



Food and Agriculture
Organization of the
United Nations



This programme is co-funded by
the European Union



IFReDI
2022 ANNUAL STATISTICAL REPORT
Inland Fisheries

©Finn Thilsted WorldFish Flicker

Statistical Report for Scientific Catch Assessment of Inland Fisheries in Cambodia

April 2023

Prepared by Inland Fisheries Research and Development Institute (IFReDI) of
Fisheries Administration

This publication was produced with the financial support of the European Union.

Its contents are the sole responsibility of Fisheries Administration and do not necessarily reflect the views of the European Union

ACKNOWLEDGEMENTS

This annual statistical report was prepared with financial assistance from the European Union under the CAPFISH programme, with technical assistance from FAO CAPFISH project in close collaboration with staff at IFReDI. Special thanks to the director of IFReDI, Dr. HENG Kong, deputy director of IFReDI, Mr. CHAY Kongkruy who provided general guidance and comments on the final draft and Mr. SOTH Sobot, who prepared most of the analysis included in the Monthly Statistical reports, that formed the basis for this report. The analysis was prepared during a number of workshops, with technical support from Theo Visser, (FAO Inland Fisheries Management Officer), SO Dane (FAO National Database Specialist - Fisheries) and UN Borin (FAO National Fisheries Research Specialist).

Document prepared by:

HENG Kong, SOTH Sobot and CHAY Kongkruy

With technical assistance from FAO CAPFISH

Citation:

Fisheries Administration (FiA). 2023. 2022 Annual Statistical report for Inland Fisheries in Cambodia. Inland Fisheries Research and Development Institute of the Fisheries Administration, Phnom Penh, Cambodia. 25 pages.

Contact:

Fisheries Administration
Inland Fisheries Research and Development Institute
#186, Preah Norodom Blvd., Phnom Penh, Cambodia

© Fisheries Administration

All rights reserved. This publication may be reproduced in whole or in part and in any form for education or non-profit purposes without the permission of the copyright holders provided that acknowledgement of the source is given. This publication may not be copied, or distributed electronically, for resale or other commercial purposes without prior permission, in writing from the Fisheries Administration. All comments and opinions expressed herein are those of the authors and may not reflect the position of the Fisheries Administration, its partners or the organizations that provided funding for the project and the publication.

EXECUTIVE SUMMARY

A scientific Catch Assessment Survey, was implemented during 9 months in 2022, by staff from IFRéDI. The survey covered on average 25 villages and 350 households each month, covering the three main inland fishery areas: Tonle Sap, Floodplain and Plateau.

Seasonal variation between areas was observed, with lower active fishing households and less fishing days during the dry season and highest monthly catch reported for households in Tonle Sap, followed by Mekong fishing and floodplain. Total estimated catch is 368,000 MT, excluding mountainous and coastal provinces, with the highest contribution from Tonle Sap (49.5%), followed closely by floodplain (42.2%), with the remainder by Plateau.

Most fishing activities are reported for male adults (91.5% of fishing trips) and female adults (9.3%), with limited variation between fishing areas. A large proportion of the catch is caught without the use of a boat (52.3%), with motorised boats only contributing 34.4% of the total reported catch. This proportion is highest for households in the Plateau fishing area.

Most of the reported catch is obtained from floodplain habitats (33.1%), followed by Mekong mainstream (19.3%) and tributaries (10.4%).

The most important gears, based on their contribution to the reported catch, are gillnets (45.1%), horizontal cylinder traps (17.6%), cast net (11.2%) and hand capture (8.4%), with stationary gillnets (35.6%) being more important than drifting gillnets (9.5%).

The proportion of the catch that is sold is 46.9%, with the remainder consumed (34.4%) or for other use (18.7%). The proportion sold is highest for Floodplain (54.8%) and Tonle Sap (47.9%), while lowest for Plateau (35.7%). Seasonal differences are present, with selling of the catch generally more important for dry season for Floodplain and Tonle Sap.

Fish makes up 86.5% of the total reported catch, with OAA contributing 13.5%, OAA is more important during the dry season. The top 20 species by weight make up 69% of the total reported catch, reflecting a broad species base for the fisheries, with *Channa striata* (Snakehead), *Anabas testudineus* (Climbing perch) and *Henicorhynchus lobatus*, making up the top 3, representing 22.7% of the total reported catch. The highest species diversity is found for August and October.

A number of recommendations for expanding the coverage and allowing provincial level estimates are included, for implementation during 2023.

Table of Contents

Acknowledgements2
Executive Summary3
Acronyms5
1. Introduction and methodology6
2. Statistical tables and results.....6
3. Discussion and recommendations19

ACRONYMS

AP	Aquatic Plants
CAPFISH	Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector
CAS	Catch Assessment Survey
CPUE	Catch per Unit of Effort
DFMP	Dai Fisheries Monitoring Programme
DPFIC	Department of Planning, Finance and International Cooperation
EU	European Union
ε%	Relative Standard Error
FAO	Food and Agriculture Organisation
FH	Fishing Household
FiA	Fisheries Administration
FiAC	Fisheries Administration Cantonment
GIS	Geographic Information System
HCI	Household Catch Interview
HH	Household
HSI	Household Selection Interview
IFReDI	Inland Fisheries Research and Development Institute
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
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
OAQ	Other Aquatic Organisms
RGC	Royal Government of Cambodia
SD	Standard Deviation
SES	Socio-Economic Survey
USD	United States Dollars
WSIM	Working Group on Statistics and Information Management

1. INTRODUCTION AND METHODOLOGY

IFReDI, with technical assistance from FAO CAPFISH project under EU budget support, is currently implementing scientific catch assessment survey (CAS), using monthly household recall interviews. The aim is to obtain better information on catch and effort by small-scale fishing household in Cambodia, and to develop a sustainable catch monitoring methodology for implementation by provincial fisheries administrations, supported by IFReDI.

Data collection for 2022 was conducted from April to December 2022 and the content of this annual report is based on the monthly statistical reports for that period. The statistical reports illustrate data with fishing areas, these are different from FiA Inspectorates. The distribution of provinces by fishing area, affects the calculation of the total estimated catch, which is based on the total number of rural fishing households (2019 population census) and the proportion of fishing households from the Household Selection Interview (HSI). The distribution of the provinces by fishing area, with the number of households, is included in annex 1.

A description of the methodology can be found in: 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.

2. STATISTICAL TABLES AND RESULTS

The coverage for data collection from April-December 2022, included in Table 1, shows the evolution of the random sample. Coverage for coastal provinces, was dropped after the peak in sample size for May 2022. The target sample stabilised to about 360 households towards the end of 2022, with more than 90% of the target households covered by the survey. The main reason for not reaching 100% coverage is when households cannot be found during the survey period.

Table 1. Sample villages and households, with proportion of target household by fishing area for April – December 2022.

Fishing area	Villages								
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	2	3							
Floodplain	13	17	10	8	8	8	8	8	8
Plateau	4	6	7	8	7	7	7	7	7
Tonle Sap	12	23	10	10	10	10	9	9	9
Total	31	49	27	26	25	25	24	24	24

Fishing area	Households								
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	30	45							
Floodplain	185	266	141	120	99	120	110	121	112
Plateau	56	94	95	102	105	105	105	105	105
Tonle Sap	149	328	141	142	144	146	123	121	122
Total	420	733	377	364	348	371	338	347	339

Fishing area	Target HHs interviewed (%)								
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	100.0%	100.0%							
Floodplain	94.9%	100.0%	94.0%	100.0%	82.5%	100.0%	91.7%	100.0%	93.3%
Plateau	93.3%	100.0%	90.5%	85.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Tonle Sap	82.8%	95.1%	94.0%	94.7%	96.0%	97.3%	91.1%	89.6%	90.4%
Total	90.3%	99.7%	93.1%	93.3%	92.8%	98.9%	93.9%	96.4%	94.2%

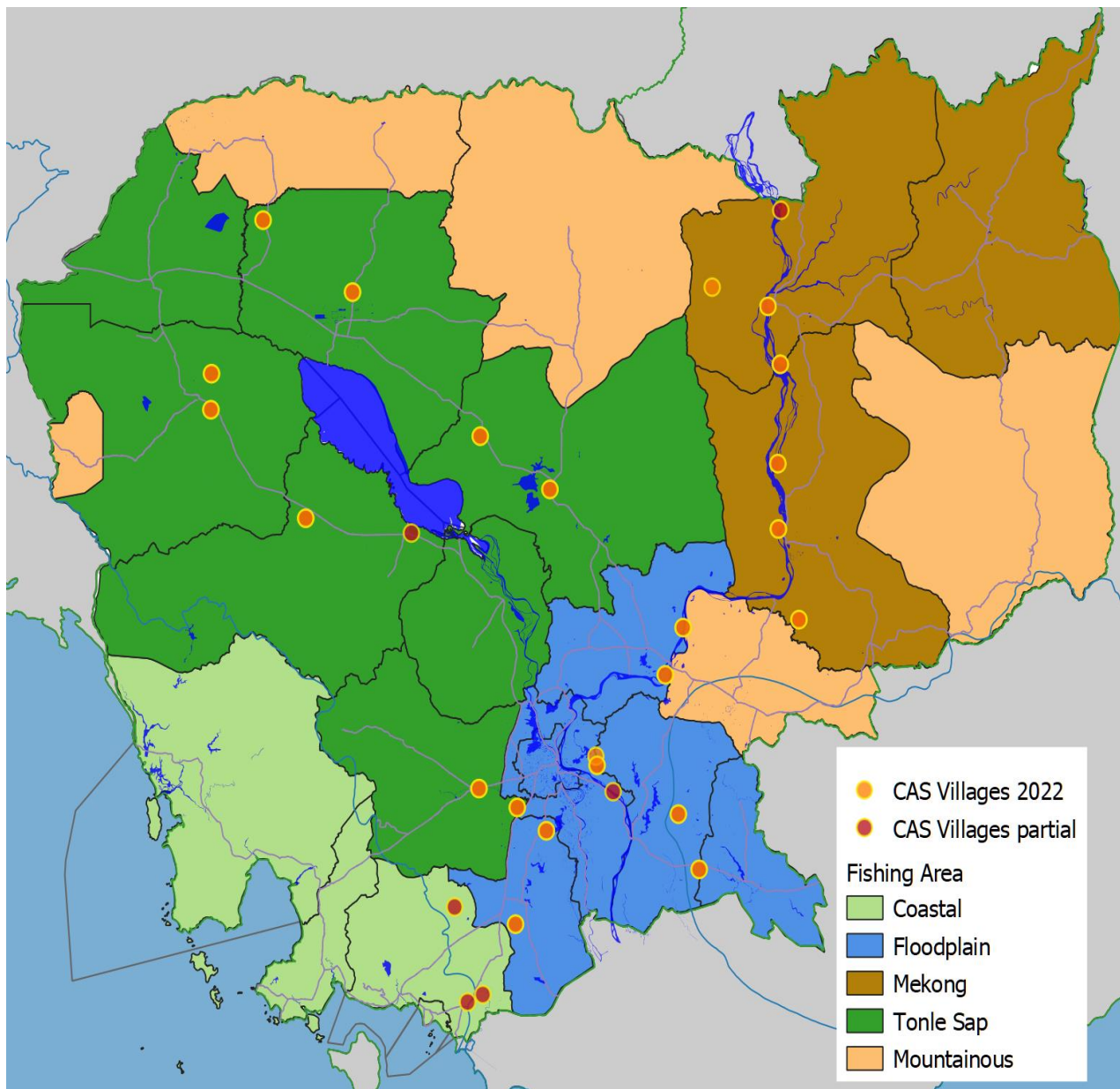


Figure 1. Random selected villages covered by CAS during 2022.

The sample coverage for the Catch Assessment Survey (CAS) during 2022, is included in Figure 1, showing the distribution of the randomly selected villages. In the map, red dots (CAS villages partial) indicate villages that were removed from the target sample early during implementation of the CAS and were only partially covered by the 2022 data collection. Mountainous provinces are not covered by the CAS, mainly because of the seasonality of fishing activities and limited resources available for the survey.

The seasonal differences for the proportion of active fishing households and mean daily household catch can be clearly seen in **Table 2**, with the highest daily catch observed for the April-June period for all fishing areas, except for Tonle Sap. The relative standard errors for mean daily catch estimates are all lower than 20%, making them statistically accurate and indicating that the sample generally is large enough for the observed variation.

The results included in the monthly statistical reports, show a somewhat higher value for the relative standard error, but tend to remain below 25%, with a few exceptions for the floodplain fishing area for April and July, where it reaches up to 27.5%, indicating the need for a slightly higher sample¹.

¹ It is estimated that a 20% increase of the sample size would bring the $\epsilon\%$ below 25% for all months and fishing areas, but that it requires almost a doubling of the sample size (89% increase) to ensure that the $\epsilon\%$ for the floodplain fishing area is always below 20% for all months.

Table 2. Active fishing households, monthly fishing days and mean **daily** household catch (kg) with relative standard error, by quarter and fishing area.

Fishing Area	Active HH		Monthly fishing days	Daily HH catch (Kg)	SD	ε%	Monthly HH catch (kg)
	No	%					
April-June							
Coastal	31	41.3%	7.2	2.85	2.99	18.8%	20.6
Floodplain	201	34.0%	5.1	4.71	8.17	12.3%	24.1
Plateau	80	32.7%	6.2	3.10	2.54	9.2%	19.3
Tonle Sap	297	48.1%	7.5	3.96	4.35	6.4%	29.8
Grand Total	609	39.8%	6.4	4.04	5.73	5.8%	25.7
July-September							
Floodplain	152	44.8%	6.7	2.26	2.88	10.3%	15.1
Plateau	197	63.1%	14.0	2.24	3.02	9.6%	31.4
Tonle Sap	289	66.9%	9.9	3.05	3.68	7.1%	30.2
Grand Total	638	58.9%	10.1	2.61	3.32	5.0%	26.3
October-December							
Floodplain	180	52.5%	8.5	2.59	3.45	9.9%	22.1
Plateau	164	52.1%	10.7	2.43	2.63	8.5%	26.1
Tonle Sap	246	67.2%	12.6	4.04	4.98	7.9%	50.8
Grand Total	590	57.6%	10.7	3.15	4.05	5.3%	33.6

Although the reported household daily catches are highest for the April-May period, this is accompanied by a considerably lower fishing effort, especially for plateau and Tonle Sap fishing households. The catches are more stable from June-December in floodplain and plateau areas. This results in an estimated monthly household catch that is very similar over the year, with the exception of the value for April for floodplain fishing households (Figure 4).

The reported daily household catch is more variable than the number of fishing days, with the fishing effort higher for fishing households in the plateau fishing area, although this is skewed with the emphasis on Mekong fishing, because of the exclusion of any data for Ratana Kiri (which contain parts of the 3S rivers, which are major tributaries to the Mekong) and other non-riparian Mekong provinces.

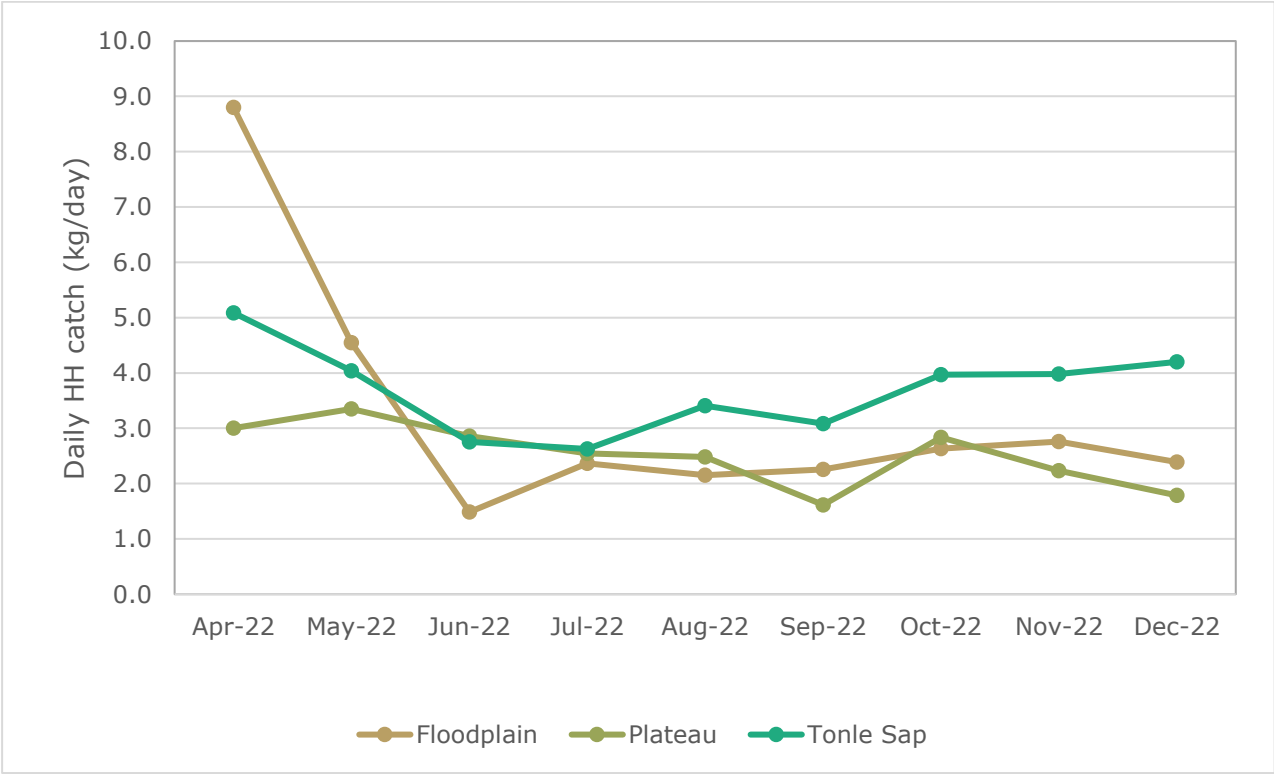


Figure 2. Reported mean daily household catch (kg/day) by fishing area and month.

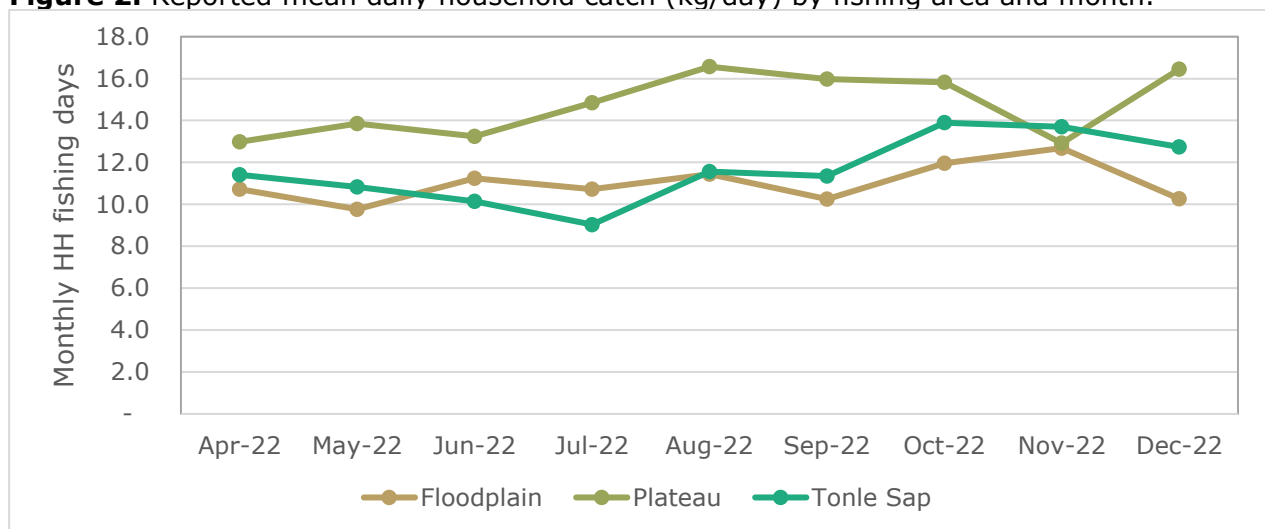


Figure 3. Reported mean monthly HH fishing days, by fishing area and month.

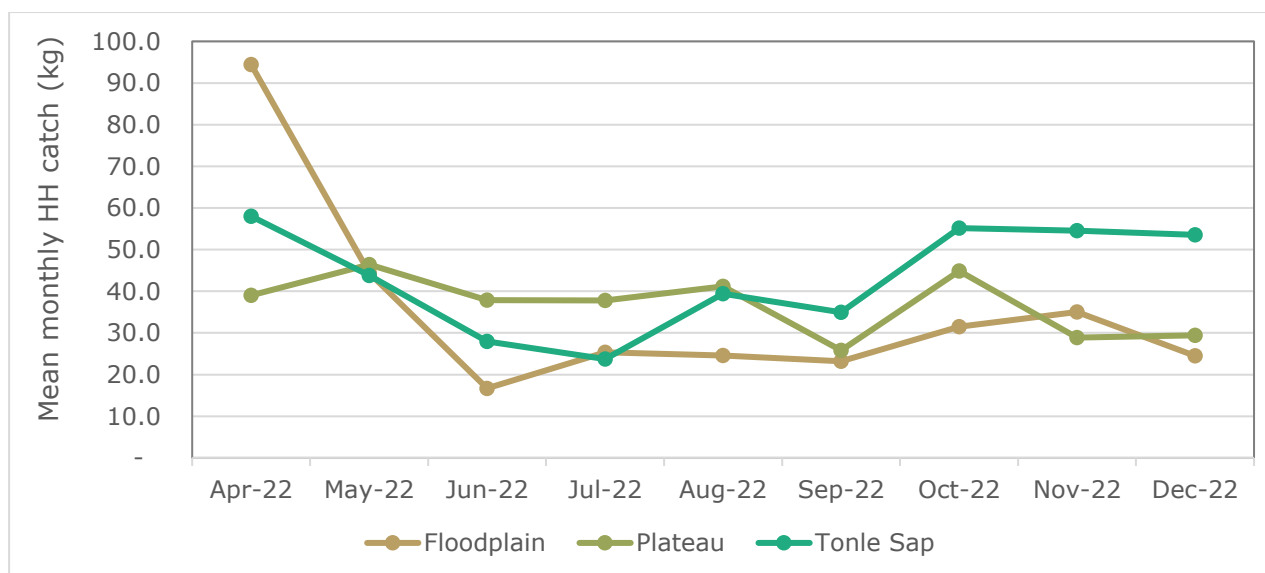


Figure 4. Estimated monthly household catch (kg), by fishing area and month.

The total estimated catch in **Table 3**, is taken from the monthly statistical reports. This represents 9 months of data collection, the total estimated catch for 2022 is calculated by linear extrapolating this for 12 months.

Table 3. Total estimated catch (MT) by fishing area and month.

Fishing Area	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
Coastal	320	1,699							
Floodplain	14,346	19,702	4,275	7,453	9,147	13,584	17,211	15,659	15,096
Plateau	1,198	2,417	1,919	3,434	4,490	1,729	4,420	2,231	1,069
Tonle Sap	14,827	12,180	7,919	8,302	12,363	13,931	25,609	21,265	20,268
Total	30,691	35,998	14,113	19,189	26,000	29,244	47,240	39,155	36,433

Fishing Area	9-month Total	Mean monthly catch (MT)	2022 Total	%Total
Coastal		1,010	12,114	
Floodplain	116,473	12,941	155,297	42.2%
Plateau	22,907	2,545	30,543	8.3%
Tonle Sap	136,664	15,185	182,219	49.5%

Total	278,063	368,059
--------------	----------------	----------------

In view of the limited coverage for coastal provinces and issues with extrapolation (the number of inland fishing households is not clear), this is excluded from the total catch estimate. Total estimated catch is highest for the Tonle Sap area, followed by Floodplain, with Plateau and Coastal at much lower levels.

Involvement in fishing (**Table 4**) is highly skewed towards adult males, who are involved in more than 90% of the reported fishing activities, involvement of adult females is considerably lower than for male, but is highest in coastal provinces (17.5%), followed by Tonle Sap (12.1%). Male children, have a higher involvement than female children, but is lower than for adult female fishers. No exact total number of fishers is available,

Table 4. Proportion of fishing days on which male and female adults and children are reporting fishing activities².

	Adult Female	Adult Male	Child Female	Child Male
Coastal	17.8%	90.0%	0.0%	8.9%
Floodplain	8.1%	89.4%	1.6%	7.1%
Plateau	5.8%	97.0%	0.5%	1.7%
Tonle Sap	12.1%	89.1%	1.5%	4.7%
Grand Total	9.3%	91.5%	1.2%	4.5%

The maximum involvement of each gender and age group is 100% for each fishing area, if they are fishing on all reported fishing days, the total for each fishing area can be more than 100%.

As shown in **Table 5**, no catches with motorised boats are reported for coastal provinces, where over 63% of the reported catch is caught with non-motorised boats. Catches without boat are highest for floodplain and Tonle Sap. Motorised boats only contribute more than 50% of the catch for fishers in Plateau, indicating a higher reliance on fishing grounds away from fisher homes.

Table 5. Reported catch (Kg) for 2022, with proportion caught by main boat type by fishing area.

Fishing Area	Total catch (Kg)	No boat	Motorised	Non-motorised
Coastal	189.7	36.7%	0.0%	63.3%
Floodplain	3,559.8	54.3%	28.2%	17.5%
Plateau	3,065.4	29.3%	54.6%	16.1%
Tonle Sap	7,117.5	61.5%	29.8%	8.7%

² No exact number of fishers are available, but some estimates based on the HH Selection Interview are available, this will be assessed further during 2023

Grand Total	13,932.4	52.3%	34.4%	13.3%
--------------------	-----------------	--------------	--------------	--------------

Overall proportion based on weighted average catch by main boat type and fishing area, not reported total catch³

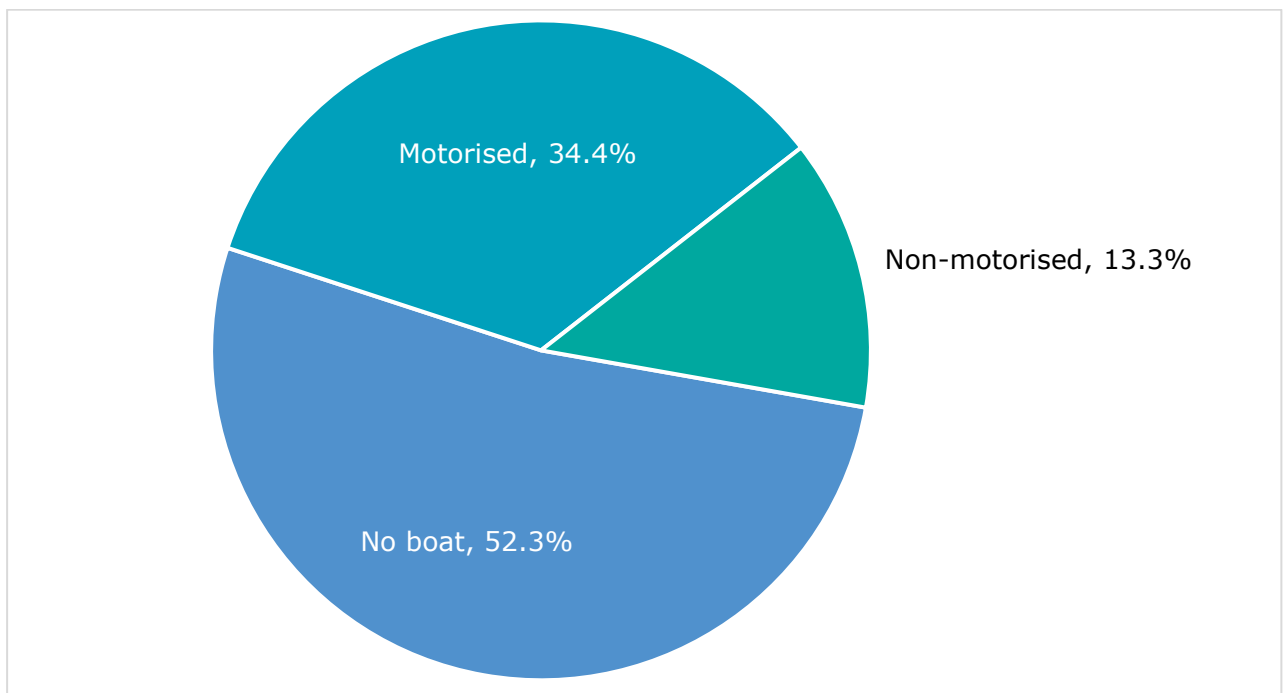
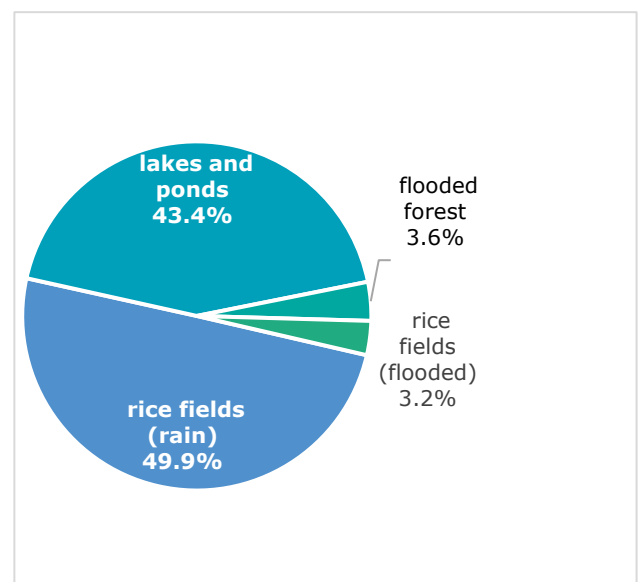


Figure 5. Overall contribution of the main boat types to total reported catch

The main fishing habitats, as indicated in **Figure 6**, are floodplain, Mekong mainstream, small streams, irrigation canals and other habitats. The main floodplain habitats are rainfed rice fields (49.9%) and lakes and ponds (43.3%). The contribution of flooded forest areas (3.6%) and flooded rice fields (3.2%) is comparatively low; flooded forest areas tend to be in protected areas, while it is likely that households have trouble to separate flooded rice fields from rainfed rice fields⁴.



³ This is the standard way to calculate, but isn't done for habitat and gear catch, as this is complicated by fishing days where the reported catch is from multiple habitats or caught by multiple gears

⁴ Unless the data collector specifically points out the difference between irrigated and rain-fed rice fields, they probably are considered the same habitats by most respondents

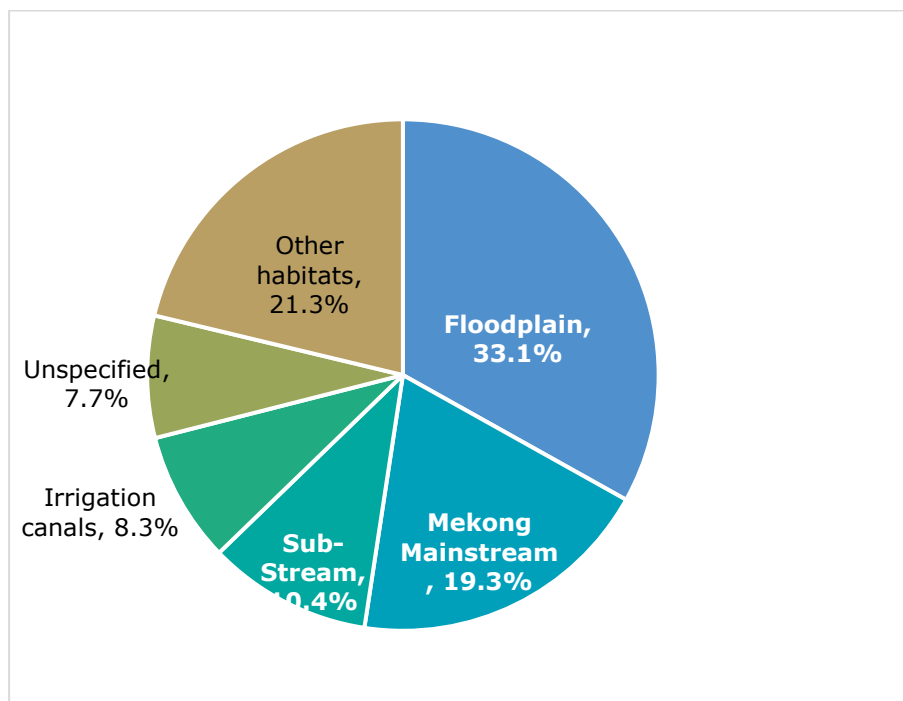


Figure 6. Overall contribution of the habitats to total reported catch, with proportion of catch for floodplain habitats.

Table 6. Proportion and reported catch by habitat for single habitat catches by fishing area.

Fishing Habitats	Coastal	Floodplain	Plateau	Tonle Sap	Total
Mekong Mainstream	0.0%	18.9%	54.3%	0.0%	19.3%
Floodplain: rice fields (rain)	17.6%	22.6%	1.1%	21.7%	16.5%
Floodplain: lakes and ponds	7.5%	30.9%	12.5%	5.7%	14.4%
Sub-Stream	0.6%	5.7%	17.1%	9.6%	10.4%
Irrigation canals	14.5%	8.7%	4.5%	10.0%	8.3%
Unspecified	0.0%	1.5%	0.1%	16.0%	7.7%
Tributaries to Tonle Sap	0.0%	2.2%	0.0%	15.6%	7.7%
Streams	58.9%	0.8%	0.0%	13.7%	7.2%
Reservoir	0.0%	1.1%	4.0%	5.1%	3.7%
Major Tributaries	0.0%	5.3%	0.0%	0.0%	1.5%
Seasonal swamps	0.0%	0.9%	2.3%	0.8%	1.2%
Floodplain: flooded forest	0.0%	0.9%	3.6%	0.0%	1.2%
Floodplain: rice fields (flooded)	0.88%	0.40%	0.58%	1.70%	1.05%
	172.8	3,880.3	3,721.6	6,507.0	14,281.7

Only catch for fishing days that report fishing in a single habitat is included.

The differences between the fishing areas (**Table 6**), reflect the nature of the fisheries, with Mekong mainstream fishing most important for households in the Plateau, followed by those in the Floodplain. Major tributaries are only mentioned for Floodplain households and not for Plateau, this almost certainly refers to the Tonle Sap River. The omission of fishing in major tributaries for households in the Plateau fishing area clearly is a reflection of the skewed coverage of riparian communities, to the Mekong River for this fishing area. No catches are reported for 'streams', but over 17% of the catches is attributed to 'sub-streams', the distinction is that streams are smaller perennial tributaries and sub-streams are seasonal streams.

Unspecified habitats, where no fishing habitat is indicated, are mainly found for Tonle Sap and this will be addressed during 2023.

The most important gears, based on their contribution to the reported catch (**Figure**), are stationary gillnet, horizontal cylinder trap and cash net, with the catch contribution of 34.4%, 19.8% and 16.1% respectively. Stationary gillnets are more important than drifting gillnets.

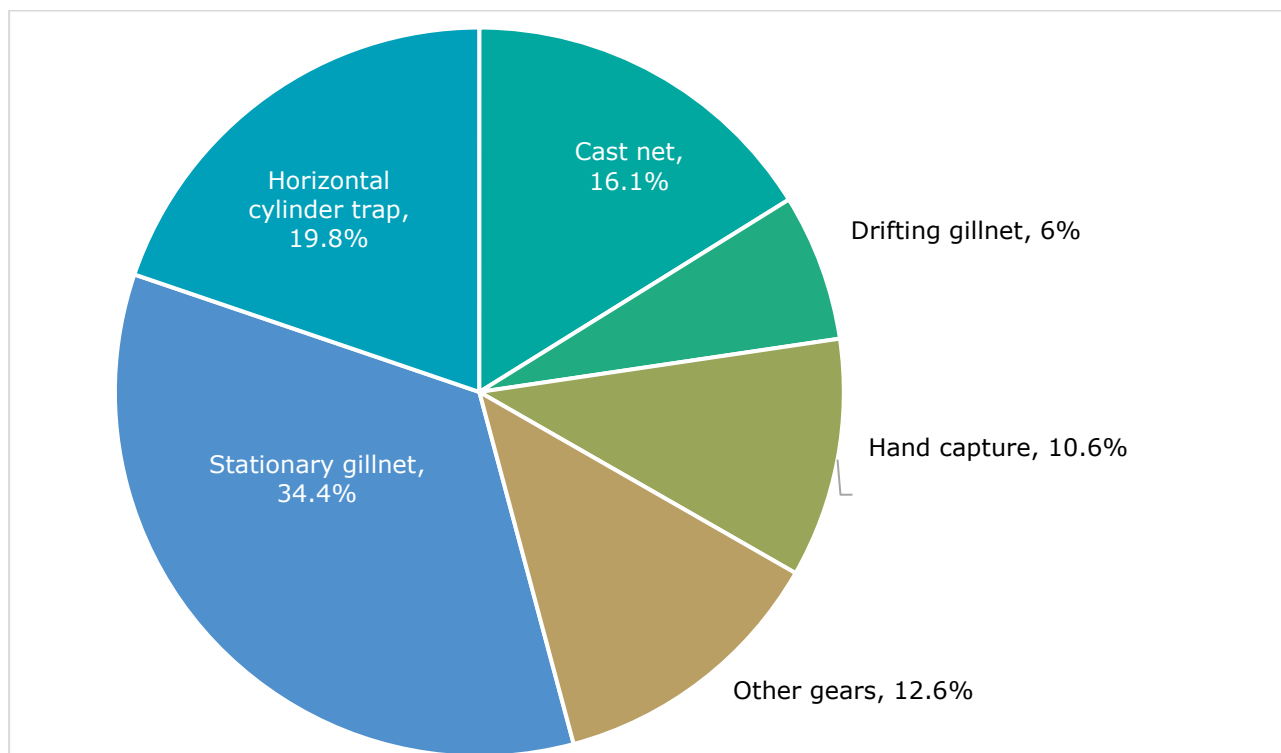


Figure 7a. Overall contribution of the gears to total reported catch.

Similar as found for fishing habitats, the importance of contribution of gears to the reported catch largely reflects the different characteristics of the fishing area, but differences in gear use are less distinct than differences for habitats. Although there are some differences (**Table 7**), with stationary gillnets most important for Plateau and cast nets most important for Tonle Sap, horizontal cylinder traps are almost equally important in all fishing zones, but smaller cylinder traps are by far more important than large traps.

Unspecified gears, where no gear type is specified, are found in all fishing areas, but are especially important for Plateau.

Table 7. Proportion and reported catch by gear, by fishing area.

Row Labels	Coastal	Floodplain	Plateau	Tonle Sap	Total
Stationary gillnet	45.0%	24.6%	50.2%	34.4%	35.6%
Horizontal cylinder trap (small)	2.8%	13.4%	11.0%	19.8%	15.9%
Cast net	13.5%	8.3%	3.0%	16.1%	11.2%
Drifting gillnet	0.0%	18.8%	6.3%	6.5%	9.5%
Hand capture	14.1%	10.2%	1.2%	10.6%	8.4%
Unspecified	4.9%	7.6%	18.5%	3.4%	7.9%
Hook long line	0.0%	2.8%	6.3%	1.1%	2.7%
Pole and line	0.0%	1.0%	1.5%	3.1%	2.1%
Horizontal cylinder trap (large)	1.1%	2.2%	0.7%	1.9%	1.7%
Bamboo vertical cylinder trap	7.5%	3.4%	0.4%	0.8%	1.5%

Row Labels	Coastal	Floodplain	Plateau	Tonle Sap	Total
Spear	11.1%	3.3%	0.1%	0.4%	1.2%
Pumping	0.0%	3.2%	0.0%	0.0%	0.8%
Push nets	0.0%	0.0%	0.0%	1.1%	0.6%
Hook and line	0.0%	0.2%	0.3%	0.5%	0.4%
Scoop baskets	0.0%	0.8%	0.0%	0.1%	0.2%
Drop door trap	0.0%	0.0%	0.35%	0.0%	0.1%
Scoop nets	0.0%	0.0%	0.12%	0.05%	0.05%
Bag nets	0.0%	0.0%	0.0%	0.08%	0.04%
Covering devices	0.0%	0.12%	0.0%	0.0%	0.03%
Wedge cone trap	0.0%	0.0%	0.09%	0.0%	0.02%
Vertical hanging vase trap	0.0%	0.07%	0.0%	0.0%	0.02%
Seine nets	0.0%	0.06%	0.0%	0.0%	0.01%
Bow and guns	0.0%	0.0%	0.0%	0.02%	0.01%
Snakehead wedge trap	0.0%	0.0%	0.01%	0.0%	<0.01%

Only catch for fishing days that report fishing with a single gear is included, therefore the total is different from reported catch by habitat.

Using the reported number of fishing days, instead of catch, makes no difference for the relative importance of gears. However, there is a distinct seasonality for some of the gears (

Figure 77b). With capture by hand most important during the dry season, while small Horizontal cylinder traps are least important from April-June and most actively used from July- December. On the other hand, cast nets are commonly used year-round but are most active during the early and peak dry seasons.

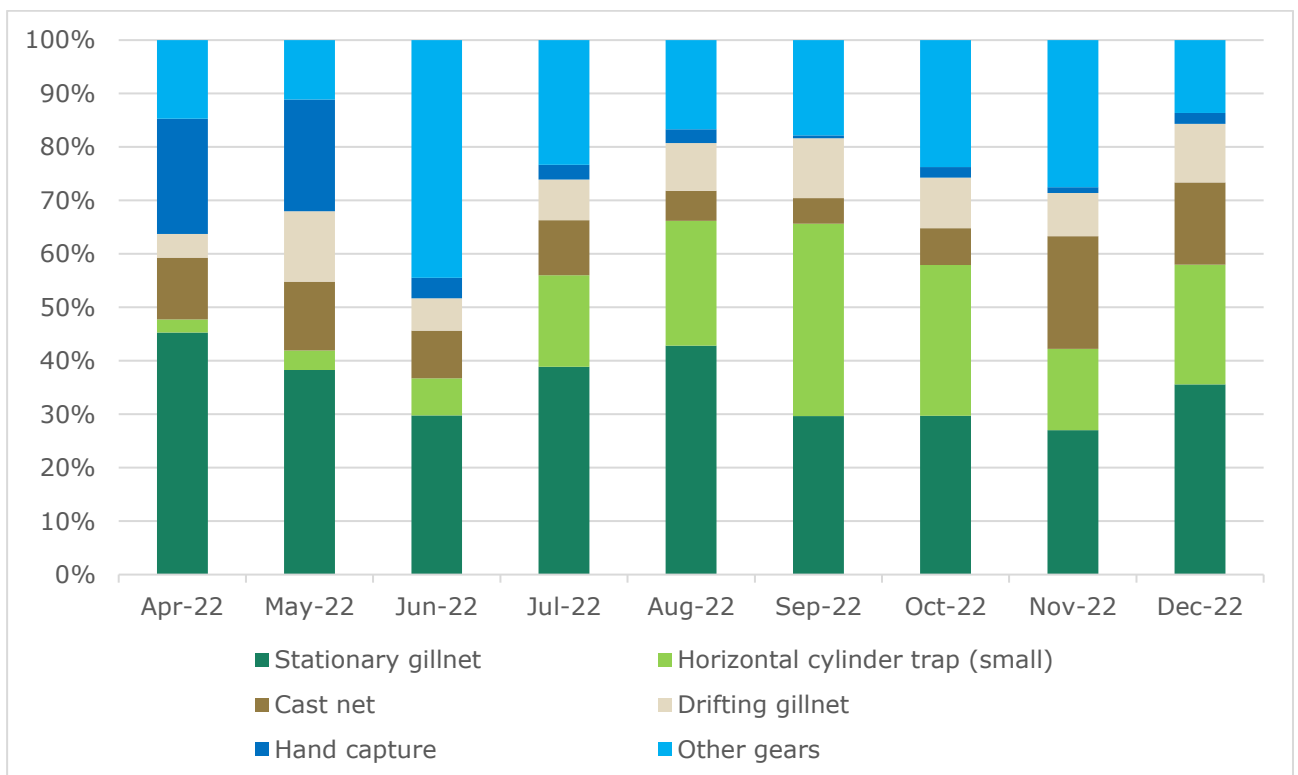


Figure 7b. Overall monthly contribution to the reported catch by top 5 gear types by month.

As can be seen (**Table 8**), selling of fish is most important for Floodplain and Tonle Sap fishing areas, where respectively 55% and 48% of the reported catch is sold, with 28% and 32% of the catch is consumed respectively. Household consumption only covers fish and OAA consumed fresh. Other use of the catch is mainly for processing, with some use in aquaculture (and crocodile culture) by households, this shows very little difference between the 3 fishing areas.

Table 8. Reported disposal by fishing area in weight and proportion.

Fishing Area	Sold (Kg)	%Sold	Consumed (Kg)	%Consumed	Other (Kg)	%Other
Coastal	102.0	43.5%	111.8	47.6%	20.9	8.9%
Floodplain	2,453.0	54.8%	1,258.1	28.1%	766.6	17.1%
Plateau	1,401.4	35.7%	1,822.8	46.4%	705.1	17.9%
Tonle Sap	4,314.1	47.9%	2,885.5	32.0%	1,804.5	20.0%
Total	8,270.5	46.9%	6,078.2	34.4%	3,297.2	18.7%

The disposal for all fishing areas combined (**Figure 8**), suggests that most of the reported catch is sold⁵.

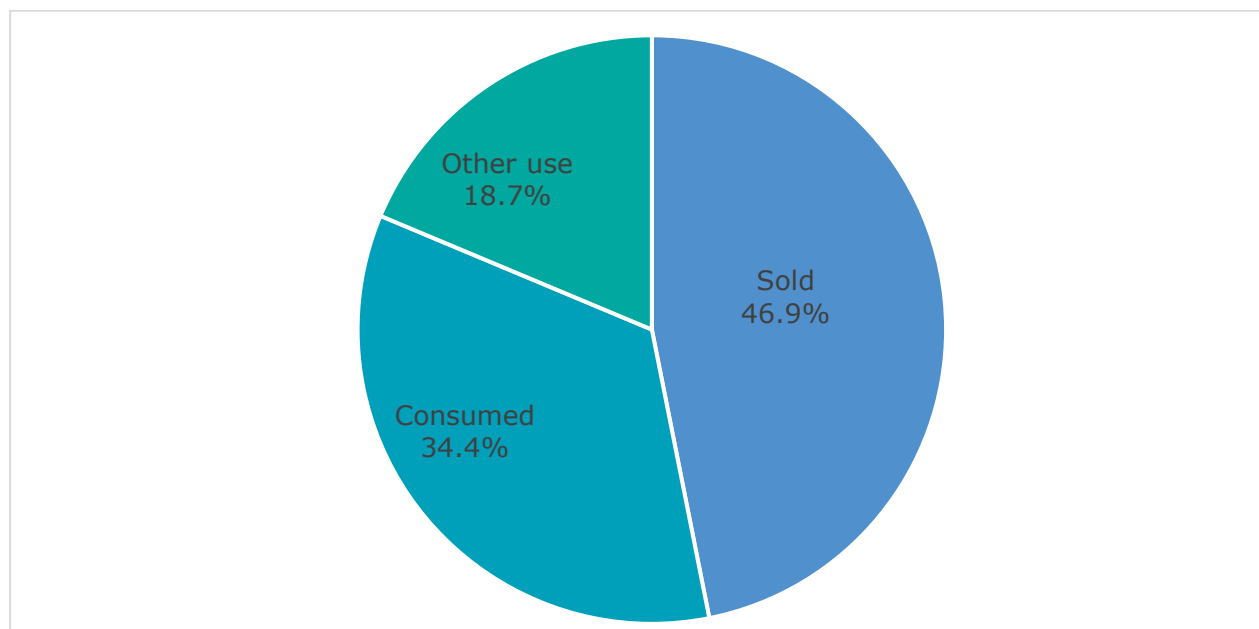


Figure 8. Overall disposal for 2022, by main category for all fishing areas combined.

⁵ Based on calculated standardized weights for disposal categories based on the relative importance of total reported catches by fishing area.

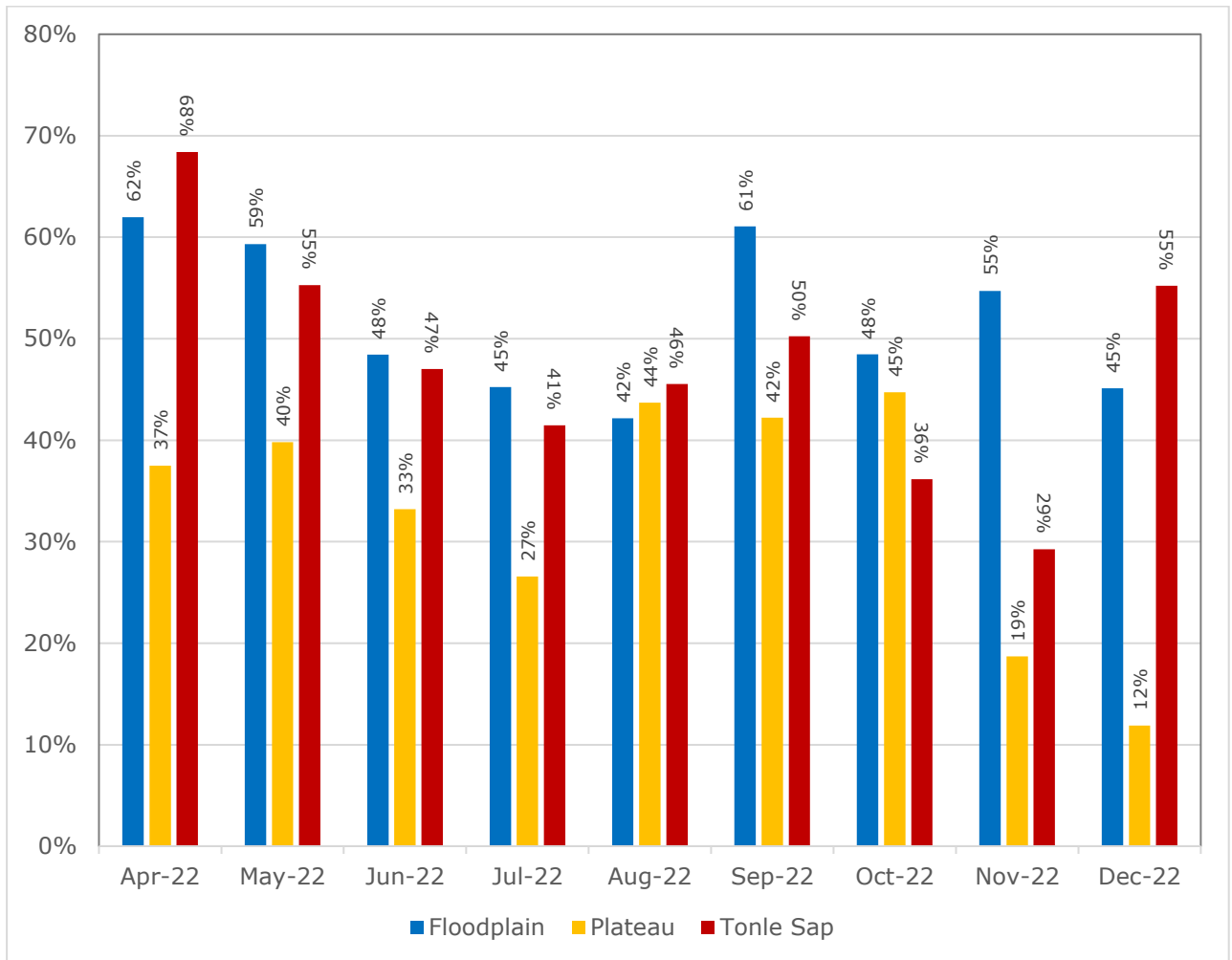


Figure 9. Overall monthly proportion of the catch sold, by fishing area.

Seasonal differences are apparent from

Figure 9, with selling of the catch generally more important for dry season for Floodplain and Tonle Sap, but for Floodplain also for months with a peak fish supply (September-November). The proportion sold is almost always lowest for Plateau and least important during the early dry season.

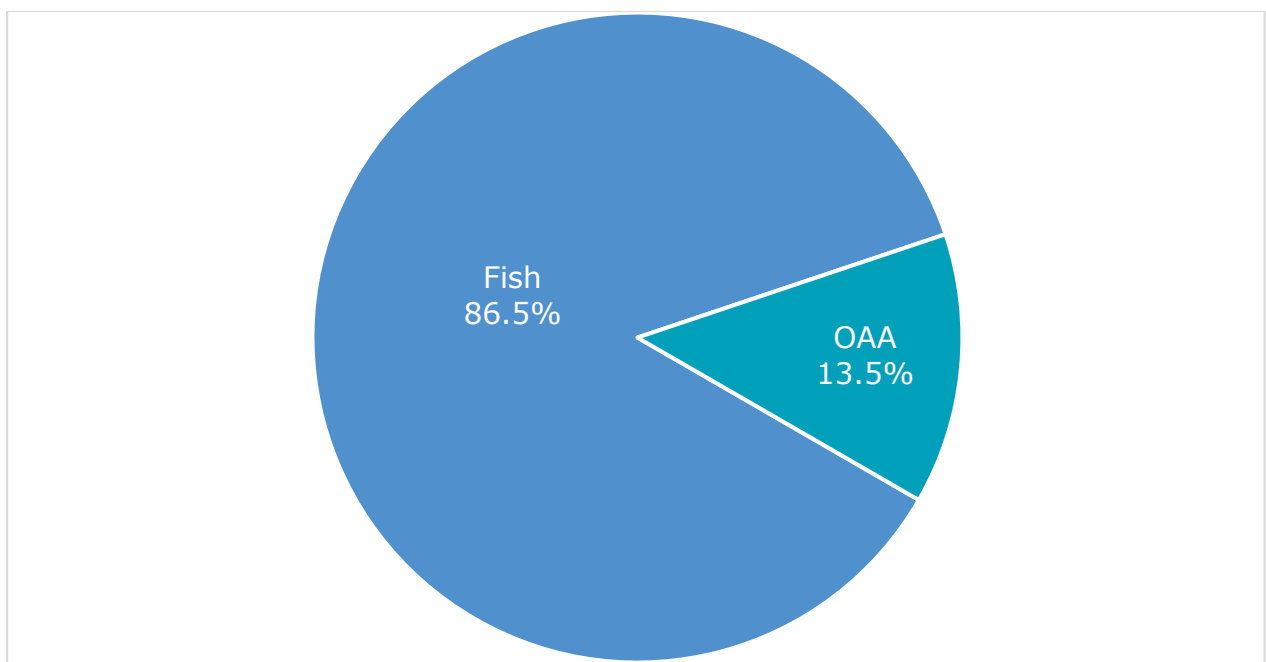


Figure 10. Overall catch contribution for fish and other aquatic animals in 2022.

The available data in

Figure 10, shows that fish represents the bulk of the reported catches. Although there is some seasonality (

Figure 11), this is in agreement with previous findings by IFReDI based on consumption studies, that OAA on average represents less than 10% of the total inland yield.

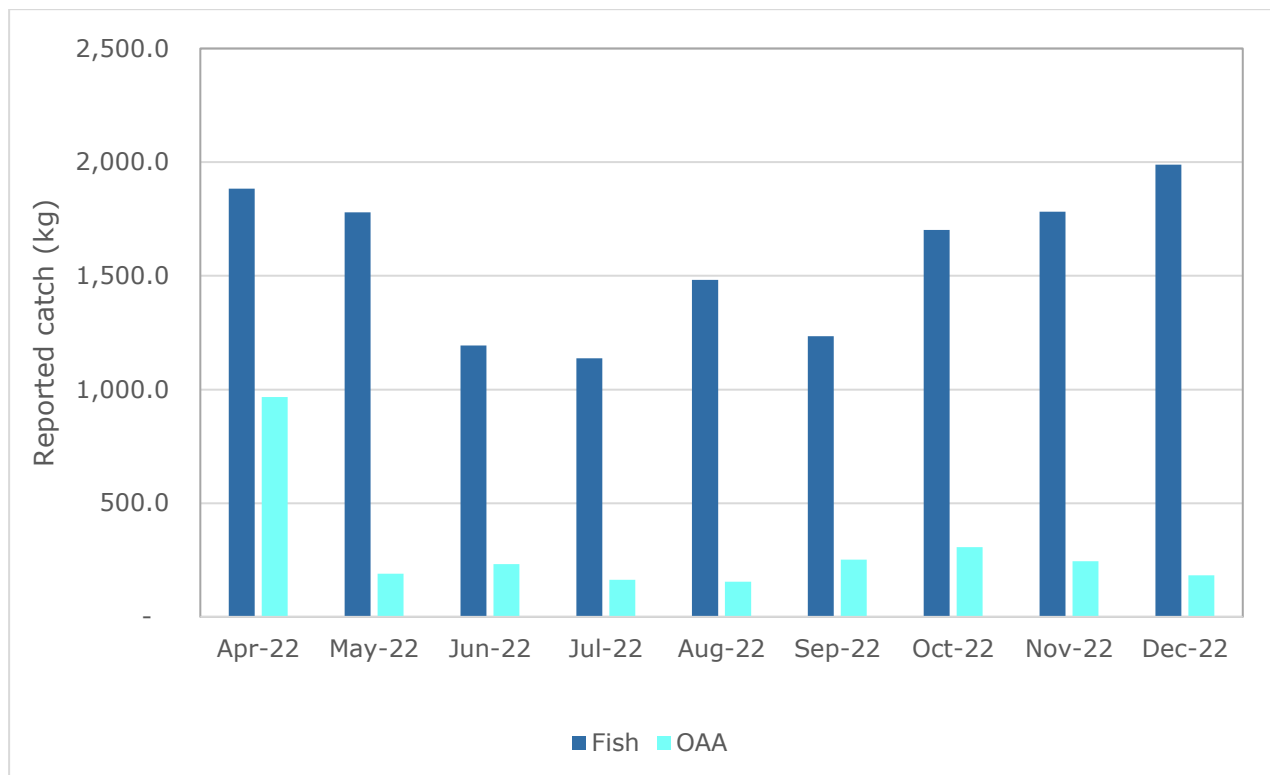


Figure 11. Reported fish and Other Aquatic Animals (kg), by month.

The top 20 species catch is shown in Table 9, with the following observations:

- Species groups (including sp. and groups nei⁶), represents 13.4% of the total catch;
- The only non-fish species in the top 20 are crab (*Somanniathelphusa sp.*), frog (*Rana tigrina*) and small mixed shrimps; and,
- A total of 101 species and species groups are included in the data. The top 20 represents 69% of the total catch⁷.

Table 9. Top 20 reported species catch by weight for 2022, with reported weight and proportion of catch by individual species and species groups.

	Scientific name	Khmer name	catch (kg)	Catch contribution	
				Proportion	Cumulative
1	<i>Channa striata</i>	ត្រីរឹស/ផ្នក់	1,433.6	8.4%	8.4%
2	<i>Anabas testudineus</i>	ត្រីក្រាញ់	1,344.0	7.9%	16.3%
3	<i>Henicorhynchus lobatus</i>	ត្រីរៀលអង្កាម	1,088.7	6.4%	22.7%
4	<i>Puntioplites proctozysron</i>	ត្រីច្រកែង	1,049.2	6.2%	28.8%
5	<i>Henicorhynchus siamensis</i>	ត្រីរៀលតុប	954.2	5.6%	34.4%

⁶ nei: not elsewhere included

⁷ Species belonging to the genus of *Henicorhynchus*, when combined would be fourth by weight or about 7% of the total catch.

	Scientific name	Khmer name	catch (kg)	Catch contribution	
				Proportion	Cumulative
6	<i>Somanniathelphusa sp.</i>	ក្តាមស្រែ	924.4	5.4%	39.8%
7	<i>Trichopodus trichopterus</i>	ត្រីកំភ្លាញស្រែ	719.3	4.2%	44.0%
8	<i>Barbonymus gonionotus</i>	ត្រីឆ្អិនប្រាក់	595.2	3.5%	47.5%
9	<i>Mixed small or juvenile fish</i>	ត្រីល្អិតចម្រុះ	571.0	3.3%	50.9%
10	<i>Clarias batrachus</i>	ត្រីអណ្តែងរឹង	460.1	2.7%	53.6%
11	Unspecified		409.8	2.4%	56.0%
12	<i>Hemibagrus spilopterus</i>	ត្រីឆ្នាំង	362.6	2.1%	58.1%
13	<i>Labiobarbus siamensis</i>	ត្រីអាចម៍កុក	301.6	1.8%	59.9%
14	<i>Rana tigrina</i>	លៀស	270.0	1.6%	61.5%
15	<i>Small mixed shrimps</i>	កំពីសចម្រុះ	232.6	1.4%	62.8%
16	<i>Macrognathus siamensis</i>	ត្រីឆ្មុញ	221.2	1.3%	64.1%
17	<i>Osteochilus lini</i>	ត្រីក្រុស	218.0	1.3%	65.4%
18	<i>Fejervarya limnocharis</i>	កង្កែប	209.8	1.2%	66.6%
19	<i>Hypsibarbus malcolmi</i>	ត្រីឆ្អិនមូល	202.3	1.2%	67.8%
20	<i>Cyclocheilichthys enoplos</i>	ត្រីឆ្កោក	194.8	1.1%	69.0%
	Other species	ផ្សេងទៀត	5,295.6	37.2%	98.6%
	Total reported catch		17,058		

The species diversity and the relative low contribution of species groups in the reported catches provides some confidence in the reported species catches, which are based entirely on Khmer local names. However, unspecified catch, where no species name was provided, represents 2.4% of the catch and this will be improved going forward.

The highest species diversity is found for August, May and October (**Table 10**), this is somewhat skewed for May, as this had the largest household sample and was the last month to include data for coastal provinces. The proportion of species groups sees large variation over the year, but generally is lowest for the dry season and highest for the rainy season. Biodiversity indices confirms that August has the highest biodiversity, as well as the highest evenness (species have similar abundance). As this is based on the reported weight, not catch numbers, this needs to be used cautiously. No in-depth comparison between fishing areas or contribution by main fish assemblage groups⁸ is presented.

Table 10. Number of species, diversity index and proportion of species groups by month for all fishing areas combined.

	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
Species #	52	65	52	62	66	60	64	58	54
Shannon	3.0328	3.3384	3.2278	3.1990	3.4617	3.2105	3.2410	3.0737	2.8672
Evenness	0.7676	0.7997	0.8169	0.7751	0.8263	0.7841	0.7793	0.7570	0.7188

⁸ Referring to white fish, black fish and grey fish named after migratory behaviour and main habitats they can be found

%Groups	4.1%	11.6%	9.0%	14.2%	12.8%	19.9%	19.7%	15.0%	9.9%
%Species	95.9%	88.4%	91.0%	85.8%	87.2%	80.1%	80.3%	85.0%	90.1%
Catch (kg)	1,556.4	3,281.1	898.0	1,347.5	1,820.8	1,611.4	2,664.9	2,020.0	1,714.4

Total catch excludes catch for coastal fishing area and is therefore different from other tables, the shading indicates the value for the diversity indices compared over 2022

The reported catch by value, shows that despite some small shifts, due to higher prices for some species, the top 10 in **Table 11**, is virtually the same as by weight, included in Table 9. The top 20 species represent more than 72% of the total reported value, indicating that the number of species with economic importance is relatively wide.

Table 11. Top 20 reported species **by value** (1000 Riel) for 2022, with reported value, proportion of value and average price.

	Scientific name	Khmer name	Value (1000 Riel)	Value Contribution		Price (Riel)
				%Value	%Cum.	
1	<i>Channa striata</i>	ត្រីវីស/ធ្នាក់	17,899	16.2%	16.2%	5000
2	<i>Henicorhynchus lobatus</i>	ត្រីរៀលអង្កាម	6,802	6.1%	22.3%	3500
3	<i>Anabas testudineus</i>	ត្រីក្រាញ់	6,767	6.1%	28.4%	3000
4	<i>Henicorhynchus siamensis</i>	ត្រីរៀលតុប	6,612	6.0%	34.4%	4000
5	<i>Puntioplites proctozysron</i>	ត្រីប្រកែង	4,938	4.5%	38.8%	3500
6	<i>Barbonymus gonionotus</i>	ត្រីឆ្កិនប្រាក់	4,642	4.2%	43.0%	5000
7	<i>Hemibagrus spilopterus</i>	ត្រីឆ្មាំង	4,122	3.7%	46.7%	6500
8	<i>Clarias batrachus</i>	ត្រីអណ្តែងរឹង	3,840	3.5%	50.2%	4000
9	<i>Trichopodus trichopterus</i>	ត្រីកំភ្លាញស្រែ	3,542	3.2%	53.4%	2500
10	<i>Macrogathus siamensis</i>	ត្រីឆ្មុយ	3,474	3.1%	56.5%	8500
11	<i>Hemibagrus wyckioides</i>	ត្រីខ្សា	3,127	2.8%	59.4%	12000
12	Mixed small or juvenile fish	ត្រីល្អិតចម្រុះ	2,008	1.8%	61.2%	2500
13	<i>Labiobarbus siamensis</i>	ត្រីអាចម៍កុក	1,867	1.7%	62.8%	3000
14	<i>Somanniathelphusa sp.</i>	ក្តាមស្រែ	1,853	1.7%	64.5%	1000
15	<i>Mystus singaringan</i>	ត្រីកញ្ចុះបាយស	1,817	1.6%	66.2%	3500
16	<i>Puntius orphoides</i>	ត្រីអំពិលទុំ	1,525	1.4%	67.5%	3500
17	<i>Cyclocheilichthys enoplos</i>	ត្រីឆ្កោក	1,468	1.3%	68.9%	4500
18	<i>Osteochilus lini</i>	ត្រីក្រស	1,310	1.2%	70.0%	2500
19	<i>Clarias cf. batrachus</i>	ត្រីអណ្តែងរឹង	1,299	1.2%	71.2%	4000
20	<i>Hypsibarbus suvattii</i>	ត្រីឆ្កិនស្មើង	1,111	1.0%	72.2%	2000
	Other species		30,785	11.0%	100.0%	
	Total reported value		110,808			

3. DISCUSSION AND RECOMMENDATIONS

Due to late arrival of the EU Budget Support, the start of CAS data collection was delayed and implemented from April-December 2022, with no data collected for the first quarter of the year. Although this is an improvement over 2021, due to the seasonality observed, it is important that the data collection is implemented for 12 months each year with an increase of sample size to improve provincial coverage. FiA should attempt

to obtain an advance for implementation of the CAS from MEF, so that data collection can be conducted 12 months per year.

Table 12. Comparison of the official published 2022 total catch, with the CAS based estimate (MT).

Inland fisheries	FiA DPFIC	IFReDI CAS
Dai fisheries	13,000	
Family fishing (fishing grounds)	247,900	260,640
Family fishing (rice fields)	145,500	99,360
Total	406,400	368,000

Rice field fishing grounds, include: rice fields, flooded forest habitats and irrigation canals

The official 2022 estimate as published by FiA is 406,400 MT for inland fisheries (**Table 12**), with 393,400 MT for family fisheries as covered by the CAS. The estimate for the IFReDI implemented CAS, which is (at least) 368,000 MT, is comparable. If the catch for the coastal provinces is extrapolated over the whole year, the 2022 total would be 380,000 MT and it is likely that adding mountainous provinces would bring the CAS estimate to around the same level as the official estimate. Based on the reported catch by habitat, 27% is caught in floodplain habitats associated with rice fields (including irrigation canals), whereas this is 37% in the official FiA statistics. This may be affected by exclusion of the coastal provinces for much of 2022, in the CAS data, which has a significant dependence on rice field fishing.

The catch by gear and habitat, only includes data where the catch was caught by a single gear and/or in a single habitat. This excludes data where respondents report using multiple gears or fishing in more than one habitat. Reported weight for fishing days accessing multiple habitats amounts to 3,364 kg (19% of total) and reported weight for multiple gear days amounts to 4,893 kg (27.7% of total).

The current sampling design has a good coverage for Floodplain and Tonle Sap, but focuses almost entirely on riparian communities for Plateau and only covers Kratie and Stung Treng, without any data collected for Ratana Kiri (which covers parts of the watershed for of 3 main tributaries to the Mekong). Mountainous provinces, e.g. Mondul Kiri and Tboum Kmoum provinces, in Plateau fishing area, and mountainous provinces elsewhere are also excluded; mainly because of the highly seasonal nature of fishing in upland areas and the high effort involved in covering remote areas. The CAS currently also excludes coastal provinces. This means that the current findings, do not cover the entire inland fisheries.

In addition, the current distribution of the sampling effort and the relatively high variation, means that estimates for some provinces are not statistically accurate, not even when the data is combined by quarter.

Table 13. Calculated sample size for statistical accurate estimates for catch and effort by province, based on 2022 CAS data.

Province	Fishing Area	Q2	Q3	Q4
Kampong Cham	Floodplain	200	83	77
Kandal	Floodplain	68	35	52
Prey Veng	Floodplain	112	59	65
Takeo	Floodplain	67	51	42
Banteay Meanchey	Tonle Sap	100		
Kampong Speu	Tonle Sap	73	47	35
Kampong Thom	Tonle Sap	371	30	29
Battambang	Tonle Sap	25	35	27
Pursat	Tonle Sap	16	34	58
Siem Reap	Tonle Sap	79	41	42
Kratie	Plateau	97	51	49

Stung Treng	Plateau	200	33	94
Kampot	Coastal	68		
Total sample estimate		1208	499	570
Average		NA	45	52

In order to increase statistical accuracy and reduce the relative standard error ($\epsilon\%$), to less than 25%, the required sample, based on the 2022 variation and active fishing households is calculated in **Table 13**. The variation is very high for the first quarter, combined with a low proportion of active fishing households, this leads to a required sample 1200 households for a quarterly estimate by province for the currently covered provinces. The minimal and optimal calculated sample size depends on the observed variation and this varies by province. For the 3rd and 4th quarter, the average sample size is between 45-60 households by province each month. This means that if a full national coverage is needed, this would need to include 3-4 communities in each province, with 15 households each, for a total of 1080-1440 households.

As an alternative, non-core fishing provinces for coastal and mountainous fishing areas, could be represented by 1 or 2 provinces each and this would result in a total sample of between 765 and 1140 (**Table 14**). This represents an 2-3 time increase of the 2022 sample and may be difficult to implement.

Instead of resampling, it is highly recommended to re-instate village samples that have been previously removed from the CAS, as establishing a new random sample is very time-consuming. It may make sense to also consider making use of the random household sample used by the World Bank Mekong Integrated Water Resources Management Phase 3 for the Plateau fishing area, which is described in detail in available documentation.

While the minimum and optimal sample sizes have been calculated, the actual sampling size that can be supported and maintained, depends on the level of collaboration with FiAC for data collection. One of the objectives for scientific catch assessment is to improve the provincial catch estimates. Increased collaboration with FiAC, would allow to collect more data with lower cost without over-burdening FiA/IFReDI staff. Adjustment to the coverage can be considered based on what the CAS will be used for, especially related to how the CAS will contribute to the national fishery statistics and use lessons learned from the implementation to improve and standardise data collection responsibility by FiAC.

It is important for IFReDI to closely monitoring the statistical accuracy on a monthly basis, to assess if changes to the sampling design are necessary. Preparing the monthly statistical reports as data becomes available, using the on-line CAS database that is developed with support from FAO, will facilitate evaluation of the data collection.

Table 14. Recommended sample size for 2023 CAS implementation.

Fishing area	Provinces	CAS provinces	Minimum (45 HH)	Optimal (60 HH)	2022 sample
Floodplain	5	5	225	300	115
Tonle Sap	7	7	315	420	135
Plateau	3	3	135	180	100
Mountainous	5	1	45	120	0
Coastal	4	1	45	120	40
Total	24	17	765	1140	390

Mountainous provinces can be covered only during part of the year, when they are expected to be fishing, or even on a quarterly basis

Decisions related to the number of fishing households and stratification, need to be reviewed. There are 2 further aspects to this:

- 1) Currently, Kampong Speu is included in the Tonle Sap, but the fisheries are more similar to that found in the floodplain provinces. Similarly, Kampong Cham is included in Floodplain, even though it is part of the Mekong inspectorate, as the fisheries is akin to that in Floodplain fishing area; and,
- 2) Total catch estimates are based on the number of rural households obtained from the 2019 Population Census and the proportion of fishing households, obtained from the HSI.

IFReDI needs to initiate a discussion to decide on:

- Purpose and future of the CAS, related to improving the official statistics for inland fisheries, especially in relation to the draft roadmap and the newly established FiA Working Group on Statistics and Information Management (WSIM);
- How the data collection form can be rationalised if transferred to FiAC, e.g. by removing indicators that don't contribute to the core estimates for species catch and effort: gear use, disposal, fishing habitat and involvement by household members;
- Expansion of coverage to coastal and mountainous provinces and the way to implement this, without overwhelming the limited staff resources of FiA/IFReDI, e.g. by mobilising FiAC staff for data collection;
- Requirement for monthly total catch estimates and other statistics, by province (which has implications for the sample size and distribution); and,
- Stratification, to decide if another distribution of the sampling effort and communities makes more sense, e.g. by riparian and hinterland communities.

In view of the analysis done by IFReDI, some issues were uncovered with the data, specifically:

- 1) Occurrence of unspecified categories. The Kobo data collection tool needs to be updated to prevent the entry of catch and effort data, without specifying species, gear or habitat.
- 2) Species codes currently are using a combination of 2 different sets of codes, MRC codes and HCI codes, these include the same codes that refer to different species depending on the type of code used, e.g. SpeciesID 23, MRC: *Probarbus jullieni* and HCI: *Hemibagrus spilopterus* or SpeciesID 131, MRC: *Oxyeleotris marmorata* and HCI: Marine shrimps and prawns nei. This is confusing and this needs to be fixed by using the MRC codes as the standard;
- 3) The way that species codes are entered need to be reviewed as the data often includes many records without species names or codes, which then are manually adjusted based on the reported gear, location and habitat to add missing data. Records with missing key data need to be flagged during data collection to minimise data cleaning;
- 4) The habitat and gear lists need to be reviewed to ensure that no ambivalent categories are included.
- 5) Total disposal weight and total species catch often doesn't match, this needs to be flagged in the Kobo data entry tool during data collection, so this can be addressed during data collection;
- 6) The data collection form and sequence need to be adjusted based on a review by IFReDI of necessary data.

In view of the evolution of the CAS, sampling design, coverage and classifications used, it is recommended to update the CAS manual to reflect these changes.

IFReDI needs to seek technical support from FAO CAPFISH to address the above identified issues and work closely with the Department of Planning, Finance and International Cooperation (DPFIC), to agree on how the results from the CAS will be used to improve national fishery statistics.

Annex 1. Distribution of provinces by fishing area and number of fishing households.

Province	Fishing Area	2019 population census			Rural Fishing HH	Notes
		Total	Urban	Rural		
Banteay Meanchey	Tonle Sap	189,588	68,660	120,928	58,416	
Battambang	Tonle Sap	227,237	45,556	181,681	87,763	
Kampong Cham	Floodplain	217,197	30,386	186,811	148,263	Included in Mekong inspectorate
Kampong Chhnang	Tonle Sap	126,299	28,523	97,776	47,232	
Kampong Speu	Tonle Sap	195,882	114,380	81,502	39,371	Included in Tonle Sap, although similar to Floodplain
Kampong Thom	Tonle Sap	160,766	16,118	144,648	69,874	
Kampot	Coastal	143,402	13,258	130,144	49,975	
Kandal	Floodplain	265,803	170,782	95,021	75,413	
Koh Kong	Coastal	28,027	12,359	15,668	6,017	
Kratie	Plateau	86,176	9,297	76,879	51,416	
Mondul Kiri	Mountainous	20,409	7,500	12,909	4,360	
Phnom Penh		499,299	499,299			Not included, all households are urban
Preah Vihear	Mountainous	56,713	5,650	51,063	17,246	
Prey Veng	Floodplain	266,934	14,168	252,766	200,608	
Pursat	Tonle Sap	103,862	17,624	86,238	41,658	
Ratanak Kiri	Plateau	49,741	6,877	42,864	28,667	
Siem Reap	Tonle Sap	224,672	67,845	156,827	75,757	
Preah Sihanouk	Coastal	47,381	34,060	13,321	5,115	
Svay Rieng	Floodplain	132,492	37,285	95,207	75,561	
Takeo	Floodplain	208,698	62,856	145,842	115,748	
Otdar Meanchey	Mountainous	60,886	19,826	41,060	13,868	
Kep	Coastal	9,605	7,714	1,891	726	Excluded, Kep only has marine fishers
Pailin	Mountainous	17,177	13,050	4,127	1,394	
Tboung Khmum	Mountainous	178,942	15,667	163,275	55,146	
Stung Treng	Plateau	35,833	9,761	26,072	17,437	
Total					1,287,031	

Annex 2. Estimated catch by province, based on quarterly data.

Q2: April-June

Province	Fishing Area	% Active HH	Monthly HH catch (Kg)	SD	ε%	Total (MT)
Kampong Cham	Floodplain	28%	84.62	26.46	30.8%	3,517
Kandal	Floodplain	38%	51.89	11.10	15.7%	1,490
Prey Veng	Floodplain	26%	51.55	11.54	22.7%	2,681
Takeo	Floodplain	42%	73.25	16.28	16.9%	3,528
Banteay Meanchey	Tonle Sap	40%	127.93	33.51	42.0%	2,989
Kampong Speu	Tonle Sap	37%	30.45	6.54	20.4%	444
Kampong Thom	Tonle Sap	18%	70.67	24.30	33.9%	904
Battambang	Tonle Sap	90%	54.11	10.66	12.1%	4,256
Pursat	Tonle Sap	82%	90.55	13.84	9.9%	3,090
Siem Reap	Tonle Sap	40%	33.19	7.77	28.1%	1,014
Kratie	Plateau	24%	48.11	9.68	21.3%	586
Stung Treng	Plateau	44%	71.61	9.55	11.5%	545
Kampot	Coastal	41%	45.43	8.42	20.0%	938
Total estimated mean monthly catch (MT)						25,982
Total estimated quarterly catch (MT)						77,946

Q3: July-September

Province	Fishing Area	% Active HH	Monthly HH catch (Kg)	SD	ε%	Total (MT)
Kampong Cham	Floodplain	30%	64.95	13.59	25.6%	2,889
Kandal	Floodplain	51%	41.93	7.41	16.6%	1,620
Prey Veng	Floodplain	44%	16.55	3.48	20.0%	1,475
Takeo	Floodplain	53%	30.15	6.58	19.1%	1,843
Kampong Speu	Tonle Sap	76%	28.76	7.20	18.3%	862
Kampong Thom	Tonle Sap	57%	31.05	5.30	14.4%	1,243
Battambang	Tonle Sap	71%	55.98	11.70	16.3%	3,493
Pursat	Tonle Sap	61%	77.43	14.83	15.6%	1,979
Siem Reap	Tonle Sap	69%	36.56	7.99	17.2%	1,913
Kratie	Plateau	73%	66.05	16.71	16.2%	2,470
Stung Treng	Plateau	57%	41.06	7.52	10.5%	409
Total estimated mean monthly catch (MT)						20,196
Total estimated quarterly catch (MT)						60,588

Q4: October-December

Province	Fishing Area	% Active HH	Monthly HH catch (Kg)	SD	ε%	Total (MT)
Kampong Cham	Floodplain	34%	84.81	18.14	24.2%	4,242
Kandal	Floodplain	69%	56.39	14.04	20.1%	2,924
Prey Veng	Floodplain	49%	19.64	4.61	21.2%	1,926
Takeo	Floodplain	59%	41.82	8.74	17.2%	2,850
Kampong Speu	Tonle Sap	66%	20.87	4.18	15.6%	545
Kampong Thom	Tonle Sap	61%	149.21	26.12	17.0%	6,390
Battambang	Tonle Sap	84%	141.38	28.03	14.2%	10,464

Province	Fishing Area	% Active HH	Monthly HH catch (Kg)	SD	ε%	Total (MT)
Pursat	Tonle Sap	50%	36.19	8.06	28.5%	754
Siem Reap	Tonle Sap	65%	69.01	15.00	17.3%	3,386
Kratie	Plateau	61%	61.54	13.95	15.0%	1,922
Stung Treng	Plateau	46%	39.81	10.84	18.0%	316
Total tentative mean monthly catch (MT)						35,720
Total tentative quarterly catch (MT)						107,159
Tentative 9-month estimate						245,693
2022 tentative 12-month estimate						327,591