CAPFish CAPTURE

CAPFISH-Capture: Post-harvest Fisheries Development project is implemented jointly by UNIDO and Fisheries Administration (FiA)

REPORT

Profiling Of Post-harvest Fishery Value Chains And Market System Analysis

In Battambang And Kampong Chhnang Provinces

June 2021

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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PREPARED BY:

International Development Enterprise (iDE),
Phnom Penh, Cambodia

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Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (CAPFISH-Capture)

Profiling Of Post-harvest Fishery Value Chains And Market System Analysis

Prepared for

The Fisheries Administration of Ministry of Agriculture, Forestry and Fisheries

Prepared by:

International Development Enterprise (iDE) Cambodia
and
United Nations Industrial Development Organization (UNIDO)

Foreword

Fisheries play a significant role in socio-economic development in Cambodia through providing employment, income generation and enhance food and nutrition security. It provides direct and indirect employment to around 2 million people.

Fish is an extremely perishable food product which requires proper handling soon after harvest. Proper post-harvest handling and practice could definitely create more value for fishery value chain actors. However, these issues have often received less attention in development programs.

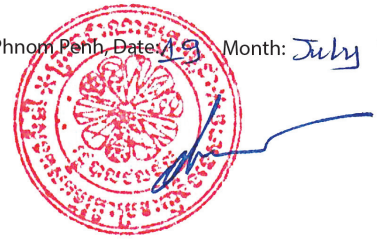
In reference to the above-mentioned, the Royal Government of Cambodia (RGC) through Ministry of Agriculture, Forestry and Fisheries (MAFF) has clearly identified fisheries as a priority sector for achieving Agriculture Sector Development Plan (ASDP 2019-2023) of MAFF. To achieve these development goals, the Fisheries Administration (FiA), has developed and adopted the Strategic Planning Framework for Fisheries (SPF 2015-2024), which consists of four key pillars, out of which Fisheries Value Chain is one of the key pillars which emphasizes a strong focus on the development of the post-harvest fisheries.

Under the CAPFish-capture: Post-harvest Fisheries Development project, co-funded by the European Union and implemented jointly by the Fisheries Administration and United Nations Industrial Development Organization (UNIDO), a study entitled "Profiling of fishery value chains and marketing systems" carried out in Battambang and Kampong Chhnang Provinces. The study describes the profiles of fisheries Micro, Small and Medium Enterprises identifying their challenges, opportunities. It also identifies the needs for both technical and financial supports for improving their business operations in order to meet market requirements and improve competitiveness. Furthermore, the study identified six fishery products with high potential for future development in terms of upgrading, value addition and exploring new markets. The key findings of this study were validated with key stakeholders in both provincial and national levels.

On behalf of Fishery Administration and Department of Fishery Post-Harvest Technology and Quality Control, I would like to encourage relevant departments, development partners and all stakeholders in fishery to make use of the key findings and recommendations of this study while designing future development programs or policies to improve the competitiveness of Cambodia's fishery products to ensure sustainable and inclusive growth in fishery sector.

I express sincere gratitude to the European Union for financial assistance through CAPFISH Capture programme and appreciate UNIDO for carrying out this important activity.

Phnom Penh, Date: 1-03 Month: July Year: 2021



Poum Sotha
Delegate of the Royal Government of Cambodia
Director General of Fisheries Administration

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List of Abbreviations

ABA	Advanced Bank of Asia
AFE	Action for Enterprise
AMK	Angkor Mikroheranhvatho Kampuchea
CCD	Community Capacity Development
CFi	Community Fisheries
CQS	Cambodia Quality Seal
EU	European Union
FiA	Fisheries Administration
FGD	Focus Group Discussion
GHP	Good Hygiene Practices
GI	Geographical Indication
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Point
HCD	Human Centered Design
HH	Household
iDE	International Development Enterprises
IDI	In-Depth Interview
ISC	Institute of Standards of Cambodia
ISO	International Organization for Standardization
KII	Key Informant Interview
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MISTI	Ministry of Industry, Science, Technology and Innovation
MoC	Ministry of Commerce
MSG	Monosodium Glutamate
MSME	Micro, Small, Medium Enterprises
NGO	Non-Governmental Organization
PDAFF	Provincial Department of Agriculture, Forestry and Fisheries
UNIDO	United Nations Industrial Development Organization
USA	United States of America
VCA	Value Chain Assessment

1.
EXECUTIVE SUMMARY

1. Executive Summary

This report provides profile of post-harvest fishery value chains and market systems in two pilot provinces, namely Battambang and Kampong Chhnang in Cambodia. The objective of the study is to identify and analyze the most promising fishery value chains that the CAPFish-Capture: Post-harvest Fisheries Development Project would focus on for future upgrading of fishery businesses undertaken in Battambang and Kampong Chhnang as well as to replicate in other provinces in Cambodia.

The study conducted a detailed analysis of the actors along the post-harvest fisheries value chains and their roles and functions in the value chains. The post-harvest fisheries value chains in Battambang and Kampong Chhnang are complex and multi-functional; the actors are mostly informal and producing variety of fishery products under very unhygienic conditions with low market competitiveness. Three main market actors identified: 1) fish processors 2) collectors/interprovincial traders 3) wholesalers/ retailers.

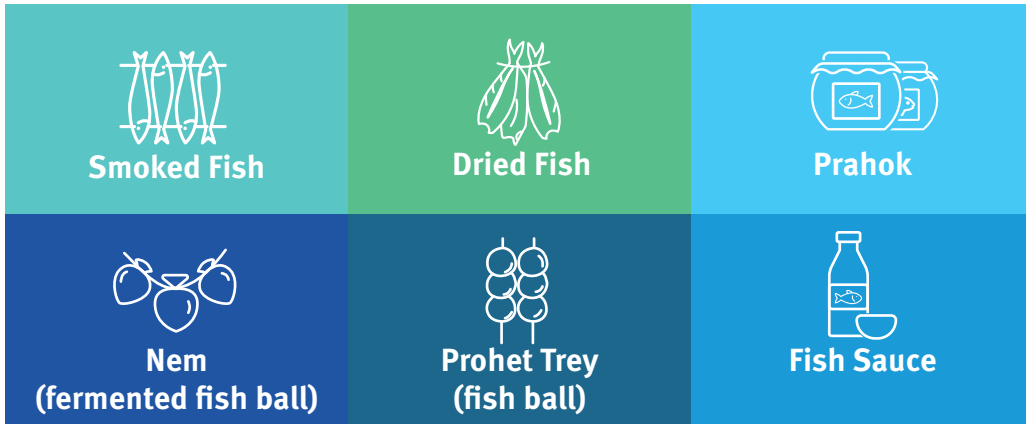
Promising Fish Products

Identification of the most promising fishery products was conducted through following two criteria:

Capacity for Outreach:
Availability of raw materials, market size, pricing, technology required for production, capital investment required and MSME growth potential

Capacity for Impact:
Income generation potential

Based on the field analysis, the study identified six fish products that have the potential to increase both income and outreach.



Fish Sauce:

This can be produced year-round by small-medium-scale processors. There is increasing demand for fish sauce domestically and for export to Vietnam, Thailand and Korea. Certification, value addition and improved processing technologies can lead to significant increases in sales, income generation and employment opportunities.

Nem:

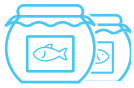
This product can be produced year-round (with use of farmed fish) by micro and small-scale processors. Battambang province is popular for producing Nem products and recently this product is in high demand in urban areas, supermarkets in Phnom Penh and has the potential to export to regional markets. Due to its recognition among the consumers, there is also the potential for Geographical Indication (GI) registration in the future if local raw materials (aquaculture and capture fish catch) are used in the production process. Improvements in food safety and hygiene standards and post-harvest handling can lead to increased sales, income generation and employment opportunities.

Prophet Trey (Fish Ball):

This can be produced year-round (with use of farmed fish) by micro and small-scale processors in Kampong Chhanng Province. There is an increasing demand for Prohet Trey in domestic urban and niche markets, and potential export potential to regional markets. Improvements in food safety and hygiene standards and post-harvest handling can lead to increased sales, income generation and employment opportunities.

Smoked Fish:

These can be produced year-round (with use of farmed fish) by micro, small and small-medium scale processors. Smoked fish is sorted into two levels of quality: low-value for domestic market and high-value for domestic market and some export. There is increasing demand for high-value smoked fish in niche markets (Cambodian upper middle class) and potential to export to regional markets and beyond. Due to its recognition among consumers (made in Kampong Chhnang), there is also the potential for Geographical Indication (GI) registration in the future if local raw materials (aquaculture and wild fish catch) are used in the production process. Improvements in food safety and hygiene standards, post-harvest handling, branding and packaging can lead to increased sales, income generation and employment opportunities.



Prahok:

This can be produced year-round (with use of farmed fish) by micro, small and small-medium scale processors. Prahok is sorted into two levels of quality: low-value (Prahok Cha-Oeung) for domestic market and high-value (Prahok Sach) and prahok Treykompleanh for domestic market and some export to neighboring countries. Increasing demand for high-value prahok derived from the Cambodian upper middle-class and increased exports to Thailand. Due to its origin status among consumers (made in Battambang), there is also the potential for Geographical Indication (GI) registration in the future if local raw materials (aquaculture and capture fish catch) are used in the production process. Improvements in food safety and hygiene standards and post-harvest handling can lead to increased sales, income generation and employment opportunities.

Dried Fish:

Can be produced year-round (with use of farmed fish) by micro, small and small-medium-scale processors. Dried fish is sorted into two levels of quality: low-value for domestic market and high-value for domestic market and some export. Increasing demand for high-value smoked fish derives from the Cambodian middle-class as well as increased export potential to Thailand and the region. Improvements in food safety and hygiene standards and post-harvest handling can lead to increased sales, income generation and employment opportunities.

The estimated total demand of these processed fish products is over 52,000 tons per year in Battambang, Kampong Chhnang and Phnom Penh (not including other provinces in Cambodia). Additionally, there is an increasing demand for high-value processed fish products due to the increase in the Cambodian middle class.

Key Challenges of Post-harvest Fisheries Value Chains

1. Post-harvest Operations

- Fishermen, fish traders, fish processors and fish distribution centers do not follow proper use of cold chain, storage or handling transportation practices for fresh and processed fish products, leading to increased post-harvest losses
- Fishermen have limited access to reliable market information and do not sort or grade their fish to add value and increase their selling price
- Fish processors lack knowledge of proper packaging and labeling to access high-value domestic or export markets
- Most value chain actors lack knowledge on proper food hygiene and safety standards leading to increased post-harvest losses and lower prices

2. Financing

- Most micro and small-scale enterprises lack financial literacy for operating their businesses and understanding of loan application process
- Lack of access to reliable formal financing due to limited collaterals, financial statement, business plan and high interest rate
- Access to finance is limited to small loans used for working capital not for improved technologies or upgrading of facilities

3. Value Chain Governance

- Market actors are required to pay formal and informal fees for trading activities leading to lower profits and a reluctance to register with the Fisheries Administration Cantonment
- Lack of existing data on registered and unregistered of fishery MSMEs

4. Input Supply for Fresh and Processed Fish

- Some types of fish processing have a limited access to input supply including the availability of resources to improve trade efficiency and quality of products
- Lack of access to quality ice and its use for storage and transportation.
- Salt is a common ingredient which is invariably used for most of the products; however, the locally produced salt is costlier when compared to imported even though of better quality.

5. Limited Processing Technology

- Market actors lack access to improved technologies and techniques to improve production and operational efficiency
- Many fish processors, including dried, smoked and fermented, are processing and packaging products using labor intensive and inefficient traditional methods

6. Food Safety Compliance

- Lack of access to food safety knowledge and training (vocational training and skill development) through short courses with affordable cost
- Lack of capacity and finance to meet food safety certification and standards by most of the producers
- Most of the businesses and their processes never meet minimum hygiene requirements

7. Market Access

- Lack of access to reliable market information and product development for high-value markets and export leads to lower prices for value chain actors
- Lack of market facilitators and trust among the fishery value chain actors

8. Access to Business Development Services

- Lack of access to business development services for capacity building and training on fishery post-harvest technology and food safety standards
- Lack of research and development on new product development and improved techniques to improve the post-harvest practices

Key Recommendations

1. Technology (know-how)

- Provide access to improved technologies to reduce costs and increase business efficiency (processing machinery, solar technology, cold chain, etc.) to increase production, productivity and income generation for micro, small and small-medium -scale fish processors
- Promote enterprise development through establishment of food safety system and value addition for better product diversification and competitiveness
- Provide training and capacity building for enterprises on food hygiene and food safety standards.

2. Products

- Provide training in post-harvest handling for value chain actors (fish traders/ collectors, wholesalers/interprovincial traders/exporters and processors)
  - Provide capacity building on proper storage and transportation of fresh fish and processed fish products
  - Provide training in proper sorting and grading to add value to fresh fish products and market development and sustainable business operations
  - Provide capacity building and coaching on product marketing to meet market demand for high-value markets, export and potential GI (safe packaging and branding of products)
  - Differentiation or labelling of natural wild fish processed products or high value products from other products
  - Provide capacity building on traceability of products through proper registration, labeling and use of barcodes
  - Training in food safety and hygiene system (ex. GHP, GMP, HAACP, ISO and HALAL) to eligible Small, Medium and Large Enterprises

3. Market Access

- Promote aquaculture as an alternative supply of fish for year-round production and supply of fishery products to the markets
- Provide access to reliable market information in order to achieve higher prices and consistent market demand
- Provide training on food safety awareness and skills of processors to improve product quality and access new market segments
- Export Market for promising products through:
  - Training on food safety and hygiene standards including GMP and GHP
  - Certification of HACCP, ISO and HALAL for small-medium-scale processors
  - Capacity building and coaching on product marketing to meet export market demand

4. Organization and Management of businesses

- Provision of financial software to improve record keeping, stock management and financial statements
- Provide access to improved linkages among all post-harvest fisheries value-chain actors to address gaps in market information and develop long-term business relationships between market actors
- Development of post-harvest market actors' association to improve the collective marketing of processed fish products, improve information flow, and enhance competitiveness and marketability

5. Value Chain Governance

- Improved advocacy or advisory from the FiA and Provincial Fishery Cantonment aimed at the fishery enterprises and communicate the benefits of registering their businesses in order to formalize the MSMEs
- Coordinate with FiA to conduct a comprehensive market survey (domestic and export) and mapping of private operators and registration at PDAFF level
- Support or coordinate with the FiA to develop a database for key fisheries post-harvest actors in order for the project and FiA to identify key market actors and improve strategic planning to provide technical support, monitoring, food security and market development
- Implement a 'Single Window' environment to expedite and simplify information flows between trade and government to reduce non-tariff trade barriers and deliver immediate benefits to all parties involved in cross-border trading

6. Finance

- Capacity building for micro, small and small-medium enterprises on financial literacy, data management and loan application process
- Link micro and small enterprises to affordable financing such as group loans through MFIs (no collateral required, repayment of principal at the end of the session, pay in village and receive financial literacy training) or develop customized financing solutions by providing a bank guarantee in order to reduce interest rates and collateral for loans
- Promote investment support for women and youth considering collateral requirements, supporting business plan development and collective loans to women's associations or cooperatives
- Link small and small-medium-scale enterprises to business expansion loans through MFIs or banks in order to upgrade their facilities and provide working capital to grow their business
- Capacity building of financial institutes on fishery post-harvest businesses and encourage them to tailor their existing loan products to be available for upgrading MSMEs.
- Promote and encourage new investment or scale investment on fishery post-harvest businesses

7. Input Supply

- Promote the use of local aquaculture fish as an alternative to wild nature capture fresh fish for processing (especially during closed fishing season: May- late October)
- Provide access to improved technologies to reduce costs and increase business efficiency (processing machinery, solar technology, etc.)
- Promote local input suppliers (ice factories and ice distributors) to compliance with at least minimum requirement of food safety standards
- Promote GI standards for salt enterprises in Kampot province to improve their quality and competitiveness in the market.

8. Infrastructure

- Upgrade the public facilities of the fish distribution system to meet food hygiene and safety standards and improve loading and unloading efficiency including cold chain system
- Provide access to good roads for all value-chain participants for efficient transportation maintaining cold chain
- Develop infrastructure including ice factories, public health facilities and cold storage to reduce post-harvest losses

9. Business Development Services

- Link registered MSMEs with FiA and Provincial Fishery Cantonment to access training in sustainable fishery management and food safety standards
- Coordinate with the FiA to develop a clear communication strategy on the benefits of registering businesses with the Provincial Fishery Cantonment in order to increase the number of registered MSMEs in Battambang and Kampong Chhnang so that they can have access to training in sustainable fishery management and food safety standards
- Link micro fish processors to facilitate processed fish product development (smoked fish) and capacity building for market network and market access

2.
INTRODUCTION

2. Introduction

2.1 Project Background

CAPFISH-Capture - Post Harvest Fisheries Development project is part of the CAPFISH-Capture component of the "Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector" (ACA/2019/408-424) funded by The European Union (EU). Its overall objective is to contribute to the Royal Government of Cambodia's long-term vision of social and economic development, food security and poverty reduction. The "CAPFISH Capture - Post Harvest Fisheries Development" project is being implemented jointly by UNIDO and the FiA. The specific goal of the project is to assist development of post-harvest fisheries through the adoption of better practices and innovation in the private sector, and by improving the regulatory and institutional system.

This project aims at inclusive post-harvest fisheries value chain development. It focuses on a) strengthening the institutional capacity of Competent Authority to establish official control systems and b) upgrading of post-harvest fisheries businesses through capacity building, food quality control and safety measures, matching investment support and improved business support mechanisms.

2.2 Purpose & Scope of the Study

The purpose of the current study is to identify and analyze the most promising fishery value chains for upgrading of fishery businesses in Battambang and Kampong Chhnang, as well as to replicate in other provinces. The assessment focused on identifying fishery products with potential for growth, profitability, additional employment opportunities, access to better and more profitable markets, and further business development in the sector.

The geographical scope of the study: The proposed study focused on post-harvest fishery value chains of Battambang and Kampong Chhnang province (Details are in the Annex of the TOR).

2.3 Methodology

A mixed-method approach of both qualitative and quantitative research methods was used for this analysis.

Value Chain & Market Assessment: a templated methodology to value chain analysis (VCA) was used to analyze the fisheries value chain in the two target provinces. It is derived from the approach of Action for Enterprise (AFE), Washington DC, USA; and iDE has used it successfully many times. It is a framework for the design and implementation of market development programs, utilizing the strengths of VCA to identify sustainable market-based solutions which promote competitive industries, and create benefits for the poor.

The study identified constraints hindering business growth and competitiveness, and identified commercially viable solutions to these issues. An understanding of market trends and industry dynamics was gained through value chain maps, and through structured and semi-structured interviews with primary and secondary sources. The roles and relationships of value chain participants were identified.

Analysis tools were used to understand governance structures within the value chain and to explore both vertical and horizontal inter-firm cooperation.

The full VCA approach typically follows the following 6 steps but this project included only steps 1 through 4.

Step 1: Value Chain/Market System Selection

During this step, selection criteria are used to choose promising value chains. These criteria could include:

- Unmet demand in the market for particular products, domestic and export
- Potential for increase in household incomes
- Number of MSMEs in the value chain
- Potential for employment generation
- Existence of linkages conducive to inter-firm collaboration
- Potential for positive coordination and synergy with donors and government
- Representation of women in the value chain

Once the criteria are established, they are used to compare different value chains. Those that rank the highest are then chosen for more detailed analysis.

Step 2: Value Chain/Market System Analysis

During this step, interviews and research are carried out to gain a greater understanding of market trends and industry dynamics including value chain participants, their roles, and interrelationships. The goal of this step is to determine key issues hindering MSME growth and competitiveness.

A value chain map is developed that graphically presents all the relevant private sector actors and their relationships with one another. Based on the initial findings of this map, interviews with market-based participants and "key informants", both large and small, are conducted to identify major constraints and opportunities throughout the value chain. These can be grouped in the following categories:

- Technology/product development,
- Market access,
- Input supply,
- Management and organization,
- Policy makers
- Finance, and
- Infrastructure

In-depth interviews, semi-structured interviews, focus group discussions and stakeholder meetings, were used to analyze the value chain.

Step 3: Identification of Market-Based Solutions

During this step, a variety of methods are used to identify and prioritize sustainable, market-based solutions (potential at this point) that can contribute to competitiveness of the targeted value chain and address the constraints and opportunities identified in Step 2 above.

Step 4: Assessment of Market-Based Solutions

During this step, a variety of methods are used to assess the market-based solutions identified in Step 3. Areas of assessment include:

- Identification of existing/potential providers of targeted market-based solutions
- Challenges to the commercial viability of the targeted solutions
- Satisfaction with and awareness of market-based solutions currently provided
- Number of MSMEs that could benefit from the market-based solution

Private sector "lead firms" in the value chain are assessed as to whether they have the requisite incentives and ability to provide needed products and support services to MSMEs in a commercially viable and sustainable manner. Discussions include the provision of "embedded" services by these firms to MSMEs that take place as part of their commercial relationships.

Step 5: Identification and Selection of Facilitation Activities (N/A)

Step 6: Monitoring and Performance Measurement (N/A)

Profiling of the Value Chain: for the profiling of the post-harvest fisheries value chain, the iDE team used a Human Centered Design (HCD) approach to uncover explicit and latent needs, and identify the most significant triggers and constraints of the post-harvest processors market actors. Using this methodology people are always at the center of the process, engaging stakeholders throughout by listening, observing, and obtaining feedback.

This empathic approach of talking with and observing people in their natural habitat helps the consultant team connect with stakeholders and generate deep insights into the constraints and needs for the different actors in the value chain.

The iDE team aims to have a holistic, immersive approach to understand the stakeholder's constraints and needs and applied the following research methods.

2.4 Research methods

Desk Research: a comprehensive literature review was conducted to shed light on the current situation of the fisheries industry in Battambang and Kampong Chhnang. The desk research helped to identify gaps in post-harvest business development where the CAPFish project should focus.

Kick-off Meeting: building on desk research, the iDE team met with key members of UNIDO (CTA and other key team members) on October 27th, 2020 to ensure both teams were aligned on goals and expectations. It was also an opportunity for the iDE team to absorb as much knowledge as possible from key team members, dig deeper into the CAPFISH-Capture project and fill in gaps. The scope and objectives of the study were agreed, which, briefly stated, is to support the CAPFish project's key output on upgrading post-harvest fisheries businesses, including capacity building, food safety system implementation and market access through matching value chain investment support.

Inception Report Review: during the week of November 16th, 2020 the iDE team met with key members of UNIDO and the Fishery Administration to review the inception report including timeline, work plan, survey questionnaires, etc. Field data collection commenced in Battambang and Kampong Chhnang on November 22nd, 2020.

Expert Interviews: interviews were conducted with key members of the UNIDO team, the Fishery Administration, Fishery Cantonment and other key relevant stakeholders. This information complemented the research and gave a broader perspective of the situation.

Immersive Field Research: the consultant team conducted in-depth interviews (IDI), focus group discussions (FGD), observations and shadowing different profiles of stakeholders impacted by the CAPFISH project. Rapid interviews were also conducted with relevant profiles to add a different perspective to the research.

- **Focus Group Discussions:** this method is useful to gather broad, diverse insights and get group consensus in a particular area. The consultant team used these discussions to build a focus for the in-depth interviews.
- **In-Depth Interviews:** these interviews took place in the natural environment of the respondents and were longer conversations (typically 1 hr.) with respondents (fishermen, traders, processors etc.) and other stakeholders (Fishery Administration, Fish Distribution Center, etc.). The goal was to understand their experiences, challenges, achievements, changes and aspirations in their own words.

The consulting team conducted one FGD each in Battambang and Kampong Chhnang. The FGD was with the Community Fishery (CFi), which included the committee and members of the CFi and post-harvest fishery value chain actors (ex. Input suppliers, traders, processors, etc.). Our team consulted with the Department of Community Fisheries and both Fishery Cantonments in Battambang and Kampong Chhnang.

- **Rapid interviews:** a faster interview approach, no more than 30 minutes, used to gain information about a specific topic, obtain general feedback to validate an insight, or gain a different perspective. This is a way to get quick information from a larger number of participants.
- **Observations:** what people say they do and what they actually do is sometimes different, and situational learning through observation helps to identify these gaps. The team aimed to gain a deeper understanding and gather richer stories from observing the lives of respondents (including seeing their businesses, homes, set-up, technology, etc.)
- **Validation Workshops:** a mix of market actors (input suppliers, traders, processors, etc.) and key stakeholders (FiA & PDAFF) were invited to attend a one-day workshop in Battambang and Phnom Penh to validate the findings of the field assessment. One validation workshop was scheduled in Kampong Chhnang, but due to a COVID-19 outbreak, the workshop had to be cancelled. The purpose was to develop a shared understanding of the strengths and weaknesses of the post-harvest value chain in Battambang and Kampong Chhnang. The findings of the analysis were validated by the various stakeholders that attended including the FiA, EU, UNIDO and key post-harvest fisheries value chain actors.

2.5 Data Management

Data Collection:

- Daily data collection was gathered from the survey team
- Daily data validation was conducted by the Field Team Lead
- Provincial validation workshops were held to validate data and identify data gaps

Data Entry:

- Following field work, the research team used double data entry in excel spreadsheets for further analysis

Data Analysis:

- Team Lead consolidated and systematically analyzed field data to incorporate in the final report
- Validation and Stakeholder Workshops were held in Battambang and Phnom Penh to further validate data findings

2.6 Research Plan

The field research plan (Annex VIII) was designed based on the kickoff meeting, expert interviews and desk research. The team traveled to the target provinces (Battambang & Kampong Chhnang) to speak with relevant market actors and stakeholders to achieve the study's objectives. The team also conducted interviews with key actors and stakeholders in Phnom Penh (Annex III).

2.7 Sample Size

The samples were selected purposely to represent all the actors and to fishery post-harvest value chain actors, in view of lack of data on post-harvest actors at both national and sub-national levels. The survey was conducted with 206 enterprises, 57.2% of whom were women. The respondents are mainly the market actors (collectors, retailers, wholesaler and processors) and support actors (Table 1).

Table 1: Sample details

No	Name of Respondents	Total Respondents	Number of Women Respondents	% of respondents
1	Processors	72	43	35%
2	Wholesaler and fish trader in two provinces	11	6	5%
3	Supper Market	2	0	1%
4	Wet Market wholesalers and retailers in Phnom Penh	24	19	12%
5	Restaurant	7	4	3%
6	Input supply	12	6	6%
7	Bank	4	2	2%
8	Consumers	29	20	14%
9	Fisherman	23	9	11%
10	NGO	2	0	1%
11	CFi	18	9	9%
12	FiA	2	0	1%
Total		206	118	100%

2.8 Limitations of the study and Constraints

Sample Size:

- The randomized sample size is not statistically significant due to time and resources constraints. However, it captured meaningful insights and variations along the value chain
- The team was not able to follow the international trade route of the post-harvest fisheries value chain (i.e., Vietnam & Thailand) due to time and resource constraints. However, the team used expert interviews with the FiA, Fishery Administration Cantonment and exporters to gather this information to include in the final report.

Availability of Data:

- Revenues, costs, and assets from respondents used for the value-chain analysis was obtained from some individuals that did not have detailed records of their businesses
- Multiple-period data for long-term strategic decision-making, changes in cost structures, capital investments and market prices were not immediately available
- Resistance from Respondents:
- There was resistance from some survey respondents to answer questions related to their business

COVID-19:

- There was a 2-week lockdown in December 2020 due to in-country COVID transmissions, which resulted in delays with data collection, consolidation and analysis

3.
CONTEXT OF THE FISHERY SECTOR IN BATTAMBANG & KAMPONG CHHNANG

3. Context of the Fishery Sector in Battambang & Kampong Chhnang

Battambang is a large province in Cambodia, which borders the northwestern edge of the Tonle Sap Lake and Great Lake, which is the largest lake in South-East Asia and is the center of inland fish production in the Mekong River system.

Kampong Chhnang is located in northwestern Cambodia, 91 km from Phnom Penh on National Road No. 5. The province is bordered by Kampong Thom to the north, Kampong Cham to the east, Kampong Speu to the south and Pursat to the west. With access to the Tonle Sap Lake, the province is rich in natural resources such as inland fishery resources.

3.1 Fish Production

The total fish production in Battambang is approximately 57,979 tons per year. Fish catch from Tonle Sap and natural streams is 42%, aquaculture 30% and rice field fishery is 27%. Thus, aquaculture continues to play a significant role in supporting and complementing fish production in Battambang province, while fish catch has been gradually declining over the past five years (FiA database 2019). The total annual fish production in Kampong Chhnang is approximately 70,681 tons. 54% is fish catch from Tonle Sap and other natural streams, 31% is from aquaculture and 15% is from rice field fishery. The trend of aquaculture development in Kampong Chhnang has continued to increase over the last five years due to an increase in the population and a decline of natural fishing yields (FiA database 2019).

Table 2: Fish Production in Battambang & Kampong Chhnang (2019)

Study Site	Capture fisheries		Rice field fisheries		Aquaculture		Total fish catch (Ton)
	(Ton)	Percent	(Ton)	Percent	(Ton)	Percent	
Battambang	24,510	42%	15,800	27%	17,669	31%	57,979
Kampong Chhnang	38,200	54%	10,800	15%	21,681	31%	70,681

(Source: Fishery Administration, 2019)

There are two types of aquaculture farming systems in Battambang and Kampong Chhnang: pond and cage. There are approximately 282 ponds in Battambang, totaling 119 hectares, and 899 ponds in Kampong Chhnang totaling 13.5 hectares. Fish from cage culture are harvested seasonally or year-round depending on the farmers and is done along streams and the Tonle Sap Lake. There are approximately 1,170 fish cages in Battambang that cover 7,020 square meters and 919 fish cages in Kampong Chhnang totaling 7,428 m2. Additionally, there are at least 20 hatcheries in Battambang that can produce 13 million fingerlings to support aquaculture farmers in the province (FiA database 2019).

3.2 Processed Fish Products

Processed fish products play a vital role for both consumption and supply domestically and for export to Thailand and Vietnam. The main processed fish products include Prahok, smoked fish, dried fish, mam, pa ok, fish ball among others. The source of fish inputs is derived from capture fisheries and aquaculture.

The total production of all processed fish products according to the 2019 FiA database is approximately 3,232 tons per year in Battambang and 9,493 tons in Kampong Chhnang (FiA Database 2019). There were 13 registered processors in Kampong Chhnang, however the number of registered fish processors in Battambang is unknown. It is likely that this figure only refers to those fish processors that are registered with the provincial fishery cantonment of Battambang.

Based on this field assessment, there are approximately 124 fish processors in Battambang and 153 in Kampong Chhnang including smoked fish, dried fish, Prahok, fish ball and fish sauce (excluding thousands of household fish processors, such as Prahok, Mam, Pa-Ok and other forms of fish processing). Thus, the estimated volume of processed fish products is significantly higher compared to the FiA database statistics.

Fish enterprises interviewed include fishermen, rice field fish farmers, aquaculture farmers, collectors or direct fish purchasing businesses, traders, wholesalers, and processors of fish products such as fish paste (Prahok), fish sauce, dried, fermented or smoked fish.

The majority of fish processing businesses use manual labor alone, or very basic machinery, to remove fish heads, skin, intestines, and fat (Field survey, November-December, 2020).

Processed products are generally sold to domestic markets, cross interprovincial trade routes, and some products and species are also sold to neighboring countries. For instance, Prahok and smoked fish are exported to Thailand and Vietnam. Based on the survey data, approximately 5% of the total production of processed fish products from Battambang and Kampong Chhnang are exported.

3.3 Fishery enterprises

3.3.1 MSMEs Definition

According to the Ministry of Industry, Science, Technology and Innovation (MISTI), there are four categories of enterprises in Cambodia: micro, small and medium-sized enterprises (MSMEs) and large enterprises (Table 3). The micro enterprises are unsystematic and dominate the SME sector. The SME Development Framework, developed by the SME Sub-Committee of the Private Sector Steering Committee (MISTI), classifies SMEs according to the number of their employees (based on equivalent full-time employees) and the value of their assets (capital investment excluding land property).

Table 3: MSMEs Definition by MiSTI

Classification	Cambodia Definition	
	Employees	Assets (USD)
Micro	Less than 10	Less than 50,000
Small	11-50	50,000-250,000
Medium	51-100	250,000-500,000
Large	Over 100	Over 500,000

(Source: Ministry of Industry, Science, Technology and Innovation- The Royal Government of Cambodia., "SME Development Framework", 2005)

Table 4: MSME Definition by the European Commission

Classification	European Commission Definition			
	Headcount Annual Work Unit (AWU)	Annual Turnover (EUR)	Or	Annual Balance Sheet
Micro	Less than 10	Less than or equal to 2 million	Or	Less than or equal to 2 million
Small	Less than 50	Less than or equal to 10 million	Or	Less than or equal to 10 million
Medium	Less than 250	Less than or equal to 50 million	Or	Less than or equal to 43 million

(Source: European Commission https://ec.europa.eu/growth/smes/sme-definition_en)

3.3.2 Fishery post-harvest MSMEs

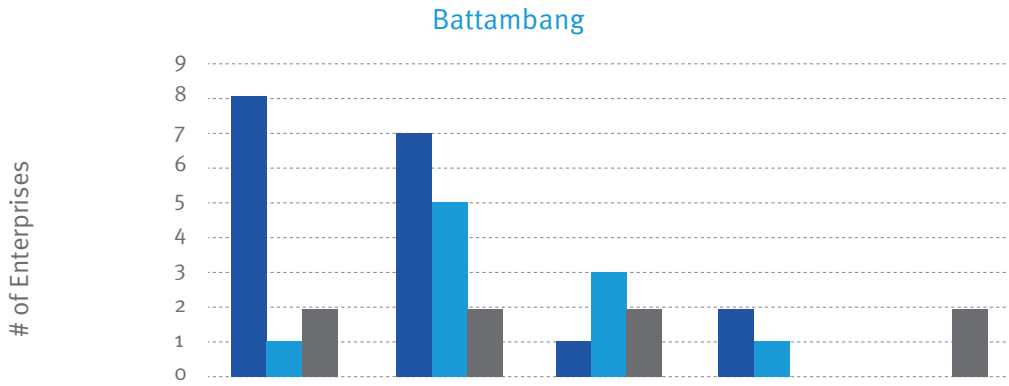
Based on the MSME definition, the main criteria to define the scale of MSMEs is associated with capital assets and total labour force.

Capital assets include warehouses, trucks, processing machinery/facilities, working capital for purchases up to 3 months (peak season fish catch), staff salary, and other equipment. Additionally, permanent labor and casual labor (those who work 7-9 months/years and get paid by the volume of fish that they process).

12% processors of total processor respondents had capital assets that met the criteria of medium enterprises, but they did not meet the labor criteria based on the definition from the MISTI. For purposes of this study, these processors were defined as small-medium scale. Based on the field survey, there are 6 processing enterprises in Battambang and 2 enterprises in Kampong Chhnang that fall into this category.

Figure 1 and Figure 2 below are categorized by samples of fish processors that fall under each category of MSMEs as defined by the Ministry of Industry, Science, Technology and Innovation. Among the 66 fish processors from the sample sites, 40 or 60% are micro enterprises, 18 or 27% are small-scale enterprises and 8 or 12% are small-medium-scale enterprises.

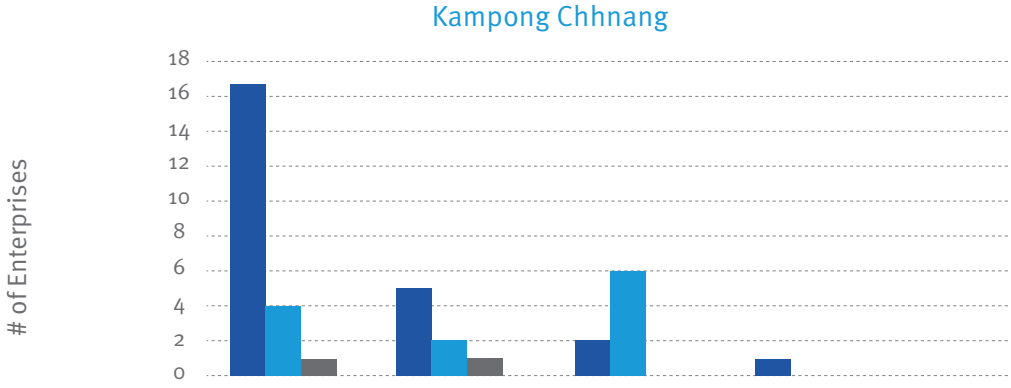
Figure 1: MSMEs by Product in Battambang



	Smoked Fish	Dried Fish	Prahok	Nem	Fish Sauce
Micro	8	7	1	2	0
Small	1	5	3	1	0
Small-Medium	2	2	2	0	2

(Source: Field Survey, November-December, 2020)

Figure 2: MSMEs by product in Kampong Chhnang



	Smoked Fish	Dried Fish	Prahok	Prohet Trey
Micro	17	5	2	1
Small	4	2	6	0
Small-Medium	1	1	0	0

(Source: Field Survey, November-December, 2020)

3.4 Direct Market Actors

3.4.1 Fish Processors

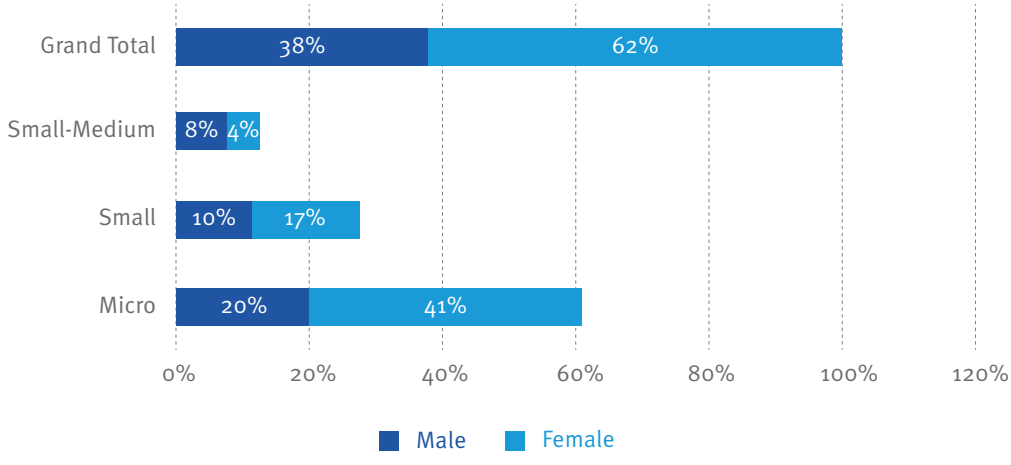
Fish processors are the main direct market actor for processed fish. Many MSMEs along the value chain process a diversity of products. For example, each actor often produces more than one processed fish product; in some cases, they also trade fresh and/or chilled fish. However, there are a few processors that specialize in a particular processed product. For instance, the micro and small-scale enterprises in the Noreay commune (comprised primarily from the Cham minority) process only dried fish. Other micro enterprise processors in Battambang provincial town specialize in smoked fish using high-value aquaculture (catfish with 2-3 head/Kg).

Business Profile of Fish Processors

Fish processors are with micro, small, or medium enterprises. 66 processors or 32% of total respondents were interviewed during the field data collection process. The average length of businesses is about 14 years, although the range is from 1-40 years.

The (Figure 3) below indicates that 62% of the processors interviewed were women-led business. The majority of them owned or managed micro and small enterprises, accounting for 41% and 17% respectively. However, the small-medium enterprises owned/managed by men represented around 8%. This is also reflected in the national statistics which reported that more than 90% of Cambodia SMEs are micro business and owned/managed by women[1].

Figure 3: Number of MSME interviewed, disaggregated by Gender



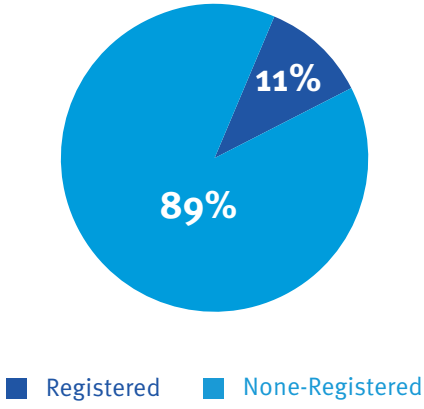
(Source: Field Survey, November-December, 2020)

[1] https://www.ifc.org/wps/wcm/connect/9e469291-d3f5-43a5-bea2-2558313995ab/Market+Research+Report+on+Women_owned+SMEs+in+Cambodia.pdf?MOD=AJPERES&CVID=mOU6fpx

The majority of fishery processors in the two provinces were informal without any registration of their operations. Of the total of 66 fish processors interviewed, 11% were registered with either the FiA or MISTI (Figure 4) mostly belonging to small-scale and small-medium scale enterprises while none of micro-enterprise interviewed were registered 89%, while (Figure 5) only 4.5% small-medium scale enterprises and 1.5% small-scale enterprise were registered with the FiA and 4.5% small-medium-scale enterprises were registered with MISTI.

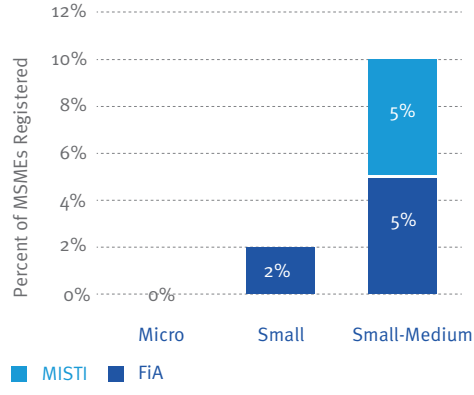
Among the surveyed processors, the registration was done at Provincial Cantonment office, Provincial Department of Agriculture Forestry and Fisheries (PDAFF) or MiSTI, but not at Ministry of Commerce (MoC) even though they do cross border export or informal export to Thailand.

Figure 4: Status of Business Registration of Processors



(Source: Field Survey, November-December, 2020)

Figure 5: Percentage of Processor MSMEs Registered



(Source: Field Survey, November-December, 2020)

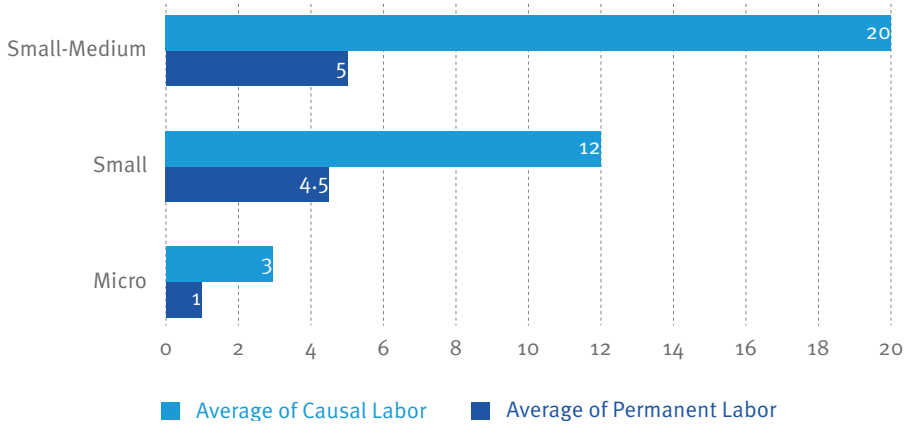
Most of these businesses are family run, small business operation and transferred from one generation to the next which are the main reasons for not registering the business for micro-enterprises, in particular, they don't have desire to register due to the uncertainty of their business operations due to limited resources and high competitions with similar business. A dried fish processor in Kampong Chhnang says "I was informed and encouraged to register my business, but I am delaying the process since I am not confident about continuing this particular business because the resources are scarce and prices are competitive".

The small and medium enterprises, on the other hand, reported that the following difficulties: complicated process of business registration involving too many different documents, limited understanding on the benefits registration and lack of information on the registration process

Labor use by MSMEs

In general, micro enterprises do not hire permanent labor, instead they use family labor for running the business and in average, they hire about 3 casual laborers, the majority of them are women in the same community (Figure 6). In contrast, small and small-medium enterprises hire more of permanent labor than casual labor.

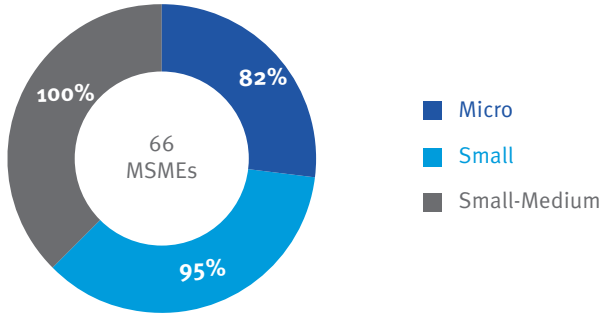
Figure 6: Average Labor hired by MSMEs



(Source: Field Survey, November-December, 2020)

(Figure 7) shows that the majority of the interviewed processors take loans, 100% of small-medium processors, 95% of small scale and 82% of micro enterprises respectively. The small and medium processors access to loans from or Banks or MFIs, while the majority of micro enterprises access loans from informal money lenders due to small size of loan.

Figure 7: Access to loans by size of fishery processors

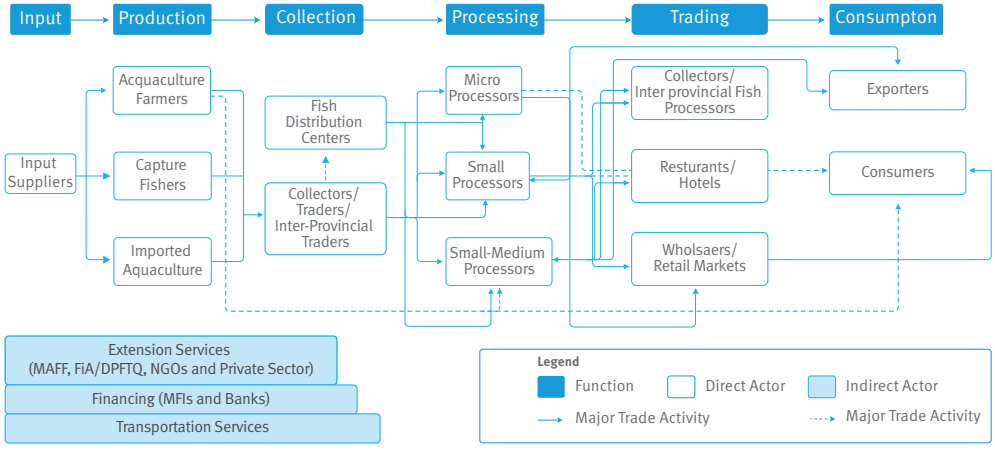


(Source: Field Survey, November-December, 2020)

Fish Products Value Chains

The market actors along the value chains and trade routes for processing fish are complex and multi-functional. The value chain map below maps out actors along the processed fish trade route that interact with each other. The results from the field survey suggest that there are three main market actors: (1) Fish Processors, (2) Collector/Interprovincial Traders, and (3) Wholesalers/Retailers as highlighted in (Figure 8).

Figure 8: Value Chain Map of Processed Fish Products



Micro Enterprises

54% of the enterprises interviewed in Battambang and 66% of the enterprises interviewed in Kampong Chhnang were micro enterprises (Figure 9 and 10). Most of the micro fish processors produce only one product, such as smoked or dried fish, fish ball (Nem and Prohet Trey) and Prahok, while other enterprises process a range of fish products depending on purchase orders or informal contract agreements with various clients. For instance, a processor in the floating village in Peam Seima, Ek Phnom district produces a range of semi-processed products based on purchase orders from small or small-medium-scale fish processors on the mainland (e.g., Phsa Prahok or Prahok Market), selling products at the provincial town, such as Beng Chouk and Pou Phuy provincial market in Battambang.

Figure 9: MSMEs by Enterprise

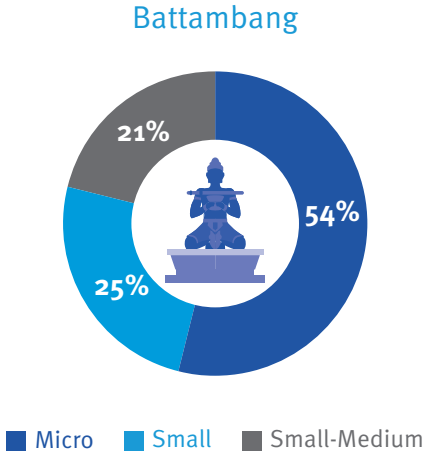
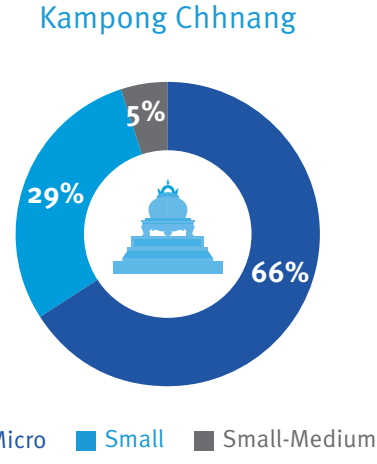


Figure 10: MSMEs by Enterprise



(Source: Field Survey, November-December, 2020)

In the provincial town and the neighboring village adjacent to Battambang provincial town, a few micro fish processors produce specialized processed products for sale interprovincially, including provinces close to the border of Thailand. The products include dried fish and smoked fish mainly distributed to Oddar Meanchey and Banteay Meanchey, urban areas, and Phnom Penh (high-value smoked fish).

In the floating village in the provincial town of Kampong Chhnang, most micro enterprises are owned and operated by Vietnamese, who sell their product to urban areas and Phnom Penh through purchase orders from buyers.

The processing technology and skills depend on the type of processed fish products. The majority of them process products manually through use of combination of family labor and some casual labor. Majority of micro-scale fish processors self-finance their enterprises and/or access loans from informal moneylenders or Micro Finance Institutions (MFI); 80% and 84% of micro enterprises interviewed in Battambang and Kampong Chhnang respectively have loans with MFIs/banks.

The average annual sales per micro enterprise is approximately USD 91,400 in Battambang and USD 65,100 in Kampong Chhnang (Table 5), however, the production costs are high leading to low profit margins (20% in Battambang and 13% in Kampong Chhnang). The majority of them operate seasonally, while a few operate year-round as they either use in-country/province aquaculture or import fish from Thailand or Vietnam to process.

Table 5: Volume and Sales of Micro Enterprises

Province		Volume of Sale (Ton/Year)		Value of Sale (USD/Year)
Battambang	Average	13.39	Average	91,404
	Range	0.54 - 32.16	Range	2,100 - 249,240
Kampong Chhnang	Average	12.26	Average	65,083
	Range	0.30 - 63.87	Range	840 – 255,500

(Source: Field Survey, November-December, 2020)

Small-Scale Enterprises

25% of the enterprises interviewed in Battambang and 29% of the enterprises interviewed in Kampong Chhnang were small-scale enterprises. Most of the small-scale fish processors in Battambang are located in the provincial town or in neighboring villages/communes adjacent to Battambang provincial town and Kampong Tra Lach and Boribo district (Chhnok Trou landing site) in Kampong Chhnang provincial town. Similar to micro-enterprises, small-scale fish processors produce single/specialized or multiple fishery products.

The specialized fish products produced from small-scale enterprises include smoked fish, dried fish, and fish ball (Nem and Prohet Trey). Small-scale processors that process multiple fish products depend mainly on purchase orders or informal contract agreements with buyers. Most fish products are sold to Battambang provincial town, interprovincially, urban areas, Phnom Penh, provinces on the border of Thailand (e.g., Poipet of Banteay Meanchey and Anlong Veng of Oddar Meanchey) as well as exported to Thailand (e.g., Nem).

The small-scale enterprise category uses a combination of manual processing and basic mechanization, with the degree and type of technology dependent on the product. For instance, Prahok products are processed mostly with machines to remove the fish heads, intestines and fat, while smoked fish is typically done manually. Labor needs are met through a combination of family, a few permanent staff, and casual laborers', ranging from 10-17 people per enterprise. The sophistication of machinery and technology used for processing is fairly basic.

Capital requirements are met from the entrepreneur's own savings, moneylenders (informal creditors), MFIs and banks. 100% of the small-scale enterprises interviewed in Battambang and 91% of small-scale enterprises in Kampong Chhnang indicated that they have loans with MFIs/banks.

The average annual sales of processed fish products for small-scale processors are approximately USD 509,000 per enterprise in Battambang and USD 564,000 in Kampong Chhnang (Table 6). However, due to high production costs, the profit margins for small-scale enterprises are low (10% Battambang and 7% for Kampong Chhnang). Most small-scale enterprises operate year-round by utilizing in-country aquaculture and/or imported fish from Thailand and Vietnam to produce their products.

Table 6: Volume and Sales of Small Enterprises in Battambang Province

Province		Volume of Sale (Tons/Year)		Value of Sale (USD/Year)
Battambang	Average	215.09	Average	508,987
	Range	14.4 - 727	Range	72,000 – 2,096,900
Kampong Chhnang	Average	130.12	Average	564,000
	Range	12.75-483	Range	123,600 – 1,393,344

(Source: Field Survey, November-December, 2020)

Small-Medium-Scale Enterprises in Battambang and Kampong Chhnang Provinces

21% of the enterprises interviewed in Battambang and 5% of the enterprises interviewed in Kampong Chhnang were small-medium-scale enterprises. Most small-medium-scale fish processors operate with single/specialized fish products, such as fish sauce, smoked fish, and dried fish or multiple fish products. These enterprises are located in Battambang provincial town or in neighboring communes/villages. For instance, Prahok market (Phsa Prahok), which is a hot spot production for Prahok and other fermented fish, located in Prek Kanchreng village, Prek Norin commune, Ek Phnom district, Battambang province. Small-medium-scale enterprises in Kampong Chhnang are located in Kampong Chhnang town and floating villages.

Most of the Small-medium fish processors understand the market well and have developed trust and strong relationships with the value chain actors, such as exporters, wholesalers and interprovincial traders. Equally important, they have good relationships with fish and aquaculture suppliers within and neighboring provinces and the Fish Distribution Centre in Phnom Penh (KM No. 9 and No. 11). This allows them to secure year-round fish supply.

Small-medium-scale enterprises sell a small portion of their products to Battambang and Kampong Chhnang provinces, but the majority is traded interprovincially, to urban areas, Phnom Penh, provinces bordering Thailand (e.g. Poipet of Banteay Meanchey and Anlong Veng of Oddar Meanchey) and exported to Thailand.

Small-medium-scale processors use mechanization for removal of fish heads, intestines and others. These enterprises require an intensive labor force for loading and unloading of fish products, cleaning and processing. Thus, these enterprises employ over 20 laborers', especially casual labour to ensure year-round production. Similar to small-scale processors, the sophistication level of machinery and technology is fairly basic.

Small-medium-scale enterprises typically use their own savings to expand their business operations and/or access loans from MFIs and banks. 100% of small-medium-scale enterprises interviewed stated that they have an outstanding loan with an MFI or bank.

The average annual sales of processed fish products for small-medium-scale enterprises are approximately USD 1,762,000 in Battambang and USD 4,510,000 in Kampong Chhnang. However, due to high production costs, the profit margins for small-medium-scale enterprises are low (19% Battambang and 8% for Kampong Chhnang) as shown in (Table 7). All of the small-medium-scale enterprises that were interviewed are operating year-round as they source fish supply from in-country aquaculture and/or imported fish from Thailand and Vietnam.

Table 7: Average Volume and Sales of Small-Medium-Scale Enterprises

Province	Volume of Sale (Tons/Year)		Value of Sale (USD/Year)	
Battambang	Average	565.75	Average	1,762,179
	Range	164.25-1,230	Range	225,000 – 4,142,000
Kampong Chhnang	Average	126.19	Average	4,509,750
	Range	41.14 – 211.25	Range	1,461,000 –7,558,500

(Source: Field Survey, November-December, 2020)

Table 8: A comparison of Average Volume and Sales of MSMEs

Province	Average Volume of Sales (Tons/Year)			Average Value of Sales (USD/Year)		
	Micro	Small	Small-Medium	Micro	Small	Small-Medium
Battambang	13.39	215.09	565.75	91,401	620,484	1,762,179
	Micro	Small	Small-Medium	Micro	Small	Small-Medium
Kampong Chhnang	12.26	130.12	126.19	65,083	564,000	4,509,750

(Source: Field Survey, November-December, 2020)

3.5 Collectors/Interprovincial Traders

Collectors and interprovincial traders are those that purchase processed fish products from micro, small, and small-medium-scale processors and distribute to various provinces in Cambodia. In most cases, small and small-medium fish processors play the role of interprovincial traders. When they receive purchase orders from wholesalers in other provinces, they often use their own vehicle or outsource transportation to transport fish products from their warehouse/store to the target sites. However, the number of collectors has declined due to market linkages between processors and wholesalers/retail markets.

All of the collectors/interprovincial traders that we interviewed lacked proficiencies in post-harvest handling including storage and transportation. There is potential for these market actors to add value to their products through capacity building on improved storage and transportation practices (cold storage and packing), which would reduce spoilage and maintain the quality of the product along the trade route.

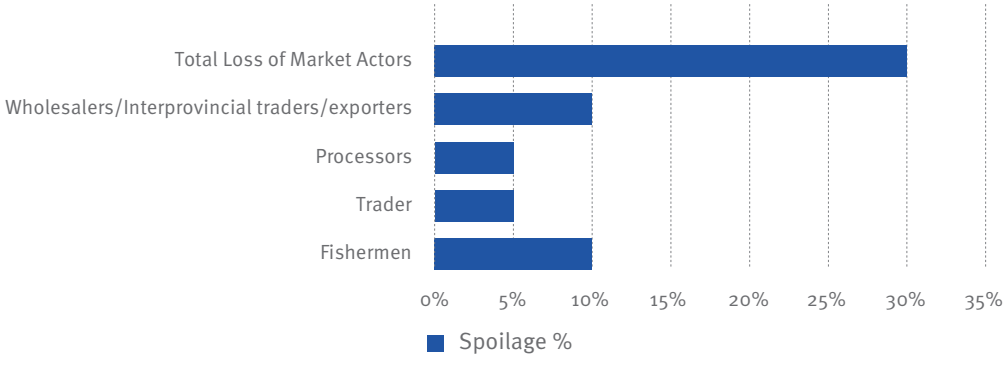
3.6 Post-harvest Handling

3.6.1 Storage

Majority of the fishermen, fish traders, fish processors and fish distribution centers do not follow proper use of cold chain or storage practices for fresh and processed fish products, leading to increased damage and spoilage of fish. However, those dealing with handling and transporting high-value fish do use good amount of ice for preservation. All of fishermen respondents who catch fish from the lake do not use ice boxes and sell fish to traders in raw form, which negatively impacts the quality and freshness of fish and leads to lower prices.

The standard practice to store fish fresh as it is being transported along the market chain is in plastic boxes that are poorly iced. A slab of ice is put in the bottom of the box, the fish are placed on the ice and a final slab of ice covers the fish on top. As a result, this method is subject to damage and spoil fish as it arrives at each landing site along the trade route, post-harvest lose is high as indicated in (Figure 11). All of the respondents did not understand how to use proper ice on fishery products.

Figure 11: Post-harvest losses of fish by Market Actors



(Source: Field Survey November-December, 2020)

3.6.2 Sorting and Grading

Sorting and grading according to the size and species of fish add value to fresh fish trade. Fishermen are generally not aware of market prices and trends and do not sort or grade their fish to add value and increase the selling price. As a result, in general, traders and wholesalers/exporters buy the fish from them in a flat-rate lump sum without sorting or grading. The traders, wholesalers and exporters then grade and sort the fish in accordance to the current market price, thereby increasing the average selling price.

3.6.3 Packaging and Labeling

In general, product packaging, labeling and branding of fish and fish products such as dried fish, smoked fish and fermented fish products (Prahok, Pa-Ok, Mam, and others) is rare. One consequence of this is increased difficulty in verifying or tracing the production source, or indeed contacting the producer for future purchase orders. However, in case of fish sauce, they are generally well packed and labelled.

3.6.4 Food Hygiene and Sanitation and value addition

95% of fish processors and other actors interviewed, including micro, small, and small-medium-scale enterprises do not meet the minimum basic food hygiene standards. They typically remove the fish heads and skin on the ground without any hygiene or safety measures. Additionally, the fish heads used as raw material are mixed with salt and other ingredients in the same manner. Small and small-medium-scale Prahok processors store the fermented fish in concrete rings and plastic drums and package their products in plastic buckets.

However, some small-medium-scale fish sauce processors were found to follow food hygiene standards in order to comply with national standards of the MISTI, which is a key institution that provides certificates and conducts regular monitoring and certification of compliance. But none of them in the province have any certification.

Figure 12: Prohet Trey Processing

Prohet Trey Processors, Kampong Chhnang; © iDE

Figure 13: Prahok Processor

Prahok Processor, Battambang; © iDE

4.
PROMISING PROCESSED FISH PRODUCTS

4. Promising Processed Fish Products

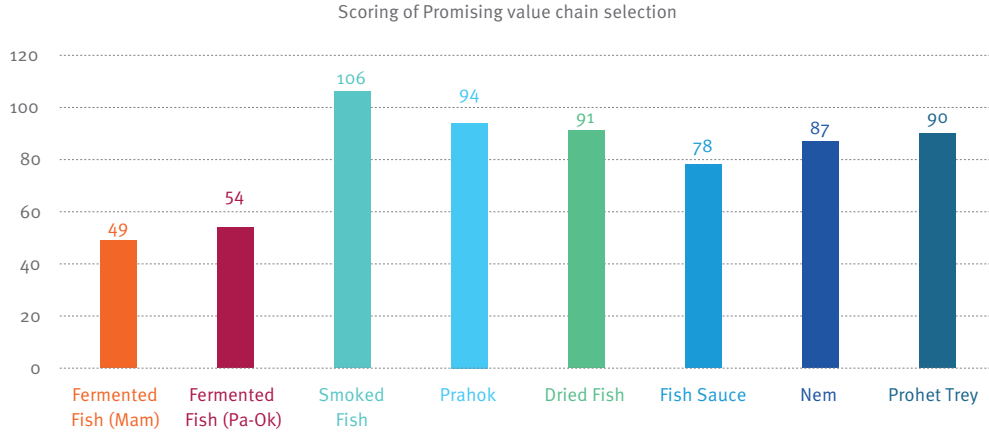
Field survey was conducted in Battambang and Kampong Chhnang Provinces to execute a value chain selection on the most promising processed fish products. A cross section of value chain participants, fishermen, aquaculturists, fish traders, wholesalers/interprovincial traders /exports, retailers and input suppliers were interviewed on a range of topics. Interview questions were designed to give an understanding of how the business operated and to identify constraints and opportunities within each business and the wider value chain.

The Value Chain Selection contains the following value chain selection tools (Annex I). Based on this analysis, the selection of the most promising fish products followed two criteria:

Capacity for Outreach:
Availability of raw materials, market size, pricing, technology required for production, capital investment required and MSME growth potential

Capacity for Impact:
Income generation potential

Figure 14: Scoring of promising value chains



The field analysis identified six main processed fish products that have the potential to increase income, outreach and institutional capacity. The scoring of the value chain indicated in (Figure 14) indicates that Smoked fish is the most promising value chain with a total score 106, followed by Prahok, Dried fish Prohet Try, Nem and Fish Sauce

The small and small-medium processors for these products have the potential to upgrade their facilities to meet food safety and hygiene standards, which will allow them to access premium markets increasing and garner higher prices for their products. To achieve it, the enterprises should focus on improving safety practices by following Good Hygiene Practice (GHP) and Good Manufacturing Practice (GMP), while small-medium-scale enterprises should focus on Cambodia Quality Seal (CQS) or international food hygiene certifications (ex. HACCP, ISO, HALAL, etc.).

4.1 Smoked Fish

Smoked fish processors operate at the micro, small, and small-medium-scale enterprise level, however, small and small-medium-scale enterprises that process multiple fish products only process a small quantity of smoked fish products.

Based on KIIs with smoked fish processors and high-value markets in Phnom Penh, specifically Orussey and Central market, smoked fish in Kampong Chhnang is gaining popularity in terms of quality and producing high-value products made from fish catch (Trey Kes and Trey Taon). This is due to increasing demand from the Cambodian upper middle class. Several high-value smoked fish enterprises that are popular in Cambodia are located in Kampong Chhnang, especially Kampong Chhnang town.

Smoked fish enterprises in Battambang are located in floating villages (e.g., Peam Seima village, Prey Chas commune, Ek Phnom district and Battambang town. High volumes of high-value smoked fish made from aqua culture are produced in Battambang town. The two smoked fish processors that were interviewed that made high-value smoked fish from aquaculture (Trey Andeng) stated that they sold the majority of their products to Orussey and Central market in Phnom Penh.

Figure 15: High-Value Smoked Fish

High-Value Smoked Fish Kampong Chhnang; © iDE

1.1.1 Smoked Fish Value Chain

Micro enterprises that produce smoked fish purchase fresh fish from fishermen and cage farms (aquaculture) along the Tonle Sap Lake to process and sell to wholesalers in Battambang and Kampong Chhnang (Figure 16). Smoked fish processors operate in both the wet and dry seasons, almost year-round. They grade fish species to process according to market value. Although various species of low-value fish have the same value, sorting them separately before processing leads to different prices. The enterprise involves both low and high-value processed fish. The low-value small fish include Trey Riel (Channa micropeltes), Trey Kanchos (Mystus rhegma), and Trey Andeng[2] (Catfish). The majority of micro enterprises and small-scale smoked fish businesses, produce semi-processed products (high water content) that wholesalers purchase and finalize by reducing the water content according to market specifications.

In Battambang province, higher-value fish such as Trey Ta Onn (Malay glass catfish), Trey kes (Phalacronotus apogon) are rarely caught at marketable size. In Kampong Chhnang province, higher-value fish such as Trey Ta Onn (Malay glass catfish), Trey Kes (Phalacronotus apogon) is processed by small and small-medium enterprises in the provincial town. There are approximately 15-20 enterprises that have invested significantly in their businesses. Most smoked fish enterprises have contract price agreements from wholesale/retail markets or small-medium-scale fish processors.

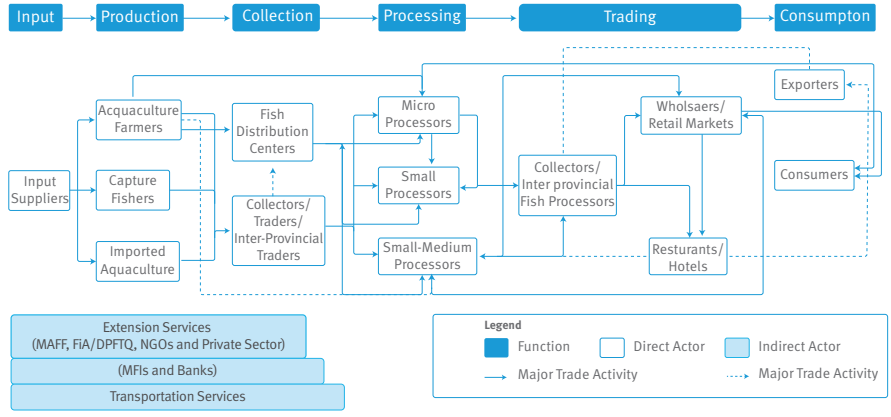
All small-scale smoked fish enterprises in Kampong Chhnang produce only high-value fish species for large-scale production. However, one small-medium fish processor produces both high and low-value semi-processed smoked fish purchased from micro enterprises and finalizes the processing for sale to markets. The small-medium-scale enterprises interviewed stated that purchasing semi-processed products form micro enterprises increases their efficiency and volume of supply and the time to process semi-processed smoked fish is quicker. Similarly, micro processors semi-process smoked fish due to decreased processing times leading to increased volumes, but also due to low quality processing technology (kilns).

The field survey in consultation with the provincial cantonment of Battambang estimates that three small and small-medium-scale enterprises are located in Battambang town. All use aquaculture as a source of fish. Trey Andeng (Large catfish) harvested at 3-4 heads/Kg are considered high-value for smoked fish production.

Small and medium-scale enterprises purchase between 500 and 5,000 Kg of fresh fish per day for the purpose of producing smoked fish products, mostly supplied to wholesale markets in Phnom Penh and provincial town markets.

[2] Mainly purchased from small aquaculture raisers along Tonle Sap Lake.

Figure 16: Smoked Fish Value Chain Map



4.1.2 Smoked Fish Production Process

The smoked fish process starts by curing fish using a brine solution and smoke from fuelwood to extend its shelf life. This is the traditional practice in Battambang and Kampong Chhnang. First the intestines are removed; fish is cleaned with water and skewered with bamboo. The fish skewers are placed in a kiln over fuelwood. The fish is smoked for one day. The kilns have the capacity to smoke up 100 Kg per day.

The main fish species for smoked fish include walking catfish (Clarias batrachus), Trey Andeng (Large catfish), Trey kes (Phalacronotus apogon) another species of catfish (Phalacronotus apogon), Trey Ta Onn (Malay glass catfish), Trey kanchos (Mystus rhegma) and Trey Riel (Channa micropeltes). Smoked fish are sorted into low-value and high-value quality for the domestic market. Trey Kes (Phalacronotus apogon), Trey Ta Onn (Malay glass catfish) are considered high-value, while Trey Riel and others are small and are low-value in the market. Most is from natural fish catch; except Trey Pra, which can be either from aquaculture or natural fish catch from Tonle Sap Lake.

The production facilities are very poor with no basic facilities for hygiene and sanitation. Food safety practices are never applied with least protection of fish products from contamination and spoilage

4.1.3 Low-Value Smoked Fish

The (Table 9) below indicates the cost, revenue, and profit margin of low-value smoked fish in Battambang and Kampong Chhnang. The results indicate that the profit margin is 0.19 USD/Kg in Battambang and 0.42 USD/Kg in Kampong Chhnang.

Table 9: Profit Analysis for Low-Value Smoked Fish

Item	Battambang		Kampong Chhnang	
	Unit (USD/Kg)	Unit (USD/T)	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	1.545	1,544.962	3.31	3,309.54
[b]Fixed Cost	0.01	10.45	0.28	280.91
Revenue	1.75	1,750.00	4.01	4,010.47
[c]Profit	0.19	194.59	0.42	420.02

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as bamboo skew, sugar, fuelwood and other ingredients
b: This includes warehouse, transportation (i.e., moto, van), kiln and building
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey ,November-December, 2020)

4.1.4 High-Value Smoked Fish

(Table 10) below indicates the cost, revenue, and profit margin of smoked fish for small and small-medium-scale enterprises that use high-value fish species, for instance Trey Kes (Phalacronotus apogon) and 6-7 heads per skewer.

The results indicate that the profit margin of high-value smoked fish is USD 2.18/Kg or USD 2,177/ton in Battambang and USD 1.47/Kg or USD 1,467/Ton in Kampong Chhnang.

Table 10: Profit Analysis for High-Value Smoked Fish

Item	Battambang		Kampong Chhnang	
	Unit (USD/Kg)	Unit (USD/T)	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	5.33	5,333.20	24.90	24,900.66
[b]Fixed Cost	0.17	167.16	0.09	92.30
Revenue	7.68	7,677.50	26.46	26,460.00
[c]Profit	2.18	2,177.15	1.47	1,467.04

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as bamboo skew, sugar, fuelwood and other ingredients
b: This includes warehouse, transportation (i.e., moto, van), kiln and building
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

4.2 Dried Fish

Dried fish products produced in significant volume from Battambang and Kampong Chhnang. Nor Reay commune is a hot spot for processing dried fish in Battambang and Kampong Chhnang provincial town and the floating village are hot spots for processing dried fish in Kampong Chhnang. Most dried fish processors fall into the micro enterprise category, only a few are considered small-scale and small-medium-scale enterprises.

The field survey reveals that fresh fish species, such as Trey Raws and bullseye snakehead (Chana marulius) are commonly processed into dried fish, which are considered high-value for the domestic market, and meet the needs of the Cambodian middle-class. However, most of the fish supply is sourced from aquaculture and the majority is imported from Vietnam. Fish processors are increasingly reliant on aquaculture because of the decline of fish supply from the Tonle Sap, however, the sales price is the same. Additionally, wild capture fish from fishermen are often not as fresh.

Figure 17: Low-value dried Fish

Low-Value Dried Fish Battambang, ©iDE

Figure 18: High-value dried fish

High-Value Dried Fish Kampong Chhnang, ©iDE

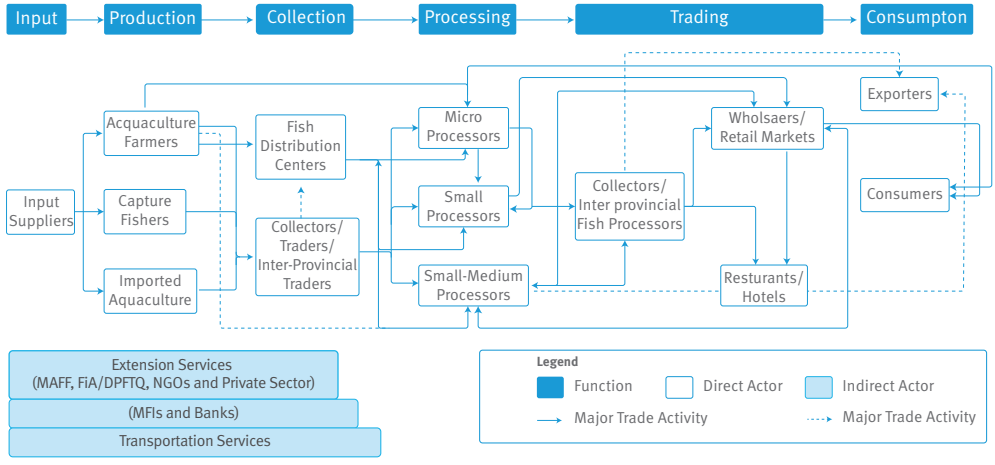
4.2.1 Dried Fish Value Chain

There are at least 40-50 micro enterprises located in Nor Rear commune, Battambang and a few micro enterprises in Kampong Chhnang provincial town that only process dried fish. The 19 dried fish processors interviewed all stated that they process year-round due to aquaculture as a complement to fish catch. Most of the aquaculture supply for these businesses comes from cage aquaculture from Vietnam and a small proportion is from local cage aquaculture (Figure 19).

Dried fish are processed in batches of approximately 500 Kg (usually 1-2 batches per week). Most products are sold interprovincially, in Pailin, Banteay Meanchey, Preah Vihear, urban areas, and Phnom Penh. The majority of dried fish is sold through purchase orders and contract agreements. Only a small percentage of dried fish products were sold in Battambang and Kampong Chhnang provinces (10-15%).

There is a small-medium-scale dried fish processor located in Nor Rear commune, Battambang that employs 17 laborers and produces year-round, using aquaculture as its primary source of fish. The enterprise produces upwards of 100 tons of dried fish per year. The majority of their products are sold to wholesalers/retailers from different provinces including markets in Phnom Penh. The majority of their products are sold through contract agreements and purchase orders from clients.

Figure 19: Dried Fish Value Chain Map



4.2.2 Dried Fish Production Process

The basic operation for making dried fish includes gutting and beheading. This process uses wooden boards and water tanks. Fish waste such as heads and guts are stored in plastic bags and sold to companies that raise carnivorous fish and crocodile farms. The yield is about 1:0.5. The gutted fish are cleaned, sliced, immersed in salt (1Kg gutted fish: 0.07Kg of salt). They also use sugar, Monosodium Glutamate (MSG) and vinegar solution before drying. Most processors dry fish under the sun for two days in the dry season and 10-15 days in the wet season. Some use plastic canvases as a cover during the rainy season; dried fish products are sorted by size before packaging and delivery, usually in plastic bags.

The production facilities are very poor with no basic facilities for hygiene and sanitation. Food safety practices are never applied with least protection of fish products from contamination and spoilage

4.2.3 Low-Value Dried Fish

The main fish species to produce low-value dried fish are Trey Raws (Bullseye Snakehead (Chana marulius) and Trey Deip (Channa micropeltes). Most Trey Raws and Trey Diep are imported from Vietnamese aquaculture operations.

The dry season is favorable due to sunlight conditions for drying fish and is the peak season for catching fish from the Tonle Sap, resulting in a lower market price compared to the wet season. During the wet season prices increase significantly due to limited supply, fueled by low fishing yields and limited sunlight and hence tent/solar drying could be the alternative option.

The result of data analysis indicates that the profit margin for low-value dried fish processors is estimated to be USD 0.55/Kg or USD 551.18/Ton in Battambang and USD 0.72/Kg or USD 723.60 in Kampong Chhnang as highlighted in (Table 11).

Table 11: Profit Analysis of Low-Value Dried Fish

	Battambang		Kampong Chhnang	
Item	Unit (USD/Kg)	Unit (USD/T)	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	3.40	3,404.86	4.70	4,699.91
[b]Fixed Cost	0.48	482.59	0.08	76.49
Revenue	4.44	4,438.64	5.50	5,500.00
[c]Profit	0.55	551.18	0.72	723.60

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, and other ingredients.
b: This includes warehouse, transportation (i.e., moto, van), machine, building and other.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

4.2.4 High-Value Dried Fish

There are two fish species used to make high-value dried fish in Kampong Chhnang, Trey Prama (Boesemam Croaker) and Trey Bra (Pengasius). There was no high-value dried fish processed in Battambang. The result of the analysis reveals that the profit margin of high-value dried fish is approximately USD 2.91/Kg or USD 2,913.60/Ton (Table 12).

Table 12: Profit Analysis of High-Value Dried Fish

	Kampong Chhnang	
Item	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	19.33	19,334.88
[b]Fixed Cost	0.31	313.07
Revenue	22.56	2,2561.55
[c]Profit	2.91	2,913.60

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, and other ingredients.
b: This includes warehouse, transportation (i.e., moto, van), machine, building and other.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

4.3 Prahok

Prahok is a salted and fermented fish paste that is served as a condiment for Cambodian cuisine. Prahok is a fermented product that can be stored for several months without spoiling. This makes it a reliable (and ready-made) source of protein throughout the year, even when it is no longer fishing season.

Based on the field survey, there are two main types of Prahok: Prahok Sach (boneless) and Prahok Cha-oeung. Prahok Cha-oeung includes fish bones throughout production and is made with 15%–20% salt. Meanwhile, Prahok Sach is made by first discarding the fish bones and using 25%–30% salt. Prahok Sach is made of high-value fish species; as a result, it garners a higher price compared to Prahok Cha-oeung. The main fish species used to produce Prahok include Trey Raws (Channa marulius), Trey Kros (Chitala chitala), Trey Kampleagn (Trichogaster micropelis), Trey Riel (Cirrhinus caudimaculatus) and Trey Chhdor (Cyclocheilichthys enoplus).

The peak season for Prahok production is from November to February when there are higher yields of low-value migratory fish. The main hot spot for Prahok production in Battambang is Prahok Market (Phsa Prahok) located in Prek Kanchreng village, Prek Norin commune, Ek Phnom district, Battambang province and Seb village, Seb commune, Kampong Trolach/Prey Khmer district in Kampong Chhnang. Most Prahok processors use machines to remove fish heads, skin, intestines and sell semi-processed products to different interprovincial traders that purchase for making their own Prahok for resale. Some also sell semi-processed products to fish sauce enterprises in Phnom Penh.

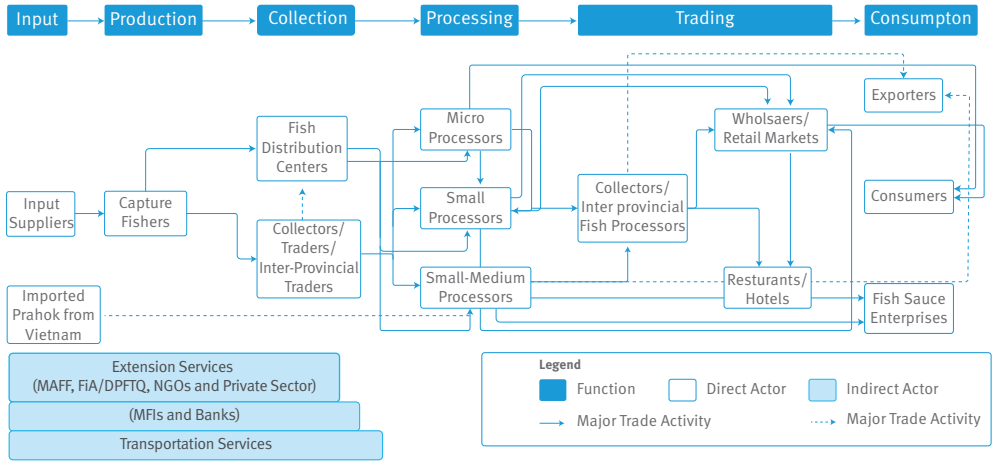
4.3.1 Prahok Value Chain

Micro Prahok processors make most of their products during the peak season of migratory small-value fish. Most of the micro Prahok enterprises semi-process Prahok manually, removing heads, intestines and fat and salting. These products are sold to small and small-medium-scale enterprises located in the Phsa Prahok landing site in Battambang and Chhnouk Trou landing site in Kampong Chhnang (Figure 20).

The small and small-medium-scale enterprises purchase Prahok from micro enterprises after the product has been semi-processed (heads and skin removed, salted), or from fishermen to produce self-made Prahok by using machines to behead and 'trundle' the fish. The processors sell their product to interprovincial traders, wholesalers/retailers, urban markets, Phnom Penh or informal export to Thailand through purchase orders and/or contract agreements.

The Phsa Prahok (Prahok Market) landing site is a hot spot of the Prahok industry in Battambang. Approximately 20 small and small-medium-scale enterprises that process Prahok sell at Prahok Market. Some of these processors could also be categorized as medium-scale Prahok processors in terms of volume and value of trading activities. The main hot spot of commercial Prahok processors in Kampong Chhnang is located in Kampong Tralach district. There are 30-40 enterprises that make semi-processed or fully processed Prahok. Fish are mechanically beheaded. Additionally, there are also commercial Prahok processors located in Boribo district (Chhnouk Trou Landing Site). The majority of these are Vietnamese ethnic minorities.

Figure 20: Prahok Value Chain Map



4.3.2 Prahok Production Process

Commercial and trade activities of Prahok in Battambang have increased significantly in recent years due to increased local and export demand. Increased mechanization to remove fish heads, and intestines has grown dramatically among commercial fish processors. Removal of heads, and other materials reduces the fresh fish weight by about half. The final step is to salt the processed fish in a tank and allow a period of a month or longer for fermentation to take place. Salt is sourced locally from Kampot/Kep and represents about 15-30 percent of Prahok by weight. Other ingredients used in the production of Prahok are sugar and monosodium glutamate (MSG). Microprocessors use water from the Tonle Sap River for cleaning and processing fish, while small and small-medium-scale processors have access to piped water for cleaning and processing their products as they are located in urban areas. The products are packaged in plastic bags or plastic buckets. Meanwhile, the waste, such as fish heads, intestines and others are sold separately as fish feed to aquaculture farmers or crocodile farms.

The production facilities are very poor with no basic facilities for hygiene and sanitation. Food safety practices are never applied with least protection of fish products from contamination and spoilage

4.3.3 Low-Value Prahok

Trey riel (Cirrhinus caudimaculatus) caught mostly in the peak season is harvested in Tonle Sap from November to February. This species is considered to be low-value Prahok. The table 14 below details the cost and profit analysis of low-quality Prahok made from trey riel (Cirrhinus caudimaculatus).

The results of the analysis indicate that the profit margin of low-value Prahok is USD 0.32 or USD 318.45/Ton in Battambang and USD 0.39/Kg or USD 390.71/Ton in Kampong Chhnang (Table 13).

Table 13: Profit Analysis for Low-Value Prahok

Item	Battambang		Kampong Chhnang	
	Unit (USD/Kg)	Unit (USD/T)	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	1.75	1,754.56	1.86	1,855.04
[b]Fixed Cost	0.04	36.99	0.08	82.06
Revenue	2.11	2,110.00	2.33	2,327.82
[c]Profit	0.32	318.45	0.39	390.71

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, and other ingredients.
b: This includes warehouse, transportation (i.e., motorcycle, van), machine for fish head, intestine and fat removal, building and tanks.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

4.3.4 High-Value Prahok

Trey Kampleagn (Trichogaster microlepis) is used for making high-value Prahok in Battambang. Trey Kampleagn is caught in the Tonle Sap Lake, with a peak season from November to February. The price of Prahok made from Trey Kampleagn is higher than that of Trey riel. This species of fish is used to make Prahok Sach, which receives a higher price in the market. There were no high-value Prahok processors identified in Kampong Chhnang.

The result of the analysis reveals that the market price for high-value Prahok in Battambang is USD 3.99/Kg or USD 3,996.67/Ton, and the profit margin is estimated to be USD 0.71/Kg or USD 709.25/Ton (Table 14), which is more than double of the low-value Prahok product. This high-value Prahok made from Trey Kampleagn in Battambang has a very good reputation within Cambodia and with Cambodian expatriates living abroad making it a potential product for Geographic Identification (GI) registration.

Table 14: Profit Analysis of High-Value Prahok

Item	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	3.19	3,190.12
[b]Fixed Cost	0.10	97.29
Revenue	3.99	3,996.67
[c]Profit	0.71	709.25

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, and other ingredients.
b: This includes warehouse, transportation (i.e., motorcycle, van), machine for fish head, intestine and fat removal, building and tanks.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020))

4.4 Nem (Nem Trey)

Nem is one of the well-known Khmer delicacies made of raw spiced fish wrapped in Banana leaves, usually eaten as a snack or after meals. It is totally distinct from Vietnamese made Nem (known as "Chi Yor" among Cambodians).

Battambang province is popular for producing Nem products and recently this product has been in high demand in urban areas and in Phnom Penh. Nem can be produced from several available fish species. High-value Nem is made from fish caught from the Tonle Sap Lake, such as Trey Raws and Snakehead. However, low-value Nem is made of Trey Nourn Chan (Thai name) which is imported from Thailand aquaculture.

Figure 21: Packaging activity and Machine of a Micro Nem Processor in Battambang

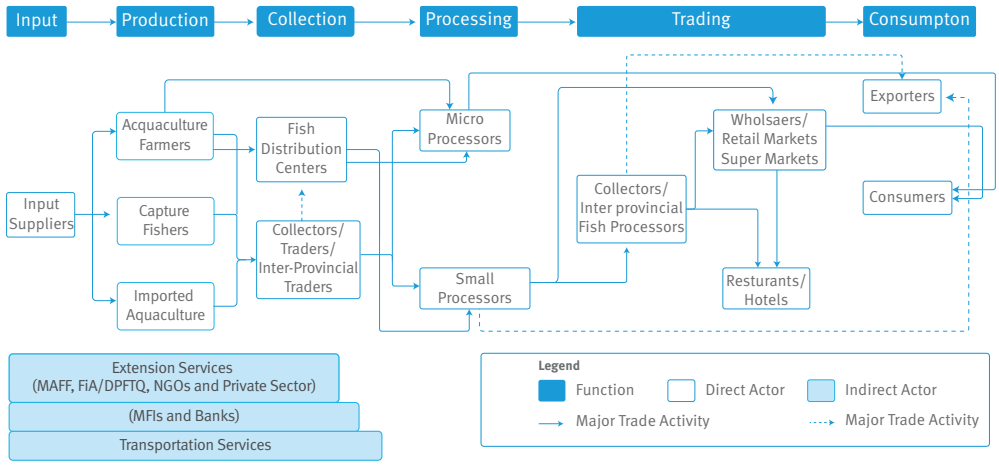
A Micro Nem Processor Battambang- a modern facility owned by a community; ©iDE

4.4.1 Nem Value Chain

Nem processors range from micro to small-scale enterprises in terms of capital investment and employment. There are about 35 Nem processors located in Prek Kpok and Prek Lourng commune of Ek Phnom district in Battambang. Most Nem micro enterprises purchase aquaculture fish (Nourn Chan) imported from Thailand because it is cheaper than local fish, which allows them to produce year-round. However, one small Nem social enterprise has formed an association that is in compliance with basic food safety standards, including storage, labeling and packaging, and has implemented barcodes, enabling it to supply supermarkets and the export market. Their main source of raw material is wild fish, such as Trey Raws (Great Snakehead).

Most Nem is sold in Phnom Penh, Battambang town and Banteay Meanchey province (Figure 22). The average production of micro Nem processors is approximately 26 tons/per year which is sold to wholesalers/retailers. Small-scale processors produce approximately 54 tons/years and sell to niche markets and supermarkets in Phnom Penh.

Figure 22: Nem Value Chain Map



4.4.2 Nem Production Process

Nem is made from minced fish meat (fish is deskinned and deboned, then pounded into paste along with other ingredients) to mix with a variety of herbs such as star gooseberry leaves locally-called Sleok Kantout srok; rorlous bai, a vine with an edible tuberous root leaves; Sleok Chaplu, a kind of vegetable with betel-shaped leaves and are formed into small balls or rectangular shapes and wrapped in banana leaves or polythene tubes. Toasted rice, ginger, chilies, sugar, salt, and seasoning are added for flavor.

The production facilities are very poor with no basic facilities for hygiene and sanitation. Food safety practices are never applied with least protection of fish products from contamination and spoilage

4.4.3 Profit Analysis of Nem

The (Table 15) below indicates the revenue for Nem micro enterprises in Battambang is approximately USD 4.69/Kg or USD 4,694.76/Ton and the profit margin is about 0.07 USD/Kg or 72.89 USD/ton.

Table 15: Profit Analysis of Micro Nem Enterprises in Battambang

Item	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	4.52	4,516.84
[b]Fixed Cost	0.11	105.03
Revenue	4.69	4,694.76
[c]Profit	0.07	72.89

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, and other ingredients.
b: This includes warehouse, transportation (moto, van), machine and building.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

The (Table 16) below shows that the revenue for small-scale Nem enterprises in Battambang is approximately USD 7.50/Kg or USD 7,500/Ton 0.12 USD/Kg or 118.06 USD/ton.

Table 16: Profit Analysis of Small-Scale Nem Enterprises in Battambang

Item	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	6.96	6,962.04
[b]Fixed Cost	0.42	419.91
Revenue	7.50	7,500.00
[c]Profit	0.12	118.06

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, and other ingredients.
b: This includes warehouse, transportation (moto, van), machine and building.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

4.5 Prohet Trey (Fish Ball)

Prohet Trey is popular in urban areas and Phnom Penh. It is commonly grilled or used in Cambodian soups. Prohet Trey is made from several species of fish caught in the Tonle Sap Lake, such as Trey Kros (Osteochilus microcephalus), Trey Kaek (Morulius chrysophekadion), Trey Slat (Notopterus notopterus), which are high-value and Try Riel (Cirrhinus caudimaculatus) which is considered low-value. Most of Prohet Trey is made by Vietnamese ethnic minorities in the floating village of Kampong Chhnang provincial town. There are at least 10 Prohet Trey processors currently active in Kampong Chhnang provincial town. The production is very labor intensive. Once produced, it is packaged in plastic bags and placed in a cold ice box for sale to various market actors.

Figure 23: A Micro Prohet Trey Processor

Micro Prohet Trey Processing; ©iDE

Figure 24: A Small-Scale Prohet Trey processor

Small-Scale Prohet Trey Processing; ©iDE

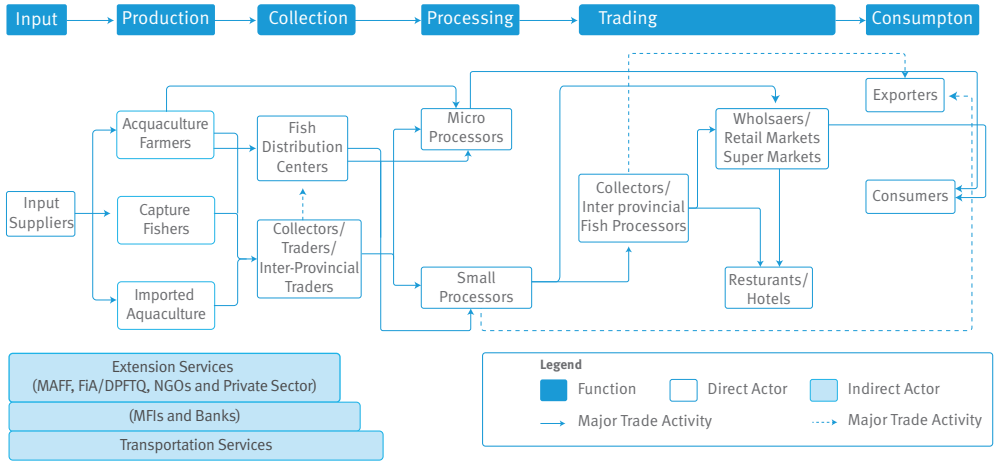
4.5.1 Prohet Trey Value Chain

Prohet Trey processors range from micro to small-scale enterprises in terms of capital investment and employment. There are 10 enterprises located in the floating village of Koh Krabei, Kampong Chhnang province.

Micro Prohet Trey enterprises sell to domestic markets and interprovincially. Typically, family labour and/or a few casual laborers are utilized. Fresh fish is purchased from markets or from fish traders. Processors can produce and sell between 10-80 Kg/day to retail markets. Prohet Trey is highly perishable; it must be sold within one day. Small-scale Prohet Trey processors from Kampong Chhnang market town often sell their products directly to consumers, or contract-out with local restaurants.

Small-scale Prohet Trey processors operate only in Kampong Chhnang province. The total daily production of Prohet Trey in Kampong Chhnang is approximately 300-500 Kg per day. The processors have a labor force of 8-10 people. Most Prohet Trey from small-scale processors is sold to markets in Phnom Penh, e.g., Orussey Market, Olympic Market, Central Market, and various restaurants in Phnom Penh and Kampong Chhnang. Most Prohet Trey processors transport their produce to Phnom Penh in their own vehicle, or via taxi.

Figure 25: Prohet Trey Value Chain Map



4.5.2 Prohet Trey Production Process

Prohet Trey is processed by removing the head, skin, and intestines and removing the bones manually with an iron skewer. Machines are used to process Trey Riel, but this product garners a low price in the market. The processed fish is then either formed into fish balls. It is then packaged in plastic bags in weights of 1, 2 or 5kg and stored in an ice box.

A few species of fish are used for making Prohet Trey: Trey Slat (Notopterus notopterus), Trey Kaek (Morulius chrysophekadion), Trey Kros (Osteochilus microcephalus), and Trey Riel (Cirrhinus caudimaculatus). Prohet Trey is produced in both Kampong Chhnang provincial town and the floating village, however, the supply of products to markets is low. Prohet Trey is popular for use in Cambodian soups, and fried or grilled for domestic restaurants in urban areas. Prohet Trey can be produced year-round, but production declines in the closed fishing season between May and late October.

The conditions of the production facilities are very poor with no basic facilities for hygiene and sanitation. Food safety practices are never applied with least protection of fish products from contamination and spoilage

4.5.3 Profit Analysis of Prohet Trey in Kampong Chhnang

The species of fish determines the price of Prohet Trey, for instance, Trey Kaek (Morulius chrysophekadion) and Trey Slath (Notopterus notopterus) garner the highest price. These species are harvested in Tonle Sap Lake during the peak harvest season from November to February.

The result of the field analysis indicate that the revenue of micro Prohet Trey in Kampong Chhnang is USD 4.96/Kg or USD 4,958.33/Ton and the profit margin is approximately USD 1.25/Kg or USD 1,252.81/Ton as indicated in as detailed in (Table 17).

Table 17: Profit Analysis of Micro Prohet Trey Enterprises in Kampong Chhnang

Item	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	3.55	3,552.08
[b]Fixed Cost	0.15	153.45
Revenue	4.96	4,958.33
[c]Profit	1.25	1,252.81

a: This includes the purchasing price of fish, labor cost, transportation cost and ingredients.
b: This includes warehouse, transportation (moto, van), building and ice box.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

The (Table 18) below points out that the revenue of small-scale Prohet Trey in Kampon Chhnang is USD 7.33 /Kg or USD 7,328.95/Ton and the profit margin is approximately USD 1.73/Kg or USD 1,727.25/Ton.

Table 18: Profit Analysis of Small-Scale Prohet Trey Enterprises

Item	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	5.53	5,528.48
[b]Fixed Cost	0.07	73.21
Revenue	7.33	7,328.95
[c]Profit	1.73	1,727.25

a: This includes the purchasing price of fish, labor cost, transportation cost and ingredients.
b: This includes warehouse, transportation (moto, van), building and ice box.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

4.6 Fish Sauce

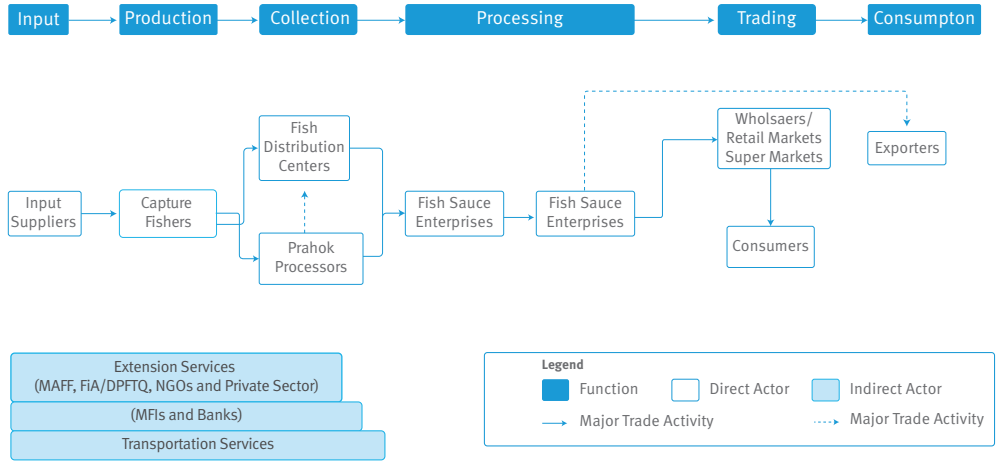
Based on the field survey, there are at least 6 fish sauce enterprises in Battambang province. Four of them are located in Battambang province and two are located in Mong Ruessei district. These enterprises are mainly operated by Khmer-sino and their skills and expertise have been transferred generationally. There were no fish sauce enterprises identified in Kampong Chhnang.

4.6.1 Fish Sauce Value Chain

Two small-medium-scale fish sauce enterprises that were interviewed had significant capital investment with a large labor force. These two firms have been registered at MISTI and have complied with the National Standard from MISTI. There is regular monitoring for quality of these enterprises from MISTI, Camcontrol, and other government institutions at the national and provincial level.

Data analysis from the field survey estimates the total annual fish sauce production to be 315,333 liters per enterprise. These enterprises also produce other products, such as soya sauce. The majority of fish sauce products are sold in other provinces in rural districts, such as Oddar Meanchey, Banteay Meanchey and Preah Vihear provinces.

Figure 26: Fish Sauce Value Chain Map



4.6.2 Fish Sauce Production Process

Fish sauce is produced in small factories in Battambang using basic processing techniques, but with good packaging and labeling procedures. There were no fish sauce processors identified in Kampong Chhnang during the field survey. Fish sauce processors in Battambang use a mixture of 95% liquid Prahok and 5% fresh fish (Trey Riel purchased from wholesalers at the fish distribution center) to make fish sauce. The liquid Prahok is filtered in a tank to remove residue and then boiled for 20-30 minutes. The remaining liquid is then transferred to a 5,000-liter tank and stored for fermentation. The fish sauce is packaged in 720ml glass and plastic bottles, sealed and labeled. The final product is transported by van 4-5 times per week with volumes up to 1,730 bottles per trip to remote markets in Battambang, Banteay Meanchey and Oddar Meanchey.

The use of liquid Prahok to make fish sauce is a way for fish sauce processors to expedite the production process as liquid prahok is already fermented. The advantage of this method is that it reduces the production time from 3-6 months to approximately 10 days. The disadvantages of this method include a lower quality product, a lower price point and limited market access compared to medium and large-scale processors in Phnom Penh that ferment for 3-6 months.

The main raw material is Trey Riel that is collected from Dai fishery or from fish wholesalers in the peak season of fish production, Nov. to Feb. The fish are cleaned and mixed with 10-15% salt in the fermentation tank and covered with a second layer of fish. The fish are mixed monthly to ensure they are well salted. The fermentation process takes between 3-6 months, however, the longer it is fermented the better the quality of fish sauce. When the fish sauce is ready, it is bottled and labeled.

4.6.3 Fish Sauce Profit Analysis

The (Table 19) below demonstrates the cost, revenue, and profit margin of fish sauce enterprises in Battambang. The result of the analysis reveals that the revenue of fish sauce is USD 0.50/Liter or USD 500/Ton, and the profit margin is estimated to be USD 0.10/Liter or USD 101.70 /Ton.

Table 19: Economic Analysis of Fish Sauce in Battambang

Item	Unit (USD/Liter)	Unit (USD/T)
[a]Variable Cost	0.29	292.90
[b]Fixed Cost	0.11	105.39
Revenue	0.50	500.00
[c]Profit	0.10	101.70

a: This includes purchasing price of fish, labor cost, transportation cost, ingredients such as salt, sugar, liquid Prahok and others, fees and patent.
b: This includes warehouse, transportation (moto, van), bottles, machine, building and tanks.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

5.
VALUE CHAIN ACTORS AND SERVICE PROVIDERS IN POST-HARVEST FISHERIES

5. Value chain Actors and Service Providers in post-harvest fisheries

5.1 Fishermen

Natural fish catch has declined reportedly due to population increase, illegal fishing activities, hydro-dam construction upstream of the Mekong River and climate change, which has had a negative impact on the livelihoods of fishermen along Sangke River and Tonle Sap. The daily catch per fisherman has reduced drastically; the catch mainly consists of low-value fish which fetch low market prices.

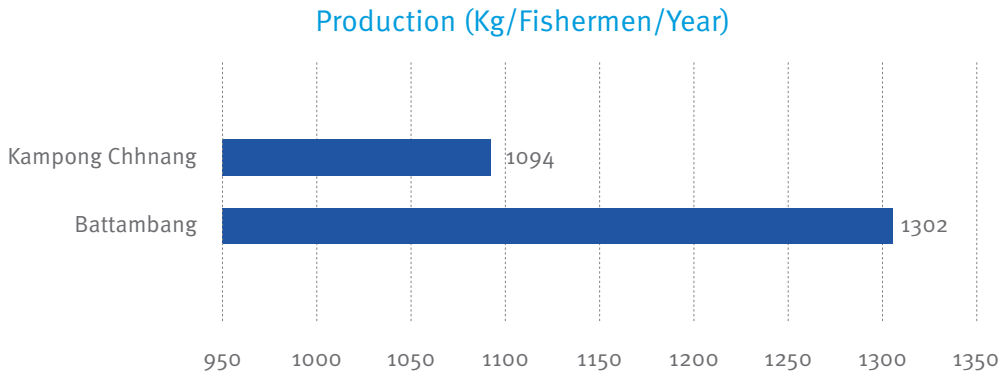
Family-scale fishermen and small-scale fishermen catch approximately 1,000 – 1,300 kg per year per household as indicated in (Figure 27). Around 80-90% of fish caught by fishermen in Battambang are sold to fish processors at the village level and 10-20% is used for household consumption and for feeding fish in cages. 95% of fish caught by fishermen in Kampong Chhnang is sold to fish traders/ collectors and 5% is sold to local markets. (Table 20) shows that the fishmen can earn profit around USD 450.93 per year.

Fishermen sell their products to traders individually, rather than collectively, which decreases their bargaining power. Based on FGDs, 60-70% of fishermen are in debt, requiring loans to purchase fishing equipment. The money lenders are often fish traders, and the fishermen thereafter are forced to sell their catch at discounted prices to these fish traders / moneylenders. The majority of fishermen also raise fish in cages.

Another key challenge for fishermen is fish spoilage. The majority of fish (80-90%) are sold within one day of capture, but approximately 10% of their harvest spoils. Cold chain (ice boxes, refrigerators, etc.) is seldomly practiced to keep fish fresh and extend the shelf life. As a result, fishermen's catches garner a lower price from collectors/traders. However, spoiled products may still be used for other fish products, such as Prahok and Pa-Ok, if fish traders/collectors offer a lower price.

90% of the fishermen interviewed reported that they did not grade their fish and a few stated that they did not differentiate fish species from the volume of catch. As a result, the majority of fishermen interviewed are receiving lower market prices, leading to reduced incomes.

Figure 27: Total Fish Catch in Battambang and Kampong Chhnang (Kg/Year/HH)



(Source: Field Survey, November-December, 2020)

Table 20: Profit Analysis of Fishermen

Item	Unit (USD/Kg)	Unit (USD/Ton)
[a]Variable Cost	0.31	306.26
[b]Fixed Cost	0.47	474.19
Revenue	1.23	1,226.39
[c]Profit	0.45	445.93

a: This includes purchasing price of fish and labor cost
b: This includes storage and transportation (moto, van)
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

5.2 Aquaculture farmers

The majority of aquaculture farmers use fish cages to harvest fish including catfish, giant snakehead, Pangasius species and a few others raise crocodiles in Peam Seima village, Prey Chas commune, Ek Phnom district, Battambang province as shown in (Table 21). Most cage culture enterprises use low-value fish catch from the Tonle Sap Lake for fish feed. However, for mainland pond culture, the majority of enterprises use imported commercial feed from Vietnam and Thailand. Both cage and pond culture enterprises sell their aquaculture products to micro, small and small-medium-scale processors and a small portion to local consumers.

Smallholder aquaculture farmers purchase fingerlings from village traders; some fingerlings are imported from Vietnam. The price of fingerlings produced locally and imported is the same. However, the imported fingerlings have reported to be having better growth rate. The mortality rate for fingerlings is high at approximately 20-50% (depending on species) due to poor storage and a long trade route.

The length of time to raise fingerlings is between 3-6 months depending on the type of fish. The average annual fish harvest for cage culture is approximately 300 Kg per famer (4-6m2).

The aquaculture farmers have learnt the fish raising techniques from relatives, friends and feed suppliers in the community while some of them learnt from NGO programs. Most of the fish harvest is sold to fish processors at the village level, wholesalers and local markets.

Price competition with massive imports of fish from neighboring countries is a main challenge for Cambodian farmers. Though Cambodians prefer to consume locally produced fish but those products are more expensive which may become affordable for only well-off population.

Table 21: Pond and Cage Statistics

Province	Pond				Cage			
	Total		Operational		Total		Operational	
	No.	Area (m2)	No.	Area (m2)	No.	Area (m2)	No.	Area (m2)
Phnom Penh	285	1,214,670	282	1,190,670	859	22,850	832	21,905
Kampong Chhnang	899	134,850	366	54,900	919	7,428	835	10,020
Battambang	500	196,000	500	196,000	1,170	7,020	1,170	7,020

5.3 Fish Traders/Collectors

Fish traders/collectors are those that purchase fish from fishermen from various fishing areas. Fish traders aggregate fish products, and add value by sorting and grading by size, weight, and fish species. They typically own boats, motorbikes, or minivans to collect fish from fishermen using ice boxes to store fish during collection and distribution. They buy fish throughout the year and sell them to fish wholesalers.

Most fish traders also play the role of informal creditors in order to secure volume of supply. They provide credit in cash or in-kind (e.g., fishing equipment) to fishermen; in turn, fishermen must sell exclusively to the fish trader. An interest rate is not directly charged; however, fishermen discount the fish price by KHR 300-500/kg compared to the market price. In some cases, collectors get loans from wholesalers and exporters and use these loans to extend to fishermen. The average trading volume per year is 20 Ton in Battambang and 17 ton in Kampong Chhnang. The profit analysis of fish traders illustrates in (Table 22).

Based on KIIs with fish traders/collectors, their main challenge is fish spoilage, as it represents about 5% of the total volume of fresh/chilled fish that they purchase. The fish traders/collectors purchase fish from fishermen, store it in an ice box with a block of ice on the bottom, place the fish on top of the ice block and cover the fish with another ice block. This method does not have good cooling effect, instead leading to damage of fish during transport. Additionally, when fish traders/collectors

sell to the wholesale market/distribution center, they unpack the fish to weigh and then re-ice to sell to retail markets and consumers. This process leads to increased spoilage along the trade route.

The second main concern is the risk of loan defaults from fishermen. Based on the field survey results, traders/collectors stated that 20-30% of fishermen who access to informal credit do not pay off their debts. There were two main reasons for loan defaults:

- Fishermen are no longer fishing and migrate to employment in other sectors (e.g., garment factories, agricultural labour, etc.) due to reduced fish harvests
- Fishermen did not adhere to their contract agreement with the traders/collectors and sold their harvest to other traders. The loan arrangements are informal and are often not honored by the fishermen.

Table 22: Fish Traders/Collectors Profit Analysis

	Battambang		Kampong Chhnang	
Item	USD/KG	USD/Ton	USD/KG	USD/Ton
[a]Total Variable Cost	0.62	622.75	3.93	3,925.41
[b]Total Fix Cost	0.11	105.00	.06	64.71
Revenue	1.20	1,200.00	4.35	4,347.06
[c]Profit	0.47	472.25	0.30	356.94

a: This includes the purchasing price of fish, labor cost, gasoline and other.
b: This includes warehouse, transportation (moto, van, boat) and ice box
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

5.4 Wholesalers/Interprovincial Traders/Exporters

These market actors purchase fresh fish from traders/collectors, and in some cases directly from fishermen. They strategically establish permanent fish stalls in places such as the landing sites, floating villages and other important fishery areas.

Most wholesalers in Battambang settle their business at the Fish Distribution Centre in Chin Dam Spey Village, Slaket commune, Battambang district. In Kampong Chhnang, most businesses are located in the Kampong Leng landing site or in the Kampong Chhnang provincial town, Chhnok Trou landing site.

Wholesalers transport fish in ice boxes, however, the average spoilage is approximately 10% of total volume of fish sold. Wholesalers sell fish to fish micro and small-scale processors. 70-80% of fish trading volume by wholesalers is high-value and 20-30% is low-value.

Wholesalers that operate their businesses at the provincial landing site located at the fish distribution center are required to pay the center 4% royalty on the total value of fish/Kg. They also buy fish from Vietnam, especially during the wet season when there is a low supply of local fish in Kampong Chhnang.

The fish wholesalers interviewed play multi-functional roles along the trade route. Based on KIIs with 11 traders and wholesalers (out of which 2 are men), they play the role of interprovincial traders and indirect exporters. Fish export to Thailand goes through Poipet's border checkpoint informally through local distributors who reside in Poipet and have a good connection with Thai Traders. Most of them receive order via phone.

The KII's interview with the respondents revealed that all of them sell fresh fish and multiple processed products such as: Pohoc, Parok, Mam, Dried Fish and Smoked fish; they do not have registered business and all of them have a store in the provincial market. Women respondents have a smaller business size than men in terms of volume of sales and inventory. Table 23 highlights the profit analysis of traders in Battambang and Kampong Chhnang provinces.

A wholesaler in Battambang says "the value of sale is around USD 250-400/day". This amount is almost 8 or 9 times bigger than the average trader. He adds "My gross revenue is around USD 50-USD 100 per day".

For interprovincial fish transport, a license and transport permit from FiA cantonment and FiA central are required; this puts an added constraint on these market actors. Informal check points across the trade route from landing site to border may charge fees of KHR 30-50/Kg of chilled/fresh fish. The fee paid to cross into Thailand is about KHR 200/Kg of fish.

Most wholesalers that were interviewed stated that they provide loans to traders and fishermen to ensure a regular volume of supply, however, these loans pose a high risk, as the default rate among fishermen is high. One of two fresh-fish wholesalers in Kampong Chhnang (Chhnok Trou landing site) has ceased loan activity, and reverted to a cash-only basis after several fishermen defaulted on their loans.

With regard to access to loan, only the bigger sized wholesalers' access to loan for purchasing stock; a wholesaler in Pu Puy's market said that "I borrow money from bank for purchasing stock during the harvesting season, the interest rate is 1.1% per month and I repay in the next 3 or 4 months after resell the products". While, the smaller size wholesalers seem satisfied with their current business practice and they do not want to get loan due to the uncertainty of their business while some of them received advance cash from their buyers. A wholesaler at Psar Ler, Kompong Chhnang provinces said that "I just use my own funds to purchase stock since the price of products is highly fluctuating, the more products in stock, the riskier is the business, specifically, for Prohock and Pa-ork".

All the wholesalers reported that they were never trained on post-harvest handling for processed products and their skills and knowledge were passed down from their ancestors. A few of them reported that they stock smoked fish and dried fish products, while the majority of them do not due to a lack of knowledge of insect control techniques and fungi infestation. Interestingly, they also reported that most of their products are re-packaged and re-sold by retailers in Phnom Penh including online-shops.

Table 23: Wholesaler/Interprovincial Trader/Exporter Profit Analysis

Item	Battambang		Kampong Chhnang	
	Unit (USD/Kg)	Unit (USD/T)	Unit (USD/Kg)	Unit (USD/T)
[a]Variable Cost	1.85	1,845.92	4.22	4,220.99
[b]Fixed Cost	0.01	7.86	0.02	18.78
Revenue	2.19	2,187.50	4.43	4,429.35
[c]Profit	0.33	333.72	0.19	189.58

a: This includes purchasing price of fish and labor cost
b: This includes storage and transportation (moto, van)
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

5.5 Fish Distribution Centers

There is one medium-scale fish distribution center in Battambang that is located in Chen Dam Spay village, Sla Ket commune, Battambang district, Battambang province and operates year-round. The fish distribution center aggregates fish and aquaculture products to support different fish processing industries, such as Prahok, smoked fish, dried fish, Mam and Pa Ok, and other forms of processed fish products in Battambang. The distribution center is owned by a private company, which was auctioned from the provincial government and the Provincial Department of Economics and Finance.

All fresh fish caught from the Tonle Sap Lake and aquaculture farmers is sold in the fish distribution center. Field interviews reveal that there are approximately 20 fish wholesalers in the fish distribution center in Battambang. It is estimated that the number of fish sold per wholesaler in the fish distribution center is approximately 3 tons per day; therefore, the total annual quantity of fish sold per year is estimated to be 21,900 tons.

Overall, the facilities in the distribution center totally not in compliance with the hygiene and sanitation practices and poor access to potable water

There are two landing sites for fish at Kampong Chhnang:

1. **Provincial Town:** is the main fish distribution center in Kampong Chhnang. It is leased to a private operator and has approximately 25 fish brokers/wholesalers. The fish traded here comes from Phat Sandai (Kampong Thom) and Chnok Tru (Kampong Chhnang) fishing grounds and cage culture. The estimated volume of fish sold per wholesaler is approximately 4 tons per day; therefore, the annual quantity of fish sold per year is estimated to be 36,500 tons.

2. **Chnok Tru:** this landing site lacks proper facilities for storing, cleaning or trading. Transactions are typically made from boat to boat. It is located 50 kilometers away from the provincial town in Chnok Tru commune, Boribo district.

All traders pay royalty fees to the Fish Distribution Centre, ranging from 2-4% of the total value. Here again, the facilities in the landing center are not in compliance with the hygiene and sanitation practices and facilities and poor access to potable water

5.7. Value Chain Development Supports

The Fisheries Administration Cantonment in Battambang is divided into 4 Fisheries Administration Divisions:

Anlung Vil Fisheries Administration Division:

responsible for implementation within Battambang, Sangke, Mung Rouesey, Kos Krolor, Rotanak Mondul, Banorn and Sam Lout districts

Prek Til Fisheries Administration Division:

responsible for implementation within Ek Phnom district

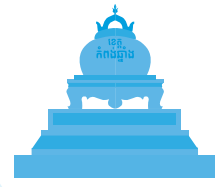
Ou Taki Fisheries Administration Division:

responsible for implementation within Thmor Kurl, Bor Vil, Kamreang, Sampauv Lun and Phnom Prik districts

Pailin Fisheries Administration Division:

responsible for implementation within Pailin and Salarkrao precincts

The Fisheries Administration Cantonment in Kampong Chhnang is divided into 2 Fisheries Administration Divisions:



Phchar Chhnang Fisheries Administration Division:

responsible for implementation within Kampong Chhnang, Kampong Lerng, Boribou and Toeuk Poush districts

Srer Pock Fisheries Administration Division:

responsible for implementation within Chaulkiry, Rorlea Pha Ear, Kamong Tralach and Samaky Meanchey district

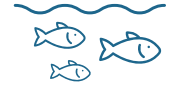
6.
INPUT SUPPLIERS (ICE, FEED, FINGERLING, SALT, AND ETC.)

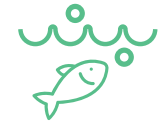
6. Input Suppliers (Ice, Feed, Fingerling, Salt, and etc.)

A total of 14 input suppliers were interviewed during the field survey in Battambang and Kampong Chhnang of which all were micro enterprises without business registration. These include suppliers of ice, salt, fingerlings and fish feed .


ice


salt


fingerlings


fish feed

6.1. Ice Suppliers/Factories

The majority ice suppliers/factories in Battambang supply ice for both fisheries activities and restaurants. Ice is used for packing and storing fresh fish to prevent spoilage.

Due to the decline in fish catch, the two ice factories interviewed in Kampong Chhnang stated that “the fish industry now represented just 10% of their sales”. Over the past 5-years they cited an 80% decrease in revenue. The average amount of ice sold per month is approximately 15-18 ton, mainly to fresh fish suppliers.

One of the ice factories in Battambang stated that “I have been in this business for more than 10 years and I supply ice to around 5 fishery traders and wholesalers and they pay the bill once a month without interest rate”.

Among the ice factories, 66% of the respondents are registered and receiving technical support from MiSTI. The MiSTI team visits once every six months to test the quality of water, operation and provide technical support on safety practices. However, they are far from reaching good standards for food safety compliance due to the absence of washable and hygienic walls, floors and windows. They also lack preventive mechanisms for pests and animals through doors and windows. There is no documentation or record of cleaning, disinfection, hygiene or food safety related activities.

In relation to the number of employees, 4 factories reported that they employ 10 -15 staff per enterprise, the majority of whom are men. Among the 4 ice factories and 2 distributors, none of them plan to upgrade their businesses due to lack of capital investment and the uncertainty of business operation which is partly affected by the Covid-19 outbreak.

6.2. Salt Suppliers

Three salt suppliers were interviewed who are retailers and one of them is a small-medium processor in Battambang Province. The majority of salt is sold to fish processors including Prahok, mam, and Pa-Ok. Salt suppliers sell both salt from Kampot/Kep and imported salt from Vietnam.

The majority of Prahok and dried fish in Battambang is made with salt from Kampot/Kep because the sea salt produced good quality Prohok than factory salt, but in Kampong Chhnang they use imported salt from Vietnam due to its color which is whiter and it can preserve the products longer because it consists of higher level of sodium chloride.

A salt supplier in Phnom Penh said that “the price of imported salt, of course, is cheaper than the local salt from Kompot; however, they report that the quality of Kompot salt is better because it is produced naturally”.

Another respondent in Battambang said that “Kampot salt has a higher demand in the market specifically, during the fishing season due to its better quality. However, Kampot salt is seasonally produced and the production techniques still depend on weather and human labor. So, in order to have a whole year supply of Kampot salt, a large amount of working capital is needed to purchase the stock and store it in a proper warehouse”.

The estimated average amount sold per month is between 15-to-20-tons per enterprise. They employ 2-3 people as casual labor with output-based payment. Each of the salt suppliers in the two-provinces sell salt to approximately to10 micro-fish processors on credit with the average interest rate of 1% per month. The survey indicates that Kompot/Kep Salt is of good quality and in high demand; however, seasonal production, limited marketing activity and limited number of producers are the main concerns.

6.3. Fingerling Suppliers

According to KII with a fingerling supplier in Battambang, they are sold to aquaculture enterprises, mostly the Pangasius and catfish. There are 3 fingerlings suppliers in Ekphnom district of Battambang and all of them are similar in size that can produce and supply around 10,000 fingerlings per year.

Some fingerlings are produced within the province while the majority is imported from Vietnam and sold through local suppliers in Phnom Penh and Takeo. Locally produced fingerlings are outcompeted with imported in terms of quality and price.

The fingerling supplier reported that "fingerling produced in Cambodia is not as good quality as the seed imported because they are smaller in size and the growth rate is slower". He also shared that "Price of imported fingerlings is around USD 5/kg, so I have to sell to local seeds at the same price with no profits in order to attract farmers to purchase my seeds".

Poor transportation and a long trade route result in a high mortality rate (20-50% depending on species). Besides the high mortality rate, there are a number of challenges faced by local hatchery and fingerling suppliers due to the production techniques and equipment, quality of water and poor environment surrounding farms

6.4. Fish Feed Suppliers

The majority of fish feed for cage aquaculture is low-cost fish catch, especially by fishermen who play double roles as aquaculture farmers too. Fish feed is also derived from the remains of fish processing (fish head). For both provinces, the price of trash fish is estimated to be 500-800 KHR/Kg. Nevertheless, the majority of pond aquaculture farms use imported fish feed from Vietnam and Thailand, especially for Pangasius. All the 3 respondents supply fish feeds imported from Vietnam. The feed retailers purchase feed from distributors in Phnom Penh.

The demands of fish feed increased past few years possibly due to shortage of low-cost trash fishes from the river; "I started selling the imported fish feeds few years ago; the total sales increased from year to year, the current price of feeds is USD 15/25kg bag for the first grade and USD 11/25kg bag for second grade. In the past, cage farmers did not purchase imported feeds like nowadays", a statement of feed supplier respondents in Battambang town.

Lack of working capital to store the feeds and credit sales practice are the main challenges of feed suppliers. The majority of clients do not pay the cost of feed immediately, but pay after harvesting. A fish feed distributor in Phnom Penh said that "In order to sell the products and compete with other feed suppliers, I have to sell on credit and provide technical support to my clients. I sometimes feel that I run a small micro-finance with a low interest rate 3-5% per month".

7.
MARKET SURVEY
FROM DEMAND SIDE

7. Market Survey from Demand Side

7.1 Consumers, Restaurants and Hotels

Based on the field survey in Battambang, all consumers including individual households, local restaurants, and expatriate restaurants purchase fish from the wet markets: Beng Chhouk, Pou Phuy, and Central Market.

Individuals prefer to buy natural fish catch from the lake, most fresh fish are purchased and cleaned at home. Likewise, processed fish products, such as Prahok, dried fish and smoked fish are purchased from the wet markets. Some middle-class consumers are willing to pay a higher price for Prahok processed from natural fish catch, provided it is safe. However, there is little trust that proper hygiene standards are being followed.

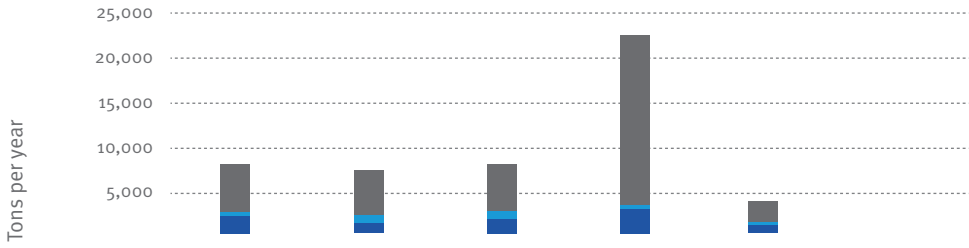
Expatriate restaurants largely do not use processed fish products in their daily menu, but some fresh fish (Salmon, Barracuda, Trey Raws and Trey Chhdao). They purchase fresh fish from Central Market to make fish fillets.

One local restaurant in Battambang serves approximately 400-500 people on a daily basis. The restaurant purchases 100-150 kg of fresh fish (Trey Raws, catfish, Giant Snakehead, etc.) and 20-30 kg of processed fish (dried fish, Prahok, smoked fish) per week. They either purchase fish or fish products from the wet markets or from traders that deliver to their restaurant. The basic food hygiene is essential because they focus on consumers' health, which affects the credibility of the restaurant. Fresh fish is graded from the market/distributor in order to ensure quality for clients. Therefore, higher quality fish sells for a higher price.

The local restaurants interviewed in Kampong Chhnang serve approximately 100-200 people on a daily basis. They purchase approximately 100-150 Kg of fresh fish and 20-30 Kg of processed fish daily. They either purchase fish or fish products from wet markets or have it delivered by traders. Fresh fish is graded by the market/distributor, which though costlier, is of a higher quality and more consistent standard.

Figure 28 shows the demand of processing products in Phnom Penh, Kampong Chhnang and Battambang.

Figure 28: Estimated Demand for Processed Fish Products



	Dried Fish	Smoked Fish	Prahok	Nem Prohet Trey	Fish Sauce
Phnom Penh	6,531	6,917	7,280	19,414	2,631
Kampong Chhnang	344	553	577	282	165
Battambang	2,180	1,114	1,453	3,649	1,140

(Source: Field Survey, November-December, 2020), (Calculation: Average HH Consumption x Population)

7.2 Wholesale/Retail Market

All of the 11 wholesale/retail markets in Battambang and Kampong Chhnang that were interviewed were micro enterprises. Wholesale/retail markets are separated by fresh and processed fish. Fresh fish wholesale/retail markets purchase both wild fish catch and aquaculture from fish traders/collectors and fish distribution centers and sell to local restaurants and end-consumers. Processed fish wholesale/retail markets purchase processed fish products such as Prahok, dried fish, smoked fish and Pa-Ok from micro, small and small-medium-scale enterprises in both Battambang and Kampong Chhnang.

The overall condition of the wholesale/retail markets are poor, and first impressions are of squalid, unsafe, unregulated facilities with no protection from rodents and pests. The sites are crowded and unhygienic and there is no access to piped water for cleaning.

The average volume of sales for fresh fish wholesale/retail markets in Battambang is approximately 18.20 tons per year and 15 tons per year in Kampong Chhnang. The average volume of sale of processed fish wholesale/retail markets from the respondents is approximately 57.20 tons per year in Battambang and 39.48 tons per year in Kampong Chhnang. The revenue of sale fresh and processed fish of wholesale/retail markets are shown in (Table 24 and 25) bellow.

Table 24: Profit Analysis for Fresh Fish in Wholesale/Retail Markets

Item	Battambang		Kampong Chhnang	
	USD/KG	USD/Ton	USD/KG	USD/Ton
[a]Total Variable Cost	1.63	1,628.35	1.51	1,508.67
[b]Total Fix Cost	0.06	60.44	0.06	64.00
Revenue	2.13	2,127.25	2.10	2,100.00
[c]Profit	0.44	438.46	0.53	527.33

a: This includes purchasing fresh fish, and labor cost.
b: This includes shop rental and patent.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

Table 25: Profit Analysis for Processed Fish in Wholesale/Retail Markets

Item	Battambang		Kampong Chhnang	
	USD/KG	USD/Ton	USD/KG	USD/Ton
[a]Total Variable Cost	2.54	2,540.95	17.55	1,7554.23
[b]Total Fix Cost	0.13	127.49	0.06	62.89
Revenue	3.49	3,489.79	18.42	18,420.85
[c]Profit	0.82	821.36	0.80	803.72

a: This includes purchasing process fish and labor cost.
b: This includes shop rental and patent.
c: Profit = Revenue – (Variable Cost + Fixed Cost)

(Source: Field Survey, November-December, 2020)

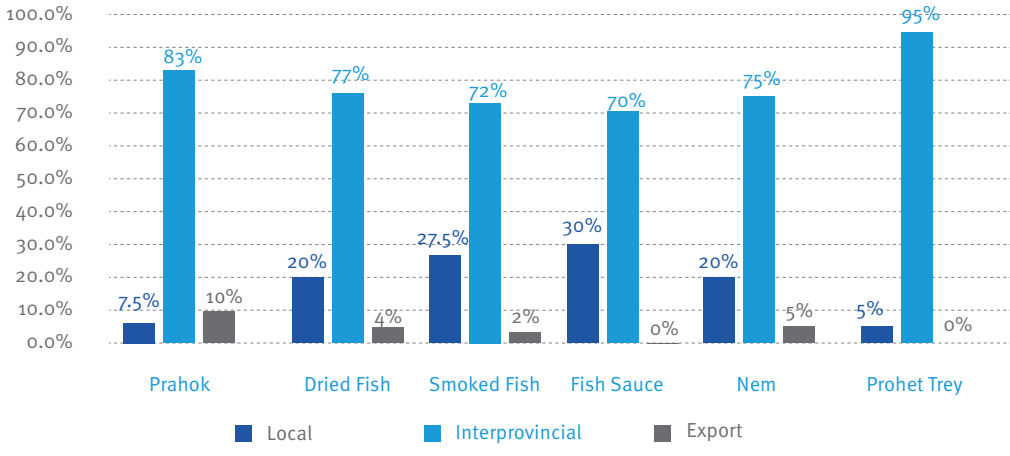
7.3 Export Market

All the promising products identified in this study have the potential for export formally and informally to regional and international markets. All but one product (Prohet Trey) is currently being exported in small volumes, but there is an opportunity to increase volumes with improved food safety standards, packaging and labeling and ensure the sustainable supply of raw materials.

(Figure 29) reveals that a significant quantity of fishery products is traded within the country between provinces. With regard to exports, total of 10% of high value Prahok (Trey Kampleagn and Trey Ros) are informally exported to Thailand without brandings and proper packaging; followed by dried fish which represented around 4%, 2% of high value smoked fish which is mainly from Kompong Chhang province and 5% of high value Nem in Battambang province.

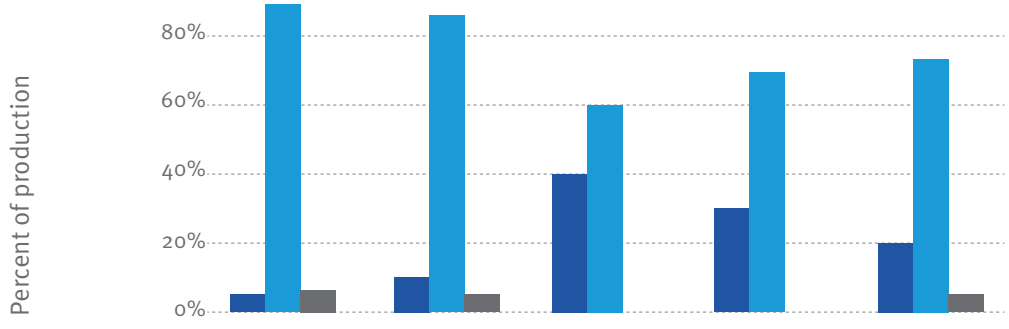
Figure 30&31 highlight the distribution of fish processing products in Battambang and Kompong Chhnang respectively.

Figure 29: Promising Products exported to regional and international markets



(Source: Field Survey, November-December, 2020)

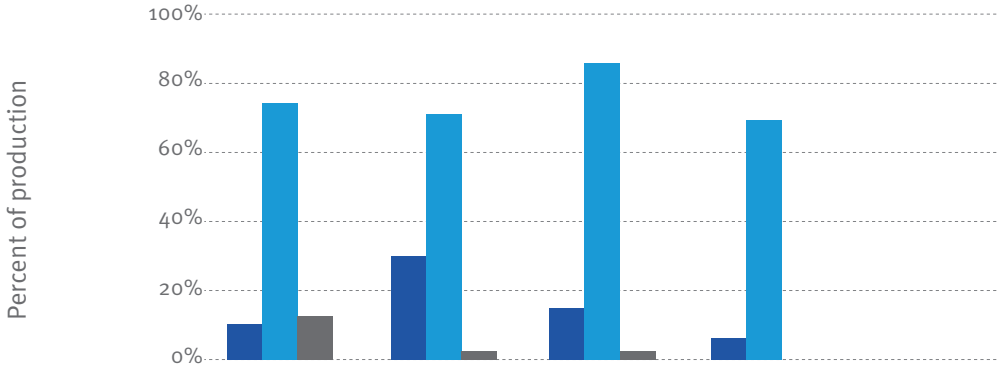
Figure 30: Distribution of Processed Fish Products in Battambang



	Prahok	Dried Fish	Smoked fish	Fish Sauce	Nem
Local	5%	10%	40%	30%	20%
Interprovincial	89%	85%	60%	70%	75%
Export	6%	5%	0%	0%	5%

(Source: Field Survey, November-December, 2020)

Figure 31: Distribution of Processed Fish in Kampong Chhnang



	Prahok	Dried Fish	Smoked fish	Prohet Trey
Local	10%	30%	15%	5%
Interprovincial	77%	68%	83%	95%
Export	13%	2%	2%	0%

(Source: Field Survey, November-December, 2020)

A small-medium Prohok Processor in Batambang said that "more than 80% of her high-value Prahok (Trey Kompleagn and Prohok Sach are supplied to Thai traders who reside close to the Poipet border". "High-value smoked fish that is produced from high-value natural fish species, such as Trey Kes, Trey Taon and catfish have been informally exported in small volumes to international markets, mostly for consumption by Cambodian expatriates" as confirmed by a smoked fish processor in Kampong Chhnang province. However, high-value smoked fish can be produced year-round, but only in small volumes during the closed fishing season (May-late October). As a result, there is an opportunity to ensure year-round domestic and international supply.

Nem Trey made from wild fish catch and aquaculture is available in supermarkets and exported to regional markets. One Nem social enterprise in Battambang shared that "they exported approximately 200-300 Kg to the USA in late 2020 as a trial, however they have not had any further orders since". She added that "the product is well packaged, labeled, barcoded and the facilities have been upgraded to meet the minimum requirements of food safety and hygiene standards".

While none of the fish sauce firms in the two provinces exported, two fish sauce producers interviewed in Phnom Penh exported their products to Thailand, Vietnam and Korea. The latter products are certified and accredited by International Certifications, such as, ISO, HACCP, HALAL, and others. One of them said that "The advantages of these certifications increased demand in domestic supermarkets (middle-class and upper-class Cambodians) and regional export leading to increased profitability. But for exporting to Korean Market or high-end market, more product development study needs to be conducted".

8.
PHNOM PENH
ANALYSIS

8. Phnom Penh Analysis

8.1 Distribution Channel for Fresh and Processed Fish

Middlemen control the fish distribution channel including fresh and chilled fish as well as processed fish. This begins at the farm gate for aquaculture, landing site, Dai fisheries in Phnom Penh for captured fish that are later sold to collectors, traders, retailers, wholesalers and processors. Traders for processed fish products have contract agreements with small and small-medium-scale enterprises from Battambang and Kampong Chhnang or sell it later to middlemen mostly in Phnom Penh.

8.2 Fish Distribution Center (KM No.9 and No.11)

KM no. 9 Fish distribution center is owned by the government and KM no. 11 is owned by a private entity. Live and chilled fish from the Great Lake including Battambang and Kampong Chhnang is transported by waterway and distributed through KM No.9 fish distribution center.

There are approximately 21 shops located at KM no 9, and 20 shops located at KM no. 11. Besides these licensed facilities, there are a number of smaller unlicensed fish distribution centers operating informally around the Phnom Penh area.

Most wild fish, aquaculture and imported fish/aquaculture from Vietnam are distributed through these two locations. Every fish wholesaler/retailer in Phnom Penh market and other provinces have been purchasing live fish, chilled and fresh fish from these two centers. The average sales per day per shop is 5-6 tons, therefore, it is estimated that fish production for both aquaculture and fish catch is approximately 400 tons/day, the majority of which is aquaculture products.

KM No.9, Phnom Penh landing site is the only one that has a structure for fish trading, however, fish handling, sorting, unpacking and repacking are done using traditional methods and are labour intensive. There are no machines used for hauling nor are there proper sorting facilities. All post-harvest activity in these sites is on the ground or at the trader's open fish tanks.

Moreover, loading and unloading, sorting, unpacking and repacking are all done in poor conditions. The traders have stalls in the sites that have broad fish tanks where procured fish are stored. Ice, plastic bags and food items are also sold at the landing sites. Most ice suppliers have stacks of ice blocks that are stored on the ground upon buying.

The overall condition of the two landing sites is poor, and first impressions are of squalid, unsafe, unregulated facilities with no protection from rodents and pests. The sites are crowded and unhygienic, despite selling both fish and non-fish products (prepared food items, vegetables, fruits, etc). There is no quality control or monitoring of operations; contamination of fish products is possible since food safety appears to be a low priority. Construction is rudimentary, often consisting of temporary wooden structures, and lacking basic machinery such as wheeled haulers, chain blocks or mechanized platforms.

Of particular concern, traders in the landing sites who are in contact with other traders and distributors practice price fixing, to the detriment of both consumers and fishermen. The operators of the fish distribution centers charge a 4% sales fee to wholesalers in the center. In return, the wholesalers have a location to sell their products and access to water for cleaning their fish.

8.3 Dai Fishery

DAI fishery or bag nets are located in Phnom Penh along the national Road No. 5 (KM no. 9). Dai fishery's peak season fish harvest is from November to February. The total Dai fishery production is approximately 870 tons per year (FiA 2019). However, anecdotal evidence from the field survey suggests that the figure should be substantially higher.

There are several hundred processors from all over Cambodia that purchase low-value fish (Trey riel and others) from the Dai in order to make Prahok for family consumption. They typically use motorbikes or vans to transport fish.

Normally, when purchasing from traders or Dai owners, processors or operators purchase between 300-400 Kg/person and use machines to remove fish heads, intestines and skin. As a result, only 50% of the fish processed can be used to make Prahok. The cost for accessing the fish processing machine is 7.5 USD/ton of fresh fish.

Meanwhile, fish sauce enterprises in Phnom Penh, such as, Thai Hong Keat, Leang Leng, and others have agreements with the Dai fisheries system to purchase low-value fish to produce fish sauce.

8.4 Phnom Penh Market for Fish Products

8.4.1. Wet Market

Wholesaler/Retailers from local markets have purchase orders or contract agreements in place, with various fish processors in Battambang, Kampong Chhnang, Siem Reap and Kampong Thom. From their stalls in the markets, they sell to retail consumers, and wholesale to restaurants, other small Phnom Penh markets, or interprovincially.

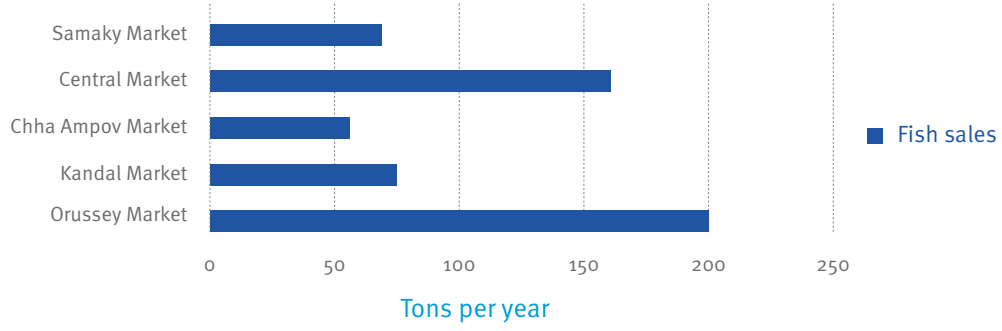
For local markets in Phnom Penh, the present study covered Central market, Orussey Market, Chbar Ampov market, Kandal market, and Samaky. Central market and Orussey Market play the role as wholesale and distribution channel to other local markets, local restaurants, and other provinces.

Orussey Market and Central market wholesalers sell/distribute processed fish, including dried fish, smoked fish, Prahok, and Prahet Trey. There are both low and high-quality products available to cater to the needs and budgets of consumers. The wholesalers have purchase orders from local restaurants and smaller local markets in Phnom Penh, and other provincial markets in Cambodia.

Wholesalers also sell to local restaurants and small local markets in Phnom Penh and other provincial markets throughout Cambodia. The total production sold is approximately 158 Tons/year. Among these sales, at least 50% of them are in high-value processed fish products.

The (Figure 32) below displays the total annual volume of processed fish sales in the main markets in Phnom Penh. Orussey and Central market have the largest volume of sales. These two markets redistribute processed fish to smaller local markets in Phnom Penh, other provincial markets, local restaurants and consumers.

Figure 32: Annual Volume of Processed Fish Sales



(Source: Field Survey, November-December, 2020)

8.4.2. Super Market

Two supermarkets in Phnom Penh were interviewed. A few species of fresh fish (Red Tilapia, Trey Chkok and Trey Chhpin) and high value processed fish product Nem Prohoc, Paok, salted dry fish, dried fish, fish sauce and smoked fish are sold in Supermarkets. The Nem vendor for these markets is Handicraft Phnom Sampov located in Battambang. However, the majority of processed fish products were not always available in these two supermarkets. Most of processed products are re-packaging by these two shops. This is due to deficiencies in post-harvest handling including sorting, grading, packaging, labeling and branding (traceability) and lack of consistent supply to meet the market demand.

On the other hand, a very limited amount of both fresh and processed fish sold in those niche markets, targeting mainly the medium to high income consumers. The low-income consumers purchase fishery products from the wet market as a cultural belief of being fresher and cheaper.

Besides the local fishery products, imported fish fillets such as: salmon, pacific cod fish, white cod fish, cobia fish are available in those supermarkets, with high demands. One of the shops suggested the project to provide support to local firms or traders to supply fish fillet that can be produced from snakehead fish or giant snakehead fish by using a rapid-freezer system and the products must be available whole year-round.

One supermarket sale manager stated that “the future consumer behavior related to fish products will shift to fish fillet because the eating habits of the young generation are changing, so, if those products are available with reliable supply, the shop signs an agreement or contract”. Interestingly, shop managers highlighted that “the minimum safety standard practices and regular and reliable supply are the key conditions to be applied by all suppliers as also stated in the agreement as part of specification”.

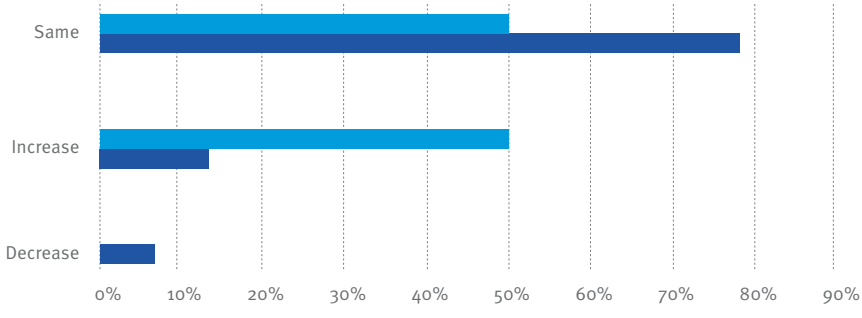
The analysis of the Phnom Penh market, both in wet markets and supermarkets on the supply of processed fish products highlighted that smoked fish, dried fish and Prohok are in high demands compared to other products. This finding is co-responding to the identified six promising products described in section 4. Importantly, the majority of Phnom Penh distributors purchased processed products from processors from the two provinces. However, labeling, packaging and food safety standards seems less important to the wholesalers and retailers in wet markets.

8.5 Market trends of Fish and Fishery Products

8.5.1 Fish Production and Price

The (Figure 33) below indicates the trend of fish and fish prices over the last five years as reported by 14 respondents from the 5 main markets in Phnom Penh. As per the trend, majority of respondents opined that the production quantity increased and the price remained almost stagnant.

Figure 33: Trend of Fish Production and Price



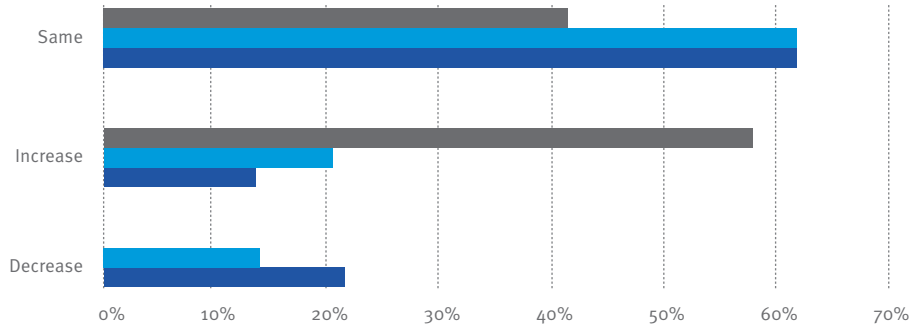
	Decrease	Increase	Same
Fish Prices	0%	50%	50%
Fish Production	7%	14%	79%

(Source: Field Survey, November-December, 2020)

8.5.2 Processed Fish Products, Traders and Prices

The (Figure 34) below underlines the trend of processed fish production, traders and prices over the past five years according to 14 respondents from the 5 main markets in Phnom Penh. As per this trend, it can be stated that the production of fishery products increased significantly over the last 5 years.

Figure 34: Trend of Processed Fish Production, Fish Traders and Prices



	Decrease	Increase	Same
Processed Fish Prices	0%	57%	43%
Fish Traders	14%	21%	64%
Processed Fish Production	21%	14%	64%

8.6 Fish Sauce Enterprises

Three Phnom Penh fish sauce enterprises were interviewed. All of them are medium-scale enterprises; however, they register as small enterprises for tax purposes.

One Fish Sauce Enterprise is registered and certified by the Institute of Standards of Cambodia (ISC) which includes ISO 22000-2015 (Food Safety management), ISO 9001 (Quality management System), HACCP, and HALAL. Most of their products are sold interprovincially and exported to Korea, Thailand and Vietnam. The owner stated that their sales had increased by a factor of 10 since they received their certifications.

For all the three enterprises, the average annual volume of fish purchased to make fish sauce is approximately 2,133 Tons and the average annual sales volume is approximately USD 1,773,908 per enterprise.

8.7 Consumer Perspective on Fish and Fishery Products

The (Table 26) below shows total household consumption of fish and fish products per year. The results indicate that the total fish consumption is estimated to be at 62 Kg/Year/HH, while processed fish is about 24 Kg/Year/HH.

Fish and fish products are purchased from markets nearby residential areas. In terms of consumer demand, the top three processed fish products are:

Table 26: Fresh Fish and Processed Fish Consumption (Kg/Year)

Type of Fish/Processed Fish Consumption	HH Consumption of Fish and Processed Fish (Kg/Year)
Fresh/chilled fish production purchase (Kg/Year)	61.9
Average of Total Dried fish production (Kg/Year)	4.05
Average of Total Smoke fish production purchase (Kg/Year)	2.07
Prahok production purchase (Kg/Year)	2.7
Nem/Prohet Trey production purchase (Kg/Year)	6.78
Mam production purchase (Kg/Year)	1
Pa-Ok production purchase (Kg/Year)	1
Average Total Fish Sauce Purchase (L/Year)	6
Average Total Consumption of Processed Fish (Kg/Year)	23.6

(Source: Field Survey (November-December, 2020)

9.
MAIN CHALLENGES

9. Main Challenges

9.1 Post-harvest Handling

9.1.1 Storage

Fishermen, fish traders, fish processors and fish distribution centers do not follow proper use of cold chain or storage practices for fresh and processed fish products, which leads to increased spoilage and damage of fish. Lake fishermen do not use ice boxes, and sell fish to traders in raw form, which negatively impacts the quality and freshness of fish and leads to lower prices.

The standard practice to store fish fresh as it is being transported along the market chain is in plastic boxes that are poorly iced. A slab of ice is put in the bottom of the box, the fish are placed on the ice and a final slab of ice covers the fish. As a result, this method is subject to damaged and spoiled fish as it arrives at each landing site along the trade route.

There is also distrust amongst market actors – fish must be unloaded and loaded to check the weight at each stop along the trade route. This practice leads to increased product spoilage before reaching its final destination at the retail market.

9.1.2 Sorting and Grading

Fishermen a generally not aware of market prices and trends and do not sort and grade to add value and increase the selling price. As a result, traders and wholesalers/exporters buy the fish from them in a flat-rate lump sum without sorting or grading. The traders, wholesalers and exporters then grade and sort the fish in accordance to the current market price, thereby increasing the average selling price.

9.1.3 Packaging and Labeling

Packaging and labeling for Dried fish, smoked fish and fermented fish products (Prahok, Pa-Ok, Mam, and others) are neither done nor poorly done. Packaging and labeling with proper information will add value to the product, but they are totally ignored in all the products except for fish sauce. Lack of proper packaging and labeling also hinders access to high-value markets and export.

9.1.4 Food Hygiene and Sanitation

Most fish processors, including micro, small, and small-medium-scale enterprises do not meet the minimum basic food hygiene standards. They typically remove the fish heads and skin on the ground without any hygiene measures. Additionally, the fish heads used as raw material are mixed with salt and other ingredients in the same manner. Small and small-medium-scale Prahok processors store the fermented fish in concrete rings and plastic drums and package their products in plastic buckets.

9.2 Financing

Access to credit plays an important role for post-harvest fisheries market actors. In order to both operate and/or expand their business, small and small-medium-scale enterprises need capital investment for working capital, upgrading facilities (storage, hygiene and sanitation) and modernizing technologies. Most of the enterprises that were interviewed stated that they did have access to loans (Table 27), but the terms and conditions (high interest rates, land title as collateral, payback period, etc.) of the loans were not advantageous for growing their business. Capital cost and collateral requirements from bank are too high, the collateral required by FIs amounts up to 200%[3] or 50% of total value of the accepted collaterals of the total loan. For the most part, they stated that they used loans for working capital and did not have access to financing to upgrade their facilities or grow their business.

Table 27: MSMEs with Access to Finance (outstanding loans)

	Micro		Small		Small-Medium	
Access finance to MFI/Bank	Number	Percent	Number	Percent	Number	Percent
Battambang	12	80%	7	100%	6	100%
Kampong Chhnang	21	84%	10	91%	2	100%

(Source: Field Survey November-December, 2020)

9.2.1 Access to Micro Finance Institutions (MFIs)

KIIs with fish processors indicate that micro and small-scale enterprises found it challenging to access funding from MFIs to operate their business in order to meet the demand of their buyers. The challenges included the complexity of the application process (required documents, financial statements, etc.), lack of stable income, high interest rates, collateral requirements and fear of not being able to pay back their loan.

9.2.2 Informal Money Lenders

The informal credit system is the core loan system the fishermen and micro and small-scale fish processors are reliant on. The main creditors are fish traders and wholesalers from market value chain actors. In order for wholesalers to ensure regular supply of fish products, they provide loans to traders and fishermen for them to improve their fishing efforts and technology. In lieu of receiving direct interest, wholesaler lenders purchase fish products at a discounted market price from KHR 300-500/Kg.

[3] http://documents1.worldbank.org/curated/en/564391468212981409/pdf/367480FinancingoSMEsoPSDP1No1141EN.pdf

9.3 Value Chain Governance

Transporting a shipment in excess of 200 Kg of fish or fish products is regulated for interprovincial and export. For export, licenses and transport permits from FiA cantonment and FiA central are required. The issuance of licenses and transport permits is a complex process involving many government actors. Formal and informal fees must be paid along the trade route. "The annual formal fee is approximately KHR 400,000 (USD 100)" as highlighted by local traders.

Likewise, the fish distribution centers at both Battambang and Kampong Chhnang require wholesalers to pay 2-4% of sales, with little service provided to comply with basic food hygiene and food safety. All processors registered at the Provincial Fishery Cantonment office are subject to pay USD 100/year, for both Battambang and Kampong Chhnang. As a result, many of the MSMEs interviewed were reluctant to register with FiA and the cantonment office, seeing only increased cost and no clear benefit.

9.4 Input Supply

Declining fish catch has led to inconsistent supply of fresh to fish traders and retailers and fish processors (smoked fish, dried fish, Prahok, Nem, Prohet Trey and fish sauce). As a result, there are significant volumes of imported aquaculture fish from Vietnam and some from Thailand to meet the local demand.

There is declining supply of fuelwood for smoked fish processors due to an increase in population, a higher consumption of fuelwood from households and the conversion of inundated forest areas to agriculture farming.

Lack of access to quality ice and how to proper use of ice for storage and transportation. The majority of fishery value chain actors purchase ice from ice distributors available in the district or at commune level. Those distributors do not know about safety and how it uses.

Salt is a common ingredient that is invariably used for most of the products; however, the locally produced salt is more costly when compared to imported salt even though it is of better quality.

9.5 Limited Access to Technology (know-how)

Fish processors lack knowledge of production techniques and access to improved processing technologies (processing machinery, solar technology, cold chain development, etc.) and value addition leading to lower productivity, profit margins and income generation. Processors are packaging using traditional methods, without proper labeling or branding.

There is limited understanding of food safety and hygiene practices among all value chain actors, leading to increased post-harvest losses, lower margins and income generation.

9.6 Organization and Management

There is a lack of organizational structure along the post-harvest fisheries value chain governance resulting in unharmonized product quality standards, limited information flow, and loss of competitive advantage. Additionally, fish processors in Battambang and Kampong Chhnang have limited organizational management skills, financial management, business development, trade and market knowledge.

Poor communication, trust and linkage among value chain participants (input suppliers, traders/ collectors, processors, wholesalers/interprovincial traders/ exporters and retailers) results in lack of reliable and consistent market information flow.

9.7 Food Safety Knowledge

Food safety knowledge and awareness among value chain actors is very limited. A few MSME's that have been registered have obtained some training through FiA, Institute of Standards of Cambodia (ISC) and K2A Management, but the majority of MSMEs have not received training on proper food handling and food safety. Awareness of quality and safety concerns could be improved amongst actors with some appropriate written marketing material designed for this purpose, which would be an important first step in the value chain development process.

The key challenge to improving hygiene and sanitation practices lies mainly in changing people's attitudes and behavior, raising public awareness of the importance of hygiene practices and stimulating a demand and willingness to pay extra for hygienic and safe food products. To implement such food safety practices, the processors need finance or funding support to which they are not capable to access.

The Cambodian middle-class has shown a willingness to pay more for safe and quality products, however it is important to combine these practices with proper packaging and labeling in order to provide traceability of products to garner trust with consumers.

9.8 Market Access

Lack of access to market information and product development for high-value markets and export leads to lower prices for value chain actors. Based on the field survey, processors lack strategic business planning, trade and market knowledge leading to ad hoc sales strategies. Additionally, weak trade linkages and/or market networks from fishermen, fish processors and other actors along the market chain attribute to lower prices.

9.9 Business Development Services

There is limited availability of business development services and R&D service in post-harvest fisheries. Specifically, there were no private business development service providers identified during the field survey that provide capacity building for market actors.

The Fisheries Administration Cantonment is the main agency that should provide provides capacity building and training; but they are focusing mostly on fishery management and conservation.

Knowledge of cantonment officials on food safety standards is very limited or lacking.

The reluctance to register is primarily due to formal and informal fees, leading to denial of access to capacity building support and other incentives offered by the government.

10.
RECOMMENDATIONS

10. Recommendations

10.1 Technology (know-how)

- Provide access to improved technologies to reduce costs and increase business efficiency (processing machinery, solar technology, cold chain, etc.) to increase production, productivity and income generation
- Promote enterprise development through modernization of handling and processing facilities for better productivity, value addition and product diversification for small and small-medium-scale fish processors
- Provide training and capacity building for micro enterprises on improved processing techniques, financial literacy and food hygiene and food safety standards.
- Provide training in improved production techniques to reduce costs and increase business efficiency for micro, small and small-medium-scale fish processors

10.2 Products/process

- Provide training in post-harvest handling for value chain actors (fish traders/collectors, wholesalers/interprovincial traders/exporters and processors)
- Provide capacity building on proper storage and transportation of fresh fish and processed fish products
- Provide training in proper sorting and grading to add value to fresh fish products
- Provide capacity building and coaching on product marketing to meet market demand for high-value markets, export and potential GI
- Provide capacity building on traceability of products through proper registration, labeling and use of barcodes
- Training in food safety and hygiene (CQS, GHP, GMP, HAACP, ISO, HALAL and other standards) for SMEs and encourage them to apply a traceability system with their suppliers and buyers
- Promote enterprise development through modernization of handling and processing facilities for better productivity, value addition and product diversification to access new markets segments
- Enable access to Research and Development Service for product development and market research

10.3 Market Access

- Promote use of aquaculture products as an alternative fish supply for year-round production
- Provide access to reliable market information in order to achieve higher prices and consistent market demand
- Provide training in food safety awareness and skills of processors to improve product quality and access new market segments
- Export Market for promising products
- Provide training in food safety and hygiene standards including GMP and GHP
- Facilitate certification of HACCP, ISO and HALAL for small-medium-scale processors
- Provide capacity building and coaching on product marketing to meet market demand
- Provide support in identifying potential buyers, assess their needs and facilitate business linkages and business negotiation

10.4 Organisation and Management

- Introduce a practical or Provision of financial software to improve record keeping, stock management and financial statements that are suitable for MSMEs
- Provide access to improved linkages among all post-harvest fisheries value-chain actors to address gaps in market information and develop long-term business relationships between market actors
- Development of post-harvest market actor's association to improve the collective marketing of processed fish products and product quality standards, increase cooperation among the actors, improve information flow, and enhance competitiveness

10.5 Value Chain Governance

- Coordinate with the FiA to develop a database for key fisheries post-harvest actors in order to identify key market actors and improve strategic planning to provide technical support, monitoring, food security and market development
- FiA and Provincial Fishery Cantonment need to enhance communication with the value chain actors on the benefits of registering their businesses
- Loosen restrictions on documentation systems to start, operate and register businesses in order to precipitate the transition from informal business to formal business
- Implement a 'Single Window' environment to expedite and simplify information flows between trade and government to reduce non-tariff trade barriers and deliver immediate benefits to all parties involved in cross-border trading

10.6 Finance

- Capacity building for micro, small and small-medium enterprises on financial literacy, data management and loan application process
- Link micro and small enterprises to affordable financing such as group loans through MFIs or develop customized financing solutions by providing a bank guarantee in order to reduce interest rates and collateral
- Promote investment support for women and youth considering non-collateral requirements, supporting business plan development and collective loans to women's associations or cooperatives
- Link small and small-medium-scale enterprises to business expansion loans through MFIs in order to upgrade their facilities and provide working capital to grow their business
- Sensitization and capacity building of financial institutes on fishery post-harvest businesses and encourage them to tailor their existing loan products to be available for upgrading MSMEs.

10.7 Infrastructure

- Upgrade the facilities at the fish distribution centres to meet minimum food hygiene and safety standards and potable water
- Provide access to good roads for all value-chain participants linking the landing centers
- Develop public infrastructure along the value chain including ice factories, public health facilities and cold storage to reduce post-harvest losses

10.8 Business Development Services

- Link registered MSMEs with FiA and Provincial Fishery Cantonment to access training on food safety standards for private sector development
- Coordinate with the FiA to develop a clear communication strategy on the benefits of registering businesses with the Provincial Fishery Cantonment in order to increase the number of registered MSMEs in Battambang and Kampong Chhnang so that they can have access to access training in sustainable fishery management and food safety standards
- Capacity building of existing BDS on fishery post-harvest businesses, food safety and encourage them to provide services to fishery SMEs.

11.
SWOC ANALYSIS FOR SELECTED PRODUCTS AND VALUE CHAINS

11. SWOC Analysis for Selected Products and Value Chains

S Strengths

- Job creation potential for MSMEs producing processed fish products
- Strong demand for processed fishery products
- Large number of fish species available
- Year-round production of processed fish products possible with aquaculture as a complementary source of raw material
- High demand for high-value processed fish products in niche markets (upper middle-class Cambodians)
- Support from development partners
- Government prioritized value chains development

W Weaknesses

- Poor post-harvest handling, processing, packaging, storage and value addition
- Poor hygiene and sanitation practices
- Poor financial literacy of MSME's
- Lack of business development service providers
- Competition with other imported meat products (i.e., chicken and pork), which are cheaper compared to processed fish products.
- High post-harvest losses due to poor cold chain
- Poor water quality used along the value chain operations

O Opportunities

- Increasing demand for processed fish products in domestic, niche, urban and Phnom Penh markets
- Potential to access markets in nearby districts and provinces
- Improving operational efficiency of post-harvest fisheries market actors (
- Aquaculture (cage, pond and rice field) as a means to increase fisheries production

C Constraints

- Declining fish supply in the Tonle Sap Lake
- Infiltration of imported products from Vietnam & Thailand
- Increased price competition among wholesalers
- MSME's are reluctant to register their enterprises with FiA, which prevents access to training and technology from FiA

O Opportunities (Continue)

- Upgrading MSMEs facilities to meet food safety and hygiene standards to access new market segments and increase volume of sales
- Certification of products for accessing better markets
- Development of post-harvest market actor's association to improve the collective marketing of processed fish products

C Constraints (Continue)

- Lack of financing to upgrade facilities
- Lack of access to improved technologies
- Lack of innovative technology to improve processing efficiency
- Decline in DAI fishery production, which attributed to price increases for low-value fish
- License and transport permit requirements leads to less trade efficiency (interprovincial trade)

Recommendations for Project on Investment Supports to post-harvest fishery MSMEs

1. Promote investment support for women and youth considering collateral requirements, supporting business plan development and collective loans to women's associations or cooperatives or self-help groups
2. Provide training on food safety and hygiene standards including GMP and GHP and CQS by focusing on the improved practice for better market access and better value addition
3. Provide training on improved production techniques and technologies to improve operational efficiency, productivity and income through upgrading the operations
4. Promote use of aquaculture products as an alternative fish supply for year-round production and support in develop sustainable supply chain with existing fishery supply chain actors
5. Conduct the feasibility for potential GI standards on fresh fishery and post-fishery products
6. Create improved linkages among all post-harvest fisheries value -chain actors to address gaps in market information and develop long-term business relationships between market actors

7 Development of post-harvest market actor's association to improve the collective marketing of processed fish products and product quality standards, increase cooperation among the actors, improve information flow, and enhance competitiveness.

8 Provide capacity building training in post-harvest fisheries and value addition

- Provide capacity building on proper handling, storage and transportation of fresh fish and processed fish products
- Provide training in proper sorting and grading/packing/labelling to add value addition
- Provide capacity building and coaching on product marketing to meet market demand for domestic markets and niche markets

9 Product development and innovations and compliance to national and international certifications and linkages to high-end and international markets

10 Provide access to Research and Development Services and Business Development Services to improved technologies to reduce costs and increase business efficiency (processing machinery, solar technology, cold chain, etc.)

11 Capacity building on financial literacy, record keeping, data management and loan application process

12 Access to affordable financing such as group loans or develop customized financing solutions with MFIs by providing a bank guarantee (no collateral required, repayment of principal at the end of the session, pay in village and receive financial literacy training) for working capital and improved technologies

Appendix 1: Value Chain Selection

1.1. Critical analysis of Value Chains of Micro, Small and Small-Medium-Scale Processors

Code	Product	Potential to Increase Incomes	Value Chain Growth Potential	Employment Potential	Demand
1	 Dried Fish	High to increase enterprise income, especially for high-value Prahok	High to expand business activities and year-round production due to aquaculture complimentary	Moderate to employment opportunity	Moderate response to market demand because of availability of fish.
2	 Prahok	Very high contribution to increasing income for all value chain actors, especially for high value Prahok product.	Highly promoting value added along trade routes, especially export to Thailand.	Highly potentially to promote employment due to requiring intensive labor for processing.	High to moderate demand in Cambodia, Year-long consumption
3	 Fish ball	Highly income generation activities to enterprise	Moderate growth, as it involves a few actors along the value chain.	Moderate to employment opportunity	Moderate to market demand, especially for urban areas.
4	 Fish Sauce	Very highly income generation especially when applied to food standards.	Highly participated in both domestic and export to different countries	Moderate for employment opportunities due to use machinery	Moderate for market demand due to strong competition among local and imported products.

Fish Issues/ Quality	Technology/ Know-how	Seasonality/ Availability	Potential Outreach	Institutional Mandate (Gender, Climate Change, Conservation)	Value
High moisture levels lead to spoilage and poor quality of product	Know-how required for all-season production	Best in dry season to dry fish products and	High	Important for gender participation in processing and marketing products.	Medium to high depending on fish species or aquaculture
Quality depended on fish species, salt concentration, and freshness of fish	Requires improved food hygiene and food safety standard and potential for GI products	Year-round production, but peak season for natural fish catch is from December to February	High-very high	High rate of gender participation in the processing.	Medium to high depending on fish species High value Prahok doubles profit as compared to low value products
Quality depends on fish species Requires credit to investment/ expansion	Requires food hygiene and food safety as well as improved modern input	Produced year-round because of aquaculture complimented, although natural fish is declining.	High-very high	Highly gender participation for processing.	High-value and earned a higher income from enterprise
Decline fish catch, especially lead to constraints on production. Require credit for expanding business	Use modern technology but may need to comply with International Standard if export needs.	It product year round produc-tion/supply to clients	Medium -high	Zero wastage and pollution and impact on environment Utilizes fish only during peak season fish catch.	High-value products can be expanded for formally exported to international markets, if certified.

Code	Product	Potential to Increase Incomes	Value Chain Growth Potential	Employment Potential	Demand
5	 Pa –Ok (Fermented Fish)	Moderate income generation activities, competes with Prahok.	Low to medium to value chain growth	Medium employment opportunity	Low to medium for market demand because the product is strong and competes with Prahok.
6	 Fermented Fish (Mam)	Moderate income contribution.	Low to medium as the products is not widely consumed by Cambodian	Moderate employment opportunity because this product is mainly small-scale processing product.	Low Cambodian market demand.
7	 Smoked Fish	Very important and high return benefit to enterprise	Adding high value for processing from farm gate to market-end, especially for high-value fish species	Important to create employment and better offer higher income.	High demand in local market in Cambodia, especially high value products is increased demand for Cambodia middle class

1.2. Critical analysis of Impact and Outreach of Micro, Small and Small-Medium-Scale Fish value chains

Criteria for Outreach:

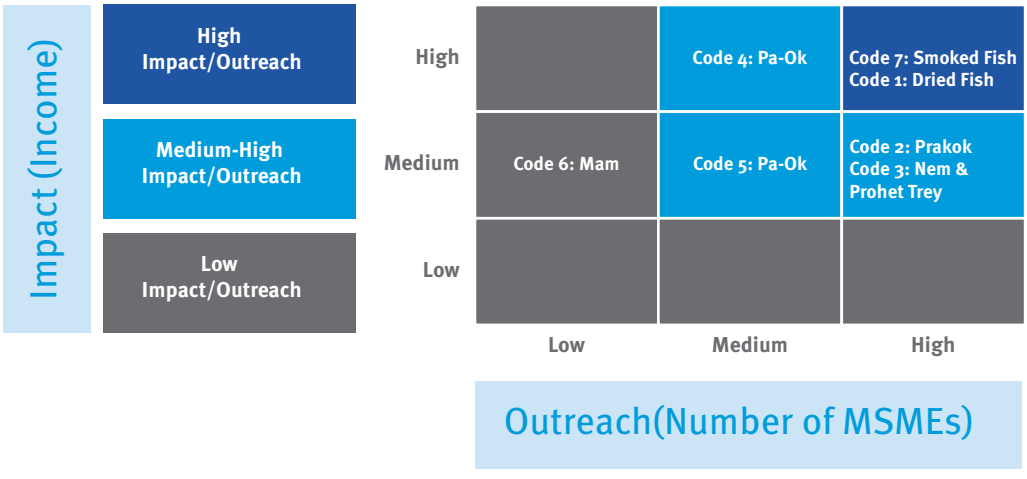
Market size, pricing, production cycles, technology required for production, capital investment required.

Criteria for Impact:

Income generation potential

Fish Issues/ Quality	Technology/ Know-how	Seasonality/ Availability	Potential Outreach	Institutional Mandate (Gender, Climate Change, Conservation)	Value
Spoilage and poor post-harvest handling and lower demand as compared to Prahok fermented fish.	Required capital investment. Low demand products in Cambodia	It can be produced year-round production/ supply	Medium	Medium	Medium value of product and lower demand domestically,
Spoilage is 5-10% and higher, if kept longer and not properly stored.	Most are required to improve food hygiene and food safety.	Can be year-round production low demand	Low and medium	Medium	Medium value and rare to consume by Cambodian.
Spoilage and broken after post harvested (5-10%) Investment in modern inputs requiring access to credit	Requires availability of improved modern inputs, and training and food hygiene and food safety, and potential for GI products	Can be produced year-round production for small and small-medium enterprise	Very high	Important-high level including gender participant, but little harm to climate change due to fuelwood collection.	It is a high-value market for certain fish species. 50-60$ for Trey Kes. It is highly value-add process-ing

Impact (Income)



1.3. Value Chain Selection for Processed Fish Products

Criteria	Weight	Fermented Fish (Mam)		Fermented Fish (Pa-Ok)		Smoked Fish	
		Rating	Score	Rating	Score	Rating	Score
IMPACT							
Potential to increase household incomes	3	2	6	3	9	5	15
Potential for employment generation	2	2	4	2	4	4	8
Growth potential of the value chain	3	2	6	2	6	5	15
Unmet market demand	3	1	3	1	3	4	12
OUTREACH							
Availability of Raw Materials	3	2	6	3	9	4	12
Number of households	3	2	6	2	6	4	12
Number of MSMEs	2	2	4	2	4	4	8
INSTITUTIONAL MANDATES							
Gender	3	3	6	3	9	4	12
Climate Change	2	2	4	2	2	2	4
Conservation	2	2	4	2	4	4	8
Total			49		54		106

Weight: 1 = Low Importance 2 = Medium Importance 3 = High Importance
Rating: 1 = Poor 2 = Fair 3 = Good

	Prahok		Dried Fish		Fish Sauce		Nem		Prohet Trey	
	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
	4	12	4	12	5	15	4	12	5	15
	4	8	3	6	2	4	2	4	3	6
	3	9	4	12	4	12	3	9	3	9
	3	9	3	9	2	6	3	9	3	9
	3	9	4	12	3	9	4	12	4	12
	4	12	3	9	2	6	3	9	3	9
	4	8	3	6	3	6	3	6	3	6
	4	12	3	9	3	9	4	12	4	12
	3	6	4	8	3	6	3	6	3	6
	3	6	4	8	3	6	4	8	3	6
		94		91		78		87		90

4 = Very Good 5 = Excellent

Appendix 2: Constraint or Opportunities and Market-Based Solutions

2.1. Technology Constraints and Market-Based Solutions

Constraint or Opportunity	Market-Based Solutions
Technology (Know-How)	
Limited understanding and practicing on technical know-how for increased production, improved quality and response to market demand.	Training in and access to improved technologies such as solar energy for dried fish, improved kiln technology for smoked fish, cool chain development, and storage facilities
Limited knowledge on hygiene and food safety.	Training in hygiene and food safety (HACCP, ISO, HALAL)
Poor aquaculture technical know-how resulting in low yields and increased mortality rates and low incomes	Training in innovative aquaculture technology, such as, pond and cage management species selection, feed, pest and disease identification and control

2.2. Product Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Products	
Market actors have limited knowledge of post-harvest handling including storage, transport, sorting, grading and packaging resulting in losses due to spoilage and lower profits for enterprises	Training in post-harvest handling for market actors
Products are not properly branded, labeled or packaged for sale to high-value markets resulting in lower prices in the market	Provide capacity building and coaching on product marketing to meet market demand (high-value markets, export and potential GI)
Lack of proper food hygiene and safety practices	Training in food safety and hygiene (HACCP, ISO, HALAL)

2.3. Market Access Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Market Access	
Limited access to high-value markets	Access to market information and improved product quality in order to meet high-value market demand
Declining fish supply in the Tonle Sap Lake resulting in increased importation of live, fresh/chilled and aquaculture from Vietnam and Thailand	Promote aquaculture development as an alternative fish supply Regulate illegal fishing activities, and protect inundated forests

2.4. Organisation and Management Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Organisation and Management	
Lack of financial literacy	Training in financial literacy
Lack of financial management systems for MSMEs	Provision of financial software to improve record keeping, stock management and financial statements
Lack of organizational structures along the fisheries value chain resulting in lack of harmonized product quality standards, limited cooperation among the actors, limited information flow and loss of competitive advantage	Development of collective action (i.e. producer groups, association, etc.) to improve the collective marketing of processed fish products, product quality standards, increase cooperation among actors, improve information flow, and enhance competitiveness
Poor communication, trust and linkage among value chain actors (input suppliers, fishermen, traders, processors and wholesalers/retail markets) resulting in lack of market information flow, and irregular quality	Access to improved linkages among all value-chain actors to address the gap of market information and develop long-term business relationships between market actors

2.5. Regulatory or Policy Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Regulatory or Policy	
Most enterprises are hesitant to register with FiA and MISTI due to formal and informal fees	Collaborate with FiA to develop a clear communication strategy in order to advocate the advantages of MSME registration (i.e. capacity building, access to finance, etc.)
Informal fees for exporting and trading across provinces	Consider to decentralise transport permit and license
Transport permit and license for fish/fish product transport across provinces or export is complex and takes longer process	Consider to decentralise transport permit and license
Lack of available data on existing MSMEs	Develop a database for MSMEs Mapping of private operators and registration at PDAFF level

2.6. Finance Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Finance	
Lack of capital investment for expanding business and upgrading facilities (food safety and hygiene requirements, storage facilities, working capital, innovative technologies, etc.)	Link enterprises to affordable financing (Lower interest rates, collateral) Promote women and youth for investment support
Application process for accessing loans is complex (documents, financial statements, etc.)	Capacity building for MSM's on financial literacy, data management and loan application process
High interest rates from informal loans to fishermen lead to increased debt and lower profits	Link fishermen to affordable financing options

2.7. Input Supply Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Input Supply	
Price volatility of fresh wild fish as raw material for processing leading to reduced cost efficiency	Promote the use of aquaculture as an alternative to fresh fish for processing (especially during closed fishing season: May-October) Capacity building for aquaculture farmers to increase production Access to improved technologies to reduce costs and increase business efficiency (processing machinery, solar technology, etc.)
Declining fish supply in the Tonle Sap Lake	Promote the use of aquaculture as an alternative to fresh fish Regulate illegal fishing activities, and protect inundated forests

2.8. Infrastructure and Other Constraints and Recommendations

Constraint or Opportunity	Market-Based Solutions
Infrastructure	
Poor rural road conditions and remote location of water access for fishermen and aquaculture farmers discourage transportation of inputs and fish products between cities and rural production areas, resulting in waste and increased costs for input suppliers, fishermen/aquaculture, traders and processors	Access to good roads for all value-chain participants.
Poor fish distribution centre facilities	Upgrade the facility of the fish distribution centre to meet international food hygiene and safety standards
Other	
Lack of access to Business Development Services	Link market actors with service providers such as the Fisheries Administration Cantonment in Battambang and Kampong Chhnang

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WHAT WE DO:

CAPFish-Capture: Post-harvest Fisheries Development project

The CAPFISH-Capture: Post-harvest Fisheries Development is designed with the specific objective to contribute to the development of post-harvest fisheries through upgrading the regulatory and institutional system, as well as the adoption of better practices and innovation by the private sector under the following major interventions:

1. Institutional support for establishing an efficient food safety official control system in post-harvest fisheries to harmonize Cambodian products with global market requirements including the EU.
2. Suport to private sector businesses through value chain financing support along fishery value chains for upgranding the operations and market conplance to enhance business compertitiveness.
3. Suport for research and development through networking of Universities and research institutes, improving capactives for product development, innovations and entrepreneurship.

The project is co-funded by the European Union

UNIDO- CAPFish Capture:
Post-harvest Fisheries Development Project

Fisheries Administration, No. 186, Norodom Boulevard, Phnom Penh, Cambodia.


023 900 974
CAPFish-Cambodia@unido.org
https://fia.maff.gov.kh | www.unido.org