- When the discussion is done, a recorder ought to record the final 3D modeling mapping for digitization.

- Note: MOFR may conduct a GPS Transect Walk to collect boundary data to identify the area of a village easier if needed when preparing satellite imagery basemap for scale-mapping and contour data for 3D modeling.

(S3.3) Verify and collect more accurate location data with GPS

This step can be known as GPS Transect Walk too. It is the use of GPS to collect more accurate point data of the boundary and location of the resources pointed out on the sketch map or scaled-map drawn by the community members. Therefore, the information on the map can be verified by going to the field together with the selected community's person-in-charge and experts.

Other than GPS, MOFR can consider to use field data collection apps for Android or iPhone, which can also collect location data, such as Avenza Map (Android & iOS), and Open Data Kit (Android). Using these tools not only allows the collection of location data but also other data such as images and attribute data (the width, height, length, characteristics, etc).

Depending on the location of the targeted site, MOFR staff may need to hike, drive into remote area or take a boat, and the period of time needed may be either short or long. Hence, MOFR will have to arrange for transportation and perhaps accommodation. Because the time taken may be long, it would be better that MOFR compensate the participating community members with some stipends, food and even accommodation if needed.

Note: The community members joining this field trip should have had training during the S2.5. However, if they are yet to be trained, MOFR should provide a simple training before the field work to ensure the data collected are consistent and highly accurate. It would be best to allow them to verify and collect the data on their own as a means of

community empowerment.

(S3.4) Transcribe field data onto new maps

This is the step whereby we think it is difficult to be carried out by the local community members unless they have electricity supplies, and relatively good quality computers in their villages. Therefore, we think that MOFR has to take over this step.

MOFR has to digitize data collected from S3.2 and transcribed field data collected from S3.3 onto new maps with GIS software such as QGIS. Please ensure that the maps created includes standard features such as title, north arrow, scale, grids, source of data and legend, which was determined by the community in S3.1. Of course, if possible, it is best to teach the young generation from the communities about GIS so that the project can last longer and enhance the sense of ownership.

(S3.5) Analyze and evaluate information on the new maps

After the new maps are created, please print out and take the maps back to the community members for verification. The facilitator has to lead the community to discuss the overall quality and completeness of the mapped data and examine their accuracy and relevance (IFAD, 2010)). During the discussion, some community members who doubted the project may be willing to share more when they see the resulting maps.

In this step, all community members of the targeted community, including those who are not directly involved in the map making process (Stage 2 and S3.1 – S3.4), should have the rights to add, remove or modify any information shown on the map (IFAD, 2010)). The community members should check and evaluate information on the new maps because this project is partially done by outsiders and/or MOFR during S3.4. Besides, it is also important if the community members or MOFR intends to share the map with outsiders or if the information on the map was provided by only one community group (eg. the youth).

(S3.6) Correct the digital data again and finalize the map

If there is no correction nor additional information from the community members, MOFR may give the maps and data in a usable format directly to the community members. However, if there is any correction or additional information, please re-edit the maps with GIS before printing.

If possible, MOFR shall repeat S3.5 to ensure that all information on the map are 100% accurate before returning the maps for them.

Note: If the community has the ability to use computer and GIS software, please do send them the editable softcopy or database. Else, it would be good enough just to send them the hardcopy.

Stage 4. Map Use & Decision Making

(S4.1) Use maps to support communities' natural resources management initiatives

Participatory mapping activities provide the community with a way to determine the location of the resources available (e.g., a map of the current land use plan), and to become aware of the problems (IFAD, 2010), challenges and potentials of their community especially when they try to figure out their future plan by determining their objectives and formulating a future land use plan. After all, maps can be used for decision-making and to prioritize the plan that ensures sustainable use of resources.

When MOFR provides training, facilitates the participatory mapping activities, provides support and even lends the communities some equipment such as GPS to help the communities to conduct the communities initiated activities in solving problems and/ or achieving their objectives, they will be empowered and thus becoming better equipped to manage their local natural resources.

However, MOFR should not assume that the local community can come out with effective solutions and plans even though they know what they need and the issues that they have better than outsiders. It is probably because of their low educational level and limited exposure to other ideas and experience, hence they have restricted understanding of the causes to develop effective solutions. Besides, when the solution and plan are proposed by the powerful elites in the community, there is a risk of biased solutions which do not regard the interests of minorities within the community.

Therefore, facilitators can assist by introducing new ideas for discussion, providing information on strategies that have worked elsewhere, introducing others who can provide expert advice, besides ensuring that legal, management and safety issues are properly considered (IFAD, 2010). (Refer to the case studies in section 2 may provide

some ideas and information). To reduce biased solutions, the facilitators can try to engage and listen to more groups of people by dividing them into groups during mapping and brainstorming sessions so that they would feel more comfortable to share in their respective groups.

Note: It is important for the community members to see that their efforts are put to use and that the completed maps serve their purposes so that they would be encouraged to sustain the project. When the community members have a clearer idea of how the maps might be used, they might innovate and come out with new applications of maps (IFAD, 2010).

(S4.2) Communicate mapping information to stakeholders

Maps are a powerful visual and communication tool for the community members to communicate mapping information to stakeholders and outsiders because the maps are created based on international standards (map with title, north arrow, scale, legend, source, and copyright). MOFR can also organize a workshop, which also involves relevant stakeholders such as governmental organizations, NGOs, private companies and local universities, to provide an opportunity for the community members to present their plan and suggestions. When the community members have the sense of ownership over the maps they have created, they can usually present their thoughts and ideas with pride and confidence.

Nevertheless, the facilitator needs to discuss with the community members about the maps and data' ownership issues so that the community members are clear about who will use the final map, and who authorizes its use (Corbett & Keller, 2006). It is best to develop a set of regulations that control how the maps are used and distributed to prevent the local knowledge from being manipulated and used for matters that would probably put the community at disadvantage, in danger and/or infringement of the law.

(S4.3) Influence planning

The resulting maps can influence the planning process especially when the project intermediaries represent government or non-governmental organizations. Therefore, when MOFR, the main organizer, is a governmental organization, the maps created may be used more effectively in achieving the goals of the community as well as MOFR's. MOFR can utilize the maps to make decisions in developing policies and management plan, and even generating more effective and efficient solutions to the environmental

issues.

(S4.4) Other uses of participatory mapping

- Evaluate projects (IFAD, 2010)
- Plan the land use (Kingsolver, Boissière, Padmanaba, Sadjunin, & Balasundaram, 2017)
- Predict future environmental impacts based on current and past interaction between the local and their environment (Weyer, Bezerra, & De Vos, 2019)
- Investigate land cover change (Mapedza, Wright, & Fawcett, 2003)
- Enhance local mangrove rehabilitation and management (Damastuti & de Groot, 2019)
- Empower the urban poor with new knowledge and tools to help them articulate their needs and demands using digital media, hence achieving national government goals (Livengood & Kunte, 2012)
- Provides basic facilities support to the community (CEDT, Unknown)
- Enhance land tenure security (Di Gessa, 2008)
- Document, visualize and communicate indigenous communities' traditional and contemporary knowledge (Corbett & Keller, 2006)

Note: Please refer to the case studies in part 2 for more detailed uses of participatory mapping

Stage 5. Evaluation

Evaluation stage is mainly to assess the impacts and changes of the participatory mapping project. MOFR should evaluate all three levels: the community, project intermediaries and the government (local, district and national) (IFAD, 2010).

(S5.1) Communities evaluation

The facilitator shall lead the community to do a self-assessment from time to time on their progress, achievement, challenges, improvement, and solutions by asking the correct questions such as 'how well the project has progressed?', 'how much the community has achieved?', 'what are the challenges and how can the community improve?', etc. The facilitator shall act like a coach, who asks the correct questions but without giving any answers so that the community members can reflect and discuss among themselves to provide their own answers.

MOFR can also combine a few communities together to conduct the self-assessments simultaneously. Such an opportunity would allow a discussion and exchange of thoughts on their mapping experience, challenges and solutions. Such an activity is known as the horizontal exchange activity (IFAD, 2010). Based on the results of community self-assessment, MOFR can refine and scale up the mapping process.

However, these activities require further training of facilitators in areas such as facilitation skills, session planning, interview techniques and coaching techniques. And MOFR shall allocate resources to this activity at the beginning of the project (S1.4).

(S5.2) MOFR evaluation

Ideally, MOFR should have a monitoring system which include a feedback mechanism to reflect and evaluate what has been achieved at the start of participatory mapping activities.

MOFR can assign one or a few committee member from the working group to be the project officers taking care of a few communities. The project officer should ensure that all communities' person-in-charge and facilitators regularly report their progress or consult for advices and support.

MOFR should also share the monitoring-and-evaluation criteria and indicators developed in S1.5 so that they can evaluate the results and impact achieved. Then, the communities should be able to identify potential opportunities, issues or risks, and propose necessary adjustment.

(S5.3) Administrative evaluation of overall policy change and decision-making

This step is to evaluate the contribution of mapping activities to the development of policy and strategies for local development at district, regional or national levels. Examples of indicators are the actual changes in legislation, government decision-making, and policy implementation (IFAD, 2010).

(S5.4) Post-project mapping

This step examines whether the expected changes and impacts persisted, hence occurring at the end or even after the completion of the MOFR project. MOFR can conduct another participatory mapping project to evaluate the impact of the project and compare it to the maps created at Stage 3.

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