Fisheries
Local Indicators of Climate Change Impacts

Protocol for the Collection of Cross-cultural Comparative Data on Local Indicators of Climate Change Impacts on Fisheries

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Suggested citation

Fundings:

Definitions

Aquatic species: living organisms that live in the water (freshwater, brackish waters or marine waters) most or all of their lifetime.

Fisher: people who consider their main activity to be fishing and identify themselves as fishers. Ensure that participants go fishing regularly in the fishing grounds associated with the study site.

Fishing ground: defined area where local people fish; often fishing grounds have particular names to designate and to distinguish them from one another. Fishing grounds can be far from fishers' place of residency.

Fishing technique: method used for catching fish or other aquatic animals such as mollusks (shellfish, squid, octopus) and other marine invertebrates and plants. Fishing techniques include hand-gathering, spearfishing, netting, angling and trapping. Please describe in detail how fishing is conducted and be specific with fishing technique descriptions including: number of people involved, whether it uses boats (what type and how many), gear used, target species, habitat or habitats where it is used, etc.

Gear: the tool or group of tools used for fishing. Try to be specific when doing gear description, e.g., size, mesh size for nets, type of nets (bagnet, gillnet, etc.), hook type and size, etc.
You can check some gear descriptions below:
> Diving/spearfishing: https://www.fish.gov.au/fishing-methods/diving
> Hook and line: https://www.fish.gov.au/fishing-methods/hook-and-line
> Nets: https://www.fish.gov.au/fishing-methods/nets
> Traps: https://www.fish.gov.au/fishing-methods/traps-and-pots

Habitat: the type of natural environment in which a particular species lives or dwells, characterized both by physical and biological features. A species' habitat includes places where it can find food, shelter, protection and mates for reproduction. The habitats can be specific to each particular site. Please take into account local peoples classification and describe each type of habitat according to its distinct biophysical characteristics (depth, substrate, whether marine, brackish or freshwater, structural organisms (e.g. coral, seagrass), etc.). For instance, in the Solomon Islands site the habitats would be mangrove, coral reef, drop-off, sandbank, seagrass, deep pelagic, and passage or channels between inner lagoon and outer lagoon.

Target species: aquatic species targeted by fishing, either for selling, for consumption or for other purposes (please record what they are used for).

Protocol for capturing local climate change impacts and adaptations in fisheries

Goals: i. To obtain a list of aquatic species commonly found in the field site, ii. To document changes in species abundance, location, temporality and size, iii. To identify the main factors driving these changes, iv. To assess the adaptations made by the fishing community in response to those changes, v. To quantify changes in catch composition, and vi. To quantify changes in diet composition.

The fisheries protocol follows the same methods and sampling design as described in the qualitative part of the core LICCI protocol (i.e., semi-structured interviews and FGDs) and ideally would be conducted as an extension of this part of the LICCI protocol.

Specifically, the fisheries protocol expands the content of the qualitative part (at the **village level**) of the LICCI methods as follows:

(A) The _semi-structured interviews_ aim at assessing the diversity of **fishing grounds, aquatic species,** and **fishing techniques (**and associated **target species)** present in the village. A description of the typical local diet and the perceived reasons for any changes in local diets should also be provided at the village level.
Partners should follow the standard LICCI protocol to **document the local observations of changes, with a special focus on changes in aquatic species and habitats** over time, as well as any **adaptations** the community members are implementing in response to those changes. Finally, a total of four pebble games should be carried out with the aim of capturing changes in a) catch composition and b) diet composition with respect to 10 years into the past.

(B) The _focus group discussions_ aim at assessing **observations of changes in aquatic species and habitats** more in depth, including: i) experienced fishers' observations concerning changes in aquatic species abundance, size, distribution and behavior, and ii) experienced fishers' observations about changes in the aquatic environment. The main addition to the LICCI FGD protocol is bringing the **adaptations related to aquatic environments** for discussion, aiming at documenting any existing changes in fishing gear, habitat, target species and/or timing of fishing or gathering practices. It is recommended that at least one of the 2-4 focus groups envisioned in the LICCI protocol is specifically dedicated to discussing aquatic changes and adaptations.

Before starting to conduct the interviews, you should make sure you have clarified a "glossary" with the interview terminology. If possible, run 3-5 pilot interviews to check how the concepts work and train your translator. Examples of tricky concepts are "fishing ground", "gear", or "habitat" (see definitions).

Material recommended: If possible, a booklet with the picture and scientific names (and local names, if available) of all the aquatic species expected to be present in the study area should be printed before going on the field (including algae, mangrove species, and other aquatic plants). This booklet will be a reference for the village surveys and can be adapted by adding species that were not included initially. The pictures should be clear and display the whole organism (preferably in their habitat), as well as details relevant for its identification. When possible, we

recommend choosing pictures representing the diversity of the subspecies/different life stages observed in the area.

Figure 1. Scheme of how the fisheries data collection flow is integrated in the LICCI protocol.

I. Background data

A. **Weather** station data

If you are collecting data for the LICCI project, you are asked to provide at least temperature and rainfall weather station data series from a local source in your site. This is also relevant for the fisheries group since it can provide information about weather changes in the coastal environment.

If available, you can also provide time series for water parameters such as temperature, salinity, turbidity, wind and currents at the local level. This will be especially relevant if the interviewees mention changes in those elements or impacts driven by those changes.

To submit extra background data, you can use the same format provided in the LICCI Manual (https://licci.eu/wp-content/uploads/2020/01/LICCI_Protocols.pdf), adding extra excel sheets for the extra data series and adding the variable and source description in the metadata sheet.

B. GPS data

Similarly to the weather station data, if you are collecting data for the LICCI project, you should provide an excel/csv file with waypoints and shapefiles with areas relevant to map village and site information (see LICCI manual). This is also relevant for the fisheries group, in order to

better map the fishing communities studied. In addition, you should also add a shapefile depicting the contours of the fishing grounds area and waypoints for the main ports and fish markets.

II. Sampling

The fisheries protocol follows closely the main LICCI protocol, so the sampling for both is very similar. This means different sampling strategies and sizes for SSI Section 1, SSI Section 2 and FGD. However, unlike the main LICCI protocol, the fisheries data from SSI Section 1 is collected at the village level - as opposed to the site level- to capture the potential variability in aquatic environments (see below for details).

A. SSI Section 1 (Village level)

To select informants for these interviews we will follow "judgmental or convenience sampling". The aim is to interview the most knowledgeable people (local experts) who can inform about local livelihoods (specially fishing), local timeline events and the aquatic environment. Specifically, we will target people who have lived in the site for a long time (at least 30 years) and are long-term fishers (including women if relevant). For instance, a good interviewee for this section would be a fisheries representative.

Information stemming from these SSI will be gathered at the village level, sampling 3 to 5 interviewees in total (at least one interviewee per village). More informants will be needed depending on the number of selected villages and saturation of information (i.e., when the following interview does not add much information on the topics). For researchers who have a well-established site, some of the information needed in this section can come from personal knowledge or observations, although this should always be verified and complemented with interviews with the local experts.

B. SSI Section 2 (Site level)

For this part of the semi-structured interviews we will use "quota sampling". We acknowledge that different people, through their different activities, have different knowledge and perceptions of local indicators of climate change impacts (LICCIs). We aim to capture the diversity of knowledge within the site by creating a grid/table of categories of interest (gender, age, fishing technique or fishing ground habitats) specific to the site and try to fill it with informants (e.g., man and woman; young, middle aged and elderly; hook fisher, net fisher; deep water fisher, shallow water fisher).

This information is gathered at the site level, sampling 20 to 25 interviewees in total, minimum 3-5 per village and trying to have at least 3 interviewees per quota. To select people within each quota, partners should rely either on key informants or on snow-ball sampling. Note that we will use local age categories (no fixed age limit but what the locals consider as young, middle aged, and old).

C. Pebble game (Individual level)

The pebble games can be done directly after the SSI Section 2, or you may randomly enlist participants (or a combination of both to reach the 20-25 expected pebble games). For the catch composition pebble games, you should focus on 1-3 of the main fishing techniques and make

sure that the participants represent de different types of fishers using that fishing technique. For the diet composition pebble games, participants should include 50% women. This is likely to involve enlisting a few extra participants to cover the sampling targets, and some participants will probably be different for the catch and diet composition exercises.

> D. FGD (Site level)

The specific number of Focus Group Discussions (FGDs) will be different for each case, and will depend on the local context (e.g., village sizes and number and characteristics of the selected villages). If possible, sampling should be done following the sampling recommendations specified below.

<u>Number of FGDs:</u> We aim to organize 3-5 FGDs per site, spread in different villages as much as possible. We recommend that at least two of the FGD is specifically dedicated to discussing aquatic changes and adaptations. More than one FGD per village can be conducted depending on:

1. village size (e.g. in very large villages), and

2. whether there are conflicts or power imbalances within the village. For example, if in a village there is a gendered division of tasks or power imbalances, you should conduct independent FGDs with men and women. In the same way, if there are conflicts between the different groups practicing the primary activities in the village, or power imbalances between youngsters-elders, you should organize separate FGDs for each of the sub-groups.

<u>Selection of FGDs participants:</u> Between 4 and 12 participants will participate in each FGD. Participants will be selected through convenience sampling aiming to capture the site diversity in terms of fishing techniques and grounds, expertise (i.e., special preference will be given to inviting elders or local experts to the FGD), age and gender.

III.   Semi-structured interviews

A. Local livelihoods semi-structured interviews (SSI section 1 - Village level)

During the local livelihoods semi-structured interviews (comprising 3-5 in-depth interviews with knowledgeable members of the community), partners should gather all the contextual information needed to carry out the fisheries protocol effectively. This includes assessing the diversity of **fishing grounds and fishing techniques** and getting a comprehensive idea of what are the types of fisheries operating **in the village**, their seasonality and which groups are involved in each kind of fishing. For example, in some sites of the Solomon Islands, men are involved in spearfishing and fishing in the pelagic areas, while women are involved in gleaning (gathering of shells in the mangroves) and fishing in the coral reefs. This should all be detailed in a narrative you will write and upload together with the fisheries data. During these interviews, you should also start filling up the species table with the most common target species.

This phase should also serve as preparation for the pebble games you will run in section 2 of the SSIs. For that, you should **inquire about the typical diet**, i.e. what are the main food sources and ingredients (e.g., bread, potatoes, cabbage, sardines, etc.) in the village, nowadays as well as in the past, and record participants' explanations of any changes in their local food

sources. At this point, you should already have a good idea of the catch composition for each type of fishing after having filled the fishing techniques table.

Expected outputs: Partners should produce a description of the different fishing grounds that fishers visit, a description of all the fishing techniques employed by fishers in the village, and a description of typical diets. You should also start filling the species list with the target species and main aquatic species mentioned during this phase.

1. **A narrative of the fishing livelihoods** providing a general overview of the fishing situation, including a description of the aquatic environments, the percentage of villagers who are fishers, the different types of fishing and who does them, how often people fish, the seasonality and events pertaining to the fishing livelihoods, the main target species, the main food sources, details about the importance of aquatic sources in diet, income and culture, and any other details of relevance in your sampled villages. Specify if the fishing activities are subsistence-oriented or market oriented, what are the main value chains, what are the main constraints, and what have been the major changes observed in that area. This should be submitted as text and there is no length limit.

2. **A list of target species with description** (*refer to the output manual table 1*). This list will be useful when describing the fishing techniques, fishing grounds and typical catch composition. It will be complemented with the rest of aquatic species during SSI section 2.

3. **A list of fishing techniques with descriptions** (*refer to the output manual table 2*). Please include: the gear they employ (list of gear and where fishers can get it from), habitat and species they target, whether it is performed from a boat/canoe or from shore, roughly how many people use it, and what is the typical catch composition (including bycatch) for each fishing method, with a short description of the fishing process with each technique.

4. **A description of the different fishing grounds** and their characteristics. If a fishing ground is shared between villages, information should be entered only once.
   a. Partners should *fill the table* (*refer to the output manual table 3*) as follows: Establish the **list of fishing grounds** that people distinguish and name using their local names. Indicate the main target species per fishing ground. Provide: i) a brief description of the **biophysical characteristics** of each fishing ground (e.g., habitat type, distance to village, approximate surface area), ii) the **main target species** associated with each fishing ground, and iii) **management rules** (if they have formal or informal rules in place regulating the harvesting in that particular area).

5. Lists of the **categories to be used in each of the pebble games**: a **list of the main target species** for each of the main fishing techniques (e.g. Trolling: wahoo, bonito, barracuda, shark, trevally; Netting: sardine, anchovy, turtle), and a **list of the main food items** (e.g. bread, potatoes, cabbage, sardines, wild boar, etc.) in the area.

B. Changes and adaptations semi-structured interviews (SSI section 2 – Site level)

During the ***changes and adaptations*** (20 interviews) semi-structured interviews of the LICCI protocol, partners should ask participants for a ***free listing of all aquatic species known*** to them (this involves a free listing by participant appears to become tired, or more than 15 min have been invested). When doing the species list, please follow the local name as a guide, but bear in mind that sometimes local people distinguish two or more "types" of the same species, depending on their life stage (e.g. they have one name for juvenile fish and a different name for adult fish), physical features, behavior, culinary use, etc. In this case, you should list both local "subspecies" in two separate rows (noting their local name, and English and scientific name whenever possible) and record any reported changes for each subspecies separately.

While administering the LICCI protocol, ask specifically about any changes people may have observed in relation to marine and freshwater physical and biological systems. Inquire about adaptations to the observed changes, and about changes in fishing behavior (changes in frequency of fishing in general, frequency visiting certain fishing grounds, changes in gear or target species, etc.). Please note that taking up fishing as a novel livelihood activity can be an adaptation too, e.g., to a decrease in agriculture productivity; in this case, record all the available information on the target species, gear and fishing grounds, and on how fishing was adopted (temporality, who were the early starters in the community, etc.).

As with the core LICCI protocol, the purpose of this phase is to gather all the possible information needed about changes and adaptations, which (in the particular case of fisheries) will be verified and consensuated in the focus group discussions.

Expected outputs:

1. **A list of known aquatic species in the area** *(refer to the Output manual table 1).* Fill the output table by establishing a list with the correspondence between the local species name and the scientific name of the aquatic species (Use the species pictures booklet as a reference). If it is not possible to identify the species, please provide a physical description of the organism.
   Indicate:
   - Aquatic habitats where the species is present.
   - Typical size range
   - Abundance in the area
   - For target species, please specify how many people fish for them (give as a percentage) and what are the mainly used for (food, sale, medicine, etc.).

2. **A list of LICCI** - Same as for LICCI main protocol but with emphasis on changes in aquatic environments.

3. **A list of LACCI** - Same as for LICCI main protocol but with emphasis on adaptations in aquatic environments.

C. Pebble game - Catch and diet composition changes (Individual level)

This exercise aims at quantitatively documenting changes in (1) the average catch composition (species typically caught and their abundance) for each type of fishing technique, and (2) the average daily diet composition of participants. We will use the 'pebble distribution method' (Colfer et al. 1999; Lynam et al. 2007), in which study participants are asked to distribute a given number of points ('pebbles') across different items based on their relevance for a given purpose. The pebble game should be done for the catch and diet composition today and for the typical catch and diet 10 years ago. If participants in your site find it difficult to relate to the 10 years mark, you can mention remarkable events that happened at about that time as reference (e.g., when the bridge fell from a storm, when your son was married).

Some guiding questions can be:

- What is the average catch that you can get after going on a fishing trip/session, in the current season, nowadays? (for a certain fishing technique)
- What is the average catch that you used to get after going on a fishing trip/session, in the current season, 10 years ago? (for a certain fishing technique)
- What is the approximate amount of these food items you typically eat, in the current season, in a day?
- What is the approximate amount of these food items you would typically eat, in the current season, in a day 10 years ago?

The categories of target species and food items offered to participants should be based on the information gathered in section 1, and no more than 10 options should be offered. It is recommended that 100 pebbles are used in each game.

For the catch composition: If more than two fishing methods are common in the study site, partners should select a **maximum of three fishing techniques** for the pebble game to ensure enough representativity of the data collected. To assess the catch composition, the most common species reported for the participants' main fishing methods should be provided (e.g. as pictures or drawings), and if they note that some species are missing, they should be noted, and their percentage of the catch accounted for.

For the diet composition: record the relative importance of the food sources for the typical diet today and 10 years ago. If aquatic food sources are mentioned, please specify the species name of the fish/other aquatic sources.

The catch and diet composition pebble games can take place at the end of the semi-structured interviews or by recruiting participants independently. At least 20-25 participants should be surveyed, and it is likely that some participants may be different between the catch and diet pebble games to ensure that men and women are appropriately represented in the diet composition part.

Expected outputs:

1. **A table of pebble game participants information** *(refer to the Output manual table 4)*, including their age, gender, years living in the village, monthly income (current and estimated for ten years ago). If participants are fishers, record also their main fishing techniques and fishing grounds.
2. **A table of catch composition** separated by fishing technique *(refer to the Output manual table 5)* summarizing the results from the pebble game for today and 10 years ago. Please include a small narrative with any relevant points raised during the focus group discussions with regard to the reasons for any changes in the catch.
3. **A table of diet composition** *(refer to the Output manual table 6)* summarizing the results from the pebble game for today and 10 years ago. Please include a small narrative with any relevant points raised during the focus group discussions with regard to the reasons for any changes in diet.

IV.   Focus group discussions

Sampling recommendations: at least one group interview focusing on fishing should be conducted in each village. Each group should include between **4 and 12 people**. The procedure for sampling will be the same as for the Focus Group Discussion in the main LICCI protocol but targeting only people involved in fishing as their main livelihood activity. When applicable, we will use quota-sampling to capture fisher variation within the local communities in terms of gender and age. If the partners feel that power relationships may impede some specific group to express their viewpoint freely, or if more than one fisher collective exist that employ different fishing techniques or target different species or fishing grounds, more than one focus group discussion should be completed per village to include all the relevant groups. Informants selected for the fisheries protocol may need to be selected independently from those selected for the core LICCI FGD. Partners can choose to do these group interviews together with the FGD conducted in the core protocol or independently. In any case, bear in mind time constraints, and if the general LICCI FGD is too long, try to do the fisheries FGD separately.

Content: In the group interviews we will explore two main topics: (1) reach consensus on fishers' observations (recorded during SSI Section 2) concerning changes in aquatic species size, distribution and abundance, and the main drivers of such changes (focusing on the impacts of climate change but recording all drivers); (2) document adaptations in the community with regard to the aquatic environment, including changes in fishing behavior (target species, fishing grounds, timing, fishing methods, etc.), local livelihoods and changes in the consumption of fish/aquatic organisms.

*Expected Outputs***:**
Researchers should note any extra information and as many details as possible about reported changes in the aquatic environment and species, as well as a table of consensuated adaptations in terms of fishing and/or seafood gathering.

From the data gathered in the app (or alternatively using field notes and Output Manual tables), we expect to produce:

1. **A table of perceived changes for aquatic species by species *ID***. (Please make a new row in table 2 for each observed change, repeating the species local name as many times as needed, including the direction of change, driver(s) and classification in the LICCI tree.)

2. **A table of perceived changes in the aquatic environment by habitat**. (Please make a new row in table 4 for each observed change, repeating the habitat name as many times as needed, including the direction of change, driver(s) and classification in the LICCI tree.)

3. **A table of adaptations to changes in the aquatic environment,** similar to the LICCI core protocol table. For changes that have to do with fishing behavior please also include changes regarding the frequency of fishing, frequency visiting certain fishing grounds, changes in gear and changes in target species.

V.   Data processing and submission

All data collected should be submitted via de LICCI app (licci.eu/app) or via the Project Send repository (licci.eu/files). For more information on these tools please check the [LICCI Technical Manual](). We highly recommend using the app, as it has been developed to ease the data collection and helps you check whether all information has been collected. However, if using the app is unfeasible, you can fill up and submit the data tables given below.
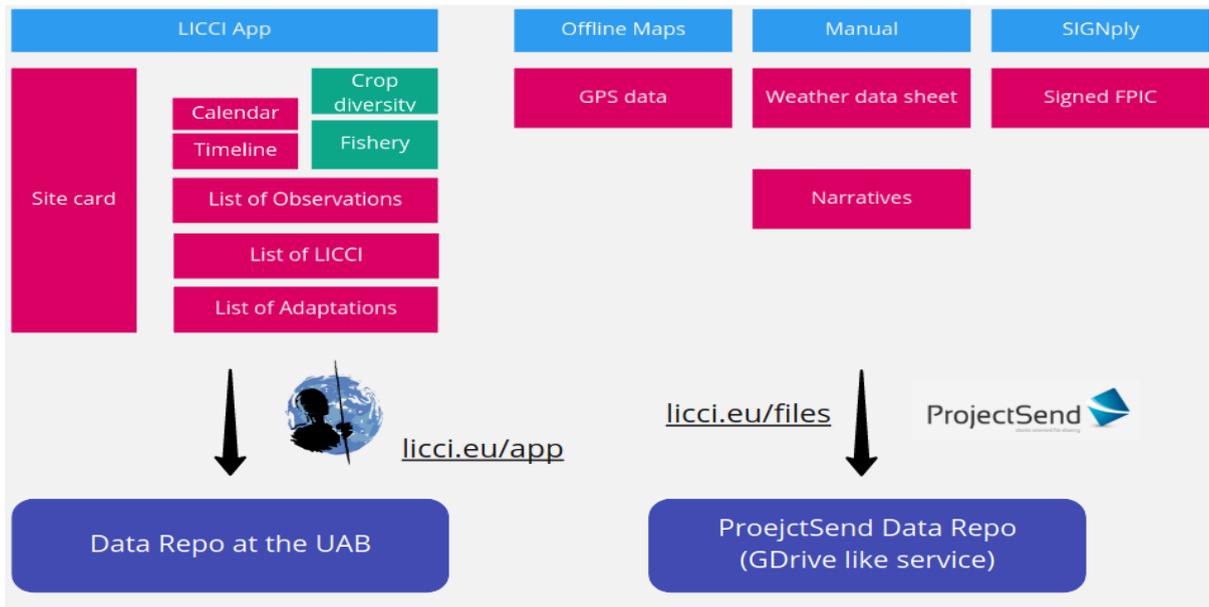
Researchers should not submit raw data, but only the data described as "Expected outputs". However, researchers should keep their raw data for a period of 3 years, as it might be required for clarifications. Raw data includes transcripts or recordings of the interviews, field notes, etc.

To better process the data, we recommend that raw information is transformed into tables before introducing it in the app:

Table 1- Species list

ID	Species (local name)	Species (English)	Species (scientific name)	Description (if unidentified)	Habitat(s)	Typical size range? (cm)	Abundance in the area	Fishing grounds where species is present	Target species? (yes/no/NA)	Uses (consumption, sale, others)	% fishers target this species
							One of the most abundant/ common/s omewhat common/r are/disapp eared	(Linked with fishing grounds table)	select	Select consumption/sale/ other_ specify text	

Table 2- Fishing techniques (with an example)

Name of fishing technique	Description of system	Target species (list)	Fishing grounds list	Gear list	Average catch (kg)	% catch for own consum ption	% catch for sale	% catch for other uses
Trolling	fishers use a canoe to reach the fishing ground (passage with current linking the lagoon to the open ocean). they throw a hook and line and start paddling slowly in the opposite direction to current. The bait in the hook is moving and attracts the target species. Once a fish bites, they retrieve the line slowly towards the canoe -to avoid releasing it- and they lift the fish to the canoe and kill it with a knife or log hit in the head. They usually do this in the early morning or evening (dusk or daw), as this is when the target species are out hunting and more active. The typical catch includes between 1 and 15 kg of tuna, wahoo, barracuda or...	bonito, tuna, wahoo, barracuda	Tane loto, Kare kare, Imbusa	hooks, line, bolt, basket	8	80	20	0

Table 3- List of fishing grounds

ID	Fishing ground name	Habitat type(s) present	Distance from village (km)	Travel time from village (in minutes)	Surface area (m2)	Average depth (m)	Target species	Fishing techniques used	% fishers	Management regime
							Linked with species table (use ID)	Linked with fishing techniques table		(type of jurisdictional area the ground is in, rules & regulations in place, when were they enacted, who oversees their enforcement, and anything else that might be relevant for its management)

Table 4- Pebble game participants information

Participant ID	Age	Gender	Years living in this village	Current income (local currency/month)	Current income (USD/month)	Income estimate 10 years ago (local currency/month)	Income estimate 10 years ago (USD/month)	Fishing technique	Main fishing grounds

Table 5- Catch composition (with example)

Participant ID	Fishing technique	Time	average weight of typical catch (kg)	Species name	species ID	percent of catch
PF01	trolling	current	8	bonito	x1	50
PF01	trolling	current	8	barracuda	x2	20
PF01	trolling	current	8	wahoo	x3	5
PF01	trolling	current	8	shark	x4	25
PF01	trolling	past	15	shark	x4	50
PF01	trolling	past	15	bonito	x1	25
PF01	trolling	past	15	trevally	x5	25
PF02	trolling	current				

Table 6- Diet composition (with example)

Participant ID	Gender	Time	Number of meals per day	Food items	If fish/aquatic, which species	Species ID	Percentage of daily intake
PF01	M	current	3	rice			50
PF01	M	current	3	vegetables (specify)			10
PF01	M	current	3	fruits			10
PF01	M	current	3	fish	bonito	x1	20
PF01	M	current	3	canned food			10
PF01	M	past	3	potato			40
PF01	M	past	3	vegetables (specify)			20
PF01	M	past	3	fish	trevally	x5	10
PF01	M	past	3	fish	bonito	x1	10
PF01	M	past	3	fruits			20
PF02	F	current	2				

VI.   Ethics and publication policies

The Fisheries protocol follows the same ethical guidelines and publication policies as the main LICCI protocol.

You are required to obtain the necessary permits to conduct fieldwork at the different levels (national, village, individual consents), as well as to follow basic guides for ethical conduct and data protection. You are also advised to submit the Manual and any additional research aims to an ethics review board to obtain ethical clearance for conducting your research.

Regarding publication policies, you are the sole owner of the data for your field site and can publish these data on your own. However, if you plan to publish data collected using this protocol, you should invite the leader of the Fisheries group (Sara Miñarro) to contribute/co-author the publication. If your data is used in aggregation with other field sites data, you will be invited as a contributing author, but will have to make meaningful contributions to the manuscript to be part of the final author list.

For more information feel free to contact us and check the materials in our website.