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**IFReDI
2023 ANNUAL STATISTICAL REPORT
Inland Fisheries**

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**Statistical Report for Scientific Catch Assessment of Inland
Fisheries in Cambodia**

April 2024

Prepared by Inland Fisheries Research and Development Institute

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EXECUTIVE SUMMARY

The scientific Catch Assessment Survey, was implemented during 7 months in 2023, by staff from IFRéDI. Based on the experience during 2021-2022, it was decided to expand the coverage to 58 villages, with up to 15 households covered, with 883 unique random selected households covered by the survey, covering all fishing areas. This is more than double the 2022 coverage where each month 25 villages and 350 households were included in the survey.

Households on the plateau fishing areas have the highest proportion of active fishing households, while those in coastal and floodplain areas have the lowest participation. This closely aligns with the observed average daily catch, which was found to be highest in Tonle Sap area, followed at some distance by plateau and Mountainous households. A similar pattern was observed for fishing effort

Due to the limited coverage in time, very little seasonal variation was observed between fishing areas. Although June saw the lowest levels for active fishing households and highest mean daily catches, values for other indicators less clearly differentiate. There is a clear peak for household involvement in fishing during August-October. Households in the Tonle Sap have by far the highest monthly catch (90 kg), even when not considering the data for December, followed at considerable distance by Mountainous and plateau, with floodplain and coastal households having a much lower mean monthly household catch.

The differences are reflected in the monthly estimated catch, that vary from a low of 43 000 MT in June to almost 52 000 Mt in September and 61 000 MT in October, before dropping back to 43 000 MT in November. The lack of coverage for the dry season makes it hard to estimate the total catch for 2023, but taking the 2022 dry season catch representative for the missing months for 2023, would lead to a total catch of 489 423 MT. The highest contribution to the estimated catch for June-November 2023 is by Tonle Sap (48.2%), followed by floodplain (26.1%) and Mountainous (13.2%), with Plateau contributing 10.2% and Coastal 2.2%.

Most fishing activities involve adult males (85.8% of fishing trips) and female adults (11.3%), with limited variation between fishing areas, but adult female participation in reported fishing activities is highest for Tonle Sap (15.1%) and Floodplain (11.2). Fishing activities by children are rare, with male children participating in 3.1% of the fishing trips and female children in 0.8% of the fishing trips. Most of the catch is caught using a boat (69.1%), with the remainder caught without using a boat. The area with the highest proportion of fishing without a boat is Coastal (92.1%), followed by Mountainous (66.7%).

Most of the reported catch is obtained from floodplain habitats (32.9%), followed by tributaries to the Tonle Sap (29.5%) and Mekong mainstream (16.4%).

The most important gears, based on their contribution to the reported catch, are gillnets, with stationary gillnets (34.7%) being more important than drifting gillnets (11.4%). Horizontal cylinder traps contribute 18.7%, cast net (4.4%) and pole and line (2.7%).

The proportion of the catch that is sold is 55.5%, with the remainder consumed (25.9%) or for other use (18.5%). The proportion sold is highest for Tonle Sap (72.0%) and

Floodplain (46.1%). Seasonal differences are present, with selling of the catch generally more important for the early rainy season, but with the proportion of catch sold at consistent levels for Jun-Nov for most fishing areas.

Fish makes up 80.5% of the total reported catch, with OAA contributing 17.9%, OAA is more important during the dry season. The top 20 species by weight make up 75% of the total reported catch, reflecting a broad species base for the fisheries, with *Puntioplites proctozysron* (Smith's barb), *Somanniathelphusa* sp. (rice field Crabs) and Mixed small or juvenile fish, making up the top 3, representing 27% of the total reported catch.

A number of recommendations for integration of the CAS results into the national fisheries statistics and possible hand-over of data collection and provision of resources to provincial fishery officers are discussed. However, technical assistance on data management, data collection methodology, sample size and data analysis is needed from IFReDI.

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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, implemented a scientific catch assessment survey (CAS) from 2021-2023. This used monthly household recall interviews for fishing activities during the past 5-day period, with as main aim, to obtain better information on catch and effort by small-scale fishing households in Cambodia, and to assist in evaluating how a sustainable catch monitoring methodology could be developed for implementation by provincial fisheries administrations, supported by IFReDI.

Data collection for 2023 was conducted from June to December 2023. 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, as obtained from NIS, 2019 population census and the proportion of fishing households from the IFReDI 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.

The total estimated catch in this report is calculated using the proportion of fishing households found by the random household selection under the HSI. This is taken to be representative for the proportion of fishing households for each fishing area and this is combined with the total number of rural households by fishing area from the NIS 2019 population census to estimate the total number of fishing households. The Fishing Activity Coefficient, representing the proportion of fishing households actively fishing during individual months, is estimated from proportion of households reporting fishing activities in the Household Catch Interview.

Estimates for CPUE, the average (mean) daily household catch and the mean monthly household catch used for extrapolating the total catch, come with a value for the relative standard error ($\epsilon\%$). This is used to indicate the statistical accuracy of the estimate for the mean catch. If the $\epsilon\%$ is higher than 30% this indicates a high inaccuracy¹, either due to high variation or low sample size and the value cannot be used to represent the real value of the mean catch and are clearly indicated in the tables included in this report.

2. STATISTICAL TABLES AND RESULTS

¹ For national statistical reports the rule of thumb states that if the relative standard error ($\epsilon\%$) is higher than 30%, the average should not be **reported** and that only estimates with a value of $\epsilon\%$, below 25% should be considered **statistically valid**. The current report includes all estimated values to indicate that an estimate is available, with the value for $\epsilon\%$ indicating the statistical accuracy.

As the last year of implementation of the Catch Assessment Survey (CAS), it was decided towards the end of 2022 to target the highest possible sample, covering all fishing areas in proportion of their importance for inland capture fisheries, to obtain reliable and representative estimates for various indicators. The data collection coverage from June-December 2023, shows that the number of villages and households included in the random sample has been constant with the exception for the last 2 months of the survey (**Table 1**). The reduction in coverage for November and December were due to other field work commitments and specifically for December a reduction of the available budget and time for conducting field work, due to the closing of accounts early December.

Within the staff and field day limitations, IFReDI maintained a high random household sample during the 2023 implementation. A value higher than 100% indicates that more households were interviewed than strictly planned, mainly in case a household indicated it would move away. Specifically for December, with only 6 villages covered for the Tonle Sap, a larger per village household sample was taken to partially compensate for the reduction in coverage, leading to a 50% increase coverage of the target number of households. The main reason for not reaching 100% coverage, is when households cannot be found during the survey period, but are not dropped from the survey.

Table 1. Sample villages and households, with proportion of target household by fishing area for June - December 2023.

Fishing area	Villages						
	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	3	3	3	3	3	3	
Tonle Sap	20	20	20	20	20	16	5
Floodplain	17	17	17	17	17	17	
Plateau	10	10	10	10	10	10	
Mountainous	6	6	6	6	6	6	3
Total	56	56	56	56	56	52	8

Fishing area	Households						
	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	45	45	45	45	45	45	
Tonle Sap	288	294	299	300	299	217	109
Floodplain	255	258	253	257	254	246	
Plateau	159	149	150	151	151	142	
Mountainous	90	89	90	90	91	74	45
Total	837	835	837	843	840	724	154

Fishing area	Target HHs interviewed (%)						
	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Tonle Sap	96.0%	98.0%	99.7%	100.0%	99.7%	90.4%	145.3%
Floodplain	100.0%	101.2%	99.2%	100.8%	99.6%	96.5%	
Plateau	106.0%	99.3%	100.0%	100.7%	100.7%	94.7%	
Mountainous	100.0%	98.9%	100.0%	100.0%	101.1%	82.2%	100.0%
Total	99.6%	99.4%	99.6%	100.4%	100.0%	92.8%	128.3%

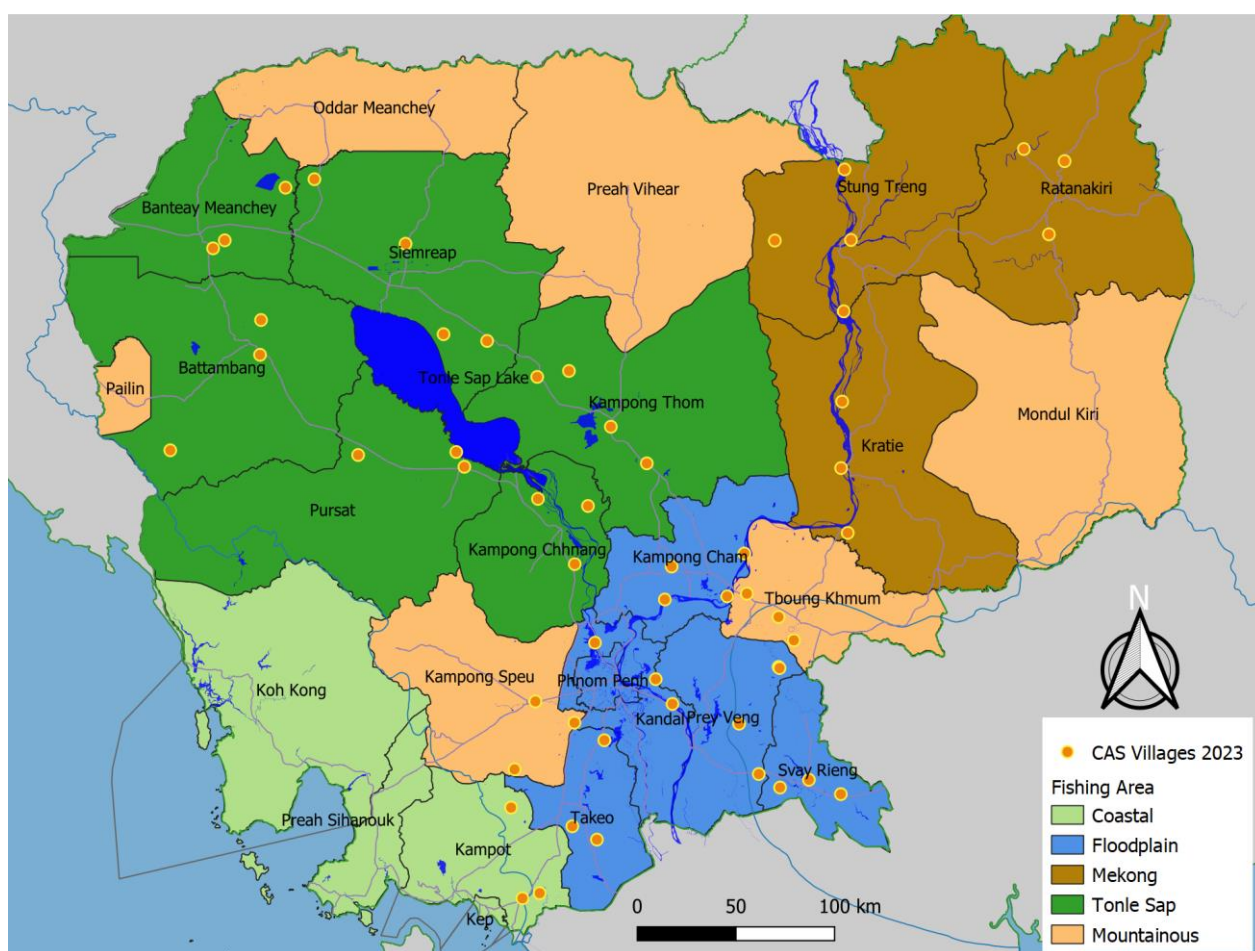


Figure 1. Random selected villages covered by CAS during 2022.

The target villages for the Catch Assessment Survey (CAS) during 2023, are shown in Figure 1. The distribution of the randomly selected villages and the fishing areas, doesn't follow the distribution of provinces by inspectorates, but according to the nature of their fisheries. Unlike what was done for 2022, the records for Kampong Speu have

been assigned to the mountainous fishing area, to complement the records from Tboung Khmum province. Similarly, Ratanakiri is included for Plateau and Kampong Cham to Floodplain fishing area, as this better reflects the available fishing habitats and types of fishing.

The seasonal differences for various indicators are included in **Table 2**, with the highest daily catches observed for June, for all fishing areas but coastal households. This reflects windfall catches from targeted fishing of habitats affected by drought conditions. The proportion of households fishing, is highest for the period August to October, but mountainous households see a distinct peak for November and December. Overall, household in Plateau have the highest proportion of active fishing household (72.8%). The fishing effort tends to be higher during the main fishing season (July-October), but lack of data before June, makes it difficult to interpret the variation. It seems not clearly related to seasonal differences in flow or flooding, indicating that households, fish, regardless of season. The fishing effort for December, is very high for Tonle Sap, but this is based on only 5 villages.

Table 2. Active fishing households, monthly fishing days and mean monthly household catch (kg) by fishing area.

Proportion of households actively fishing								
Fishing area	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023
Coastal	22.2%	48.9%	51.1%	53.3%	48.9%	53.3%		46.3%
Floodplain	30.2%	43.6%	51.0%	58.0%	56.7%	54.3%		48.9%
Plateau	45.9%	63.8%	82.0%	86.8%	86.1%	73.9%		72.8%
Tonle Sap	45.8%	51.4%	51.8%	71.7%	75.6%	60.3%	74.8%	60.5%
Mountainous	38.9%	51.7%	61.1%	64.4%	68.1%	85.1%	82.2%	62.6%
Grand Total	39.1%	51.1%	57.9%	68.4%	69.5%	63.0%	76.8%	58.7%

Mean daily household catch								
Fishing area	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023
Coastal	2.32	2.61	2.05	2.24	2.46	2.36		2.34
Floodplain	3.31	3.15	3.02	3.30	2.29	2.52		2.90
Plateau	6.07	4.11	4.16	2.90	3.16	2.42		3.64
Tonle Sap	6.23	5.64	4.44	4.95	5.40	4.32	4.87	5.13
Mountainous	5.47	2.80	4.17	4.38	3.91	3.52	2.14	3.78
Grand Total	5.31	4.18	3.85	3.89	3.87	3.16	4.07	3.97

Mean monthly household fishing days								
Fishing area	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023
Coastal	12.6	11.7	14.6	13.0	16.1	14.8		13.9
Floodplain	16.9	13.0	14.1	12.8	13.5	15.1		14.0
Plateau	20.8	16.9	17.5	14.9	16.1	14.0		16.4
Tonle Sap	15.5	16.3	16.7	16.8	19.2	16.3	24.5	17.6
Mountainous	16.1	16.0	18.3	17.1	18.1	18.9	13.8	17.2
Grand Total	17.0	15.3	16.3	15.2	16.9	15.7	21.4	16.2

Mean monthly household catch (kg)								
Fishing area	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023
Coastal	29.3	30.7	29.9	29.2	39.5	34.8		32.6

Floodplain	55.9	40.9	42.7	42.4	30.9	38.0		40.7
Plateau	126.2	69.6	72.6	43.2	50.8	34.0		59.7
Tonle Sap	96.8	91.8	74.2	83.2	103.6	70.3	119.6	90.4
Mountainous	88.2	44.7	76.5	74.8	70.7	66.3	29.5	65.0
Grand Total	90.2	63.9	62.7	59.2	65.1	49.6	87.0	64.5

The resulting mean monthly household catch is affected by variation in effort and CPUE, but apart from high values for mountainous households, doesn't provide any unexpected results. Tonle Sap households have by far the highest average daily household catch as well as the highest active fishing days. However, Plateau households have the highest mean monthly fishing days for June (20.8 days). This doesn't consider the high value for Tonle Sap households for December, as this isn't representative for the entire Tonle Sap.

The data aligns with expected dependency and catch patterns, with generally lower effort and yields for Coastal and Floodplain households and higher values for both Plateau and Tonle Sap.

The total estimated catch in **Table 3**, is taken from the monthly statistical reports. This represents 7 months of data, but with the December estimate based on only 8 villages, this is not considered representative. The 2023 total estimated catch for 2023 is calculated by linear extrapolation for 12 months, based on the average for June-November.

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

Fishing Area	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coastal	463	958	1,083	944	1,525	1,258	
Floodplain	10,223	13,094	13,742	14,333	10,969	13,083	
Plateau	6,518	5,687	6,471	3,987	4,872	2,753	
Tonle Sap	21,331	21,672	17,583	24,379	36,345	18,027	36,411
Mountainous	4,530	3,171	7,035	8,089	7,268	7,960	3,637
Total	43,066	44,583	45,915	51,732	60,979	43,081	40,048

Fishing Area	6-month Total	Mean monthly catch (MT)	2023 Total	%Total
Coastal	6,231	1,039	12,462	2.2%
Floodplain	75,444	12,574	150,888	26.1%
Plateau	30,288	5,048	60,576	10.5%
Tonle Sap	139,337	23,223	278,674	48.2%
Mountainous	38,053	6,342	76,106	13.2%
Total	289,356	48,226	578,709	

In view of the lack of coverage for the peak dry season, the average monthly catch used for the total catch estimation seems too high, compared with 2022 data where the average for April-May was 33,350 MT. Total estimated catch is by far highest for the

Tonle Sap area, followed by Floodplain, with Plateau and Mountainous areas comparable, but with Coastal area contributing only 2.2%.

Involvement in fishing (**Table 4**) is highly skewed towards adult males, who are involved in more than 85% of the reported fishing activities. Involvement of adult females is considerably lower than for male, but is highest in Tonle Sap (15.1%), followed by Floodplain (11.2%), in other areas involvement is very similar, between 7-8%. Male children, have a higher involvement than female children, with a percentage of 4.1% and 0.7% respectively, but both are 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	7.2%	59.0%	0.7%	4.1%
Floodplain	11.2%	92.2%	0.6%	1.5%
Plateau	7.8%	74.2%	0.4%	3.1%
Tonle Sap	15.1%	88.3%	0.7%	4.1%
Mountainous	7.1%	94.7%	1.8%	2.8%
Grand Total	11.3%	85.8%	0.8%	3.1%

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**, only a very low proportion of catches are with boats for coastal provinces, where over 92.1% of the reported catch is caught without using boats, followed by mountainous (66.7%) and Floodplain³ (53.5%). Motorised boats contribute the highest proportion of the catch for fishers from Tonle Sap and Plateau, with 74.1% and 71.9% of the reported catch respectively, indicating a higher reliance on fishing grounds away from fisher homes. However, fishing with motorised boat is commonly practiced for all fishing areas, contributing 60.2% of the catch overall, whereas the fishing without boat contributed 30.9% of the reported catch.

Table 5. Reported catch (Kg) for 2023, with proportion caught by main boat type by fishing area.

Fishing Area	Total catch (Kg)	No boat	Motorised boat	Non-motorised boat
Coastal	616.7	92.1%	2.3%	5.6%
Floodplain	3,933.1	53.5%	30.0%	16.5%
Plateau	5,912.9	16.5%	71.9%	11.6%
Tonle Sap	15,443.6	20.2%	74.1%	5.7%
Mountainous	3,499.0	66.7%	22.8%	10.5%
Grand Total	29,405.3	30.9%	60.2%	8.9%

Overall proportion based on weighted average catch by main boat type and fishing area, not reported total catch⁴

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

³ This is somewhat surprising and counter-intuitive, but can be caused by a bias in the sample, with fishers using motorized boats under-represented

⁴ 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

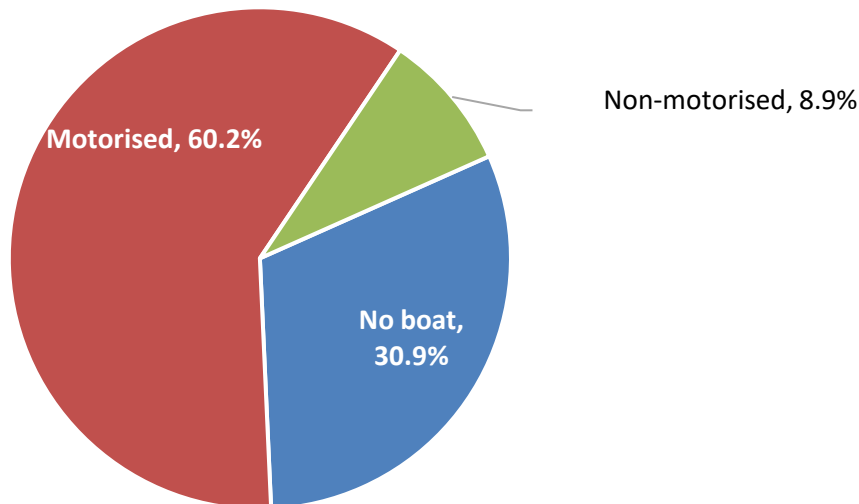


Figure 2. Overall contribution of the main boat types to total reported catch

The main fishing habitats indicated in **Figure 3** are floodplain, tributaries to the Tonle Sap and Mekong mainstream, with major tributaries and small streams less important. The main floodplain habitats are rainfed rice fields (47.7%) and lakes and ponds (33.0%). The contribution of flooded forest areas (9.5%) and flooded rice fields (9.7%) 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 fields⁵.

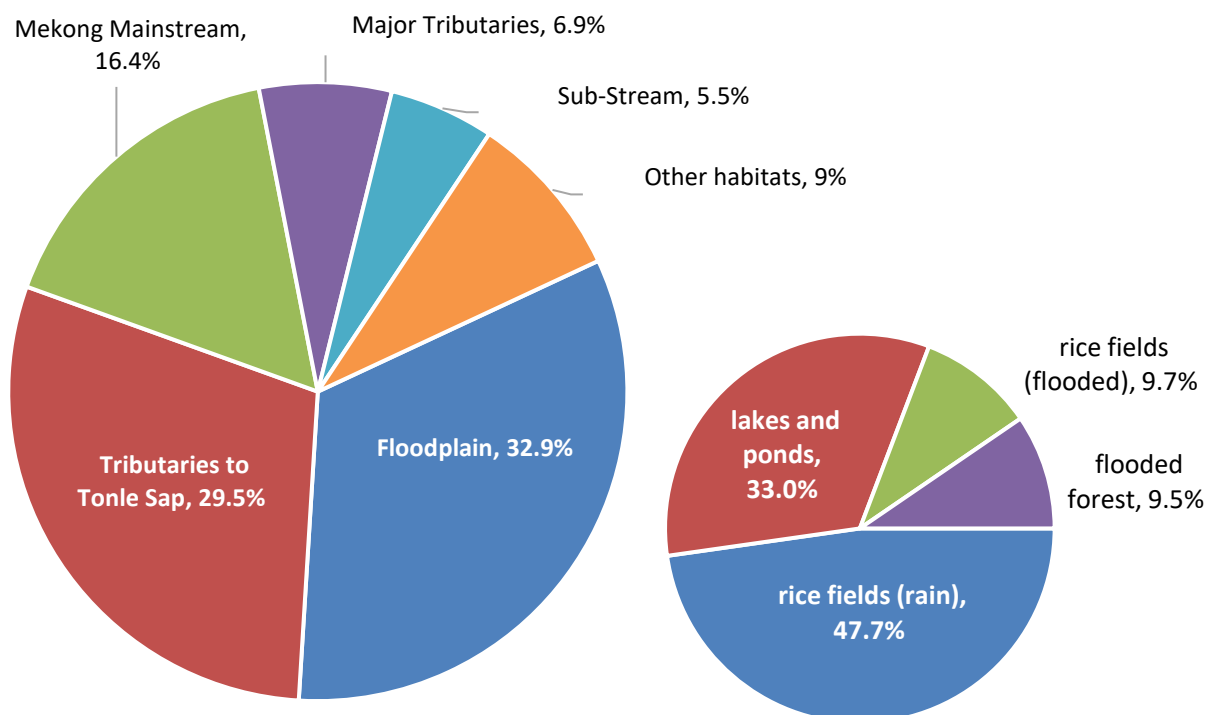


Figure 3. Overall contribution of the habitats to total reported catch, with proportion of catch for floodplain habitats.

⁵ 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

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

Fishing Habitats	Coastal	Floodplain	Plateau	Tonle Sap	Mountain	Grand Total
Tributaries to Tonle Sap	-	11.7%	-	51.9%	0.1%	29.5%
Mekong Mainstream	-	13.9%	66.0%	-	0.9%	16.4%
Floodplain: rice fields (rain)	48.3%	24.1%	2.5%	14.0%	39.1%	15.7%
Floodplain: lakes and ponds	13.7%	18.3%	3.5%	8.4%	32.1%	10.9%
Major Tributaries	-	7.0%	9.4%	3.4%	22.3%	6.9%
Sub-Stream	0.8%	5.5%	16.7%	1.9%	0.5%	5.5%
Stream	13.0%	1.3%	-	5.6%	2.6%	3.7%
Floodplain: rice fields (flooded)	3.2%	4.3%	1.3%	4.1%	0.4%	3.2%
Floodplain: flooded forest	-	0.8%	0.1%	5.6%	0.1%	3.1%
Irrigation canals	16.8%	10.2%	0.3%	1.6%	0.7%	2.6%
Reservoir	2.3%	1.8%	0.1%	2.7%	-	1.7%
Unspecified habitats	1.4%	1.0%	-	0.7%	1.1%	0.7%
Seasonal swamps	0.5%	0.1%	-	0.1%	-	0.1%
Total	755.9	5,199.3	7,832.6	19,444.0	4,395.7	37,627.5

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. Rainfed rice fields are mentioned for all fishing areas, but are relatively more important for mountainous and coastal households, even though in absolute terms they contribute more in Tonle Sap households. Major tributaries are mentioned for all but coastal households, but the distinction between the different types of streams may be difficult⁶, specifically between streams and sub-streams.

Unspecified habitats, where no fishing habitat is indicated, are reported for all but plateau, but has a very low occurrence.

When looking at the average daily catch by fishing habitat (**Table 7a**), it is clear that there are large differences both between the fishing habitats and for the same fishing habitats in different fishing areas. For most habitats, the average daily catch in Tonle Sap is much higher than in other areas. This reflects both genuine differences in productivity, but may perhaps also indicate differences in the amount or size of gears utilised.

Values that have a low statistical accuracy, i.e. a value of the relative standard error ($\epsilon\%$) of more than 30% are indicated in dark red font with light orange background. These values are not representative either because of high variability or low numbers of observations. This is especially evident for unspecified habitats, where almost all average values for the CPUE are not statistically accurate, except for floodplain. This is caused by unspecified habitats including more than one unique habitat with different fishery characteristics.

The significance of the daily catch is to provide a point of comparison between years, to assess if catches in other years have seen different values, to support making rough

⁶ streams are smaller perennial tributaries and rivers and sub-streams are seasonal streams.

estimates for total yield by household average and to evaluate the relative importance of key fisheries habitats for overall productivity in different fishing areas.

Table 7a. Mean reported daily household catch (kg/day) by fishing habitats and fishing areas.

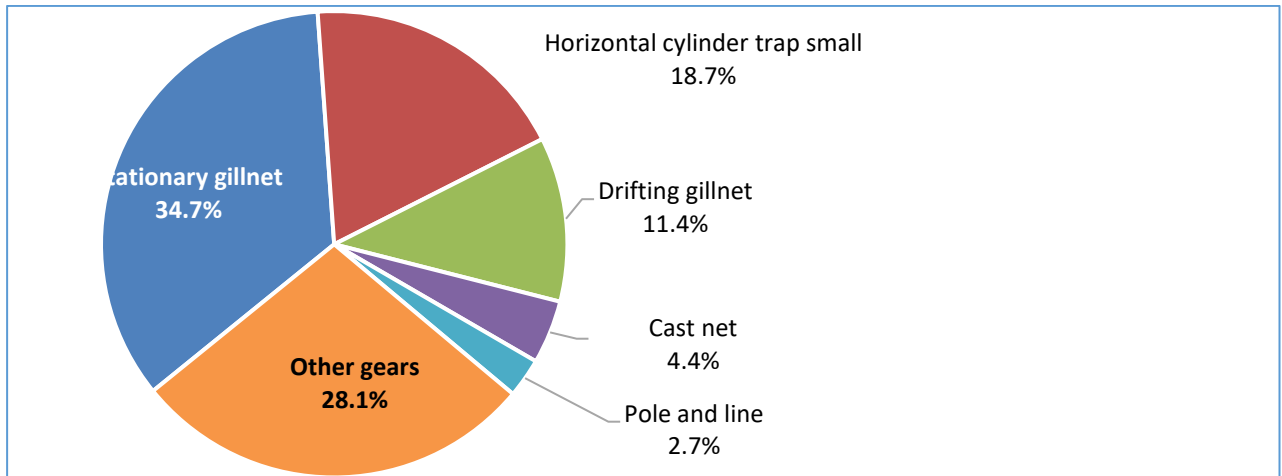
Fishing habitats	Coastal	Floodplain	Plateau	Tonle Sap	Mountain	Grand Total
Tributaries to Tonle Sap		3.2		10.1	1.6	9.1
Floodplain: flooded forest		2.7	2.0	10.1	1.3	8.9
Major Tributaries		3.9	8.3	11.9	7.7	7.6
Unspecified habitats	2.0	2.0		8.6	34.5	5.3
Mekong Mainstream		3.8	5.5	0.7	4.6	5.2
Floodplain: rice fields (flooded)	6.3	2.9	2.6	5.9	1.9	4.5
Reservoir	1.5	3.2	2.7	4.2		3.9
Permanent swamps		1.4		9.2		3.6
Floodplain: rice fields (rain)	3.5	2.8	2.3	4.5	3.2	3.6
Floodplain: lakes and ponds	2.5	3.3	2.3	3.8	3.9	3.5
Stream	1.9	4.6		3.1	4.4	3.1
Sub-Stream	1.0	2.2	3.3	1.6	5.3	2.6
Irrigation canals	1.8	1.9	1.9	1.7	2.2	1.8
Seasonal swamps	2.8	1.1		1.2		1.3

Table 7b. Proportion of habitat fishing days by fishing areas.

Fishing habitats	Coastal	Floodplain	Plateau	Tonle Sap	Mountain	Grand Total
Tributaries to Tonle Sap	-	10.7%	-	30.7%	0.1%	15.3%
Floodplain: flooded forest	-	0.8%	0.2%	3.3%	0.4%	1.7%
Major Tributaries	-	5.2%	5.3%	1.7%	11.6%	4.3%
Unspecified habitats	1.7%	1.4%	-	0.5%	0.1%	0.6%
Mekong Mainstream	-	10.7%	55.5%	0.1%	0.8%	14.8%
Floodplain: rice fields (flooded)	1.3%	4.3%	2.4%	4.2%	0.9%	3.4%
Reservoir	3.9%	1.6%	0.2%	3.8%	-	2.1%
Permanent swamps	-	0.3%	-	0.1%	-	0.1%
Floodplain: rice fields (rain)	35.7%	24.9%	5.0%	18.6%	49.1%	20.7%
Floodplain: lakes and ponds	13.9%	16.2%	7.0%	13.1%	32.9%	14.6%
Stream	17.4%	0.8%	0.0%	10.8%	2.4%	5.6%
Sub-Stream	2.2%	7.2%	23.7%	7.3%	0.4%	10.0%
Irrigation canals	23.5%	15.4%	0.8%	5.5%	1.3%	6.6%
Seasonal swamps	0.4%	0.3%	-	0.3%	-	0.2%

Meanwhile, the proportion of fishing effort for fishing habitats by fishing area (**Table 7b**), provides insights into where households fish and how their mean fishing days are distributed.

The most important gears, based on their contribution to the reported catch (



), are stationary gillnet (34.7%), horizontal cylinder trap (18.7%) and drifting gillnet (11.4%), Seines (3.9) and Cast net (4.4%). Differences in gear contribution, e.g. cast net sees a decline in use from 2022, are likely due to 2023 data not covering the dry season. Unspecified gears contribute 6.8% of the overall reported catch.

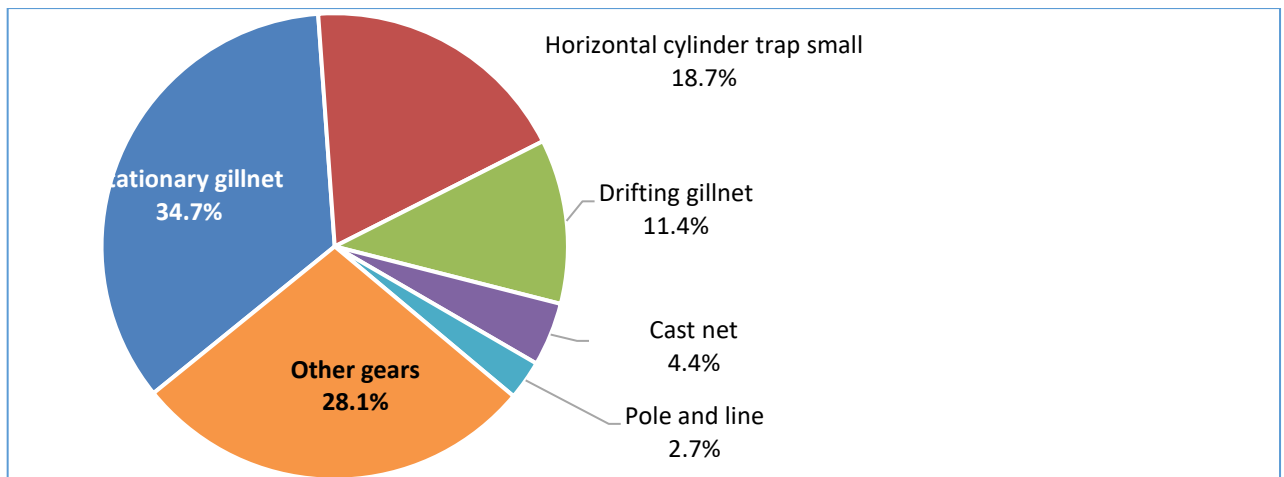


Figure 4. Overall contribution of the gears to total reported catch.

Similar to the importance of different habitats, the importance of contribution of gears to the reported catch largely reflects the different characteristics of the fishing area (**Table 8**). Stationary gillnets are most important for Plateau and drifting gillnets are more important for Floodplain. Horizontal cylinder traps are almost equally important in all fishing zones, but contribute a larger proportion of the catch in Tonle Sap and Coastal, with, but smaller cylinder traps by far more important than large traps.

Unspecified gears, where no gear type is specified, are found in all fishing areas and contribute 9.4% of the total reported catch, but contribution to the catch is especially prevalent for Mountainous.

Table 8. Proportion of reported catch by gear and fishing area for single gear days.

Fishing gear	Coastal	Floodplain	Plateau	Tonle Sap	Mountain	Grand Total
Stationary gillnet	34.4%	21.8%	71.9%	27.9%	17.5%	34.7%
Horizontal cylinder trap	17.2%	11.1%	6.3%	26.2%	10.5%	18.7%
Drifting gillnet	10.2%	29.9%	10.1%	8.6%	1.5%	11.4%
Unspecified gears	2.8%	1.8%	3.4%	10.1%	34.0%	9.4%

Fishing gear	Coastal	Floodplain	Plateau	Tonle Sap	Mountain	Grand Total
Cast net	3.9%	8.1%	1.6%	3.4%	11.5%	4.4%
Seine nets	0.0%	2.0%	0.0%	6.4%	0.4%	3.9%
Hand capture	20.3%	4.6%	0.2%	4.2%	4.1%	3.8%
Pole and line	1.3%	3.0%	3.4%	2.5%	2.4%	2.7%
Horizontal cylinder trap	0.3%	1.3%	0.6%	3.3%	3.3%	2.4%
Hook long line	0.5%	1.3%	0.5%	3.5%	0.0%	2.3%
scoop nets	0.0%	0.1%	0.0%	2.6%	0.0%	1.4%
Bamboo vertical cylinder trap	2.5%	6.1%	0.0%	0.2%	2.6%	1.3%
Spear	3.2%	5.0%	0.0%	0.3%	0.3%	1.0%
Hook and line	0.0%	1.2%	2.0%	0.7%	0.5%	1.0%
Lift nets	0.0%	0.1%	0.0%	0.0%	10.8%	0.9%
Pumping	0.0%	1.1%	0.0%	0.0%	0.0%	0.2%
Push nets	2.5%	0.0%	0.0%	0.1%	0.2%	0.2%
Pair trawl	0.5%	0.8%	0.0%	0.0%	0.0%	0.1%
Giant cast nets	0.2%	0.5%	0.0%	0.0%	0.0%	0.1%
scoop baskets	0.0%	0.1%	0.0%	0.0%	0.0%	0.03%
Bag nets	0.0%	0.1%	0.0%	0.0%	0.0%	0.02%
Bow and guns	0.3%	0.0%	0.0%	0.0%	0.1%	0.02%
Covering devices	0.0%	0.0%	0.0%	0.0%	0.2%	0.02%
Wedge cone trap	0.0%	0.0%	0.1%	0.0%	0.0%	0.01%
Giant lift nets	0.0%	0.0%	0.0%	0.0%	0.1%	0.01%
Drop door trap	0.0%	0.0%	0.0%	0.0%	0.0%	0.003%
Single gear reported catch	586.6	3,963.3	5,208.4	15,119.6	2,262.1	27,140.0

Table 8 only includes catch for fishing days that report fishing with a single gear, therefore the total is different from reported catch by habitat. As indicated in **Table 9**, overall, 27.9% of the reported catch is from fishing with multiple gears on a single fishing day. The proportion of the catch, reported for multiple fishing gear days is highest for mountainous households (48.5%) followed by Plateau (33.5%).

Table 9. Proportion of reported catch from multiple gear fishing days

Fishing gear	Coastal	Floodplain	Plateau	Tonle Sap	Mountain	Grand Total
Multiple gears	22.4%	23.8%	33.5%	22.2%	48.5%	27.9%
Multiple gear reported catch	169.3	1,236.0	2,624.2	4,324.4	2,133.6	10,487.5

Using the reported number of fishing days, instead of catch, makes some difference for the relative importance of gears. Those gears with a higher catch per unit of effort (CPUE), like seines may have a higher percentage of the catch but a lower proportion of effort.

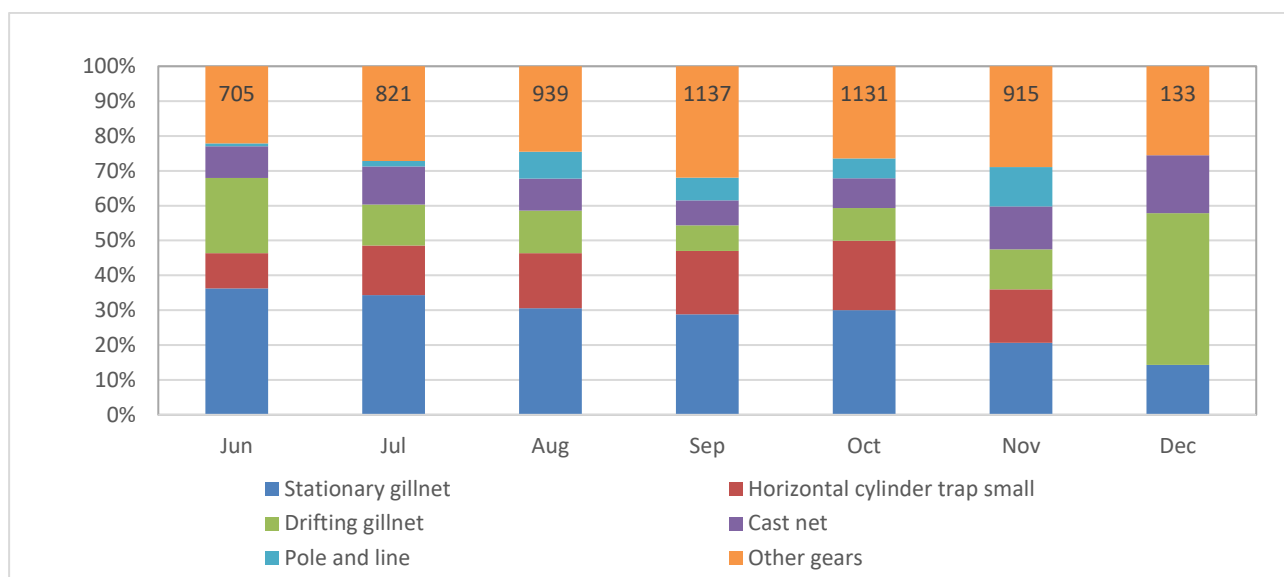


Figure 5. Overall contribution of monthly effort (fishing days) for top 5 gear types by month, with total number of reported fishing days.

Table 10. Mean daily reported catch (kg/day) by gear and fishing area, with total reported effort (days).

Fishing Gear	Coastal	Floodplain	Mountain	Plateau	Tonle Sap	Overall	Effort
Stationary gillnet	3.7	3.3	2.7	7.5	5.7	5.5	1701
Horizontal cylinder trap small	2.3	3.2	9.9	3.8	6.5	5.6	908
Drifting gillnet	1.8	3.4	3.7	3.8	7.1	4.3	715
Cast net	1.5	2.2	2.7	2.1	2.0	2.2	553
Unspecified gears	2.3	1.9	5.7	3.9	8.8	6.4	397
Pole and line	3.8	2.3	1.6	1.6	2.8	2.2	334
Hand capture	2.6	2.6	1.8	3.0	4.6	3.4	305
Bamboo vertical cylinder trap	1.7	2.2	2.9		1.9	2.2	157
Hook and line		2.5	0.7	1.1	3.1	1.7	162
Horizontal cylinder trap large	1.0	3.8	3.3	3.6	5.8	4.9	133
Hook long line	2.8	3.0		1.1	6.5	5.0	122
Spear	3.2	2.0	1.4		4.5	2.2	123
Seine nets		3.6	1.6		28.6	17.4	61
Push nets	1.9		0.9	0.5	2.3	1.7	26
Lift nets		3.0	9.8			9.5	26
scoop nets		2.6			24.1	22.9	17
Pair trawl	2.8	4.5				4.3	8
Wedge cone trap				0.5		0.5	6
scoop baskets		1.8			0.5	1.1	6
Giant cast nets	1.0	5.3				4.4	5
Bag nets		1.8				1.8	3
Pumping		21.5			0.7	11.1	4
Bow and guns	1.5		1.4			1.4	3
Covering devices			1.4			1.4	3
Drop door trap				0.4		0.4	2
Giant lift nets			2.9			2.9	1

There is a distinct seasonality for some of the gears (**Figure 5**). With pole and line almost entirely limited to the flood season and horizontal cylinder traps more important during the flood season. On the other hand, cast nets are commonly used year-round but are most active during the early and peak dry season. Note that the data for December only represents 3 mountainous and 5 Tonle Sap villages and this is not representative for the overall fisheries.

The available data allows to calculate the mean daily catch by gear or the catch per unit of effort (CPUE), which is included in **Table 10**, as well as the total reported fishing days for non-zero catch. The gears are sorted by the total reported effort, with all values for the CPUE, assessed for their statistical precision, an orange back ground and red font indicates values with a $\epsilon\%$, higher than 30%. With only a few exceptions, e.g. small Horizontal cylinder traps for mountainous households, most gears have the highest mean CPUE for households in the Plateau or Tonle Sap fishing areas. Differences between gears for the same fishing area are relatively small. Gillnets, as passive gears, are by far one of the most important gears, both in terms of effort and CPUE.

As can be seen (**Table 11**), selling of fish is most important for Floodplain and Tonle Sap fishing areas, where respectively 46.1% and 72.0% of the reported catch is sold. In most fishing areas, more than about 35% of the catch by the household is consumed, with the exception of Tonle Sap, where only 16.9% consumed. Household consumption only covers fish and OAA consumed fresh, from the household catch. Other use of the catch is mainly for processing, with some use in aquaculture (and crocodile culture) by households, this is highest for Plateau and coastal fishing areas, whereas it is lowest in Tonle Sap and floodplain, where fish is available almost year-round.

Table 11. Reported disposal by fishing area in weight and proportion.

Fishing Area	Sold (Kg)	%Sold	Consumed (Kg)	%Consumed	Other (Kg)	%Other
Coastal	248.8	32.9%	302.8	40.1%	204.3	27.0%
Floodplain	2,398.0	46.1%	1,808.1	34.8%	993.2	19.1%
Plateau	2,584.6	33.0%	2,738.3	35.0%	2,509.7	32.0%
Tonle Sap	13,998.4	72.0%	3,285.8	16.9%	2,159.8	11.1%
Mountainous	1,666.7	37.9%	1,625.6	37.0%	1,103.5	25.1%
Total	20,896.5	55.5%	9,760.6	25.9%	6,970.4	18.5%

The disposal for all fishing areas combined (**Figure 6**), suggests that most of the reported catch is sold⁷. This is heavily influenced by the data from Tonle Sap fishing area, that has the highest proportion sold and contributes more than 50% of the total reported catch. It therefore is better to separate the fishing areas by month, to show the differences in proportion sold between them and for the time of year.

⁷ Based on calculated standardized weights for disposal categories based on the relative importance of total reported catches by fishing area.

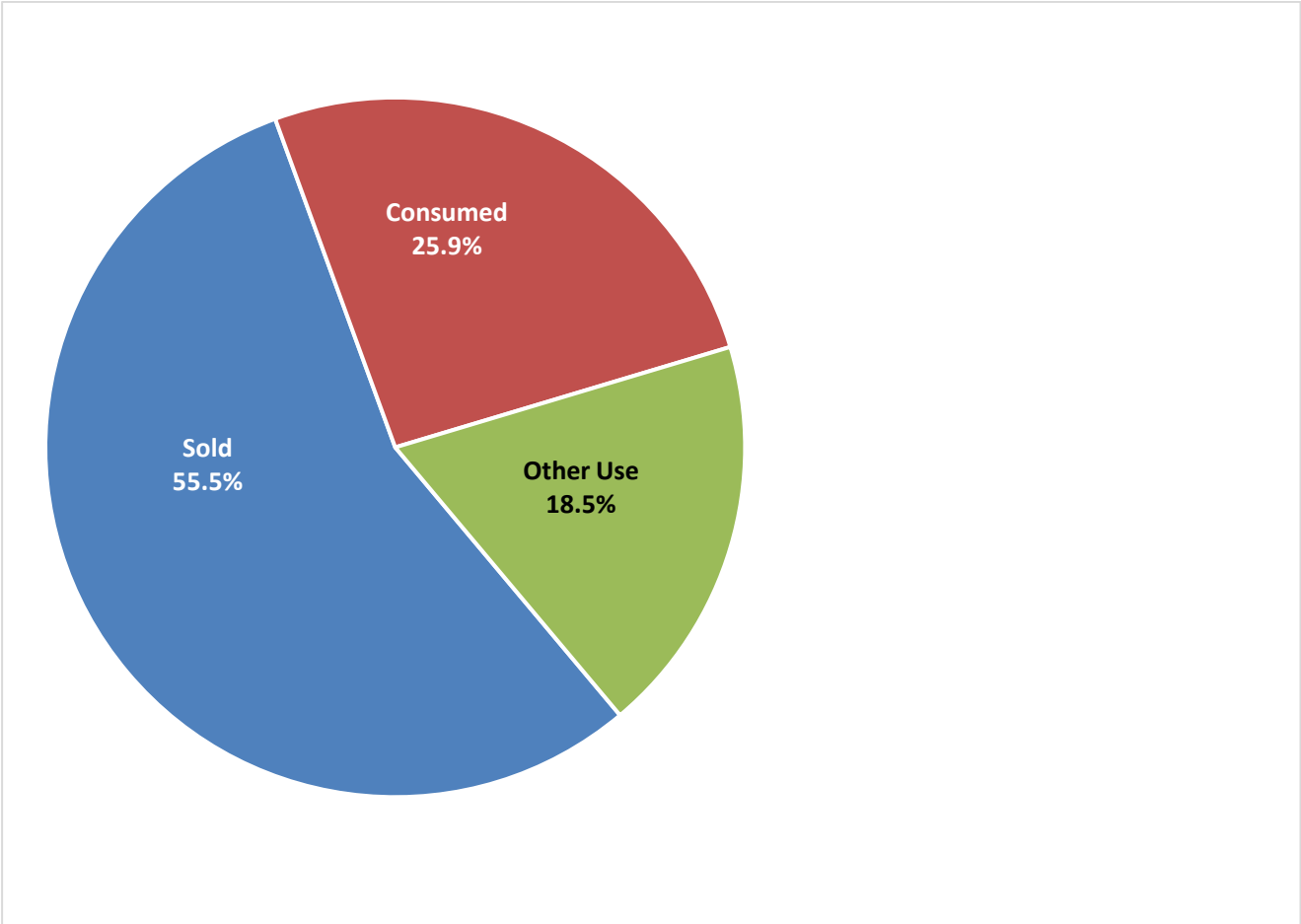


Figure 6. Overall disposal for 2023, by main category for all fishing areas combined.

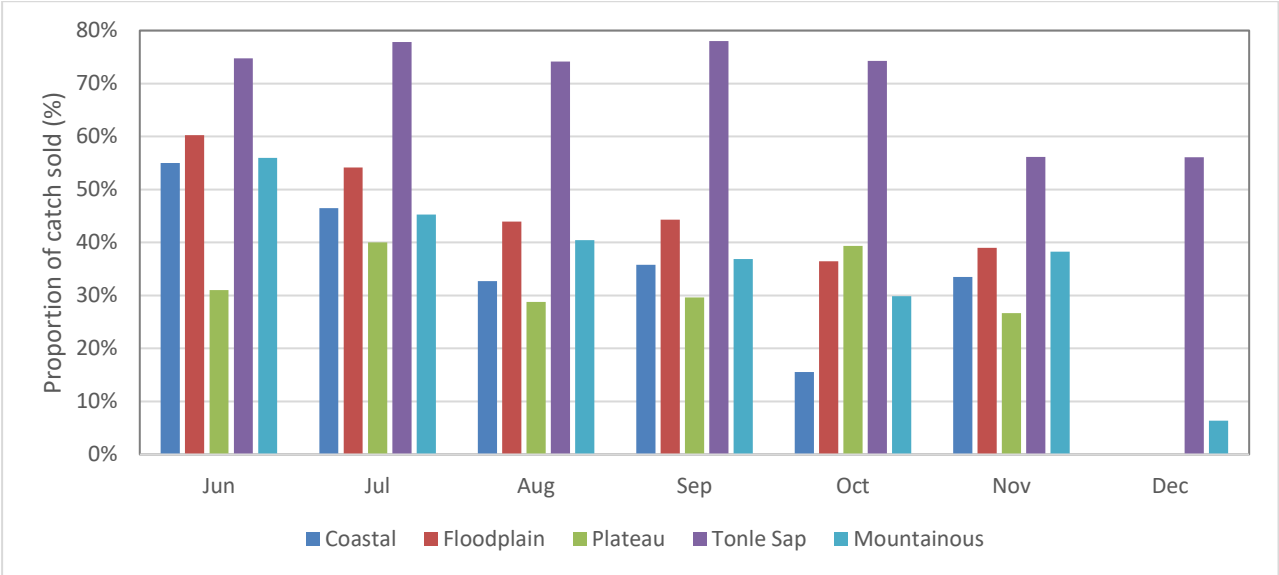


Figure 7. Overall monthly proportion of the catch sold, by fishing area.

Seasonal differences are apparent from **Figure 7**, with selling of the catch generally more important for the early rainy season, but with the proportion of catch sold at consistent levels for Jun-Nov for most fishing areas. The proportion of the catch sold is always highest for Tonle Sap and lowest for Plateau, except for October where there is a clear peak in the fish supply for Plateau.

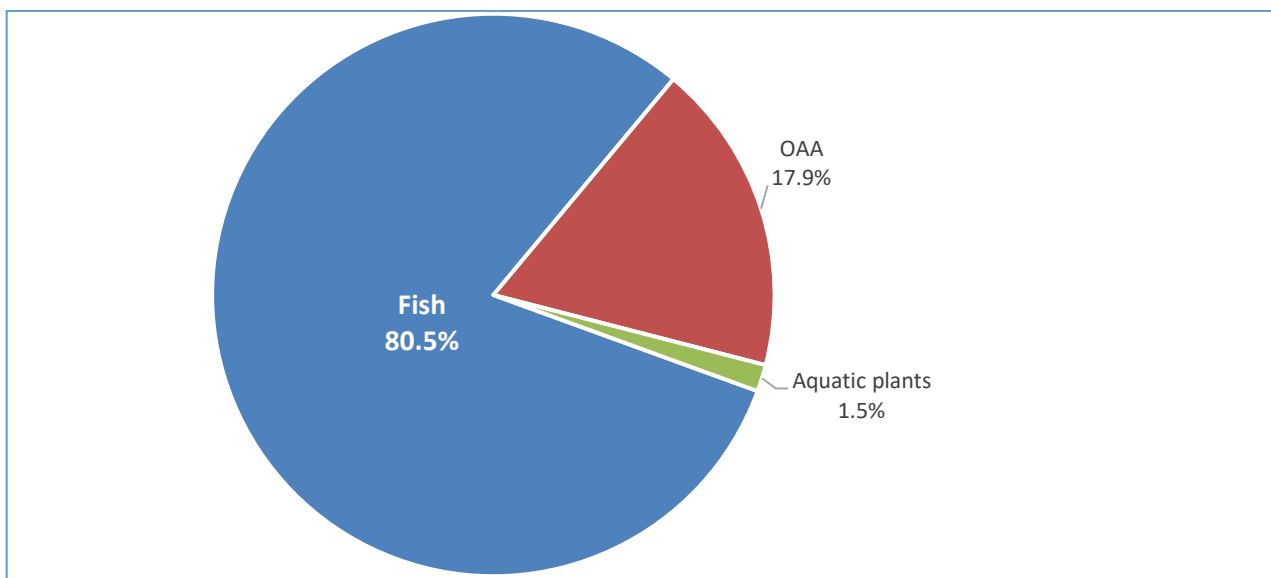


Figure 8. Overall catch contribution for fish and other aquatic animals in 2023

The available data in **Figure** , shows that fish represents the bulk of the reported catches at 80.5%, with OAA contributing 17.9% overall. Although there is some seasonality (**Figure**), this is mainly because of increased OAA during the rainy season, when a higher proportion of the catch is made up of OAA. Since the 2023 data doesn't cover the dry season (except for a small number of villages in December) 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.

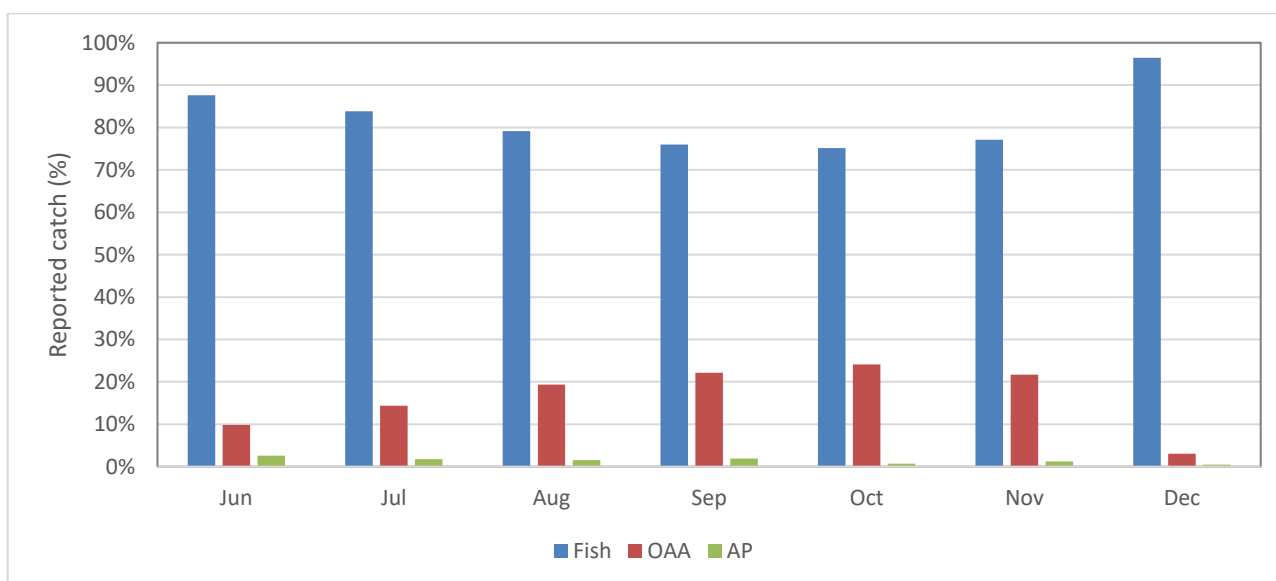


Figure 9. Reported fish and Other Aquatic Animals (kg), by month.

The top 20 species catch is shown in **Table 12**, with the following observations:

- Species groups (including sp. and species/groups nei⁸), represents 24.0% of the total catch;
- The non-fish species in the top 20 are freshwater crabs (*Somanniathelphusa* sp.) mixed small or juvenile fish, small mixed shrimps, aquatic insects and golden apple snail (*Pomacea canaliculate*); and,

⁸ nei: not elsewhere included

- A total of 139 species and species groups are included in the data. The top 20 represents almost 75% of the total reported catch⁹.

Table 12. Top 20 reported species catch by weight for 2023, 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>Puntioplites proctozysron</i>	ត្រីប្រៃកែង	4,286.4	11.4%	11.4%
2	<i>Somanniathelphusa sp.</i>	ក្ដាមស្រែ	3134.1	8.3%	19.7%
3	Mixed small or juvenile fish	ត្រីល្អិតចម្រុះ	2747.0	7.3%	27.0%
4	<i>Channa striata</i>	ត្រីវីស/ធ្នាក់	2404.3	6.4%	33.4%
5	<i>Henicorhynchus siamensis</i>	ត្រីរៀលតុប	2089.5	5.6%	39.0%
6	<i>Anabas testudineus</i>	ត្រីក្រាញ់	1778.7	4.7%	43.7%
7	<i>Henicorhynchus lobatus</i>	ត្រីរៀលអង្កាម	1598.6	4.2%	47.9%
8	<i>Hypsibarbus malcolmi</i>	ត្រីឆ្អិនមូល	1361.0	3.6%	51.6%
9	<i>Barbonymus gonionotus</i>	ត្រីឆ្អិនប្រាក់	924.3	2.5%	54.0%
10	<i>Hemibagrus spilopterus</i>	ត្រីឆ្នាំង	862.6	2.3%	56.3%
11	Small mixed shrimps	កំពីសចម្រុះ	861.8	2.3%	58.6%
12	<i>Mystus singaringan</i>	ត្រីកញ្ចុះបាយស	740.4	2.0%	60.6%
13	Aquatic insects nei	វារីសត្វល្អិត គ្មានក្នុងក្រុមដទៃ	738.8	2.0%	62.5%
14	<i>Mystus mysticetus</i>	ត្រីកញ្ចុះឆ្នុត	734.9	2.0%	64.5%
15	<i>Notopterus notopterus</i>	ត្រីស្លាត	691.3	1.8%	66.3%
16	<i>Trichopodus trichopterus</i>	ត្រីកំភ្លាញស្រែ	658.4	1.7%	68.1%
17	<i>Labiobarbus siamensis</i>	ត្រីអាចម៍កុក	648.2	1.7%	69.8%
18	<i>Osteochilus lini</i>	ត្រីក្រុស	645.2	1.7%	71.5%
19	<i>Cyclocheilichthys enoplos</i>	ត្រីឆ្កោក	640.9	1.7%	73.2%
20	<i>Pomacea canaliculata</i>	ខ្យង	610.3	1.6%	74.8%
Other		ផ្សេងទៀត	9,470.28	25.2%	
Total reported catch			37,626.8		

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, highly aggregated species groups, e.g. other fish nei, where no species name was provided at all, represents 11.8% of the catch and is mainly due to contribution of mixed small or juvenile fish (7.3%), small mixed shrimps

⁹ Species belonging to the genus of *Henicorhynchus*, when combined would be fourth by weight or about 7% of the total catch.

(2.3%) and aquatic insects (2.0%). Other fish nei, only contributes 0.2% of the total reported catch.

Table 13. Top 20 reported species **by value** (1000 Riel) for 2023, with reported value, proportion of value and average price.

	Scientific name	Khmer name	Value (1000 Riel)	%Value	Price (Riel)
1	<i>Puntioplites proctozysron</i>	ត្រីច្រកែង	13,792.4	12.0%	6,425
2	<i>Channa striata</i>	ត្រីវីស/ធ្នាក់	12,276.6	10.7%	11,100
3	<i>Hemibagrus spilopterus</i>	ត្រីឆ្មាំង	4,962.8	4.3%	10,700
4	<i>Henicorhynchus siamensis</i>	ត្រីរៀលតុប	4,860.9	4.2%	6,475
5	<i>Macragnathus siamensis</i>	ត្រីឆ្មុញ	4,469.3	3.9%	14,125
6	<i>Hypsibarbus malcolmi</i>	ត្រីឆ្អិនមូល	4,351.9	3.8%	5,600
7	<i>Somanniathelphusa sp.</i>	ក្តាមស្រែ	4,287.3	3.7%	2,750
8	<i>Mystus singaringan</i>	ត្រីកញ្ចុះបាយស	4,175.3	3.6%	6,200
9	<i>Barbonymus gonionotus</i>	ត្រីឆ្អិនប្រាក់	3,790.3	3.3%	8,225
10	<i>Cyclocheilichthys enoplos</i>	ត្រីឆ្កោក	3,679.5	3.2%	11,050
11	<i>Mystus mysticetus</i>	ត្រីកញ្ចុះឆ្មុត	3,598.5	3.1%	6,850
12	<i>Anabas testudineus</i>	ត្រីក្រាញ់	3,571.1	3.1%	6,225
13	Mixed small or juvenile fish	ត្រីល្អិតចម្រុះ	3,456.9	3.0%	4,625
14	<i>Notopterus notopterus</i>	ត្រីស្មាត	3,160.7	2.8%	6,725
15	<i>Henicorhynchus lobatus</i>	ត្រីរៀលអង្កាម	2,378.6	2.1%	5,125
16	<i>Osteochilus lini</i>	ត្រីក្រុស	1,812.7	1.6%	5,650
17	Small mixed shrimps	កំពីសចម្រុះ	1,794.9	1.6%	6,300
18	Aquatic insects nei	វារីសតូល្អិត គ្មានក្នុង ក្រុម ដទៃ	1,452.1	1.3%	3,225
19	<i>Micronema sp.</i>	ត្រីកែស	1,427.5	1.2%	15,125
20	<i>Henicorhynchus lobatus</i>	ត្រីរៀលអង្កាម	2,378.6	2.1%	5,125
Other species			28,744.84	25.1%	
Total reported value			114,478.6		

The reported catch by value, is included in **Table 13**. The top 20 species represent almost 75% of the total reported value, indicating that the number of species with economic importance is relatively wide. Prices are based only on actual sales value when part or all of the catch is sold and rounded to the nearest 25 Riel.

3. DISCUSSION AND RECOMMENDATIONS

Due to late arrival of the EU Budget Support, the start of CAS data collection was delayed compared to 2022 and implemented from June-December 2023, with a much-reduced sample for December. No data was collected for the first 5 months of the year. Therefore, the sampling doesn't properly represent the seasonality inherent in Cambodian freshwater fisheries. However, with full inclusion of a sizable household sample for both Coastal and Mountainous fishing areas and a much higher overall village and household sample, the 2023 CAS provides a much better coverage than both 2021 and 2022 surveys. The number of villages was more than doubled, as was the number of households interviewed each month.

The 2023 sampling design has a good coverage for all fishing areas, despite not properly representing seasonality in fishing activities, including some villages in Ratanakiri (which covers parts of the watershed for of 3 main tributaries to the Mekong). Mountainous provinces, are covered by Tboung Khmoum and Kampong Speu provinces, with all 3 villages from coastal from Kampot, taking this as representative for fishing in Koh Kong and Sihanouk as well. The 2023 data collection is much improved from 2021-2022 data collection and provides a much more representative data and information for the entire inland fisheries. However, while the spatial coverage is quite good, the data collection effectively is limited to a 6-month period, from June-November 2023. This means that the current findings, although representing the entire inland fisheries cannot be used to show seasonal differences, with fish abundance is highly dependent on seasonal flood, as indicated above. Therefore, the data cannot be used to provide a total catch estimate for the entire year. In comparison with the 2022 analysis several improvements can be pointed out, the 2023 data includes more species, a higher proportion of OAA (with even inclusion of aquatic plants) and removes the sampling bias that was responsible for over-estimating the contribution of fishing without a boat.

However, due to the seasonality present in the fishery, it isn't possible to calculate a total catch estimate for the entire year accurately, as the available data is based only on data for the more productive flooding season. A straight extrapolation of the available data for June-November, to the entire year, overestimates the total catch, while assuming that the average catch for April-May 2022 (33,350 MT) can be used for estimating the missing catch estimates for January-May and December, would lead to a total catch for 2023 of 489,423 MT, but this is most likely still an over-estimate and the real level of annual yield, cannot be estimated.

Based on the reported catch by habitat, 32.9% is caught in floodplain habitats associated with rice fields (including irrigation canals), whereas this is 37.0% in the official FiA statistics.

Table 14. Comparison of the official published 2023 total catch, with the CAS based estimate (MT).

Inland fisheries	FiA DPFC		IFReDI CAS
Dai fisheries	13,650		
Family fishing (fishing grounds)	260,300	63.0%	77.1%
Family fishing (rice fields)	152,800	37.0%	32.9%
Total	426,750		489,423

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

The FiA DPFC percentages refer to family fishing only, to make them comparable to the IFReDI CAS results

The official 2023 estimate as published by FiA is 426,750 MT for inland fisheries (**Table 14**), with 413,100 MT for family fisheries covered by the CAS. This amount is the only capture fisheries statistics available and this is a poor indicator for status and trends in the inland fisheries. Although it is somewhat informative to compare the total yield between the administrative reporting derived fisheries statistics and the IFRDI CAS, it makes more sense, to look at involvement and dependency, species detail, gear and habitat effort and CPUE (daily catch). These are the indicators that better represent the status of the fisheries.

Table 15. Mean daily catch, effort and proportion of active fishing households by province and month, for June-November 2023

Fishing Area	Province	Active HH	Monthly Effort (days)	CPUE (kg/day)	ε%	Monthly HH catch (kg)
Coastal	Kampot	46.3%	13.9	2.34	8.4%	32.6
Floodplain	Kampong Cham	48.9%	16.7	4.19	7.4%	70.1
Floodplain	Kandal	48.1%	17.0	2.66	8.3%	45.2
Floodplain	Prey Veng	41.7%	11.0	2.84	5.6%	31.3
Floodplain	Svay Rieng	61.1%	12.1	2.22	6.2%	27.0
Floodplain	Takeo	47.2%	13.3	2.32	9.2%	30.8
Plateau	Kratie	78.5%	15.0	2.45	6.6%	36.8
Plateau	Ratanak Kiri	71.7%	13.8	2.99	8.0%	41.2
Plateau	Stung Treng	69.6%	19.7	5.12	6.4%	100.7
Tonle Sap	Banteay Meanchey	59.1%	13.4	4.03	14.7%	53.9
Tonle Sap	Battambang	71.6%	14.9	3.63	11.2%	54.1
Tonle Sap	Kampong Chhnang	61.2%	18.7	5.74	8.1%	107.6
Tonle Sap	Kampong Thom	49.2%	17.8	2.42	7.2%	43.1
Tonle Sap	Pursat	69.2%	19.0	8.46	8.5%	161.0
Tonle Sap	Siemreap	53.5%	18.3	6.85	13.2%	125.7
Mountainous	Kampong Speu	54.4%	14.6	2.49	6.1%	36.4
Mountainous	Tboung Khmum	67.7%	20.1	5.24	7.6%	105.2
Grand total		58.1%	16.0	3.96	2.7%	63.5

As can be seen in

Table 15, comparing the main indicators for catch and effort shows some distinct differences between the provinces. The shading provides an easy way to identify the highest values for each indicator. The highest proportion of active fishing households is found for Kratie (78.5%, followed by Ratanak Kiri, Battambang, Stung Treng and Pursat, that have very similar values. Effort is highest for Tboung Khmum (20.1 days), followed closely by Stung Treng and Pursat, while the CPUE (daily catch), is highest for Pursat (8.46 kg/day), followed at some distance by Siem Reap (6.48 kg/day). The mean monthly household catch are obtained by multiplying the effort with the CPUE. This is highest for Pursat (161 kg), followed at some distance by Siem Reap (125.7 kg) and then by a group of provinces including Kampong Chhnang, Stung Treng and Tboung Khmum with about 100-105 kg.

Keeping in mind that this represents only the period of June-November, the period with the highest catches, most values seem realistic, but some of the higher values don't seem representative for the entire province, e.g. Tboung Khmum and provinces where the villages selected mainly are riparian, with insufficient coverage for hinterland villages. The sampling design was not intended to be used to estimate by province, but by fishing areas. In addition, because the CAS is a recall survey some of the data could well be inaccurately remembered by respondents, especially in areas with limited dependency on fishing in hinterland areas away from main aquatic habitats.

In part, due to the much higher sample and better distribution and representativeness, estimates for gear and habitat catch (and effort), for most fishing areas, are statistically accurate for the main survey period covered by the CAS. Monthly estimates for daily catch, by province, can be estimated (**Table 16**), based on the current sample size, but has some statistically issues for some months and provinces. At the same time, the distribution of villages may not provide a representative sample for the entire province, leading to sampling bias. Since the highest occurrence of estimates with a high value for $\epsilon\%$, is for June, it is expected that this is especially an issue for the dry season when less households are fishing in combination with a higher variation for the reported catches due to targeted opportunity fishing when floodplain habitats dry up. However, it is expected that only a modest increase of the sample size would need to be considered to allow estimates for catch and effort by province. This would require, adding more villages for province included in the current sample for floodplain and Tonle Sap and tentatively, adding coverage for the 6 coastal and mountainous provinces (excluding Kep), not currently included. The sampling design depends on exactly what needs to be estimated, but the indicated household sample size of almost 1600 households in **Table 16**, would allow for monthly provincial estimates to be made year-round for both CPUE (daily catch) and effort, but without guarantee that estimates by gear and habitat would always be statistically valid.

Table 16. Estimated household CPUE (kg/day) and current and recommended sample size by province.

Fishing Area	Province	Jun	Jul	Aug	Sep	Oct	Nov	2023 sample	Provincial sample
Coastal	Kampot	2.32	2.61	2.05	2.24	2.46	2.36	45	60
Floodplain	Kampong Cham	4.26	4.40	3.96	6.02	1.80	3.79	60	90
Floodplain	Kandal	3.62	4.29	1.88	2.34	2.25	2.31	45	75
Floodplain	Prey Veng	1.50	1.86	2.40	3.45	2.96	2.88	60	90
Floodplain	Svay Rieng	1.23	2.40	3.51	1.66	1.96	1.98	45	75
Floodplain	Takeo	2.62	3.06	3.18	1.49	2.32	1.67	45	75
Plateau	Kratie	4.12	1.92	2.73	2.14	2.06	2.22	45	45
Plateau	Ratanak Kiri	3.23	2.55	4.99	2.15	2.79	2.09	45	45
Plateau	Stung Treng	9.23	7.09	4.62	4.05	4.36	2.90	45	45
Tonle Sap	Banteay Meanchey	4.98	1.95	2.56	2.06	6.21	4.59	45	75
Tonle Sap	Battambang	4.17	4.54	1.86	3.81	2.30	4.54	60	90
Tonle Sap	Kampong Chhnang	6.43	3.80	5.78	5.44	7.20	4.50	45	75
Tonle Sap	Kampong Thom	3.21	3.04	2.63	1.85	1.99	2.24	45	75
Tonle Sap	Pursat	7.23	7.49	6.96	11.34	9.49	3.69	45	75
Tonle Sap	Siemreap	11.72	12.15	5.00	5.19	5.05	5.54	60	90
Mountainous	Kampong Speu	3.44	2.15	2.34	2.57	2.43	2.54	45	75
Mountainous	Tboung Khmum	6.28	3.40	5.49	5.58	5.05	5.47	60	60

Fishing Area	Province	Jun	Jul	Aug	Sep	Oct	Nov	2023 sample	Provincial sample
Coastal	Remaining 2 provinces not currently covered								120
Mountainous	Remaining 4 provinces not currently covered								240
Total household sample								840	1575

The current sample design implemented for the 2023 CAS, was a deliberate choice, given the time and resource limitations. Decentralising data collection to FiAC would allow for the data collection to be spread out better over each month and provide a much better coverage in space and time as the basis for statistical reporting. However, the proposed level of data collection, is unlikely to be implemented as routine data collection by provincial staff, due to cost and staff requirements. Therefore, an alternative approach would be to utilise the results of the CAS as input for a more detailed look at the status of inland fisheries and as a way to evaluate and supplement the basic inland fisheries yield included in the official fisheries statistics. The 2023 CAS provides a good basis for the current status and what is needed for assessing trends is for the CAS to be repeated at 3-5 year intervals, while at the same time improve the level of detail included in the fisheries statistics, specifically on species catch and effort, as well as involvement and dependency.

Recommendations

- IFRaDI decided not to conduct the CAS survey after 2023, the cleaned and anonymised data for both the Household Selection Interview (HIS) and the Household Catch Interview (HCI), with full documentation, needs to be consolidated in FIMS for making it easier to access, for more in depth analysis;
- If the CAS will be implemented at a 3- or 5-year interval, this needs to re-sample all households, which provides an opportunity to also assess the proportion of non-fishing households and the fishing dependency of the fishing households as an indicator for the role of fisheries for income and food security;
- IFRaDI needs to make preparations for securing budget for conducting the CAS every 3- or 5-years as a periodical fisheries assessment survey;
- It is crucial that IFRaDI is involved in decision making related to indicators for monitoring the fisheries and assessing the effectiveness of management interventions, including the focus for the fisheries statistics. This requires close collaboration with Department of Planning, Finance and International Cooperation (DPFIC), especially in relation to preparing a roadmap for the National Strategy Data collection for Fisheries and Aquaculture under the FiA Working Group on Statistics and Information Management (WSIM);
- IFRaDI needs to advance an approach for how the results of the CAS will be used to improve the official statistics for inland fisheries, with technical support from FAO CAPFISH, to work closely with the DPFIC, to agree on how the results from the CAS will be used to improve national fishery statistics;
- If routine data collection by FiAC staff on catch and effort, is implemented, this would need to be piloted during 2024, with technical support from IFRaDI staff, before making a decision on rolling it out across all provinces. This would require
 - Identifying provinces willing to test the approach
 - Rationalise the data collection form for use by 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
 - Requirements 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, for example by open water and rice field (floodplain) areas
- With the larger household sample, it is highly recommended to do a follow-up analysis, comparing the fisheries dependency assessment (included in the HSI data) for the 2021-2022 sample with that from the expanded 2023 sample, as well as a comparison with the results of the 2023-2024 fish consumption and income survey that is planned for 2023 and 2024. This may support observed shifts and importance of boat use, effort and daily catches;
- The distribution of provinces by fishing area, needs to be reviewed and decided:
 - For 2022 analysis Kampong Speu was included for Tonle Sap, however for 2023 analysis it was added to Mountainous
 - Kampong Cham is included with Floodplain, even though FiA places it under Mekong (Plateau) fishing area
 - Banteay Meanchey is included with Tonle Sap, but is more similar to mountainous.
- Review and standardisation of habitats and gears needs to be considered, to ensure no ambivalent categories are included;
- In view of the evolution of the CAS since its inception in 2021 for sampling design, coverage and classifications used, it is recommended to update the CAS manual to reflect these changes; and,
- An overview report or scientific paper should be prepared to describe the CAS and its results for the data collected between 2021-2023.
- Finally, as proposed above, IFRoDI should set up a long-term scientific monitoring programme in Upper Mekong (main habitat for fish broodstock) and Tonle Sap Lake (that contributes about 70% to the annual catch) on ecological health, implications of climate change on species diversity and connectivity of brood-stock fish between 3S, Mekong and Tonle Sap Lake.

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	Normally included in Mekong inspectorate
Kampong Chhnang	Tonle Sap	126,299	28,523	97,776	47,232	
Kampong Speu	Mountainous	195,882	114,380	81,502	39,371	Included in Mountainous, 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	