© IFReDI/FiA

Freshwater   Marine

Manual for Scientific Catch Assessment of Inland Fisheries in Cambodia

Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector:

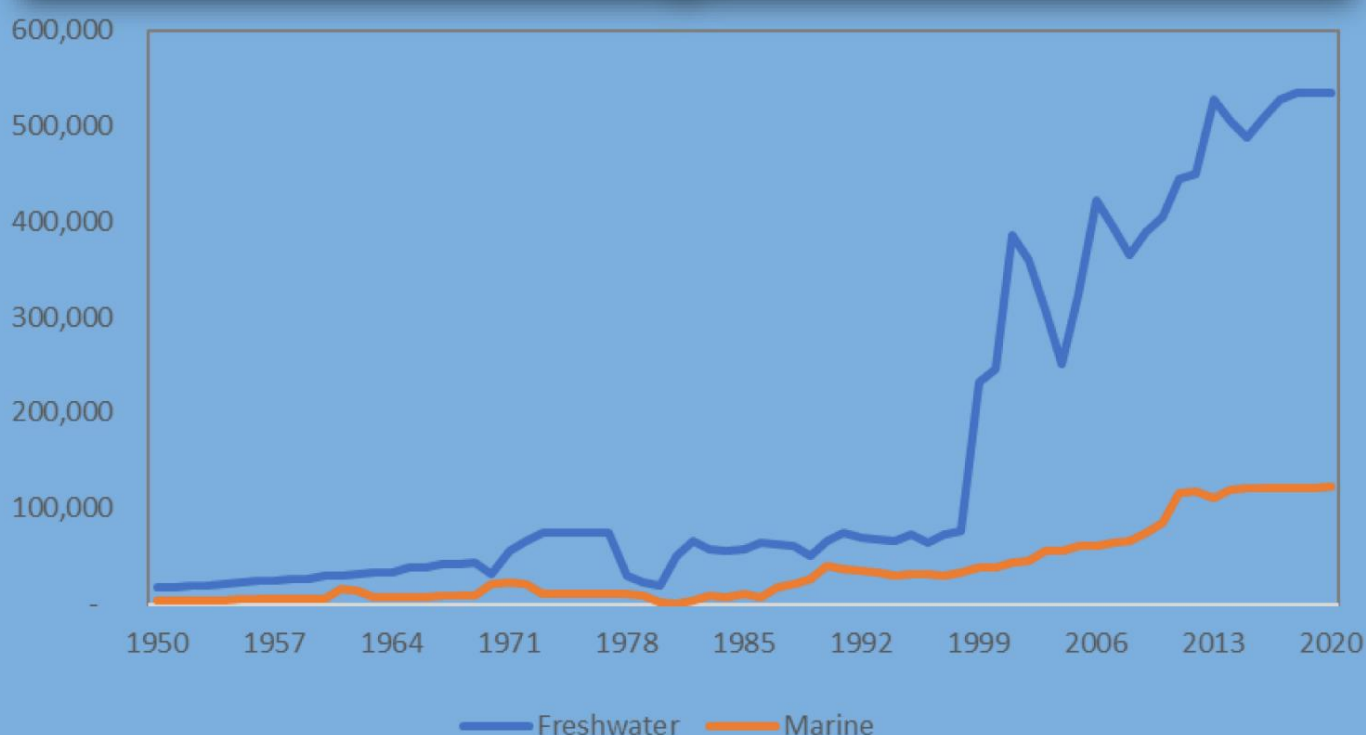Capture Component (CAPFISH-Capture)

January 2021

KINGDOM OF CAMBODIA

Nation Religion King

MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES

FISHERIES ADMINISTRATION

Manual for Scientific Catch Assessment of Inland Fisheries in Cambodia

Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector:

Capture Component (CAPFISH-Capture)

January 2021

Acknowledgements

Document prepared by:
Theo Visser, Bunthang Touch, Kongkruy Chay, Pengbun Ngor, Solyda Putrea, Phen Chheng, and Cheasan Eng

With assistance from: Borin Un and Porny You

ISBN-13: 978-9924-550-02-0

Citation:
Fisheries Administration (FiA). 2021. Manual for Scientific Catch Assessment by Recall survey of Inland Fisheries in Cambodia. Inland Fisheries Research and Development Institute of the Fisheries Administration, Phnom Penh, Cambodia. 47 pages.

Contact:
Fisheries Administration
Inland Fisheries Research and Development Institute
#186, Preah Norodom Blvd., Phnom Penh, Cambodia
Web: ifredi-cambodia.org

Preface

Cambodia's inland fisheries are an important source for food and income and have long played a key role in Cambodian life and culture. Records show that exploitation of the fisheries goes back to the ancient Khmer empire. Annual catches are conservatively estimated at over 400,000 tonnes per year, with the catch of other aquatic animals (OAAs) such as shrimps, crabs, snails, frogs, insects, snakes and turtles is at least 60,000 tonnes per year. Millions of people work full- or part-time in fisheries-related activities. Despite recent developments, fish and rice remain important for food security, and inland fisheries provide a key source of animal protein, calcium and vitamin A, as well as supplemental income as a key livelihood for rural households. Fish and fish products comprise 40-60% of the animal protein dietary intake. It is highly valuable, with some estimates placing the value of the fisheries at over 300 million USD per year and Cambodian catches account for a large proportion of the fish and other aquatic animals produced from the Lower Mekong Basin, which are traded locally and also exported. Fisheries remains an important part of the social fabric of Khmer society and is an essential part of everyday life in rural areas

Key elements of the unique position of Cambodia, especially the Tonle Sap area and extensive floodplains, place it at the centre of the Mekong ecosystem and domestic fish production as well as long-distance fish migration of river fish across national boundaries. Due to several developments, fisheries is under threat, both from within the fisheries due to overfishing, but mainly from outside the fisheries through, economic developments, e.g. draining of wetlands, pollution, etc. and development of hydro-power and irrigation schemes that affect the natural hydrology and affect the flood pulse that stands at the basis of the high productivity of the inland fisheries.

Cambodia needs to balance the economic benefits of development with the traditional benefits for livelihood and food security of fishery activities. In order to make appropriate decisions better and more detailed information needs to be available on the fisheries production, the species composition and the income derived from fisheries and related support activities. The Manual for Scientific Catch Assessment by Recall survey of Inland Fisheries in Cambodia is an important document. Implementing the methodology included in this manual is a first step in improving the available information on inland fisheries. Improved information will benefit both designing appropriate management interventions and understanding the dynamics of the fisheries, to ensure sustainable exploitation and protection of valuable aquatic resources for generations to come.

H.E. Eng Cheasan
Delegate of the Royal Government of Cambodia
Director General of the Fisheries Administration

List of Abbreviations

AP	*Aquatic Plants*
CAPFISH	*Cambodia* Programme for Sustainable and Inclusive Growth in the Fisheries Sector
CFi	Community Fisheries
CPUE	Catch per Unit of Effort
CWP	Coordinating Working Party
DFMP	Dai Fisheries Monitoring Programme
DPFIC	Department of Planning, Finance and International Cooperation
EU	European Union
FAO	Food and Agriculture Organisation
FI	Fish Inland (for species codes)
FiA	Fisheries Administration
FiAC	Fisheries Administration Cantonment
GIS	Geographic Information System
FH	Fishing Household
FM	Fish Marine (for species codes)
HCI	Household Catch Interview
HFA	Household Fishing Activity
HH	Household
HSI	Household Selection Interview
IFReDI	Inland Fisheries Research and Development Institute
MAFF	Ministry of Agriculture, Forestry and Fisheries
MaFReDI	Marine Fisheries Research and Development Institute
MRC	Mekong River Commission
MT	Metric Ton
NA	Not Applicable
nei	not elsewhere included
NF	Non-fish (for species codes)
NIS	National Institute for Statistics
OAA	Other Aquatic Animals
OAO	Other Aquatic Organisms
PAP	Pre-Analysis Plan
PDAFF	Provincial Department of Agriculture Forestry and Fisheries
PSADP	Project Support for Agriculture Development Plan
QA/QC	Quality Assurance Quality Control
QAP	Quality Assurance Plan
RGC	Royal Government of Cambodia
SES	Socio-Economic Survey
TWGFi	Technical Working Group on Fisheries
USD	United States Dollars

Table of Content

1. Summary overview

- *The household recall survey is only implemented for catch assessment (not stock assessment)*
- *Both species catch and fishing activities are covered by a Household Catch Interview survey*
- *Implement random sampling of **900 fishing households** distributed by fishery area using the estimated number of fishing households*
- *Sampling in random selected villages by fishery area, with 15 fishing households in each village, without preferential selection of households with professional/full-time fishers*
- *Implementation of a Household Selection Interview survey (HSI), to assess proportion of fishing households and relative dependence on fisheries during random selection of fishing households at the start of the survey*
- *Reported catch needs to reflect catches by all household members, including women and children, the sample unit is the fishing household, NOT individual fishers*
- *QA/QC through field inspections and validation surveys, included in survey budget, validation surveys can be implemented by an independent team*
- *Estimation of total catch will be based on 2019 population census with estimates for fishing households by province (based on either the 2018 CDB database and the results of the household selection interview survey)*
- *Implementation schedule to be decided:*
  - *Complete fishing household selection during 2020*
  - *Start covering fishing households in 2020 for Tonle Sap fishery areas*
  - *Expand to full coverage within first quarter of 2021*
- *Preparation of Pre-Analysis Plan (PAP) to inform detailed analysis and content of monthly reports auto-calculated by database*
  - *a full list of all possible analysis for annual report is included in annex 4; and*
  - *Monthly catch reports by province, for feedback and publication will focus on a more limited set of indicators that will be generated automatically by the database.*

2. Introduction

Catch assessment for inland fisheries uses a recall methodology where respondents are interviewed about the fishing household catch and effort. This allows to collect a sufficiently high sample without the high cost associated with incentives for participants in a logbook survey. Data collected is primarily for species level catch assessment, but will also allow to calculate effort, disposal[1], value of trade and involvement. The main target is to produce estimates that can be used to evaluate and supplement estimates currently produced by province level reporting-based catch assessment.

3. Survey design

Scientific catch assessment will use two main surveys to collect all necessary data for estimating fisheries indicators and allow for calculation of overall catch for inland fisheries and at fishery area and province levels.

3.1. Household Catch Interview (HCI)

The HCI will be used to routinely collect catch and effort data on a monthly basis. The HCI will cover a recall period of 3-5 days[2], depending on the observed fishing frequency (including collection of OAA), with an HH representative. The survey will initially be implemented by central level FIA/IFReDI staff,

---

[1] Catch disposal describes the use of the catch for trade, fresh consumption, processing for delayed consumption or trade and other uses (e.g. animal feed, fertilizer, bait)

[2] Using a 5-day recall period is less reliable than a 3-day recall period, but a longer recall period makes more sense if most respondents are not fishing regularly, to ensure that the recall period includes fishing activities by a larger proportion of households

with support from cantonment staff. An interview-based survey methodology to monitor household catches is considered the best choice for long-term implementation and future integration with PDAFF statistical data collection. A draft survey form covering a 5-day recall period is included as annex 1, based on surveys implemented in Laos (Cottet and Visser, 2017 and Visser *et al.*, 2016), this will be adjusted based on observed fishing frequency and data collected.

The following information is collected:

1. The **species catch** as weight (kg) and species composition, using local Khmer names, linked to species (scientific names) and species groups including Other Aquatic Animals (OAA) and aquatic plants by any fishing household (FH) member;
2. **Effort**, is recorded exclusively as fishing days/month, with involvement recorded by gender and age group; Fishing duration is not recorded; Monthly fishing effort is recorded for a 5-day recall period;
3. **Boat use** (motorised, non-motorised and fishing without boat);
4. **Gear use**, is recorded by main gear categories. Detailed gear use is not recorded, but gear details (size and numbers) for gears owned by the fishing household, are recorded at the start of the survey during the household selection survey. This includes gear type (sub category), number of units and appropriate additional information depending on the gear type, e.g. length, height and mesh sizes for gillnets and number of hooks for longlines. Gear categories are based on existing standardised lists used by IFReDI in other similar surveys (Annex 3);
5. **Fishing location** is indicated by (main) habitat type, e.g. river, lake, floodplain, swamp, rice field, with where appropriate a named location, referring to a specific aquatic habitat, e.g. name of a river/stream;
6. **Involvement**, i.e. the number of persons contributing to the catch (separated by gender for adults only);
7. **Disposal** of the fish catch (kg) for fresh consumption, sale or processing (and value if sold); and,
8. **Active fishing households**, the proportion of households that indicate they went fishing at least once for the previous month. It uses a simple yes/no question: "has any member of a fishing household fished or collected Other Aquatic Organisms (OAO), including Aquatic plants and Other Aquatic Animals (OAA) during the past month?". This data is used to assess the true number of active fishing households, compared to the number based on the HCI data, as well as for extrapolation of the total catch. The recall period only covers a 5-day period, which makes it possible that some households will indicate they haven't fished during the recall period, while they did fish outside the recall period covered

The HCI will also be used to collect data for estimating the proportion of households actively fishing during a month, for extrapolating the total catch from the average monthly household catch. Ideally this would be collected using an independent sample survey but collecting it during the HCI survey significantly reduces survey effort (and cost). Basing it on HHs involved in the HCI survey may lead to biased data[3], the potential bias will be monitored during survey implementation..

3.2. Household Selection Interview Survey (HSI)
The HSI survey will be used to assess fishery dependency of all households approached to be included in the HCI survey, mainly based on the number of fishing days/month and the importance compared to other household livelihood activities. The survey is implemented before the start of HCI survey when selecting the random sample and every time replacement households need to be selected, when participating households leave the survey. It is **not** an annual survey. The results will allow to calculate:
- The proportion fishing households;
- Assess sampling bias in fishing households that don't agree to be included in the HCI; and,

---

[3] Sampling bias will be measured to assess if this is an issue and the survey approach adjusted accordingly

- The proportion of full-time, part-time and seasonal fishing households based on activity pattern (number of fishing days per month) over a year.

The survey format is included in annex 2. The following information is collected:

1. **Fishing dependency** as measured by number of fishing days, involvement of family members, main purpose of fishing and contribution to household income or time spent (compared to other livelihood activities)
2. **Fish processing** types of fishing products made
3. **Fishing locations** (by main aquatic habitat) fished and catch contribution
4. **Boat and engine** access (ownership), including numbers
5. **Fishing gear** ownership, with relevant sizes and numbers of units

4. Classifications for species, gears and habitats

Standardised lists are used for species (and genus or family level species groups), with the aim of reducing catch assigned to 'other species' to be less than 30% of the total catch[4]. The lists form the basis for a photo flipchart, which will be used to record the local names[5] for each species and species group on the list, at least by fishery area or smaller area where approriate, to accommodate differences in species names. The local species names will be used to assign reported catches with the scientific species or family name, species code and with the common Khmer/English names. The lists uses Fishes of the Cambodian Freshwater Bodies as source for the common Khmer fish name linked with the codes as assigned in the photo flipcharts that MRC has updated (Ngor *et al*., 2016). Species codes used will include species codes included in FIA, 2019, but with updated names where appropriate based on So *et al*., 2019[6].

A first selection of 70 species as included in annex 5, was based on the reported species catch in the MRC gillnet survey data for 2017-2019. This was expanded to include 30 additional species of importance in mountainous and coastal habitats, for a total of 100 fish species. Additional codes may need to be added based on the local names provided by fishing households, but this will be decided based on the data collected. A code for mixed small species (combined with mixed juveniles) was included as well as a group for other fish not elsewhere included (nei), to allow for assigning species catch when the species isn't clear. The target for the species catch is to assign at least 70% of the catch to individual species or genus level groups.

The list was expanded to include 39 species and species groups for Other Aquatic Animals (OAA) and Aquatic Plants (AP). This includes aquatic insects, bivalves, crabs, shrimps and prawns, snails, frogs and toads, and aquatic reptiles, as included in annex 6.

Complete separation by species will not be possible, local species names as reported by fishing households will be recorded during the HCI. Non-standard names will be identified during data collection, by IFReDI and FIAC staff for proper recording of species catch. Location specific species name lists will be collated at the start of the HCI survey using a photo flipchart based on the species list included in annex 5. This will link any locally used names with the correct scientific name and codes, or species groups. Variations in local species names will be monitored throughout implementation of the survey, by flagging 'new' species names reported by fishing households.

---

[4] Especially when the catch includes a mix of small and juvenile fish it will be impossible to get accurate identification, in addition use of non-standard local fish names may refer to groups of species, especially for fish with low economic importance

[5] Common Khmer names may be linked to multiple local Khmer names, that depend on ethnic and language differences between areas, although they may be the same for most of the main species in the fisheries

[6] For example: *Cyclocheilichthys armatus*, has FIA code F18 and MRC code 1140 (and MFD code 231), both FIA and MRC codes will be included and linked in the database

Any new species name reported by the respondents will be linked to a species of species group, using the photo flipchart. If a species is not included in the flipchart, but important in the catches, it will be added to the species list and photo flipchart.

Besides a photo or photos for each species included, the photo flipchart will include common Khmer/English and scientific names (including family name), indication of size for each species (e.g. max length and weight) or a standard-length bar scaled to the size of the species to allow to gauge the size, relative abundance (how rare a species is) and seasonal occurrence. The list is sorted by family and genus names, ensuring that similar looking species can be compared easily.

Even if OAA and AP are assigned to generic nei (not elsewhere included) categories, accurately recording the reported local Khmer names will make it possible to assign OAA and aquatic plants at least to family level groups retro-actively, e.g. for snails, shrimp, crabs and frogs.

Classification of main gear types will be done using the categories indicated in annex 3, this is based on the observed gear use in the MRC funded surveys. These will be linked to gear categories currently used for DPFIC reporting, to ensure that data can be reported in the format used by DPFIC.

The catch location (habitat) is used to allow calculating the importance of fishing in various aquatic habitats. Since fishing often is done on the boundaries of the water land interface or in transition areas, it makes sense to define the aquatic habitats by main environments: lentic (standing water) and lotic (running water), with a sub-division depending on the importance of certain habitats for fisheries management: lotic e.g. perennial rivers, seasonal rivers, irrigation canals and lentic e.g. permanent and seasonal swamps, floodplain (flooded forest, rice fields, lakes/ponds), reservoirs. The habitats and codes are included in annex 9. The actual catch location (e.g. confluence, rapids, near-shore or mid-stream, etc…), will not be recorded.

5. Sampling design

The sampling unit for HCI survey is the fishing household. Catch assessment will use random sampling of fishing households. Interviews will target a household representative, if possible, the primary fisher or household head, to provide data, but specifically ask for data on fishing activities by other household members. When present during the HCI, other household members will directly be asked for their fishing activities.

5.1. Sample size

Optimal sampling size for HCI survey depend on variation in the main variables measured by the survey, the required accuracy and the available budget and staff. Using fishing households as fishing units without stratification by dependency (fishing households with commercial, part-time and seasonal fishers), there will be relatively large variation in daily and monthly reported catches as fishing households fishing commercially will be mixed with those fishing primarily for subsistence.

If the average daily reported catch is 3 kg, with a standard deviation of 3 kg[7], then according to a standard formula[8]., this would need a sample size of up to 441[9] at 90% accuracy (t_{n-1} is set at a relatively high level of 2.1 for this example), regardless of the target population, i.e. virtually the same sample size would be needed when sampling Cambodia as a whole, for each fishery area or for each province.

Sample size = $\left[\frac{[2.1*3]}{0.1*3}\right]^2$ = 441 fishing households

---

[7] A recent survey in a tributary to the Mekong showed an average daily catch of 2.72 kg with a variation of 2.82.
[8] See: FAO CAPFISH Cambodia Inland Fisheries Catch Assessment Guidelines
[9] This is an approximation, as the real recommended sample size depends on the relation of n and tn-1 which are interdependent, tn-1 tends to be smaller than 2.1

Higher variation in the reported catches will also increase the required sample size, while a lower variation would decrease the required sample size. There is no large difference in the number of samples needed between an area with 10,000 fishing households or one with 500 fishing households. The sample size is mainly determined by the variance between measured variables, which is why appropriate stratification is important.

Table 1. Proposed sample of fishing households and villages by fishery area for HCI survey.

Sample		Fishery area	Provinces	Villages /communes	Fishing households	
HHs	Villages					
300	20	Tonle Sap	Battambang, Pursat, Siem Reap, Kampong Thom, Kampong Chhnang, and Banteay Meanchey	4,229/467	59%	**586,699**
300	20	Floodplain	Takeo, Svay Rieng, Prey Veng, Kandal, Kampong Cham, and **excl. Phnom Penh**	5,839/637	56%	**586,511**
					PP HH (399,203) are excluded as urban area with only 2% fishing HH (7 984)	
75	5	Plateau	Stung Treng, Kratie, and Ratanakiri	629/131	66%	**110,999**
165	11	Mountainous	Mondulkiri, Tboung Khmum, Kampong Speu, Otdar Meanchey, Preah Vihear, and Pailin	2,954/255	66%	**334,105**
60	4	Coastal	Kep, Kampot, Preah Sihanouk, and Koh Kong	736/156	51%	**115,474**
900	60		Total (excl. PP)	14,387	60%	1,733,600

Proportion of fishing households from 2017 Socio-Economic survey, total number of fishing households based on pre-liminary results from the 2019 population census.

Since no existing data on household fishing is available, the initial sample size is based on the effective sample size used in national socio-economic surveys, which are designed to allow estimates by fishery areas. The HCI survey will target sampling of 900 fishing households. This is expected to be sufficient for the estimation of the total species catch for Cambodia with at least a 95% accuracy, with a maximum relative error of 10%. The accuracy will be reported monthly, based on the reported average household catch and variation. Adjustment to the survey design will be minimised during the first year, sample size will be evaluated within the first 3 months[10] and changes to the survey design (e.g. stratification by level of dependency, as described in Nasielski, 2012, based on CDB data) and survey methodology will be considered based on a full year of data.

The selected sample size has consequences for the accuracy of the estimate based on the HCI survey by fishery areas and by province. The sampling error and (statistical) accuracy will be assessed during the implementation based on the observed average daily catches and the variation, with the survey design adjusted if necessary. Since almost all existing fish catch data available is based on surveys that preferentially sampled professional/full-time fishers, the first year of the HCI survey will be used to develop a better understanding for sampling design and stratification, between areas with low fishery

---

[10] Adjusting the sample size or even redistribution of the sampling effort by fishery area are only expected to affect accuracy, not precision, as long as the selection of fishing households is random, therefore this will not affect analysis or comparison between areas and months

dependence and high fishery dependence[11]. The survey design and sample size will be evaluated after a full year of data is available, but a preliminary evaluation will be scheduled to be available in **June 2021**, to facilitate proposing changes to the survey design and implementation with consequences for the budget allocation.

5.2. Sampling distribution
Provinces are grouped into fishery areas[12]. The sampling effort will be distributed based on the proportion of estimated number of fishing households for each fishery area (Table 1).

Communes are selected at random for each of the fishery areas (annex 7). The communes are selected from all communes present in each of the fishery areas, with an exception made for the coastal fishery area. Since marine fishing is important for the four coastal provinces, communes (and villages), that are bordering the sea are expected to be mainly dependent on marine fishery resources. They are excluded for catch assessment for inland fisheries, this excludes all communes for Kep province. Marine communes are identified based on the location where vessel owners live (home ports), as recorded in the 2018 vessel census. All villages with 15 or more vessel owners for small- and middle scale vessels, are assumed to be mainly focussed on marine fisheries. This includes 45 communes with a total of 82 villages. The 4 communes selected for the HCI then are randomly selected from 112 remaining communes that depend mainly on inland fisheries.

Before the start of selection of fishing households for the catch assessment survey, the following actions need to be taken:
- The random selected communes are evaluated by FIA/IFReDI, based on representativeness for the fishery area[13], to exclude urban areas or a bias towards hinterland or riparian communes
- After reselection of communes where deemed necessary, 1 village is randomly selected from each commune
- Based on the location and travel routes the villages will be distributed equally over all 5 survey teams
- Up-to-date household lists for each of the selected villages will be requested from FIAC to randomise and pre-select a random household list for assessment for inclusion in the HCI survey.

In view of the possibility of large numbers of non-respondent households, non-fishing households, households that cannot be located, or those that do not want to be involved in the survey, the random list will include the first 100 randomly selected households;

The only way to cover 900 fishing HHs with 5 survey teams within 15 working days each month, is by
- equally distributing the sampling effort over all 5 FIA/IFReDI teams (180 fishing households/survey team)
- sampling 15 fishing households in each village, resulting in each survey team covering 12 villages/month.

---

[11] Depending on the objective for catch assessment, a better stratification for a country level estimate for the total catch, would be to separately sample areas within each fishery areas with low and high fishery dependence, relating to their relative access to productive fishing locations and village economy. If separate estimates are required for each province, much higher sample sizes are needed

[12] This seems based on administrative (provincial) boundaries only, without a clear link to the relative importance of fishery activities, for income and food security, and prevalence of highly productive aquatic habitats, e.g. parts of Tonle Sap fishery area may have more in common with Mountainous areas with which some communes border.

[13] This doesn't mean that random selection is abandoned, merely to assess if by chance the selected communes select a bias for low or highly productive locations that could skew the data. If necessary, the entire commune sample can be resampled, not for individual communes.

Distribution of total sampling effort is based on the geographic location of random selected villages, while minimising the travel time to reach each of 12 villages. Initially interviews are conducted as a team, for training and practice purposes, if time permits. After all FIA/IFReDI staff are familiar and comfortable with conducting the interviews this will move towards team members conducting interviews individually. This will save time and allow to increase the sample size or reduce the number of days spent on the survey or the number staff involved.

Staff will travel together (taxi/rental car) or on motorbike, to reduce cost. The locations assigned to each survey team is based on proximity (distribution) and travel time (ease of access). Each survey team will likely cover villages from multiple fishery areas.

Opinions are divided whether catches in general are under the influence of the lunar cycle, as observed for the catches of the Dai fishery (particularly of *Henicorhynchus* sp.) that vary strongly with lunar periodicity. Deap (1999) observed a peak catch period of 4–6 days before full moon and a low period during the rest of the month. This seems correlated to triggers for migration movements, which are variable between fish species, seasons and fishing method. For example, Baird and Flaherty (2001), working on a gillnet fishery targeting medium-sized cyprinids, conclude that no significant correlation can be found between peak catches and lunar phases. It is unclear if lunar periodicity will be a major factor, but its presence will be monitored, and estimates can be made for two periods each month if appropriate. To ensure this is taken into account, the sampling design will use a cyclical sampling scheme, ensuring that a fishing household isn't always interviewed for the same recall period every month. There are several approaches to do that, but the simplest is to always follow the same optimised survey sequence (minimise travel time) but start with different sample locations each month.

For example, if the 12 villages to be covered by each survey team are organised following the best survey sequence, then they are sampled in the following order for subsequent months. After 7 months the sequence repeats.

Table 2. Proposed sequential village sampling schedule for 2020-21 for each survey team.

Order	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1st	1	3	5	7	9	11	1	3	5	7	9	11	3
2nd	2	4	6	8	10	12	2	4	6	8	10	12	4
3rd	3	5	7	9	11	1	3	5	7	9	11	1	5
4th	4	6	8	10	12	2	4	6	8	10	12	2	6
5th	5	7	9	11	1	3	5	7	9	11	1	3	7
6th	6	8	10	12	2	4	6	8	10	12	2	4	8
7th	7	9	11	1	3	5	7	9	11	1	3	5	9
8th	8	10	12	2	4	6	8	10	12	2	4	6	10
9th	9	11	1	3	5	7	9	11	1	3	5	7	11
10th	10	12	2	4	6	8	10	12	2	4	6	8	12
11th	11	1	3	5	7	9	11	1	3	5	7	9	1
12th	12	2	4	6	8	10	12	2	4	6	8	10	2

Even if including travel between locations, return to Phnom Penh for weekends and limitations in budget that mean that each survey team can only cover one village/day, this should allow for all fishing households to be covered within 15 working days with some time to spare. Following a predictive sequence, facilitates fixing monthly survey schedules to accommodate holidays and important events, which are used by a separate field inspection team to verify survey team activities. In addition, following a Monday to Friday survey schedule (no over-time) ensures that fishing households are not interviewed for the same days each month, while still including fishing activities during weekends.

Analysis of the data will show if there is a significant difference in fish catches and fishing effort between different periods over the month from the available data. If low and peak fishing periods are observed for household level fishing, catch and effort data can be collected for two separate fishing periods: the low and peak fishing. This would need to increase the survey effort, as it is expected that the current sample size is insufficient for accurate independent estimates for low and peak catch periods. Because initial potential low and peak fishing periods will be covered by part of the sample, data is available for analysis to evaluate any differences. As it is unsure how the presence of low and peak catch periods affects the resulting data and variation, the impact of re-distribution of data over low and peak catch periods for estimating indicators will be assessed after at least 3 months of data is available.

5.3. Household selection

Sampling of fishing households is random. The proportion of fishing households with professional/full-time fishers, as well as part-time and seasonal fishers in the total fishing population will be established during the random household selection (using the Household Selection Interview survey), this allows to adjust the sampling frame used for extrapolation if more detailed information becomes available[14]. The overall proportion of fishing households, compared to non-fishing households, also will be established during random selection of participating fishing households, to allow for validating the existing data and to be used for extrapolating the total catch.

To facilitate selection of participating fishing households, it is recommended to randomly pre-select communes and villages in each fishery area, without preference for equal representation by province. Randomly select 1 village in each selected commune, from which up to 15 fishing households will be randomly selected[15].

Random fishing household selection is essential for collecting unbiased data. This must be clear to the FIA/IFReDI survey teams and carefully explained to village authorities. During household selection it is important that no short-cuts are taken that would exclude certain parts of communities from being considered for random selection of fishing households. Since the sample will be based on lists and population records kept by village authorities, there is the possibility that village authorities may try to steer the field team away from approaching certain households or parts of the village, because "*they are not fishing*", e.g. areas with a high proportion of government employees, police or military, or ethnic groups (immigrants) that "*everyone knows don't fish*". The HCI is **not only** targeting fishing households with a high dependency on fishing to obtain "*good coverage for a wide a selection of gears and habitats*", the goal is simply to get an accurate estimate for the average monthly fishing household catch and the species proportion. Therefore, selection of fishing households, needs to be based on random sampling.

All random selected households need to be interviewed even those that are considered to be non-fishing by the village authorities. Low fishery dependent households are probably widespread, especially in certain parts of mountainous and coastal fishery areas[16]. However, these households need to be included in the HCI survey, or at least not actively excluded, to get a proper idea about the level of fishing. As soon as assumptions are made in relation to what constitutes a fishing household and try to find target households with a higher dependence only (because "*they provide better data*"),

---

[14] If exact numbers of fishing households with full-time (commercial/professional) fishers, part-time fishers and seasonal fishers can be estimated, then catches for these groups from the available data can be used for separate estimates, or even by implementing a stratification based on fisher type to increase accuracy

[15] Similar to what is done in the recent SES

[16] The 2017 socio-economic survey indicates that a higher proportion of households from Plateau and mountainous fishery areas are fishing than in Tonle Sap and Floodplain fishery areas

sampling bias is introduced that lessen the utility of the data obtained for estimating the total catch and monitoring trends in fisheries.

Any decision to include/exclude a household in the survey is done based on the data collected during the household selection interview:
- The household has members involved in fishing activities, at least part of the year;
- The household is willing to be involved in the HCI survey; and,
- The household is not involved in seasonal migration for tending to crops or wage labour, moving away from the current home.

It is important to make sure a household really isn't fishing, as some households may initially say they don't fish, while they may collect OAA, or perhaps fishing is done by someone other than the household representative interviewed. Insisting on random sampling is to make sure that the sample covers all levels of fishing dependency, making sure it doesn't exclude households that are only sporadically fishing, as it is an important part of the population. Leaving out households with a low activity pattern would introduce a bias and can lead to an over-estimation of the catches.

The household selection interview also will provide data to estimate the number of non-fishing households for each fishery area separately, to be able to raise catches to the whole population in the villages covered. This is based on the number of households interviewed until 15 fishing households are selected for the HCI survey for each sample village. This means that in some villages selected for the HCI survey, where almost all households are fishing households, only the first 15 random selected households may be interviewed for the HSI survey. The proportion of non-fishing households obtained from the results of the HSI survey, will always be compared with the data from the 2019 population census and de CDB data that both contain data on the number of households indicating fishery as the primary or secondary occupation. The HSI data also will attempt to assess sample selection bias (by comparing the fishing dependency between fishing households that agree to be included in the HCI survey and those that don't want to be involved in the HCI survey.

The survey will look at covering a total of 60 communes, represented by 1 village each. Fishing household selection and the household selection interview survey will be done by FIA/IFReDI teams, supported by FIAC staff, but the list of communes/villages selected for each fishery area are included in annex 7 in table form and in annex 8 as a map, for planning purposes.

Random selection of villages can follow the practice similar to what is implemented by the National Institute for Statistics (NIS) for the various surveys[17], if population data is available:
1) Prepare a list of all provinces, communes and villages to be sampled
2) 'randomly' number provinces (don't use the administrative code)
3) Group the provinces into the fishery areas and sort by the randomly assigned number
4) Within each province sort villages by number of households and assign rank number
5) Within each fishery area sort provinces by random assigned number, communes by their administrative code and the villages by rank number
6) From the resulting list, randomly select the required number of villages in each of the fishery areas:
   a. Based on the total number of villages in each fishery area, create a random order and select the villages by rank number
   b. Divide the total number of villages in each fishery area by the required number of sample villages (N_{skip}) and randomly select a starting village and selected at the rate of 1 in N_{skip}

In the absence of recent population numbers by village, selection of communes instead was done using a random sequence generated for the total number of communes included in each fishery area. One

---

[17] NIS uses a list of 28,000 Enumeration Areas (EA) covering the entire country

village within each pre-selected commune then is selected randomly based on random sequences for each commune.

Unlike the surveys implemented by NIS, the HCI survey has an insufficient sample size to stratify by rural and urban areas, however following the above method will allow sampling urban and rural communes proportionally. This still may introduce a sampling bias and this will be assessed by implementing a validation survey to estimate the effect on the estimated household catch.

5.4. Fishing Household Household Selection Interview Survey

During selection of the fishing household sample the HHSI survey will be implemented to assess the status of each households randomly selected to estimate the proportion of fishing households and the dependency of fishing households on fishing as a livelihood (see form included in annex 2). Sample selection need to be implemented by FIA/IFReDI survey teams, supported by FIAC staff. It is essential to interview all random sampled households (to make sure non-fishing households are recorded) and that the reasons and if possible, the fishery dependency status of fishing households that do not agree to be included in the HCI survey to be recorded to assess sampling bias.

It is expected that some households will leave the survey within the first year[18]. Whenever replacement households need to be selected, for fishing households that no longer want to be included in the survey, who are (temporary or permanently) moving out of the village or in case of divorce, illness or death, these need to be selected using the same approach, including implementing the HSI survey. In case households move around seasonally, e.g. for tending crops or seasonal labour, they should not be considered for the HCI (questions to assess this are included in the HSI survey).

The entire sample frame also needs to be changed every few years (2-3 years), which involves random selection of new communes, villages and fishing households. This also allows updating of the information on the number of fishing households, that is used for extrapolation.

Random selection of households in the selected villages is done based on village records of household lists:
1) Meet with village authorities to introduce the survey, explain objectives and what is needed to conduct the survey'
2) Compile or copy household lists;
3) The completeness of the village lists (total number of households), need to match the totals observed during the population census;
4) Based on the total number of households prepare a random order to select households from the list; and
5) Prepare a target sample household list with 100 households from the complete village household list[19], this will include sufficient replacement households for non-fishing households or those that don't want to participate in the HCI survey.

It is necessary to do the above tasks a few weeks before the fishing household selection. It is recommended that FIAC is requested to visit each sample village before the actual random household selection to inform the village authorities about the upcoming survey and collect the village household lists. **The household lists for the random selected villages need to be available at least a week before selection of fishing households for the HCI survey**. This will allow for IFReDI to prepare randomised household lists for each location. Planning also needs to consider convenient dates when there are no conflicting activities, festivals and village authorities are available to assist with locating and

---

[18] Experience elsewhere indicates that long-term attrition with recall surveys is relatively low, as unlike with logbooks, it requires little effort, but often can be quite high during the initial period.

[19] As mentioned before not all 100 households will be interviewed for the HSI survey, only until 15 fishing households are selected.

introducing random selected households (this normally requires some payment to compensate for their time).

1) Visit the randomly selected households **in the order of the randomised household list**, with assistance from local village authorities to locate each household and introduce the survey team
    a. Introduce yourself as working for IFReDI, wear a IFReDI cap, jacket or bag or have a name tag with the IFReDI logo clearly visible;
    b. Explain objective of the survey (fish catch assessment) and the reason for doing the household selection interview; and
    c. Verify the information in the Household Identification section, to make sure this is the household that was randomly selected;
2) If a household cannot be located, make a note with the reason (moved, involved in migratory seasonal labour, nobody home). If nobody is home, check with neighbours if the household is expected back within the time the FIA/IFReDI team are in the village, if **Yes**, schedule a revisit, if **No**, make a note and move to the next household on the list;
3) Never depend on what village authorities tell the FIA/IFReDI (including variations on: "*that household doesn't fish*"), record the status and result of the interview for all households on the list that have been visited;
4) Make sure to interview household members together and to involve both male and females in the interview:
    a. Avoid relying on the answers from a single respondent, especially if the household includes more than one fisher;
    b. Involve silent members of the household as much as possible, by asking follow-up questions;
    c. Keep in mind traditional roles, but always involve both male and female members, for questions on livelihood activities and processing ;
    d. Try to get consensus in the recall for number of fishing days, average catch or importance of livelihood activities by starting a discussion between household members if there is disagreement on the answer for a specific question; and,
    e. Keep in mind that it is mainly the relative importance that is important, not absolute values for fishing days and catch amounts.
5) Start the HSI survey by asking the first question of the Fisheries Activities by Household section to establish if the household is a fishing household
    a. If the household isn't a fishing household, indicate on the survey form, this information is used for calculating the proportion of fishing and non-fishing households. Move to the next randomly selected household
    b. If the household is a fishing household, explain what is expected from the participating households to the HCI survey (frequency of interviews, duration of survey and that there will be no incentive for providing the data)
    c. If the fishing household wants to be included, proceed with the remainder of the HSI survey, before moving to the next randomly selected household;
    d. If the fishing household doesn't want to be included, ask what the reason is and ask permission to finish the selection interview survey: **this allows us to assess sampling bias**, and move to the next randomly selected household
6) Continue until 15 fishing households have been selected that agree to be included for the HCI survey for each sample village.

Household Identification, asks for the location and specifics of the household, which should not provide any difficulty and can be filled in before the survey based on the available information in the community database or the village household lists. The available information then simply needs to be verified, when visiting the household. There are two questions that are of special importance for implementation of the HCI, are at the end of the survey form in section 5.

Fishery Activities by Household, this is the main section to assess if a household is a fishing household. The first question is very important and needs to be carefully formulated to include full-time, seasonal and part-time fishing for income and/or subsistence. Even if the household indicates to be fishing only a few times in the peak fishing season, it should be included in the sample as a fishing household. The emphasis here is on catching fish. If the HH only collects OAA and/or Aquatic Plants (AP), this is not a fishing household. Be alert for the presence of fishing gears, freshly caught fish, a boat or boat engine underneath the house and any indications that a household may be fishing (e.g. the presence of a icebox).

If the household is a fishing household, ask if they want to be included in a catch assessment survey (with an explanation of what that means, see item 4b, above) and if **Yes**, proceed with the HSI survey and skip to 2. If **No**, ask for the reason and try to get the HH to agree to proceed with the rest of the HSI survey.

The number of HH members involved in fishing refers to both children and adults, record the number for female and males separately. Indicate the months when the HH is fishing and ask for an estimate for the number of fishing days for each month for 2019. This is mainly to establish the relative number of days and to indicate if the household is fishing full-time, part-time or only seasonal, so the exact numbers are not that important. Calculate the average number of fishing days per month and ask for the typical (average) daily catch during the two main seasons. This normally is very difficult, so ask what they caught the last time they went fishing and ask if that is the normal amount for the current (dry) season. Then ask if they normally catch how much more/less during the rainy season to get an estimate.

Assess the importance of fishing for income or consumption, if the HH indicates it is more or less the same, select "Same importance". If the household processes fish, ask the kind of products that are made (just the main categories).

Assessing the boat and engine ownership, should not be a problem, keep any boats and engines observed around the house in the assessment.

Next the household is asked to indicate the habitats that are fished or where OAA is collected. Go through the entire list, before asking for the importance for catch. It may be easiest to rank the selected habitats by importance for catch, because it is likely that most households will find it difficult to estimate the % catch. This may be done on the basis of the estimates for the number of days/month the habitat is visited. The last column refers to the number of HH members that fish or collect, fish and OAA in each of the habitats, just a count, not separated by gender.

The category, marine habitats only has to be included for the coastal provinces.

Fishing Gears ownership (or use), is mainly intended to assess the level of dependency. If detailed gear sizes for gillnets cannot easily be obtained, just tick the various gears operated by the household and indicate the number of units. This data is not intended to be used to calculate the CPUE by gear, collecting this in too much detail is not necessary. Similarly, for hook and line gears, it is more important to know if the household operates the different types of hooks and lines, than the number of units, or the hook size, as this can easily change. This also is the case for small traps and even large traps, that can be produced by the HH and thus the count is less important than the fact the HH owns/uses a specific trap.

If certain gears for Hook and Line and Traps are not included in the lists, please add the name of the gear, the HH owns/uses.

Household Dependency on Fishing, asks about trends in the fisheries. This section should be straightforward. Question 3 **doesn't ask** for estimating the proportion of fish protein as part of the

overall protein intake, just to indicate if the relative importance of fish and OAA in the diet is high, low or somewhere in between (medium), compared to intake of other sources of animal or plant protein sources. This should be explained in terms the households will understand, e.g. by listing the various sources of protein: meat (including from cows, pigs and hunting), fowl, eggs, reptiles and insects. It is meant to assess the importance of fishing (including OAA) for HH consumption. If the HH indicated that it doesn't sell fish or OAA then skip Q.4. If the HH can estimate the importance of fishing for HH income, this already is an indicator that it is common for the HH to sell fish. However, at least ask the household to indicate if the contribution of commercial fishing to HH income is high, low or in between, compared to other livelihood activities.

In Q.5 the HH is asked to assess if compared to other HH in the village it is catching more, less or about the same. This will provide another indicator for the relative dependence on fishing.

In Q.6, the HH is asked to list the main livelihood activities, ranked by importance for HH, this can be done based on time spent, with the addition, if possible, , with an estimate for the contribution to the income. It is not necessary that the total is exactly 100%, indicative guestimates are acceptable. The main interest is to see the number and type of various economic activities which can provide an indication of risk distribution and level of resilience towards negative impacts on fisheries income. After listing the main livelihood activities, this can be done interactively by providing all (adult) household members with 10 tokens, which they need to place on the different activities they are involved in. Each member can place more than one token for each livelihood activity.

Finally, in section 5, **Eligibility for HCI survey**, two follow-up questions are asked to assess if the HH should be included in the HCI survey:
Q.1 asks how long the household has been living in the village, to see if it is a recent migrant, i.e. if there is a chance it may move away from the village during the survey.
Q.2 asks if the household temporarily moves away from the village for work, e.g. tending to crops, livestock or seasonal labour in factories.

Both answers combined indicate if the household should be considered for the HCI. If the HH moves away at any time of the year it should be excluded from the HCI survey. If in doubt and it is a fishing household, tentatively include the HH in HCI survey, but make sure to select a replacement household, in case review at FiA indicates it should be excluded. Replacing households during a long-term survey is unavoidable, but should be minimised as much as possible.

6. HCI Field protocol

The following is a tentative description of the interview method and sequence of the survey. This is likely to change based on experience in the field during the field training and subsequent survey implementation.

The interview is expected to take less than 20 minutes, but this depends on the skill level of the data collector and the amount of fishing a household has done during the past 5 days. Long interviews need to be avoided as this interferes with household activities and willingness to continue with the survey.

It is necessary to carefully record the local Khmer species name as reported by the fishing household. When in doubt, the photo flipchart can be shown, if this doesn't disrupt the flow of the interview. The species code can only be assigned based on the local Khmer name and provides the link to the scientific name and the standard common Khmer name in the database. The locally used common names is essential for correctly assigning species catch to the right species. It is highly recommended to always enter the reported local Khmer name as well as the assigned species code into the database, as this allows verification that the code that was assigned is correct, as part of the QA/QC procedures. If only the species code or the common Khmer name is recorded, there is no way to check if the right species code was assigned.

For each location a species list survey needs to be done to establish the local names for all species covered by the reported data using the photo flipchart and additional fish guides if necessary. There are two ways of doing this:

- a group interview after fishing household selection is concluded, but before the start of the HCI survey (this doesn't need to include all selected households, mainly the more experienced fishers); or
- build this list during data collection, whenever a new local species name is encountered.

The second option is more efficient. However, this works best if data is always collected using tablets, as this will automatically indicate that a name has not yet been linked to a scientific name and provides an autofill option when starting to enter a species name from the entries already in the database. If using paper forms, it depends on the skill of the data collectors to recognise species names that are not yet linked to a scientific name, as well as the ability to consistently use the same spelling for the same name. Until tablets are used, this needs additional checks during data entry to identify spelling issues and flag potential mistakes when assigning species codes.

Since the same name can link to different species in separate locations (even within the same village), or different names can link to the same species. This can be highly complex, especially when the respondents are not frequent fishers and therefore are unsure about fish names for uncommon species. Even professional fishers in different locations will use different fish names. Another advantage of using tablets is that there is less chance new and creative ways of spelling non-standard local species names are introduced.

It is important not to assume that a certain local name always links to the same scientific species name, as ethnic or linguistic background, as well as fishing experience will affect local names used. When in doubt verify with the photo-flipchart, but generally most of the reported catch will be correctly identified using the reported local names, with only rare species causing issues.

Interviews for the HCI survey are conducted with an adult household representative, preferably in the presence of both the household head or spouse, to cover fishing activities by all household members. Fishing households are interviewed at their home. In case no household members are at home, neighbours are asked where they can be found or when they are expected to come home. Based on the available time for covering all 15 households in the sample village, a decision must be made to find households representatives working in the field (or fishing) or return later during the day.

If possible, conduct interviews in teams of 2 persons, but only if time permits, where one team member asks the questions, while the other records the answers. This is especially important during the first month, when collecting data using paper forms. The survey form is not a questionnaire and is mainly designed for recording the information, for each item a question has to be asked but the formulation is not fixed. The task for the second team member who is recording the data is to make sure that the information is complete and that data for all days and all items is collected.

The information for identification of the FH can be entered before entering the village, with only the name of the respondent and the relationship to the household head recorded at the start of the interview.

The HH members fishing refers to all **adult** household members contributing to the total household catch (only separated by gender not by age group). The species catch is for all people that are reported to be fishing (include both species detail for fish and OAA):

1) The respondent should be a person involved in fishing, preferably the household member that is fishing most;
2) The respondent should provide data for the household catch (for all household members);

3) If more household members are around, make sure to ask them for additional catches that can be assigned to species or species groups

The HCI survey will cover 5 days. The main reason is to increase the probability that catch data is collected from fishing households that fish infrequently, e.g. once a week or less. This relatively short period will ensure that the catch data is still fresh in respondents' memory and allows collecting data on both (species) catch, gear and location. Always start with the most recent day (day 5) first and work your way back to day 1. Assuming that the interview takes place after fishermen have returned home from fishing, day 5 will be the interview day. Please indicate the dates for each day on the form. It isn't necessary to cover the same 5-day period for all households in the fishery area. The 5-day period is representative for a random period of fishing and besides holidays, festivals or events in the household/village (wedding/funeral/weekly market etc…) there should not be any consequence of a differences in the coverage between households, unless there is a consistent low and peak fishing period with different fishing effort, involvement and yield (CPUE).

Indicate the days for which the FH reports fishing activities, make clear this includes any fishing, gathering of OAA or collecting aquatic plants by any member of the household. Tick the boxes for the fishing days. Make sure to enter the dates using date/month, e.g. 05/12.

The habitats fished are indicated by entering codes, more than one code can be entered for each day, refer to annex 9, for the codes. Codes for running water (lotic) start with a zero and codes for standing water (lentic) start with a 1.

The number of adult FH members contributing to the catch for each fishing day are indicated for female (♀) and male (♂) fishing household members. This is both to focus the respondent on the importance of including fishing by other fishing household members and to get an idea about the role of gender in fisheries.

The form has space for 25 species only, this should be enough for most interviews (and fishing periods), but if necessary, the table on the back of the paper forms can be used. Ask for the Khmer species name and record this using standard spelling. The columns with the **Code** refers to the species code from the photo flipchart and will be assigned after the interview is finished but before leaving the village in case the local name is not in our list and the household needs to be asked for clarification using the photo flipchart. If the species code is immediately known, this can be entered, otherwise wait until after the interview, as not to interrupt the flow of the data collection. It is recommended to use the FIA codes, as these separate inland fish, from marine fish and OAA. Enter the weight for this species in kg, based on the best estimate by the respondent (see later), for the fishing day (**1** through **5**). Each species is only added to the list once, if the same species is caught on multiple days, the weight is entered for each day on the same row, for each day it is caught.

The species catch section should include all aquatic living organisms caught or collected by the FH, as included in annex 5. This isn't only fish species, but also OAA and AP. The data entered in this section ideally should include all weight that was caught and collected by any household member.

Ask respondents to estimate the weight in kg for each species they caught for each day. In case they have trouble remembering for day 1-2, assist with asking if it was more or less than for the most recent day they fished. If households have been fishing almost daily, catches for day 1-2 will be less reliable, and these may be removed from the analysis.

Fish shapes and sizes are prepared out of cardboard, corresponding with fish of 50, 100, 250, 500, 1000 gram and then subsequently for weights of 2, 3, 5 kg. This will assist respondents to more accurately estimate fish weights. Unless fishers have sold their catch, or are very experienced, they will often not be able to remember the weight, but often can remember the approximate size of fish that were caught. The weight for any OAA will be estimated without the aid of shapes.

For all species catch reported, ask if any or all was sold, if so, ask for the price and record that in the **Price** column. This should include **all species** that were sold by the household. If there is a price difference between days a species was caught[20], take the average.

Calculate the **total daily fish catch** after the interview, based on the species codes. All non-fish codes are preceded by NF (non-fish), to facilitate this calculation. The total fish catch reported should be the same as the total weight reported for fish disposal[21]. Ask for clarification if the weights are not the same.

In many cases, especially when interviewing a FH involved in commercial fishing, the data provided will focus on the catch data by the main fisher and any FH member that assisted. Often this is only fish catch. The respondent may not know if additional fish/OAA was caught by other FH members for food consumption or doesn't consider OAA important. Therefore, if no OAA or AP have been reported, this is specifically asked after the main species catch has been recorded for each day. Any additional fish/OAA and AP then needs to be estimated. If this is based on information of other FH members present during the interview, this may be added to the main species catch list, otherwise it is just an estimated total for additional fish, OAA and AP. Additional catch by other FH members (fish and OAA) may not come from the same habitat indicated for the main species catch and this can be indicated separately in the additional catch habitat box. We don't require species details for the additional fish/OAA, just the estimated weight by day.

If the FH indicates no fishing was done for a day, please indicate the reason (select from the available codes or indicate a different reason in the comments). If only OAA (and AP) was collected please indicate, by ticking the relevant box. This will be used in the database to separate records.

Six different gear types are pre-printed for each fishing day. Tick the ones that are reported as being used for each fishing day and add the codes for gear categories not included on the form, as indicated in annex 3. The survey will only collect the gear type (category), not the detailed gear names. Also indicate if fishing was done using without a boat, a paddle boat or a motorised boat.

Don't forget to ask if the household caught any fish ready to spawn, which will be used to identify spawning seasons.

Only ask for disposal for the **fish catch**, ask for the weight that was sold, consumed by the household, processed and for other use (gifted, animal feed or discarded). If fish was sold, ask for the income received for each day. If the FH doesn't want to provide the income, that is fine, don't insist to get this information, the income can be estimated based on the reported fish price as well.

Calculate the total amount for each day to compare with the total reported fish catch.

The information on active fishing households is now based on data from the sample households, therefore it is important that all households are asked if they went fishing the previous month (which may not be clear from the reported catch data for the previous month, if this didn't include any fishing days). If the FH was fishing, ask for an estimate for the total number of fishing days.

Also make note in the **Comments** box, of any additional information provided by the respondent related to fishing and the fisheries in general, e.g. comparison of catches between years/habitats, gear use, migrations.

---

[20] Fish price for a species may depend on size and for some species if the fish is alive or dead

[21] This term refers to fish utilisation, by main category: trade, consumption, processing and other uses. It should not be confused with fish discards

When using paper forms, ONLY USE **water proof** BALLPOINT, not pencil for filling out the forms, this way edits and corrections are clearly visible.

Note: Data collection will be done using paper forms, until tablets have been procured, after which all data collection will be done using electronic recording

7. Analysis plan and estimations

Estimates will be made at country level, as well as by fishery areas. Province level values will use redistribution of the fishery area estimates, based on the proportion of fishing households in each of the constituting provinces. This is expected to be statistically invalid for most provinces, but it will allow for tentative comparison of some indicators between provinces.

The main indicator for the fishery obtained from the HCI survey, total catch, will be estimated for the three main fishery areas, using

$\tilde{X}_m$ = the median reported monthly fishing household catch (raised to the total number of calendar days in the month)

N_f = total number of fishing households in the fishery area

F_a = proportion of active fishing households (from HFA survey)

Total estimated catch $= X_m * N_f * F_a$

The species or group of species catch is calculated based on the proportion of the catch by species.

The imputed[22] value of the catch will be calculated based on median monthly recorded fish price (by species) for the entire estimated catch. This in addition to the reported household income, from fish trade. However, income may not be reported consistently or reliably, therefore this is only indicative.

Since the proportion of active fishing households is based on the activity pattern of fishing households included in the HCI survey, this will be available immediately after data collection is concluded. If data is entered immediately (either by data typist not waiting until all data is collected, or by recording the data on tablets in the field), the data will be available by the second week of the following month and the automated tentative reports can be produced, discussed and approved for publication by the end of the month. In case issues are discovered with the data, QA/QC, re-visits and adjustments of calculation procedures (to remove certain data from the analysis) may take some time. However, the interview may miss fishing activity for a household, as the recall period only covers a 5-day period. Therefore, the fishing status for all fishing households will also be assessed for the previous month. This is expected to provide a better estimate for the number of active fishing households and this will only become available each following month. This means that final estimates are expected to be available with a maximum delay of 2 months, e.g. final estimates for December 2020 are expected to be published before the end of February 2021, but preliminary estimated totals will be made available for internal FIA/IFReDI use in January 2021.

Monthly catch reports by province, for feedback and publication on the IFReDI web-site will focus on a limited set of indicators that will be generated automatically by the database, in tables and where appropriate pie graphs:
1) estimated species catch (MT) at country level (including OAA and aquatic plants);
2) cumulative contribution to total catch, disaggregated by fishery area (and if possible, province);
3) average monthly household catch (with imputed and reported income);
4) average daily household catch (CPUE);
5) proportional contribution of reported catch by boat/gear and habitat; and

---

[22] Since this will include fish that hasn't been traded, representing a proxy for the 'replacement' value for a household, if they wouldn't be able to obtain the fish consumed though their own fishing activities

6) amount, contribution and (imputed) value by disposal type.

A pre-analysis plan (PAP) will include the method for calculating these indicators for database development. Variation (Standard deviation) and where appropriate standard error and confidence limits will be calculated. A proposal for the required analysis for the annual report will be included in a separate document, to be presented and evaluated 2 months before the due date for the annual report. A list of possible basic analysis from the data included in the proposed HCI is indicated in Annex 4. The PAP will be developed alongside the implementation and evaluation of the survey.

8. Implementation

Tasks are divided between FIAC and IFReDI as follows:
FIAC   coordinates with commune and village authorities and assists with the HFA survey
IFReDI implementing agency, responsible for design, training and supervision, HCI survey data collection as well as analysis/reporting

After agreement by the TWGFi, the following sequence will be followed:

September:
- TWGFi presentation
- Preparation of detailed field manuals

October:
- Final draft field manual for approval by TWGFi and DG
- Final sampling design (with FIAC consultation)
- Consultations and planning workshops with FAIC
- Developing database and data entry interface
- Translation of manual

November:
- Training of FIA/IFReDI field team (selected FIAC staff will be trained in the field) with field exercise as test of methodology for sample area
- Start of household selection interview survey in Tonle Sap (mid-November)
- Finalisation of methodologies and briefing of FIAC

December (onwards):
- Implementation of routine collection under supervision of IFReDI staff
- Monthly data reports, ongoing evaluation and where necessary adjustment of surveys

*Random se*lection of fishing households will be time-consuming. Instead of trying to implement the catch assessment in all target fishery areas, the survey will be implemented in phases:
December 2020   coverage of Tonle Sap fishery area
January 2020   expansion to include Floodplain fishery area
February 2020 onwards expansion to include remaining fishery areas: Plateau, Mountainous and Coastal.

Full coverage for all fishery areas is expected by end of quarter 1, 2021.

Although data collection will attempt to use electronic data recording, this depends on budget disbursement and procurement of tablets for field use. Paper forms will be used until electronic data recording can be implemented, which will be centrally processed by IFReDI staff, for verification and data entry. The household selection interview survey for fishery dependence will only be done using paper survey forms, as selection of fishing households needs to start ASAP.

9. Validation and field inspections

A separate FIA/IFReDI QA/QC team is charged with field inspections and validation. This has three main components:

1. **Observation of household field interviews** (unannounced) to evaluate how FIA/IFReDI survey teams conduct the interviews;
2. **Survey activity spot checks** to check if field survey teams have visited villages and interviewed the selected fishing households as per schedule, as well as impressions, issues and comments that fishing households may have on how the field teams conduct the interviews; and
3. **Validation surveys**, where the HCI is repeated for the fishing households in random selected locations to verify the data collected by the field survey teams.

The QA/QC team will produce monthly reports with their findings, and provide 6-monthly evaluation reports of members of the FIA/IFReDI survey team members.

Error checking will be an integral part of the data collection and analysis. Since data is collected using a recall survey, it is necessary to depend on what people report. The main sources of expected error are for

reported catch weight (even when using visual aids), this tends to be unreliable, unless catch is sold, two possibilities, without resorting to validation surveys:

- investigate the distribution of average catch weight, compared between the current survey and other fisheries surveys for fishers using the same gear types for the same catch periods; or
- Test the ability for fishing household members to accurately estimate fish weights by asking a number of households involved in the survey and some from the same village that are not involved, to estimate the weight of a number of freshly caught fish. This can be done as a fun activity for fishing household members to see who comes closest to the real weight, while at the same time getting an idea about the precision of the weight estimates and any impact on the precision from being involved in the HCI; and,

Species mis-identifications, in those cases where only some households report catching certain species, or if the average weight by fish is an outlier, these respondents can be identified. Once unreliable sources of species catch are flagged, they can be left out from the species proportion calculations, while still retaining their reported total weights.

These and other approaches will be further developed by IFReDI with support from FAO. However, for a real assessment of the reliability of the survey data, a parallel validation survey is required, e.g. using a logbook. This will be proposed for implementation after 2021, alongside adjustments to the survey and sampling design.

It is standard practice to implement validation surveys for long-term surveys, for a sub-sample of the household sample with national coverage. Since validation surveys are labour intensive, it is advised to use spot checks for random selected sample locations[23]., this can be done in two ways, depending on suspected issues:

- If there are suspicions that data collectors don't follow the correct methodology, then the fishing households can simply be surveyed a second time, if possible, for the same period; or
- If the validation is required to assess the validity of the sample used for data collection, then the HCI survey is implemented for a second random selected group of households during the same month to compare data locally between households involved in the HCI survey and those that are not.

While spot checks if data is collected correctly by individual data collectors or survey teams should be done whenever issues are suspected (based on field observations and survey activity spot checks),

---

[23] This normally is done with the same methodology, but if budget is available within FIA other methods can be considered, e.g. consumption survey or comparison with a SES.

validation of the sample (and resulting estimates) only needs to be done every 3-5 years to ensure that shifts in livelihood patterns don't affect the validity of the data collected. It is recommended to implement this during the dry season and again for the flooding season. The validation survey will use a recall period with the same duration as the HCI survey, with all selected households within the same sampling/fishery area interviewed for the same 5-day period.

10. References

Baird, I. G. and M.S. Flaherty (2001) Mekong River artisanal fisheries: gill netting for medium-sized migratory carps below the Khone Falls in Southern Lao PDR. Technical Report for the Environmental Protection and Community Development in Siphandone Wetland Project. CESVI, Pakse, Lao PDR, 28 pp. + annexes.

Cottet, M and T. Visser, 2017. Fish catch and fishing practices in the Nam Theun 2 Reservoir and watershed (Lao PDR). Lakes & Reservoirs: Research & Management. 22. 10.1111/lre.12196.

Deap, L. (1999) The bagnet (Dai) fishery in the Tonle Sap River. In: Proceedings of the Annual meeting of the Department of Fisheries of the Ministry of Agriculture, Forestry and Fisheries, 19-21 January 1999. N. van Zalinge, N. Thuok and D. Loeung eds. MRC/ Danida project for management of the freshwater capture fisheries of Cambodia. Phnom Penh, pp. 141-149.

Fisheries-Administration. (2019a). Photo of Fish and Information Guidebook. Report for the project "Support for Fisheries and Aquatic Resources Management in Northern Cambodia". Fisheries Administration and Inland Fisheries Research and Development Institute. Phnom Penh.

Nasielski J., Tress J., Baran E. 2012. Fishing dependency in Cambodia - mapping and methodology report. Report for the project "Assessing economic and welfare values of fish in the Lower Mekong Basin". WorldFish, Phnom Penh, Cambodia. 16 pp.

Ngor, P. B., Chhut, C., Theng, L., Ly, V., Phommakone, S., Samphawamana, T., . . . So, N. (2016). Photos of common fish species in the Lower Mekong. Phnom Penh: Fisheries Programme, Mekong River Commission.

So, N., K. Utsugi, K. Shibukawa, P. Thach, S. Chhuoy, S. Kim, D. Chin, P. Nen. and P. Chheng. 2018. Fishes of Cambodian Freshwater Bodies. Inland Fisheries Research and Development Institute, Fisheries Administration, Phnom Penh, Cambodia. 197 pp.

Visser, T.A.M. & Ovenden, M. & Wongwai, N., 2016. Developing approaches for establishing a fisheries baseline: Case-study for Xe Bangfai basin (Lao PDR). Hydroécologie Appliquée. 19. 357-382. 10.1051/hydro/2014007.

11. Annexes

Annex 1. Household Catch Interview survey format

Village name				Commune name					
Family name				Family ID		Village code			
Respondent				Relationship to HH head (code)					

Fishing days and catch		Day	Day 2	Day 3	Day 4	Day 5		Boat gear use			
Fishing days		O	O	O	O	O					
Date (dd/mm)								**Day 1**		gillnet	O
Habitat (IDs)								no boat	O	hook/line	O
								motorised	O	Lift net	O
People contributing to catch (including *adults and children*)	♀ Adult							non-motorised	O	Cast net	O
	♀ Child									Small traps	O
	♂ Adult									Large traps	O
	♂ Child							Other gear codes			

	Species name	Code	1 (Kg)	2 (Kg)	3 (Kg)	4 (Kg)	5 (Kg)	Price	Day 2		gillnet	O
1									no boat	O	hook/line	O
2									motorised	O	Lift net	O
3									non-motorised	O	Cast net	O
4											Small traps	O
5											Large traps	O
6									Other gear codes			
7									**Day 3**		gillnet	O
8									no boat	O	hook/line	O
9									motorised	O	Lift net	O
10									non-motorised	O	Cast net	O
11									non-motorised		Small traps	O
12											Large traps	O
13									Other gear codes			
14									**Day 4**		gillnet	O
15									no boat	O	hook/line	O
16									motorised	O	Lift net	O
17									non-motorised	O	Cast net	O
18											Small traps	O
19											Large traps	O
20									Other gear codes			
21									**Day 5**		gillnet	O
22									no boat	O	hook/line	O
23									motorised	O	Lift net	O
Small/juvenile fish		3001							non-motorised	O	Cast net	O
Other fish nei		3002									Small traps	O
Total HH catch											Large traps	O
Includes all fish/OAA caught by FH, incl. women and children?					O Yes	O No		Other gear codes			
Additional catch habitat (ID)											
Additional HH fish catch											
Additional OAA								Caught fish ready to spawn?			
Additional aquatic plants								O Yes	O No		
Reason for not fishing (code)											
Only OAA and AP		O	O	O	O	O					

Fish Disposal (kg)	Day 1	Day 2	Day 3	Day 4	Day 5	Did any adult member of your household fish during the previous month?
Sold						

Consumed							O Yes O No	
Processed							**If Yes:** How many days during the previous month?	
Other use								
Income (optional)								
Total (disposal amount)								
Comments								

Form checked and without mistakes by	*name and signature*	**Data recorded by**	*name and signature*
	Date …./……/202..		Date ………/……../202..

Species name	**Code**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Price**
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							

Codes for reasons not fishing:

1 Bad weather; **2** Not enough fish; **3** Need to repair net/boat/engine; **4** Sick; **5** Work around house/agriculture/collect firewood; **6** visit family/friends attend ceremony or holiday; **7** Wage labour; **8** Attend meeting; **9** Other, *please specify*

Codes for relationship to HH head:

1 Household head; **2** Spouse; **3** child; **4** Other HH member; **5** Family member from separate HH; **6** Neighbour; **7** Other; **8** Unknown or not entered

Annex 2 Household Selection Interview Survey Form

1.   Household Identification

1. Date & Start time:	/ /	:	2. Household Book ID	
3. Province			4. District	
5. Commune			6. Village name	
			7. Village code	
8. HH head name			9. HH head gender	**O** Male **O** Female
10. Respondent name			11. Number of HH members	

2.   Fishery Activities by Household

			Yes	No
1	**Does any member of your household**, fish and collect other aquatic animals at any time of the year?		O	O
1.1	If **Yes**, do you want to be involved in a catch assessment survey during 2020-21?		O	O
1.2	If **No**, please explain why you don't want to get involved			
	Reason code			

Form checked and without mistakes by	*name and signature* Date …./……/202..	Data recorded by	*name and signature* Date ………./……../202..

2	How many members of your household are involved in fishing?											
		< 15 years	15 years up			< 15 years	15 years up					
2.1	Male			2.2	Female							
3	How many times did your household fish per month in 2019											
	Month	1	2	3	4	5	6	7	8	9	10	11	12
1	Fishing	O	O	O	O	O	O	O	O	O	O	O	O
2	Fishing days												
3	Average fishing days per month in 2019 (calculate from 3.2)												
4	Average daily catch during rainy season												
5	Average daily catch during dry season												

4	Indicate if your households **mainly** fish and collect aquatic animals for		
	O Selling	O Same importance	O Consumption
5	Does your household process fish?	O Yes	O No
6	If Yes, what kind of processed products do you produce?		

7	Own or share a boat	O own	O share	O no boat
1	If sharing boat with how many households?			
2	If owning a boat how many?			

8	Own or have access to a boat engine	O own	O share	O no engine
1	If sharing engine with how many households?			
2	If owning an engine how many?			

9	Where do household members normally fish and what proportion of catch by habitat?			
		Habitat	**% catch**	**days/month**	**HH members**
01	O	Mekong Mainstream			
02	O	Major Tributaries			
03	O	Tributaries to Tonle Sap			
04	O	Stream			
05	O	Sub-Stream			
06	O	Irrigation canals			
11	O	Seasonal swamps			
12	O	Permanent swamps			
13	O	Floodplain: flooded forest			
14	O	Floodplain: rice fields			
15	O	Floodplain: lakes and ponds			
16	O	Reservoir			
20	O	Marine habitats[*]			

[*] This is included for coastal provinces to assess if the households also fish in marine/brackish water habitats

3. Fishing Gears Ownership?

1	O Gillnet	Indicate the size, mesh width and number of units:				
	Length	**Depth**	**Mesh width**	**# units**	**Stationary**	**Drifting**
1.1					O	O
1.2					O	O
1.3					O	O
1.4					O	O
1.5					O	O

2	**O** Hook and line				
	O	Hook long line	units	**O** Hook and line	units
	O	Pole and line	units	**O** …	units

3	**O** Small traps	Units	4	**O** Large traps	Units
O	Snakehead wedge trap		**O**	Wedge cone trap	
O	Drop door trap		**O**	Bamboo vertical cylinder trap	
O	Vertical hanging vase trap		**O**	Horizontal cylinder trap	
O	Horizontal cylinder trap		**O**	…	
O	…		**O**		

5	**O** Lift net	Units	
6	**O** Cast net	Units	
7	**O** Seine		
8	**O** Others (please specify)		
9	**O** Others (please specify)		

4.   Household Dependency on Fishing

1	Has it become easier or harder to sell fish, compared with 5 years ago?			
	θ Don't sell	θ Easier	θ No change	θ Harder
2	If **Easier** or **Harder**, please explain...			
3	Importance of fishing for percentage of protein intake (%)			
	indicate high, medium or low if no percentage can be given	θ High	θ Medium	θ Low
4	If selling, importance of fishing for overall household income (%)			
	indicate high, medium or low if no percentage can be given	θ High	θ Medium	θ Low
		More	**Same**	**Less**
5	Compared to other households in the village, how much do you normally catch?	θ	θ	θ

6	What livelihood activities is your household involved in?	Activity code	% Time	% Income
1				
2				
3				
4				
5				
6				

5.   Eligibility for HCI survey

1. How many years has HH lived in village?		2. Does the HH migrate seasonally away from village for work?	O Yes O No

Activity Codes:	5. Fish culture	10. Transport service	15. Money lending
1. Rice Farming	6. Fish processing	11. Repair shop	16. Handicraft
2. CFI tasks	7. Gear repair/making	12. Hotel/restaurant	17. school/college
3. Fishing	8. Daily Labour (agricult)*	13. Petty trade/shop	18. Housekeeping
4. Livestock	9. Government service	14. Other business	19. Vegetable farming
			20. Others

* Daily labour refers to working in agriculture as an employee (for someone else)

Annex 3. Gear types

Gear code	Gear name English	Gear name Khmer
1	Stationary gillnet	មងកាំង
2	Drifting gillnet	មងបណ្ដែត
3	Hook long line	សន្ទូចរាយ
4	Hook and line	សន្ទូច
5	Pole and line	សន្ទូចបង្កៀ/បង្គង/វាត់
6	Snakehead wedge trap	ជុច
7	Drop door trap	ចាន់
8	Vertical hanging vase trap	តុម
9	Horizontal cylinder trap	លប
10	Wedge cone trap	ប៉ោង
11	Bamboo vertical cylinder trap	សៃយ៉ឺន
12	Horizontal cylinder trap	លប
13	Giant lift nets	ឈ្នុក់
14	Lift nets	ធ្នក
15	scoop baskets	ឈ្លាង
16	scoop nets	ថ្លង
17	Cast net	សំណាញ់
18	Giant cast nets	សំណាញ់ធំ
19	Hand capture	ចាប់ដោយដៃ
20	Spear	ស្នូ/សម/ច្បូក
21	Bow and guns	ស្នា និងកាំភ្លើង
22	Bag nets	ដាយ
23	Seine nets	អួន
24	Push nets	ឈឺប
25	Pair trawl	អួនអូសគូ
26	Pumping	បូម
27	Others gears	ឧបករណ៍ដ៍ទៃទៀត

Annex 4. Proposed Basic analysis for catch and effort data obtained from HCI survey

(including comparison between fishery areas).

Indicators	Presentation
Total reported OAA and AP by species (Kg)	Table
Total reported fish by species (Kg)	Table
OAA as proportion of total catch	Table
Plants as proportion of total catch (optional)	Table
Monthly median OAA catch by fishing household	Graph, time series
	Comparison between periods
Proportion of fishing households reporting OAA	Table
Estimated OAA by main group/species	Table
Origin of OAA and aquatic plants by main habitat[24]	Pie graph
Origin of reported fish catch by main habitat	Pie graph
Total reported species catch by main habitat and fishery area	Table
Contribution to the total reported fish catch by main habitat	Graph, Time series
Proportion of fishing households fishing with or w/o boats/engines	Table
Proportion of reported catch by boat type (no boat, paddle boat or motorised boat) compared between fishery areas/provinces	Table
Median daily catch, fishing days and total reported catch with or w/o boat, compared between fishery areas/provinces	Table
Proportion of Fishing Days (FD) and the median reported Daily Catch (DC) for fishing with or without boat	Graph, time series
Proportion of fishing days a specific gear type is used, expand to include sub-types, e.g. for gillnets and hook and line	Table
Fishing days by main gear types compared between fishery areas	Graph, time series
Median catch rates by fishing day for main fishing gears by fishery area (kg/HH/day) by month/season/year	Table or Graph
Proportion of fishing households fishing by fishery area/province	Graph, time series
Median monthly number of household fishing days over all habitats combined	Graph, time series
Median monthly household catch overall habitats	Graph, time series
Median number of fishing days by main habitat and fishing zone, by main season.	Table, comparison between years
Median **daily** fishing household catch by main habitat and overall by fishery area, expanded by daily catch by gear type	Graph, time series

---

[24] It is expected that most of the fishing activities will be conducted in several habitats on the same day, with the catch not separated by habitat, species catch by habitat then depends on fishing trips targeting single habitat/day, possibly combining detailed habitats in more generic habitat types: Mainstream, tributaries and streams and wetlands.

Estimated total active fishing households (by fisher type if possible)	Table
Comparison of total estimated catch (fish and OAA) between fishery areas	Graph, time series
Redistributed total estimated catch by province	Pie graph by fishery area
Disposal of fish catch by fishery area	Table
overall disposal of fish catch by main category and sub categories for fish sold (by fishery area)	Pie graph
Median number of **annual** (total) household fishing days with all catch sold	Table
Trade value and total imputed value of fish and OAA by fishery area	Table
Proportion of OAA by disposal category for all fishing	Table
Species diversity and proportion of catch reported for species groups	Table
Top 30 of species reported by (estimated) total weight, with cumulative contribution to estimated total catch[25]	Table
Contribution of OAA species groups to total reported catch	Pie graph
Reported **mean** monthly household income from HCI by fishery area	Table
Number of sample fishing households reporting income from fish trade	Graph, time series
Median reported household income from fish trade	Graph, time series
Contribution of plants and OAA to total OAO by fishery area	Table
Comparison between migratory and non-migratory species may be done after a full year of data is collected	
Number of reports of fish caught ready to spawn by month	Graph

---

[25] Note that this can be expanded, but this is intended for statistical reporting, not for scientific analysis. Full species lists are available directly from the database, but it is best to stick to a limited number of species that represent at least 80% of the catch (whatever number of species that is), with the remainder reported as 'Other species'.

Annex 5. Photo flipchart

The first 70 species represent 95% of the reported Cambodian catch in MRC catch data for 2017-2019, an additional 30 species were selected to represent upland and coastal fisheries, while OAA and Aquatic Plants were added based on perceived importance for Fishing Households consumption or income. FIA codes were added based on the available codes proposed a WB project and represented as FI007 (Fish Inland), as opposed to marine fish codes (FM). Additional codes may be linked in the database to facilitate data exchange. The included fish lengths were obtained from the MRC Mekong Fish Database and FishBase.

MRC code	HCI_ code	Family name	Scientific name	English name	Khmer name	Common length (cm)	Max Length (cm)	Grouping	Fishing Area
151	1	Ariidae	*Netuma thalassinus*	Giant seacatfish		70	185	Fish	Coastal
1700	2	Belonidae	*Strongylura strongylura*	spottail needlefish		22	40	Fish	Coastal
1509	3	Carangidae	*Selaroides leptolepis*	yellowstripe scad		15	18	Fish	Coastal
1064	4	Chanidae	*Chanos chanos*	Milkfish		100	180	Fish	Coastal
1043	5	Clupeidae	*Anodontostoma chacunda*	Chacunda gizzard shad		14	18	Fish	Coastal
1036	6	Clupeidae	*Escualosa thoracata*	white sardine		8	10	Fish	Coastal
9	7	Engraulidae	*Lycothrissa crocodilus*	Sabretooth thryssa		20	30	Fish	Coastal
154	8	Latidae	*Lates calcarifer*	Barramundi		100	200	Fish	Coastal
1517	9	Lutjanidae	*Lutjanus russellii*	Russell's snapper		30	50	Fish	Coastal
1423	10	Mugilidae	*Chelon subviridis*	Brown-backed Mullet		25	40	Fish	Coastal
187	11	Mugilidae	*Ellochelon vaigiensis*	squaretail mullet		35	63	Fish	Coastal
186	12	Mugilidae	*Mugil cephalus*	flathead grey mullet		50	120	Fish	Coastal
157	13	Plotosidae	*Plotosus canius*	Gray eel-catfish		80	90	Fish	Coastal
155	14	Scatophagidae	*Scatophagus argus*	Spotted scat		20	30	Fish	Coastal
1793	15	Scombridae	*Rastrelliger brachysoma*	Short mackerel		20	35	Fish	Coastal
1499	16	Serranidae	*Epinephelus coioides*	Orange-spotted grouper			100	Fish	Coastal
1502	17	Sillaginidae	*Sillago sihama*	Northern whiting		20	30	Fish	Coastal
123	18	Anabantidae	*Anabas testudineus*	Climbing perches		15	23	Fish	Lowlands

1329	19	Bagridae	*Bagrichthys macracanthus*	Black lancer catfish			25	Fish	Lowlands
82	20	Bagridae	*Bagrichthys obscurus*	False black lancer			30	Fish	Lowlands
1330	21	Bagridae	*Hemibagrus filamentus*			50	60	Fish	Lowlands
1777	22	Bagridae	*Hemibagrus sp.*			30-100	120	Fish	Lowlands
84	23	Bagridae	*Hemibagrus spilopterus*	Asian Redtail catfish			65	Fish	Lowlands
87	24	Bagridae	*Hemibagrus wyckioides*	Redtail catfish		50	120	Fish	Lowlands
83	25	Bagridae	*Pseudomystus siamensis*	Bumblebee catfish			20	Fish	Lowlands
183	26	Channidae	*Channa marulioides*	Emperor snakehead		30	49	Fish	Lowlands
129	27	Channidae	*Channa micropeltes*	Giant snakehead		80	100	Fish	Lowlands
128	28	Channidae	*Channa striata*	Striped snakehead		45	90	Fish	Lowlands
116	29	Clariidae	*Clarias batrachus*	Walking catfish		25	40	Fish	Lowlands
26	30	Cyprinidae	*Amblyrhynchichthys truncatus*			30	40	Fish	Lowlands
40	31	Cyprinidae	*Barbonymus altus*	Red tailed tinfoil		15	20	Fish	Lowlands
39	32	Cyprinidae	*Barbonymus gonionotus*	Java barb		35	90	Fish	Lowlands
38	33	Cyprinidae	*Barbonymus schwanenfeldii*	Goldfoil barb		25	35	Fish	Lowlands
61	34	Cyprinidae	*Cirrhinus jullieni*			15	20	Fish	Lowlands
59	35	Cyprinidae	*Cirrhinus microlepis*	smallscale mud carp		25	65	Fish	Lowlands
60	36	Cyprinidae	*Cirrhinus molitorella*	Mud carp		35	50	Fish	Lowlands
27	37	Cyprinidae	*Cosmochilus harmandi*	Green giant barb		30	100	Fish	Lowlands
1139	38	Cyprinidae	*Cyclocheilichthys apogon*	Beardless barb		15	18	Fish	Lowlands
29	39	Cyprinidae	*Cyclocheilichthys enoplos*			45	74	Fish	Lowlands
30	40	Cyprinidae	*Cyclocheilichthys furcatus*	Mekong giant barb		40	60	Fish	Lowlands
1142	41	Cyprinidae	*Cyclocheilichthys lagleri*				15	Fish	Lowlands
31	42	Cyprinidae	*Cyclocheilichthys repasson*	White eye barb		16	23	Fish	Lowlands
50	43	Cyprinidae	*Hampala dispar*	Spotted hampala barb		30	35	Fish	Lowlands

51	44	Cyprinidae	*Hampala macrolepidota*	Tranverse-bar barb		35	70	Fish	Lowlands
62	45	Cyprinidae	*Henicorhynchus lobatus*	Siamese mud carp			15	Fish	Lowlands
63	46	Cyprinidae	*Henicorhynchus siamensis*	Siamese mud carp			20	Fish	Lowlands
45	47	Cyprinidae	*Hypsibarbus lagleri*			35	40	Fish	Lowlands
44	48	Cyprinidae	*Hypsibarbus malcolmi*	Goldfin tinfoil barb		40	50	Fish	Lowlands
1158	49	Cyprinidae	*Hypsibarbus suvattii*				35	Fish	Lowlands
149	50	Cyprinidae	*Hypsibarbus wetmorei*	Golden barb		25	50	Fish	Lowlands
58	51	Cyprinidae	*Labeo chrysophekadion*	Sailfin shark carp		40	90	Fish	Lowlands
57	52	Cyprinidae	*Labeo dyocheilus*			45	50	Fish	Lowlands
163	53	Cyprinidae	*Labiobarbus siamensis*			16	22	Fish	Lowlands
18	54	Cyprinidae	*Leptobarbus hoevenii*	Hoven's carp		50	100	Fish	Lowlands
66	55	Cyprinidae	*Osteochilus hasseltii*	Nilem carp			30	Fish	Lowlands
68	56	Cyprinidae	*Osteochilus melanopleura*				40	Fish	Lowlands
69	57	Cyprinidae	*Osteochilus schlegeli*	Giant sharkminnow		30	40	Fish	Lowlands
11	58	Cyprinidae	*Paralaubuca typus*	Asiatic minnow			18	Fish	Lowlands
23	59	Cyprinidae	*Probarbus jullieni*	Isok barb		28	165	Fish	Lowlands
35	60	Cyprinidae	*Puntioplites falcifer*				35	Fish	Lowlands
34	61	Cyprinidae	*Puntioplites proctozysron*	Smith's Barb			30	Fish	Lowlands
42	62	Cyprinidae	*Puntius orphoides*	Javaen barb		10	25	Fish	Lowlands
10	63	Cyprinidae	*Raiamas guttatus*	Burmese Trout			30	Fish	Lowlands
48	64	Cyprinidae	*Scaphognathops bandanensis*	Bandan sharp-mouth Barb			20	Fish	Lowlands
49	65	Cyprinidae	*Scaphognathops stejnegeri*				25	Fish	Lowlands
133	66	Datnioididae	*Datnioides undecimradiatus*	Mekong tiger perch		25	40	Fish	Lowlands
131	67	Eleotridae	*Oxyeleotris marmorata*	Marble goby		30	50	Fish	Lowlands
118	68	Mastacembelidae	*Mastacembelus armatus*	Tiretrack spiny eel			80	Fish	Lowlands

4	69	Notopteridae	*Chitala blanci*	Indochina featherback		80	90	Fish	Lowlands
5	70	Notopteridae	*Notopterus notopterus*	Bronze featherback		25	60	Fish	Lowlands
127	71	Osphronemidae	*Osphronemus goramy*	giant gourami		40	70	Fish	Lowlands
101	72	Pangasiidae	*Helicophagus waandersii*			50	79	Fish	Lowlands
104	73	Pangasiidae	*Pangasianodon hypophthalmus*	Iridescent shark		100	150	Fish	Lowlands
102	74	Pangasiidae	*Pangasius conchophilus*	Shark catfish		50	70	Fish	Lowlands
107	75	Pangasiidae	*Pangasius larnaudii*	Black ear catfish		90	150	Fish	Lowlands
1798	76	Pangasiidae	*Pangasius macronema*	Shark catfish		20	35	Fish	Lowlands
111	77	Pangasiidae	*Pangasius pleurotaenia*			25	30	Fish	Lowlands
122	78	Pristolepididae	*Pristolepis fasciata*	Malayan leaffish		20	24	Fish	Lowlands
121	79	Sciaenidae	*Boesemania microlepis*	Boeseman croaker		20	100	Fish	Lowlands
92	80	Siluridae	*Belodontichthys truncatus*	Twisted jaw sheatfish		70	80	Fish	Lowlands
96	81	Siluridae	*Micronema apogon*			70	77	Fish	Lowlands
97	82	Siluridae	*Micronema bleekeri*				60	Fish	Lowlands
175	83	Siluridae	*Micronema cheveyi*			20	35	Fish	Lowlands
1345	84	Siluridae	*Phalacronotus micronemus*	Giant sheatfish		30	50	Fish	Lowlands
99	85	Siluridae	*Wallago attu*	Great white sheatfish		80	200	Fish	Lowlands
174	86	Sisoridae	*Bagarius suchus*	Crocodile catfish			60	Fish	Lowlands
90	87	Sisoridae	*Bagarius yarrelli*	Giant goonch			200	Fish	Lowlands
1231	88	Balitoridae	*Annamia normani*	Vietnamese Giraffe Loach			8	Fish	Uplands
1246	89	Balitoridae	*Nemacheilus platiceps*			5	6	Fish	Uplands
1249	90	Balitoridae	*Schistura porthos*				9	Fish	Uplands
184	91	Channidae	*Channa gachua*	Dwarf snakehead			20	Fish	Uplands
1384	92	Clariidae	*Clarias nieuhofii*	slender walking catfish			50	Fish	Uplands
51	93	Cyprinidae	*Hampala macrolepidota*	Tranverse-bar barb		35	70	Fish	Uplands

1200	94	Cyprinidae	*Lobocheilos rhabdoura*				10	22	Fish	Uplands
1129	95	Cyprinidae	*Neolissochilus stracheyi*				45	80	Fish	Uplands
67	96	Cyprinidae	*Osteochilus lini*	Dusky face carp				15	Fish	Uplands
22	97	Cyprinidae	*Tor sinensis*	Chinese mahseer			35	47	Fish	Uplands
21	98	Cyprinidae	*Tor tambroides*	Thai mahseer			50	80	Fish	Uplands
	99	Cichlidae	*Tilapia sp.*	Tilapia			15-40	45	Fish	
	100		Mixed small/juvenile fish						Fish	
	101		Other fish nei						Fish	
	102	Belostomatidae	*Lethocerus indicus*	Giant water bug			7		Aquatic insects	
950	103		Aquatic insects nei						Aquatic insects	
1818	104	Araceae	*Colocasia esculenta*	Taro					Aquatic plants	
	105	Ipomoea	*Ipomoea aquatica*	Water spinach					Aquatic plants	
	106	Lythraceae	*Trapa sp.*	water chesnut					Aquatic plants	
	107	Nymphaea	*Nymphaea nouchali*	blue lotus					Aquatic plants	
	108	Nymphaea	*Nymphaea pubescens*	pink water-lily					Aquatic plants	
	109		Aquatic plants nei						Aquatic plants	
3017	110	Unionidae	*Corbicula leviuscula*				4		Bivalves	
	111	Unionidae	*Corbicula moreletiana*						Bivalves	
1770	112	Unionidae	*Corbicula sp.*				3		Bivalves	
3018	113	Unionidae	*Corbicula tenuis*				2		Bivalves	
850	114		Freshwater bivalves nei						Bivalves	

	115		Marine bivalves nei					Bivalves
900	116	Gecarcinucidae	*Somanniathelphusa sp.*					Crabs
3005	117	Parathelphusidae	*Somanniathelpusa brandti*	Brandt's rice crab				Crabs
1779	118	Portunidae	*Scylla serrata*	Mud crab		20		Crabs
	119		Freshwater crabs nei					Crabs
	120		Marine crabs nei					Crabs
3024	121	Bufonidae	*Bufo sp.*					Frogs and toads
	122	Microhylidae	*Glyphoglossus molossus*	Truncate-snouted bullfrog		4		Frogs and toads
	123	Ranidae	*Fejervarya limnocharis*	Paddy frog		5		Frogs and toads
	124	Ranidae	*Hoplobatrachus rugulosus*	Rugulose bullfrog		12		Frogs and toads
600	125		Adult frogs and toads nei					Frogs and toads
650	126		Tadpoles					Frogs and toads
700	127		Aquatic/semiaquatic reptiles nei					Reptiles
701	128		Turtles					Reptiles
910	129	Palaemonidae and Atyidae	Small mixed shrimps					Shrimps and prawns

192	130	Palaeomonidae	*Macrobrachium sp.*					Shrimps and prawns
1767	131	Penaeidae	Marine shrimps and prawns nei					Shrimps and prawns
	132		Freshwater shrimps and prawns nei					Shrimps and prawns
3006	133	Ampullariidae	*Pila gracilis*			5		Snails
	134	Ampullariidae	*Pila pesmei*			4		Snails
3010	135	Ampullariidae	*Pila virescens*	Sharp-tail snail	ខ្យងគួផស្រាច្ច	6		Snails
3013	136	Ampullariidae	*Pomacea canaliculata*	Golden apple snail		10		Snails
3004	137	Viviparidae	*Filopaludina sp.*					Snails
	138	Viviparoidea	*Mekongia rattei*			4		Snails
800	139		Snails nei					Snails
	140		Other aquatic animals nei					

Annex 6. OAA types and species groups

OAA code	OAA_TypeEng	OAA_TypeKhmer
OA01	Aquatic plants	រុក្ខជាតិ
OA02	Aquatic insects	សត្វល្អិត
OA03	Bivalves	លៀស
OA04	Crabs	ក្ដាម
OA05	Frog and toads	កង្កែបនិងគីង្គក់
OA06	Aquatic reptiles	ល្វន
OA07	Shrimps and prawns	បង្គារ និងបង្កង
OA08	Snails	ខ្យង
OA09	Other (specify)	ផ្សេងទៀត (សូមបញ្ជាក់)

When Khmer names are recorded, these can often be used to assign these common names to scientific family names, if species are reported that are not part of the existing list (annex 5), they can be assessed if they proof to be important in terms of quantities reported

Annex 7. Random selected Communes for HCI survey

Tonle Sap

ProvinceEng	ProvinceKhm	DistrictEng	DistrictKhm	CommuneCode	CommuneEng	CommuneKhm	VillageCount
Banteay Meanchey	បន្ទាយមានជ័យ	Mongkol Borei	មង្គលបុរី	010205	Koy Maeng	គយម៉ែង	8
Banteay Meanchey	បន្ទាយមានជ័យ	Phnum Srok	ភ្នំស្រុក	010306	Phnum Dei	ភ្នំដី	9
Banteay Meanchey	បន្ទាយមានជ័យ	Thma Puok	ថ្មពួក	010704	Thma Puok	ថ្មពួក	7
Battambang	បាត់ដំបង	Aek Phnum	ឯកភ្នំ	020504	Preaek Luong	ព្រែកហ្លួង	7
Battambang	បាត់ដំបង	Battambang	បាត់ដំបង	020301	Tuol Ta Ek	ទួលតាឯក	5
Battambang	បាត់ដំបង	Samlout	សំឡូត	020907	Ta Sanh	តាសាញ	7
Battambang	បាត់ដំបង	Sangkae	សង្កែ	020809	Ou Dambang Pir	អូរដំបង ២	6
Kampong Chhnang	កំពង់ឆ្នាំង	Kampong Leaeng	កំពង់លែង	040402	Dar	ដារ	5
Kampong Thom	កំពង់ធំ	Kampong Svay	កំពង់ស្វាយ	060204	Kampong Svay	កំពង់ស្វាយ	12
Kampong Thom	កំពង់ធំ	Santuk	សន្ទុក	060707	Prasat	ប្រាសាទ	10
Kampong Thom	កំពង់ធំ	Stoung	ស្ទោង	060805	Kampong Chen Tboung	កំពង់ចិនត្បូង	7
Kampong Thom	កំពង់ធំ	Stoung	ស្ទោង	060810	Preah Damrei	ព្រះដំរី	9
Kampong Thom	កំពង់ធំ	Stueng Saen	ស្ទឹងសែន	060306	Kampong Krabau	កំពង់ក្របៅ	3
Kampong Thom	កំពង់ធំ	Stueng Saen	ស្ទឹងសែន	060309	Achar Leak	អាចារ្យលាក់	3
Pursat	ពោធិ៍សាត់	Bakan	បាកាន	150103	Khnar Totueng	ខ្នារទទឹង	10
Pursat	ពោធិ៍សាត់	Krakor	ក្រគរ	150307	Kbal Trach	ក្បាលត្រាច	11
Pursat	ពោធិ៍សាត់	Krakor	ក្រគរ	150309	Sna Ansa	ស្នាអន្សា	10
Siemreap	សៀមរាប	Banteay Srei	បន្ទាយស្រី	170301	Khnar Sanday	ខ្នារសណ្ដាយ	6
Siemreap	សៀមរាប	Siem Reap	សៀមរាប	171005	Nokor Thum	នគរធំ	6
Siemreap	សៀមរាប	Srei Snam	ស្រីស្នំ	171201	Chrouy Neang Nguon	ជ្រោយនាងង្វួន	7

Floodplain

ProvinceEng	ProvinceKhm	DistrictEng	DistrictKhm	CommuneCode	CommuneEng	CommuneKhm	VillageCount
Kampong Cham	កំពង់ចាម	Kampong Siem	កំពង់សៀម	030602	Hanchey	ហាន់ជ័យ	4
Kampong Cham	កំពង់ចាម	Kampong Siem	កំពង់សៀម	030605	Kaoh Mitt	កោះមិត្ត	9
Kampong Cham	កំពង់ចាម	Kang Meas	កងមាស	030703	Khchau	ខ្ចៅ	10
Kampong Cham	កំពង់ចាម	Prey Chhor	ព្រៃឈរ	031309	Prey Chhor	ព្រៃឈរ	4
Kandal	កណ្ដាល	Kandal Stueng	កណ្ដាលស្ទឹង	080118	Roleang Kaen	លៀងកែន	11
Kandal	កណ្ដាល	Khsach Kandal	ខ្សាច់កណ្ដាល	080301	Bak Dav	បាក់ដាវ	4
Kandal	កណ្ដាល	Leuk Daek	លើកដែក	080503	Khpob Ateav	ខ្ពបអាទាវ	3
Kandal	កណ្ដាល	Lvea Aem	ល្វាឯម	080606	Lvea Sar	ល្វាសរ	3
Kandal	កណ្ដាល	Ponhea Lueu	ពញាឮ	080910	Preaek Ta Teaen	ព្រែកតាទែន	3
Kandal	កណ្ដាល	S'ang	ស្អាង	081010	S'ang Phnum	ស្អាងភ្នំ	9
Prey Veng	ព្រៃវែង	Kamchay Mear	កំចាយមារ	140203	Kranhung	ក្រញូង	19
Prey Veng	ព្រៃវែង	Kampong Trabaek	កំពង់ត្របែក	140310	Pratheat	ប្រធាតុ	9
Prey Veng	ព្រៃវែង	Me Sang	មេសាង	140504	Prey Khnes	ព្រៃឃ្នេស	22
Prey Veng	ព្រៃវែង	Pea Reang	ពារាំង	140803	Kampong Prang	កំពង់ប្រាំង	6
Svay Rieng	ស្វាយរៀង	Bavet	បាវិត	200803	Chrak Mtes	ច្រកម្ទេស	15
Svay Rieng	ស្វាយរៀង	Svay Chrum	ស្វាយជ្រំ	200503	Chambak	ចំបក់	7
Takeo	តាកែវ	Bati	បាទី	210202	Champei	ចំប៉ី	7
Takeo	តាកែវ	Borei Cholsar	បូរីជលសារ	210304	Kampong Krasang	កំពង់ក្រសាំង	5
Takeo	តាកែវ	Treang	ទ្រាំង	211004	Khvav	ខ្វាវ	11
Takeo	តាកែវ	Treang	ទ្រាំង	211014	Tralach	ត្រឡាច	10

Plateau

ProvinceEng	ProvinceKhm	DistrictEng	DistrictKhm	CommuneCode	CommuneEng	CommuneKhm	VillageCount
Kratie	ក្រចេះ	Chetr Borei	ចិត្របុរី	100604	Kantuot	កន្ទួត	5
Kratie	ក្រចេះ	Chhloung	ឆ្លូង	100102	Damrei Phong	ដំរីផុង	9
Kratie	ក្រចេះ	Prek Prasab	ព្រែកប្រសព្	100302	Chrouy Banteay	ជ្រោយបន្ទាយ	7
Kratie	ក្រចេះ	Sambour	សំបូរ	100404	Kaoh Khnhaer	កោះខ្ញែរ	5
Ratanak Kiri	រតនគិរី	Ou Chum	អូរជុំ	160602	Pouy	ប៉ូយ	8

Moutainous

ProvinceEng	ProvinceKhm	DistrictEng	DistrictKhm	CommuneCode	CommuneEng	CommuneKhm	VillageCount
Kampong Speu	កំពង់ស្ពឺ	Basedth	បរសេដ្ឋ	050101	Basedth	បរសេដ្ឋ	22
Kampong Speu	កំពង់ស្ពឺ	Basedth	បរសេដ្ឋ	050106	Phong	ផុង	13
Kampong Speu	កំពង់ស្ពឺ	Chbar Mon	ច្បារមន	050204	Sopoar Tep	សុព័រទេព	10
Kampong Speu	កំពង់ស្ពឺ	Kong Pisei	គងពិសី	050301	Angk Popel	អង្គពោល	13
Oddar Meanchey	ឧត្តមានជ័យ	Banteay Ampil	បន្ទាយអំពិល	220202	Beng	បេង	23
Pailin	ប៉ៃលិន	Pailin	ប៉ៃលិន	240103	Tuol Lvea	ទួលល្វា	11
Preah Vihear	ព្រះវិហារ	Chey Saen	ជ័យសែន	130103	Khyang	ខ្យង	3
Preah Vihear	ព្រះវិហារ	Chhaeb	ឆែប	130207	Kampong Sralau Muoy	កំពង់ស្រឡៅមួយ	5
Preah Vihear	ព្រះវិហារ	Choam Ksant	ជាំក្សាន្ត	130305	Yeang	យាង	6
Tboung Khmum	ត្បូងឃ្មុំ	Ponhea Kraek	ពញាក្រែក	250501	Dountei	ដូនតី	21
Tboung Khmum	ត្បូងឃ្មុំ	Tboung Khmum	ត្បូងឃ្មុំ	250701	Anhchaeum	អញ្ចើម	22

Coastal

ProvinceEng	ProvinceKhm	DistrictEng	DistrictKhm	CommuneCode	CommuneEng	CommuneKhm	VillageCount
Kampot	កំពត	Banteay Meas	បន្ទាយមាស	070206	Sdach Kong Khang Cheung	ស្ដេចគង់ខាងជើង	4
Kampot	កំពត	Chum Kiri	ជុំគិរី	070403	Snay Anhchit	ស្នាយអញ្ចិត	5
Kampot	កំពត	Kampong Trach	កំពង់ត្រាច	070609	Ang Sophy	អង្គសុរកើ	6
Preah Sihanouk	ព្រះសីហនុ	Kampong Seila	កំពង់សីលា	180403	Ou Bak Roteh	អូរបាក់រទេះ	3

Annex 8. Map with distribution of all pre-selected communes
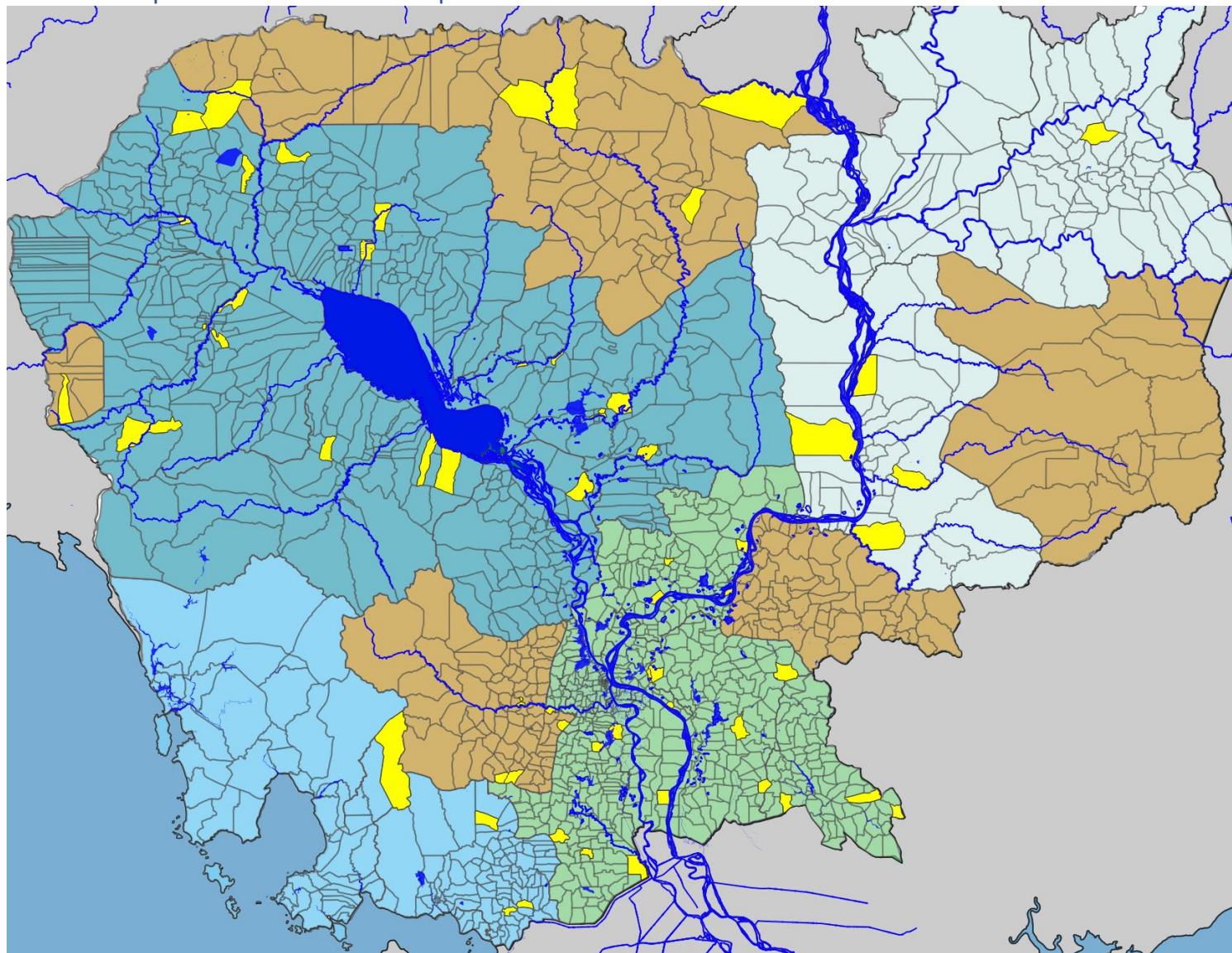
Annex 9. Aquatic habitats

	English name	Khmer name	Description
Lotic			
01	Mekong Mainstream		
02	Major Tributaries		3S, Bassac River and Tonle Sap river
03	Tributaries to Tonle Sap		River around Tonle Sap lake
04	Stream		Steung
05	Sub-Stream		Ou
06	Irrigation canals		
Lentic			
11	Seasonal swamps		
12	Permanent swamps		
13	Floodplain: flooded forest		
14	Floodplain: rice fields		
15	Floodplain: lakes and ponds		
16	Reservoir		

© FAO/CAPFISH-Capture, Yoli Penn, 2021

Prepared by:
Inland Fisheries Research and Development Institute

Technical Support by:
Food and Agriculture Organization of the United Nations

Fisheries Administration

No. 186, Norodom Boulevard, Tonle Basac, Chamcar Mon, Phnom Penh, Cambodia, P.O. Box 582
Tel: (855) 23 215 470   Facebook: https://fia.maff.gov.kh/

9 789924 550020 >