

**TOPIC AREA:
MARKETING, ECONOMIC RISK ASSESSMENT & TRADE**



**VALUE CHAIN ANALYSIS OF FRESHWATER SMALL-SIZED FISH IN
CAMBODIA**

Marketing, Economic Risk Assessment & Trade/Activity/09MER09UC

FINAL INVESTIGATION REPORT

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INTRODUCTION

Background

Cambodia is one of many countries in Southeast Asia rich with natural resources, and in particular, fisheries resources, which include inland capture fisheries, marine capture fisheries and aquaculture (both inland and marine). In 2009, total fish production was 515,000 tons, in which inland capture fisheries shares 390,000 tons representing nearly 76% of the total fish production, followed by marine capture fisheries 75,000 tons (14.5%) and aquaculture 50,000 tons (9.7%) (FiA, 2010). Inland capture fisheries were ranked fourth in the world after China, India, and Bangladesh in 1996 (FAO, 1999). Freshwater fisheries (inland capture fisheries), contributing around 90% of the total inland fisheries, are considered to be the most productive inland fisheries in the world and contribute around 60% of the country's commercial fisheries production (Ahmed et al., 1998).

Fish is the most productive fisheries resource and is believed to play a crucial role in ensuring food security to millions of people in the whole country. Most protein that Cambodian people receive comes from fish, which makes up about 75% of animal protein intake. Beyond meeting people's basic needs, fish also provides both direct and indirect benefits via employment and income generation to people and contributes to national economic growth through GDP (about 12%).

Freshwater small-sized fish are a good source of protein. Because they are not preferred to larger fish species and therefore have low market value, small-sized fish is considered an important foodstuff for the poor. Annually, thousands of tons of small-sized fish are caught in the Cambodia Mekong basin. It is estimated that at least 16,000 tons of small-sized fish were caught by using only one commercial type of fishing gear – bag net or dai – in the season of 2004 – 2005 (Hortle et al., 2004). Moreover, in the 2006 – 2007 season, the total catches of all dai was around 18,000 tons, while the average catch of each dai was about 300 tons, with ranged from 59 tons to 603 tons. More than 95% of the total dai fish catch was small-sized fish, of which the dominant species was *Henicorhynchus* spp. (52%) (FiA, 2007; and So et al., 2007).

According to Loc et al. (2009), 29,064 tons of *Henicorhynchus/Labiobabus spp.* (grouped as *Trey Riel* in Khmer) was traded in Cambodia, representing 55% of the Dai fisheries. Due to this abundance, especially in the short period during peak fishing season (December to January) along the Tonle Sap and Mekong River, these fish are typically landed in small spots and in a poor state of preservation or severely damaged from the capture method (So et al., 2005).

The Fisheries Administration before 1975 determined three grades of fish from riverine areas – lacustrine and marine catches. The last, 3rd grade of this determination referred to small-sized fish which was defined as all small species of fish with a cheap price compared to the 1st and the 2nd grades. Normally, it was used for processing into fish paste, low-quality fermented fish and smoked fish, and sun dried fish for animal feed. This category has been considered as trash fish when in abundance (FiA, 2002).

There is increasing demand and trade in the Lower Mekong Basin (LMB) of Cambodia for small-sized fish for human consumption (fresh and processed), and fish and animal feed. Significantly, pond and cage culture and crocodile farming in Cambodia are dependent on freshwater small-sized fish used for feed. Therefore, there is also conflict between the use of small-sized fish for feed and for human consumption. In some cases, such feed consists of fish species traditionally used as cheap food for people. This allocation of fish resources to aquaculture and animal feed may result in negative impacts on food security, employment and income generation. According to So et al. (2005), small-sized fish represent from 60 to 100 percent of the total feed used for fish culture and animal raising depending upon feeding strategies adopted by various farmers (So et al., 2005). It is the economics of the different uses of small-sized fish in different localities that direct the fish one way or the other. There are also trade-offs between direct food benefit and the indirect employment and income generation opportunities afforded by feeding for aquaculture. It has been argued that it would be more efficient and ethical to divert more of the limited supply to human food, using value-added products. Proponents of this suggest that using small-sized fish as food for domestic consumers is more appropriate than supplying fish meal plants for an export, income oriented aquaculture industry, producing high-value commodities. On the other hand, food security can also be increased by improving the income-generation abilities of poor people, and it can be argued that the large volume of people employed in both fishing and aquaculture has a beneficial effect. This raises some important questions regarding the social, economic and ecological costs and benefits of aquaculture, its sustainability and future trends.

To date, there has been no comprehensive study of the marketing system for small-sized fish in the LMB. The small-sized fish industry for food and feed in the LMB of Cambodia has spontaneously developed without any comprehensive analysis of the markets for the products, particularly the lack of information on the stakeholders and marketing practices. Therefore, there is a need to conduct a study covering all of the aspects of value chain for small-sized fish in the LMB. The results of this study will be useful for development of policy recommendation for upgrading current harvesting and management of freshwater small-sized fish species in the LMB in order for sustainable utilization of this limited resources. Moreover, this study will be vital for further development of the small-sized fish industry in order to stabilize and sustain the contribution of the small-sized fish to food security, job creation and marketing in the LMB.

Objectives

The overall objective of the study was to conduct a value chain analysis of freshwater small-sized fish in the Lower Mekong Basin of Cambodia in order to propose improved marketing and management solutions. The specific objectives were:

to describe and analyze situations of stakeholders participating in the value chain of freshwater small-sized fish;
to analyze value chains of freshwater small-sized fish; and
to propose improvements for upgrading the value chain, for improved marketing and management solutions.

METHODS

Scope of the Study

The duration of the study was 7 months, from June 2012 to December 2012. This included questionnaire design and pre-test, study areas and sample selection, data base design, data entry, data analysis, and report writing. This study was conducted in four provinces, namely Kandal, Kampong Chhnang, Battambang and Siem Reap provinces, and in Phnom Penh city. Phnom Penh and Kandal province are in the Mekong-Bassac Rivers area, and Kampong Chhnang, Battambang and Siem Reap provinces are near and around the Great Lake-Tonle Sap area (Appendix A, Figure 2.1). In total, there were 10 districts, 19 communes, and 38 villages selected for data collection.

Sample Selection

Stakeholders relevant to the value chain of freshwater small-sized fish were categorized into 6 different groups: fishermen, fish farmers, traders, exporters, processors and end consumers based on their different roles and functions in the chain. In this study, fisherman referred to people who engaged in all scales of fishing activities such as small scale, medium scale and large scale, (bag net/Dai) who caught freshwater small-sized fish either year round or seasonally for household consumption and sale. Fish farmers referred to people who cultured fish such as Snakehead, Pangasius catfish, etc., by using freshwater small-sized fish as fish feed. Traders focused on collectors/middlemen, wholesalers and retailers of either fresh or processed freshwater small-sized fish in markets. Exporters meant chain actors who exported either fresh or processed freshwater small-sized fish to other countries. Processors referred to chain actors who bought fresh freshwater small-sized fish for processing into final or finished preserved products. Lastly, end consumers referred to the ones who bought freshwater small-sized fish either in fresh or processed forms for household consumption or final use.

These groups were purposively chosen from each study area. In total, 206 individuals were structurally interviewed in the four selected provinces and in Phnom Penh city, which included 50 fishermen, 40 fish farmers, 50 traders, 5 exporters, 11 processors, and 50 end consumers (Appendix B, Table 2.1). Moreover, key informants (KIP) such as officers of municipal and provincial fisheries administration cantonment and local authorities in Phnom Penh and in the four provinces were also interviewed, but they were not included in the number of samples selected in this study.

Data Collection

Both primary and secondary data were used in this study. Primary data was obtained from various types of selected interviews through the research. The sampled households were interviewed by using different designed questionnaires for fishermen, fish farmers, traders, exporters, processors, and end consumers, with the emphasis on value chain of freshwater small-sized fish. Moreover, semi-structured interviews were also done with provincial fisheries administration cantonment officers, local fisheries officers and local authorities to get broader understanding on status of freshwater small-sized fish with regard to fishing status, trade, processing and consumption in locality, and to clarify and compliment information obtained from individual interview with the stakeholders.

Secondary data was obtained from government, NGOs and other sources to get general and in-depth knowledge and understanding on concerning issues.

Data Analysis

The primary data – both qualitative and quantitative - was stored in the Access software program. Quantitative data was analyzed, including descriptive statistics, frequency, percentage, mean, and cross-tabulation. The descriptive statistical analysis was used to describe the characteristics of the target stakeholders. Frequency, percentage, and mean were used in the comparative analysis to compare the mean value between the groups. Cross-tabulation was made to describe and compare the data within and between the group stakeholders. Moreover, for qualitative data analysis, data was analyzed and synthesized by two methods: 1) the data was grouped by question and then coded in order to convert into numeric, and analyzed by using descriptive statistics to explain and describe business activities; and 2) The data was synthesized by question, and described those information based on household respondents' perceptions. The qualitative data was used to provide deep understanding on root issues of each chain actor.

RESULTS AND DISCUSSION

This chapter presents the result of the study of the value chain analysis of freshwater small sized fish in the Lower Mekong Basin (LMB) of Cambodia. It consists of four parts. The first part presents the general situation and livelihood activities of chain actors in the value chain while the second part describes the value chain analysis and marketing channel of freshwater small-sized fish. The third part shows the perception and challenges/constraints of chain actors, and the fourth part provides major suggestions for upgrading the value chain of freshwater small-sized fish in Cambodia, including requests of chain-actor respondents as well.

General Situation And Livelihood Activities Of Chain Actors In The Value Chain

Fishermen

Socio-demographic Characteristics of Fishermen

The total samples of fisherman households were 50. Of this, 13 (26%) were female respondents. The average age was 43 years, ranging from 23 to 65 years. Overall, the majority age group of fishermen was 31 to 50 years with 54%. Age of female fishers was 40 years, ranging from 24 to 57 years while male was 44 years on average, ranging from 23 to 65 years (Appendix B, Table 3.1).

The average fishing experience of sample fisher households was about 24 years, ranging from 2 to 50 years. An average experience for male fishers was 25 years, higher than females who had only 19 years (Appendix B, Table 3.2).

Fishing Activities

The fishing calendar of inland capture fisheries in Cambodia is divided into two seasons: open season (from October to May) and closed season (from June to September). Open season consists of peak period and low period of fish caught, especially small-sized fish caught. The study revealed that nearly 70% of fisher households fished year round, meaning that they fished in both open and closed seasons because all of them were subsistence. However, only 30% fished in open season, while 2% fished occasionally (when they were free) (Appendix B, Table 3.3).

Normally, peak and low periods of fish caught was the same for all fish regardless of species and size. The peak period started from November until February, and low period started in October, March, April, and May (Appendix B, Table 3.4). However, these months might be found varied across the provinces. According to Leng (2006) there are two peak migration periods of fish, particularly *Henicorhynchus spp.* (i.e. Trey Riel in Khmer), from the Great Lake flood plains, via Tonle Sap River, to the Mekong River. One of the peak migration periods is at the end of December and the other is at the end of January each year. Each period lasts for 6 to 10 days before the full moon.

There were many different types of fishing grounds where fisher households normally went fishing in the study areas such as: Great Lake, Tonle Sap River, Mekong River, Bassac River, small lakes/streams, inundated forest and canals. Majority of fisher households went fishing in Tonle Sap River in both open and closed seasons (49.5%), followed by the Great Lake (22.3%), inundated forest (11.7%), and small lakes/streams, Mekong River, canals and Bassac river (16.5%), respectively (Appendix B, Table 3.5).

The purpose of fishing was for household consumption, processing and sale (both fresh and processed forms). 70% of fisher households went fishing for both household consumption and sale, while 28.6% for processing and only 1.4% for household consumption only. Around 90% of fish caught was for sale and about 10% was kept for household consumption.

Fish Catch: Species, Volume and Price of Freshwater Small-Sized Fish

On average, fisher households went fishing 3.3 months in peak period and 4.5 months in low period of open season, and 3.9 months in closed season. During peak period, they spent more days for fishing activities with 22.2 days per month and slightly different for that during low period which was 20.9 days per month. However, during closed season they went fishing only 18.3 days per month. Regarding volume of fish caught, it was different by period and season. The average volume of fish caught for all fish species in peak period was 656.1 kg per day per household, ranging from 8 to 15,000 kg, of which 77.5% (508.5 kg) was small-sized fish. However, in low period they could catch only 190.2 kg per day per household, ranging from 3 to 7,500 kg, of which 53.6% (102 kg) was small-sized fish. Fish was scarce in closed season, so that only 6.4 kg per day per household could be caught, ranging from 0.6 to 20 kg, of which 68.7% (4.4 kg) was small-sized fish. In open season, especially in peak period fisher households were heavily dependent on fishing activities for their daily living. They could earn, on average, USD 164.4 per day per household by selling their fish, in which small-sized fish shared 66.6% (USD 109.5) of that income. In the low period, they could get only USD 38.8 per day per household from fishing activities, of which 43.2% (USD 16.8) was from selling small-sized fish. However, in closed season they could earn less income from fishing activities since not much fish could be caught and the fish was mostly kept for household consumption while the surplus for selling is rare. Therefore, each household could earn only USD 5.9 per day from selling fish, of which 61% (USD 3.6) was from small-sized fish. Besides this source of income, fisher households derived more income from some livelihood activities including hunting rat, culturing fish, selling wood (for making fishing gears and cage), rice and gas, planting vegetables and lotus tree, and laboring. These activities were mostly done in closed season when they were not very busy with fishing. On average, they could get only USD 9.9 per day in peak period, USD 10.4 per day in low period, and USD 8.1 per day in closed season. Compared with income from fishing activities, it was far less (Appendix B, Table 3.6).

Approximately 49 species of small-sized fish (including juvenile of big-sized fish species) were caught by fisher household in the study areas (Appendix B, Table 3.7). Around 24,753 kg of small-sized fish were caught per household in the last open season (2011-2012) in which 23,233 kg were caught in peak period and 2,124 kg were caught in low period. Furthermore, in the last closed season (2011-2012) 300 kg of

Exchange rate: USD 1 = 4,000 Riel

small-sized fish were caught. Totally, at least 24,918 kg of small-sized fish were caught per household last year (both open and closed season) (2011-2012) (Appendix B, Table 3.8).

In terms of frequency of catch, the top ten species of freshwater small-sized fish were identified. The most commonly caught species were: *Henicorhynchus spp.* (Riel), *Puntioplites spp.* (Chrokeng), *Mystus spp.* (Kanhchos), *Osteochilus spp.* (Kros), *Yasuhikotakia spp.* (Kanhchrouk), *Cyclocheilichthys spp.* (Chhkok), *Dangila spp.* (Khnorng Veng), *Pangasius spp.* (Chveat), *Morulus spp.* (Kaek), and *Trichogaster spp.* (Kompleanh), respectively (Appendix B, Table 3.9). Moreover, in terms of volume of fish caught, the top ten fish species were determined: *Acanthopsoides spp.* (Reus Chek*), *Henicorhynchus spp.* (Riel), *Paralabuca spp.* (Sleuk Reussy), *Dangila spp.* (Khnorng Veng), *Cirrhinus Microlepis* (Kralang*), *Labiobarbus spp.* (Arch Kok), *Rasbora spp.* (Changva Moul), *Clupeichthys spp.* (Bandoul Ampov), *Yasuhikotakia spp.* (Kanhchrouk), and *Pteropangasius Pleurotaenia* (Chhveat) respectively. Price of small-sized fish was varied by species and seasonality of fishing but ranged from USD 0.1 to 1.5 per kg. In terms of price, the top 10 fish species were identified: Andat Chhke*, Phtoung, Reus Chek*, Kromorm*, Pra Kae*, Kompleav, Kaork, Kompream, Pou* and Chhlaing* (Appendix B, Table 3.10). Small-sized fish were most of the time sold in mixture form. In some cases, when it was scarce or had more commercial value compared to other species, it was sold separately.

Trend of Fish Catch: Volume and Price

Volume of fish catch per fishing effort in the last season of 2011-2012 increased by 60% to 68% of fisher households, compared to that before 2011 (Appendix B, Table 3.11). This resulted from the recent fisheries reform which cancelled all fishing lots, making fish more accessible to fisher households, especially small-scale fishers, and increasing numbers of fish shelters since some of the ex-fishing lots were taken as fish conservation areas. Besides this, flooded forest areas, and other natural areas were more protected and conserved. Moreover, reinforcement of fisheries law by putting more effort on patrolling and suppressing overfishing and illegal fishing also contributed to make fisheries resources more abundant. As reported by fisher households in 2011-2012 the water level was deeper than the previous year, which brought many fish from different water sources and made the migration of fish easier.

The majority of fisher households (60% to 70%) reported that the price of fish in the last seasons of 2011-2012 had decreased compared to that before 2011 (Appendix B, Table 3.12). This was because fish was more abundant than the previous years and the number of fishermen increased, which brought about competition in selling fish. In addition, consumption demand of wild fish decreased, influenced by domestic fish culture which increased, and import of cultured fish with lower price from neighboring countries was also high. There were also many fish traders in markets that brought fish from everywhere in the country as well as imported cultured fish and competed with wild fish in the region.

Fish Farmers

Socio-demographic Characteristics of Fish Farmers

Eighty-five (85) percent of fish farmer households were male, while the rest were female. On average, the household respondents were aged 43 years, and ranged from 23 to 61 years. The majority age group of the respondents was 41 to 60 years with 50% for male, and 41 to 60 years with 12.5% for female (Appendix B, Table 3.13).

Juvenile of commercially important fish species

The years of experience in fish farming was different by type of farming system and sex. On average, it was 9.5 years, ranging from 2 to 31 years. The respondents who practiced cage farming system had more years of experience (11.4 years) than those who applied pond farming system (6.1 years). Moreover, male respondents had higher experience in fish farming (9.9 years) than female did (7 years) (Appendix B, Table 3.14).

Fish Production Activities

There were only two types of fish farming systems practiced in the selected study areas. They were pond and cage fish farming systems. Nearly 80% of sampled fish farmer households practiced cage fish farming system, whereas more than 20% applied pond fish farming system. This was because most of the household respondents were living along and on the river where cage fish farming was more suitable in terms of location (They do not need land or large water surfaces, since some cages could be built underneath the floating houses) and condition (water level). Unlike this, some fish farmer households culturing fish in ponds had to concern about the land for building the pond leading to having more production costs and the water level of the river that might overflow into the pond (for the pond built near the river or water sources). According to the study, at least 17 fish species had been cultured by the sampled households. They were *Pangasianodon Hypophthalmus* (Pra Thom), *Pangasius Bocourti* (Pra Khchao), *Hemibagrus Wyckioides* (Khcha), *Wallago attu* (Sanday), *Brachirus spp.* (AndatChhke), *Channa Micropeltes* (Chhdaur), *Clarias spp.* (Andeng), *Pangasius Conchophilus* (Kae/PraKae), *Pangasius Larnaudii* (Pou), *Leptobarbus Hoeveni* (Proloung), *Barbonymus Gonionotus* (Chhpin), *Barbonymus Schwanenfeldii* (KaHae), *Cirrhinus Microlepis* (Proul), *Osteochilus Melanopleurus* (Krum), *Henicorhynchus Siamensis* (Riel Tom), *Pseudolais Pleurotaenia* (Chhveat), *Cyclocheilichthys spp.* (Chhkork). In terms of numbers of fish farmer households, 5 of these fish species were commonly cultured, such as: Pra Thom, Chhdaur, Pra Khchao, Khcha and Kae/PraKae with 20.5%, 19.2%, 10.3%, 10.3%, and 10.3%, respectively (Appendix B, Table 3.15). Furthermore, in terms of quantity of fingerlings stocked, 4 fish species were practically cultured, including Andeng, Pra Thom, Ka Hae, and Chhpin, respectively (Appendix B, Table 3.16).

In general, fish farmer households had 1.1 ponds, or 1.7 cages per household. On average, the pond size is 12,306.4 m³ and the cage size is 165.7 m³ per household. With this size, fish fingerlings stocked in the pond were 41,400 heads, and in the cage were 13,792 heads per household per crop. Furthermore, number of crops or cycles of fish cultured in either pond or cage was similar, around 1 time per year. However, duration for fish cultured per crop in cage was longer (13.8 months/crop) than that in pond (9.8 months/crop) due to aforementioned reasons (Appendix B, Table 3.17). Normally, fish culture could be started in any month of the year, but in this study it was most preferably commenced in September.

Normally, the price of fingerlings varied in accordance with fish species and size of fingerlings/fish stocked in each type of farming system. The price differed by size of fingerlings/fish stocked due to the fact that the size of fish bought and applied into ponds and cages was different. In pond fish culture, only fingerlings were applied and started to be cultured until maturing time. In contrast, in cage fish culture, both fingerlings and juvenile fish (included as fingerlings in this study) were applied. On average, the price of fingerlings was USD 0.15 per head, ranging from USD 0.03 to 0.39 (Appendix B, Table 3.18).

Types of fish species selected for fish culture was not very much different. About 51% of fish farmer households chose hybrid fingerlings, while the rest chose the wild ones (Appendix B, Table 3.19). Percentage of supplying sources of fingerlings by fish species is shown in Appendix B, Table 3.20. According to the table, supplying sources of fingerlings included: own capture in nature, fishers, hatchery farms/stations, nursery sites, other fish farmers, and importers (from Vietnam and Thailand). Of these sources, nearly half of fingerlings were supplied by other fish farmers (46%), followed by own capture in

nature (19.9%), fishers (15%), importers (12.4%), nursery sites (5.6%), and hatchery farms/stations (1.2%).

Types of Fish Feed Used

Types of basic feed used for fish culture included: freshwater small-sized fish in fresh and dried forms, marine small-sized fish, commercial/pellet feed, and rice bran. Besides this, there were additional feeds such as: bone and head of Pra, fish and chicken intestine, fish sauce germ, Kapok flour (Mor'saov kor), and vegetables like water spinach, etc. However, not all of these fish feeds were used by all fish farmers. Sometimes, only two or three types of fish feed were used, depending on its availability varied by time and season. When used, the feed was mixed and cooked together. Additionally, some types of the feed were given in fresh form when abundant (e.g. freshwater small-sized fish). Of these various feed types, probably 45% of fish farmer households used freshwater small-sized fish, followed by rice bran (27%), marine small-sized fish (13.5%), and commercial/pellet feed and others (14.6%) (Appendix B, Table 3.21). On average, volume of feed used for fish culture was 54,686.4 kg per crop. Most of the feed used was freshwater small-sized fish (fresh and dried) (31%), followed by rice bran (20%), commercial/pellet feed (19%), marine small-sized fish (17%), and others (bone and head of Pra, fish and chicken intestine, fish sauce germ, Kapok flour, and water spinach) (13%) (Appendix A, Figure 3.22).

Commonly, feed used for fish culture was either self-supplied or bought from markets. Some types of fish feed could be caught and found by the household themselves, including freshwater small-sized fish, rice bran, and others (bone and head of Pra, fish and chicken intestine, fish sauce germ, Kapok flour, and water spinach). They were half self-supplied and half bought from markets. Nevertheless, some types of feed such as marine small-sized fish and commercial/pellet feed were totally bought from markets. Therefore, overall, 30% of the feed used for fish culture was self-supplied by fish farmers, while 70% was bought from markets (Appendix B, Table 3.23).

Trend of the Use of Fish Feed for Fish Farming

Trends of type of fish feed, and quantity and price of freshwater small-sized fish used for fish culture over the past 5 years were asked in order to understand the changes and the development of freshwater small-sized fish used as fish feed. Appendix, Table 3.24 revealed the trend of types of fish feed used for fish culture over the past 5 years. According to the table, the use of type of fish feed was mostly unchanged (72.5% of fish farmer households) because number of fish culture was the same and fish farmers did not expand their culture. Additionally, only these few types of feed could be locally and commonly found and eaten by the fish.

There was a similarity between the numbers of fish farmer households responding that quantity of freshwater small-sized fish used for fish culture over the past 5 years was increased and unchanged, with 40% and 37.5% of fish farmer households, respectively (Appendix B, Table 3.25). The increased use of freshwater small-sized fish resulted from the abundance of the fish, particularly during last open season (2011-2012).

Trends of price of freshwater small-sized fish for fish culture over the past 5 years was decreased (57.5% of the household respondents) for several reasons (Appendix B, Table 3.26). First of all, it was the quantity of fish. Compared to the previous years, freshwater small-sized fish was more abundant. Moreover, numbers of fish farmers decreased recently, so demand on the fish for fish feed was also decreased. Furthermore, there seemed to be a decline of human consumption on freshwater small-sized fish, making the fish that was already abundant become even more so and the price of freshwater small-sized fish was consistently decreased.

Fish Traders

Socio-demographic Characteristics of Fish Traders

More than half of the sampled fish traders were male. The average age was 41 years, ranging from 20 to 66 years. The majority age group of the respondents was 20 to 50 years with 44% for male and 38% for female. (Appendix B, Table 3.27).

Overall, fish traders had an average of about 15 years of experience in fish trade, ranging from 1 to 50 years. The average years of experience was very similar among types of fish traders (collectors/middlemen, wholesalers, and retailers). Normally, females had more years of experience (16 years) in fish trade than males did (14.6 years) (Appendix B, Table 3.28).

Trading Activities of Freshwater Small-sized Fish

The study showed that fish trade took place at home, landing site, local market, bag net (Dai), fish sauce factory, or no mantic. These places were chosen based on condition and suitability of the trade, and types of traders. For instance, fish collectors/middlemen commonly traded fish at home where fish were directly brought and sold to them. However, there were also a few cases that they traded fish at landing sites or local markets. Furthermore, while most of collectors/middlemen did fish trade at home, wholesalers mostly traded fish at landing sites and retailers traded fish at local markets.

Nearly all of fish trade took place without any agreement or contract because, most of the cases, they thought that it was free markets, and not a habit. Moreover, in some condition, because some traders lived very far from the trading places and the quantity of demanded fish was much, an agreement or contract could not possibly be made. And, after fish was traded, money was given immediately, so it was not necessary to sign an agreement or contract. Nonetheless, very few of fish trader household respondents had an agreement or contract in their business. Of those, only 1 household respondent had a contract via hand-writing, and besides this, the contract was done orally due to trust.

Volume, Species and Price of Fresh Freshwater Small-sized Fish

Trade of fresh freshwater small-sized fish varied by season, mainly during open and closed seasons. On average, freshwater small-sized fish were traded 6 months per year with 20.5 days per month. However, they were sold every month in closed season with almost 20 days per month. In other words, it was sold 8 months per year with around 20 days per month. Rate of weight loss of fresh freshwater small-sized fish traded in all seasons was estimated about 4% of the total volume.

On average, volume of freshwater small-sized fish traded was 1,922 kg per day. It was different by season. During open season, volume of the fish traded was high, up to 2,001 kg per day. However, during closed season, it was only 57 kg per day (Appendix B, Table 3.29).

At least 38 species of freshwater small-sized fish (including juveniles of commercially important fish species mixed with small-sized fish when bought) was presented in the trade. The top 10 fish species in terms of volume traded in 2011-2012 were: *Henicorhynchus spp.* (Riel) (1,415.3 kg/day), *Thynnichthysthynnoides* (Linh) (907.2 kg/day), *Paralaubucariveroi* (Sleuk Reussey) (617.8 kg/day), *Clupeichthys spp.* (BandolAmpov) (550.4 kg/day), *Labiobarbus spp.* (Ach Kok) (543.5 kg/day), *Parachela spp.*(ChanteasPhlouk) (302 kg/day), *Cirrhinusmicrolepis* (Kralang-) (234.5 kg/day), *Kryptopterusmoorei*(Kompokheav) (133.7 kg/day), and *Parambassis spp.* (Kanhchanh Chrass)

. Juveniles of commercially important big-sized fish species

(118.7 kg/day) (Appendix B, Table 3.30). Availability and abundance of each species of freshwater small-sized fish was different by time in open season, especially in peak period, and by place.

Price of freshwater small-sized fish varied depending on species, its abundance, and how it was sold. Thus, it was always changing by season, and ranged from USD 0.2 to 1 per kg in all season (Appendix B, Table 3.31). Each species consisted of its own value, but some species had the same commercial value when they were mixed and sold together, particularly during peak period of open season. During low period and closed season when the fish was scarce it was mostly sold separately by species or sometimes beheaded before being sold, making its price a little bit higher.

Trend of Fresh Freshwater Small-sized Fish Traded

Volume of fresh freshwater small-sized fish traded was increased by 50% of the sampled household respondents during 2011 - 2012 compared to that before 2011. However, size, quality and information on fish selling (fish price) and consumption (demand on fish) was unchanged with 68%, 54%, and 48% of the respondents, respectively. In addition, price of fish and convenience in selling fish was decreased with 64% and 50% of the respondents (Appendix B, Table 3.32)

The respondents were asked to give marks from 1 to 10 (1-4: not good; 5: medium; and 6-10: good) to some factors related to fish trade in order to know condition and improvement in the trade. The factors included: fish species, volume, size, price, quality, distance for the trade, convenience in loading fish, packaging, support given by sellers/buyers, and behavior of sellers and buyers. The study revealed that all the above factors, except volume and price of fish, were given number 5 indicating that all these factors was neither good nor bad for the respondents. However, they marked number 6 to the volume of fish meaning good because fish was more abundant than the previous years, but they gave number 4 to the price of fish due to the fact that the price was decreased resulting from the abundance of fish. Therefore, they found it difficult to sell the fish.

Volume, Type and Price of Processed Freshwater Small-sized Fish

More than three-quarters of the sampled fish traders processed freshwater small-sized fish remaining from selling into various types of products.

Overall, processed freshwater small-sized fish was traded nearly 10 months per year in which 7 months in open season and 3.4 months in closed season. An average number of days trading fish was 23.3 days per month, ranging from 23.6 days in closed season to 24.7 days in open season.

Only processed products from freshwater fish (all species) was sold by the sampled fish traders. On average, volume of processed freshwater fish traded was 57.2 kg per day, of which 56.2 kg was processed freshwater small-sized fish. Volume of the processed small-sized fish traded was changing by season and thus it was sold in larger quantity in open season which was about 57 kg per day while in closed season it was only about 27 kg per day (Appendix B, Table 3.33).

There were 4 types of processed freshwater small-sized fish being sold by the sampled fish traders in markets. Those products were: salted-dried fish (Trey Brolark), smoked fish (Trey Chha'eur), fermented fish (Pha'ork), and fermented fish paste (Pro'hoc). Fermented fish paste was most commonly traded (39.5 kg/day) due to the fact that it was most preferably consumed by Cambodian people, compared to other processed products such as fermented fish, smoked fish, and salted-dried fish, which was traded only 24 kg, 10.2 kg and 5 kg per day, respectively. (Appendix B, Table 3.34).

Price of processed small-sized fish was different by type of products and season. On average when bought, salted-dried fish was priced USD 0.5 per kg, smoked fish USD 4.1 per kg (or USD 0.31 per skewer; 1 skewer = 7.5 g or 0.075 kg), fermented fish USD 0.8 per kg, and fermented fish paste USD 0.8 per kg. However, when sold, salted-dried fish was valued USD 0.8 per kg, smoked fish USD 4.4 per kg (or USD 0.33 per skewer), fermented fish USD 1.5 per kg, and fermented fish paste USD 1.1 per kg (Appendix B, Table 3.35). Among these products, fermented fish was more returnable (USD 0.7/kg) compared to other products (USD 0.3/kg).

Trend of Processed Freshwater Small-sized Fish Traded

If compared to the previous years (2010 - 2011), volume of processed freshwater small-sized fish traded during 2011 - 2012 was decreased by 41.7% of the household respondents. This was because freshwater small-sized fish was more abundant. Therefore, some people who liked consuming fish processed products could process fish by themselves, making volume of the processed fish sold in markets decline. Nevertheless, size, price and quality of the processed small-sized fish remained unchanged up to the present. In addition, convenience in trading, and information on selling (price) and consumption (demand) on processed freshwater small-sized fish was increased by 75% and 58.3% of the household respondents, respectively (Appendix B, Table 3.36).

The household respondents were asked to give marks from 1 to 10 (1-4: not good; 5: medium; and 6-10: good) to some factors related to the trade of processed freshwater small-sized fish in order to know condition and improvement in the trade. The factors included: fish species, volume, size, price, quality, distance for the trade, convenience in loading the products, packaging, support given by sellers/buyers, and behavior of sellers and buyers. The study showed that fish species, volume and packaging of the products and behavior of sellers/buyers when selling and buying the products was marked good for 50% to 75% of the household respondents. Nevertheless, fish size, price and quality of the products, distance/place for trading, convenience in loading the products, and support given by sellers and buyers was scored medium by 33.3% to 83.3% of the respondents.

Fish Exporters

Socio-demographic Characteristics of Fish Exporters

Sixty (60) percent of the sampled fish exporters exported freshwater small-sized fish in fresh form, while 40% exported in processed form.

Overall, more than half of the exporters were female. The respondents had an average age of 42 years, ranging from 30 to 57 years. The majority age group was from 31 to 60 years, with 40% for male and 40% for female respondents (Appendix B, Table 3.37).

On average, the household respondents had experiences in fish export 13 years, ranging from 5 to 26 years. Of this, they had been involving in the export of freshwater small-sized fish for about 12 years, ranging from 5 to 23 years. Overall, males had more year experiences (15.5 years) in the business than females did (11.3 years) (Appendix B, Table 3.38).

Exporting Activities of Fresh Freshwater Small-sized Fish

Over half of fish exporters exported fish only in open season because fish was abundant at that time and they respected fisheries law. However, fewer than 50% exported fish in both the open and closed seasons because fish was abundant and there was a surplus in domestic markets. Moreover, they exported fish in the closed season in order to get more profit, since the exported fish could be sold at a high price and was exported by species only.

All of fish exporters held loading and exporting licenses. Nevertheless, nearly all of them did not have agreements or contracts in their business because they thought that it was neither a habit nor a necessity. Additionally, the fish was paid for in cash as soon as it was bought. Of the household respondents, only 1 respondent had an oral agreement or a contract in their business with fish collectors/middlemen. The contract usually lasted for 14 days.

According to the study, volume of fish allowed for export varied by types of products. Generally, fresh fish could be exported at the volume of 2,500 kg per time, ranging from 2,000 to 3,000 kg. Furthermore, processed fish was allowed for export at 15,000 kg per time, ranging from 10,000 to 20,000 kg.

Volume, Species and Price of Fresh Freshwater Small-sized Fish

Fresh freshwater small-sized fish was exported every month of the year. However, number of days or times for the export was different by season. Fish was exported most often in the peak period of open season, which was up to 22.7 days or times per month. In low period, it was only 5.7 days per month. Therefore, it could be assumed that fish was exported about 13 days per month during open season, and 8 days per month during closed season. Thus, on average, fish was exported 11.8 days per month, annually.

On average, volume of fresh freshwater small-sized fish exported was 1,527 kg per day (57% of fresh freshwater fish exported per day at the same time). In open season, it was exported 1,556 kg per day, and in closed season it was exported 50 kg per day. Fresh freshwater small-sized fish was largely exported in peak period 1,900 kg per day (60% of freshwater fish exported per day at the same time), but least exported in closed season 50 kg per day (20% of freshwater fish exported per day at the same time) (Appendix B, Table 3.39).

Approximately 10 species of freshwater small-sized fish (including juveniles of big-sized fish) were exported every year. Those species included: *Henicorhy* (Riel), *Mystus spp.* (Kanchos), *Trichogaster spp.* (Kompleanh), *Yasuhikotakia spp.* (Kanchrouk), *Kryptopterusmoorei* (Kompleav), *Coilia spp.* (Chunlounh Morn), *Puntioplites spp.* (Chrokeng), *Acantopsis spp.* (Reus Chek*), *Macrogathus spp.* (Chhlonh*), and *Notopterusnotopterus* (Slat*). Of these 10 species, Kompleanh, Kanhchos, Reus Chek*, Kanhchrouk, Chunlounh Morn, and Chrokeng* with 891 kg, 624 kg, 534 kg, 447 kg, and 446 kg per day, respectively, were the most commonly exported (Appendix B, Table 3.40). Furthermore, there were only 2 fish species, Kompleav and Slat*, were exported during closed season.

By excluding juvenile fish species, on average, price of freshwater small-sized fish ranged from USD 0.23 to 1.75 per kg. Of the 10 species, Kompleav obtained the highest commercial value of USD 1.75 per kg, followed by Kanhchrouk (USD 0.76/kg), Kanhchos (USD 0.50/kg), Riel (USD 0.38/kg), and Kompleanh (USD 0.30/kg) (Appendix B, Table 3.41).

Trend of Fresh Freshwater Small-sized Fish Exported

The study showed that volume of fresh freshwater small-sized fish exported grew (66.7% of the household respondents) in 2011-2012 compared to that before 2011. However, price of fresh freshwater small-sized fish was decreased (66.7%), resulting from the abundance of fish and leading to the decrease in convenience in exporting fish (66.7%) because fish exporters found it hard to sell their fish when the price was declined. Nevertheless, there were many things remaining stable such as fish size (66.7%), fish quality (100%) and information on exporting fish (market demand and price) (66.7%) (Appendix B, Table 3.42).

* Juvenile of commercially important fish species

Volume, Type and Price of Processed Freshwater Small-sized Fish

Normally, export of processed freshwater small-sized fish was done only 5 months per year with 12.4 days per month. The period for the export was varied by season. In open season, it was 4.5 months (from December to April) with 13.5 days per month. Nevertheless, in closed season, it was only 1 month (June) with 2 days per month.

There were 2 types of processed freshwater small-sized fish that were exported: salted fish (Trey Brolark) and fish paste (Pro'hoc). These products were not exported together by the same exporters. More clearly, one fish exporter exported only one type of products. In term of exported volume, salted fish was the most commonly exported product compared to fish paste. On average, the exported volume of processed freshwater small-sized fish was 14,792 kg per day. The average exported volume of salted fish was 19,584 kg per day, and fish paste was 10,000 kg per day. The exported volume could be varied by season. In open season, it was 15,000 kg per day and in closed season it was 4,000 kg per day (Appendix B, Table 3.43). During closed season, only salted fish was exported.

On average, price of fish paste was a little bit higher than that of salted fish. Fish paste was priced at USD 0.55 per kg. However, salted fish was priced at USD 0.48 per kg, ranging from USD 0.45 per kg in the open season to USD 0.50 per kg in the closed season (Appendix B, Table 3.44).

Trend of Processed Freshwater Small-sized Fish Exported

Compared to before 2011, the size and quality of processed freshwater small-sized fish exports remained unchanged. However, the price and convenience in exporting the processed fish declined at the same time that volume and information on trading and consuming the processed fish (price and consumption demand) increased.

Fish Processors

Socio-demographic Characteristics of Fish Processors

Overall, more than 60% of the sampled fish processors were female. The average age of the household respondents was 51.4 years, ranging from 31 to 70 years. The majority age group of the respondents was between 41 to above 61 years (80.9%). Of this, the majority age group of male was 61 and above with 18.2%, and of female was 41 to 50 years with 45.5% (Appendix B, Table 3.45).

On average, fish processors had 16.8 years of experience in fish processing, ranging from 6 to 32 years. Female processors had more years (18 years) in fish processing than males did (15 years) (Appendix B, Table 3.46).

Fish Processing Activities

Fish processing activities were commonly done without any agreement or contract by nearly three-quarters of fish processor household respondents, because they found that it was not a habit while the business and everything now was done in free markets. Furthermore, they thought it was not necessary to do so. Nonetheless, more than one-third of the household respondents had an agreement or a contract in their business in most cases through handwriting, and least via oral agreement. This contract was done with wholesalers and collectors/middlemen, respectively, with an average duration of 23.3 days.

There were 5 types or forms of fish products preserved from freshwater small-sized fish commonly found, including: salted-dried fish (Trey Brolark), smoked fish (Trey Chha'oeur), fish sauce (Teuk Trey), fermented fish (Pho'ork), and fish paste (Pro'hoc).

Overall, number of months and days in fish processing activities could be different by types or forms of processed products. On average, fish processor household respondents were involved in fish processing 5.7 months per year, ranging from 2.5 to 12 months. Mostly, they processed fish from November to March when freshwater small-sized fish was available and abundant for processing. Furthermore, on average, they processed fish only 18.7 days per month, ranging from 9 to 30 days. Additionally, time of one processing cycle also varied by product but on average it was 30.7 days per time or cycle, which ranged from 1 day up to 2 months per time or cycle (Appendix B, Table 3.47).

Raw Materials Used for Fish Processing

Besides freshwater fish (both small and big-sized fish), other raw materials used for fish processing included: salt, sugar and gram. According to the study, 358,360 kg of raw materials were used for fish processing per year. Of this volume, 208,400 kg were from freshwater small-sized fish (Appendix B, Table 3.48).

On average, around 145,286 kg of freshwater small-sized fish was bought by processor household respondents for processing every month. With this volume, some of 13 fish species were presented, such as: *Henicorhynchus spp.* (Riel), *Mystus spp.* (Kanhchos), *Trichogaster spp.* (Komphleanh), *Thynnichthysthynnoides* (Linh), *Clupeichthys spp.* (Bandoul Ampov), *Yasuhikotakia spp.* (Kanhchrouk), *Osteochiluslini* (Kros), *Paralaubucariveroi* (Sleuk Reussey), *Cyclocheilichthys spp.* (Chhkok), *Labiobarbus spp.* (Ach Kok), *Coilia spp.* (Chunlounh Morn), *Pteropangasiuspleurotaenia* (Chhveat), and *Parachela spp.* (Chunteas Phlouk). In term of buying volume, the most common ones were Riel (112,654 kg/month), Linh (90,000 kg/month), Kompleanh (79,719 kg/month), Sleuk Reussey (15,620 kg/month), and Ach Kok (15,000 kg/month). However, not all of these species were bought by the same processors or at the same time. In addition, an average price of these fish species ranged from USD 0.25 (Kanhchos, Linh, Kanhchrouk, Ach Kok, and Chunteas Phlouk) to 0.75 (Chhveat) per kg (Appendix B Table 3.49).

Selling of Processed Freshwater Small-sized fish

With the total volume of 358,360 kg of raw materials, including fish, used for processing per year, each fish processor household could receive 237,448 kg of final or finished processed products per year. Of this volume, 210,957 kg were final processed freshwater small-sized fish products (Appendix Table 3.48). If considered by type of the processed products, on average, volume of fish sauce produced by a processor household/factory was 900,000 L (L equal kg) per year. Moreover, an average volume of salted-dried fish produced was 242,467 kg per year, of fish paste was 113,729 kg per year, of fermented fish was 17,800 kg per year, and of smoked fish was 7,100 kg per year (Appendix B, Table 3.50).

Overall, the number of months in which processed freshwater small-sized fish was sold varied by type of processed products. On average, it was 7.6 months per year, ranging from 2.5 months for smoked fish to 12 months for fish sauce. Furthermore, the average time of selling all processed products were 17.1 times per month, ranging from 16.6 times for fish paste to 25 times for fermented fish and fish sauce. This

Juvenile of commercially important fish species

Conversion ratio of freshwater small-sized fish from fresh into processed forms:

- 1:0.5 for salted dried fish
- 1:0.075 for smoked fish
- 1:0.4 for fermented fish
- 1:0.3 for fish paste
- 1:3 for fish sauce

meant that fish sauce was produced and sold out every month and nearly every day of the month, compared with other types of processed products. Moreover, volume of all processed products sold per time could be different but averaged to 5,158 kg per time. Fish sauce was the most commonly sold out processed product, with an average of 8,000 L per time, compared to fish paste, smoked fish, fermented fish and salted-dried fish with 6,661 kg, 559 skewer, 426.7 kg, and 175 kg, respectively. In addition, price of the processed products was very similar for salted-dried fish, fermented fish and fish paste (around USD 1/kg), except smoked fish (USD 0.3/skewer) and fish sauce (USD 0.5/L) (Appendix B, Table 3.51).

Trends of Freshwater Small-sized Fish Processing

Trends of processing activities of freshwater small-sized fish were divided into 2: the trend of raw materials (fresh small-sized fish) used for processing and the trend of final processed products. Respondents were asked to compare processing activities this year (2011-2012) with that before 2011.

According to the study, there were more varieties of raw materials (freshwater small-sized fish) that could be used for producing many types of processed products of freshwater small-sized fish (33.3% to 100% of the respondents). This growth resulted from the abundance of fish with low prices, which was the consequence of recent fisheries reform (abolishing all fishing lots) and fisheries law enforcement. Moreover, supply and demand on raw materials for producing smoked fish, fermented fish and fish paste has gradually increased recently (100%) because fish, particularly small-sized fish increased and the number of fish suppliers like fishermen and fish collectors/middlemen also increased. However, it remained unchanged for supply and demand on fresh and salted-dried fish (44.4% to 66.7%). Notably, volume of raw materials used for producing each processed product increased (33.3% to 100%) (Appendix B, Table 3.52). This was because small-sized fish was more abundant. Fishers could catch more fish, making the price of fish for processing low and fish processing increased. As long as the price of processed fish decreased, market demand on processed fish increased because of its better quality.

From 37.5% to 100% of the respondents revealed that type of processed products of freshwater small-sized fish, mainly fish paste, salted-dried fish and smoked fish decreased, while 37.5% to 100% more said that type of products including fish paste, salted-dried fish and fermented was stable. Type of fish processed products declined due to the fact that not many processors were willing to process more since its price was low, so it was very difficult to sell the products. Also, it was difficult to find laborers to serve in the workforce since many of them migrated for work to other provinces or countries. Moreover, regarding type of products, only fish sauce was reported increased by 100% of the respondents because freshwater small-sized fish was abundant and bought at low price. Also, supply and demand on the processed products was reported decreased for salted-dried fish, smoked fish and fermented fish paste (50% to 66.7% of the respondents), but it was unchanged for fish paste (50%) and increased for fish sauce (100%). Furthermore, volume of the processed products, especially salted-dried fish, fish paste, smoked fish and fermented fish was dramatically declined (50% to 100%) because price of the processed products decreased (resulting from abundance of fish) and processors reduced volume of processing to avoid a loss. Nevertheless, volume of fish sauce still kept on increasing (100%) (Appendix B, Table 3.53).

Fish Consumers

Socio-demographic Characteristics of Fish Consumers

Overall, an average age of fish consumers was 44 years, ranging from 19 to 76 years. More than half of them were female. The majority age group was between 31 to 60 years (76%), with 40% for male and 36% for female (Appendix B, Table 3.54).

Volume and Preferable Fish Species and Products

In this study, two different types of consumers – fishermen and non-fishermen – were selected. Volume of freshwater small-sized fish consumed (both fresh and processed forms) was varied by type of consumers and by provinces. On average, volume of freshwater small-sized fish consumed by fishermen in all provinces was higher (231 kg per year per household) than that consumed by non-fishermen in all provinces (195.8 kg per year per household). Therefore, regardless of type of consumers, an average volume of freshwater small-sized fish eaten was 213.4 kg per year per household, ranging from 19 to 921 kg. This volume was found the highest in Phnom Penh with 267.7 kg per year per household, and the lowest in Battambang province with 107.4 kg per year per household (Appendix B, Table 3.55).

Many fish consumers revealed their own preferences in fish species differently. However, in most of the cases these species were ranked into 5 categories. Number 1 referred to the most preferable fish species and number 5 referred to the least preferable fish species. The study showed that of the species of freshwater small-sized fish, *Henicorhynchus spp.* (Riel) got number 1 which meant the most preferable fish species, followed by *Mystus spp.* (Kanchos), *Opsariuskoratensis* (Changva), *Trichogaster spp.* (Kompleanh), and *Anabas testudineus* (Kranh), respectively. There were many reasons to prefer such fish species, one of which was low price. Another thing, it was delicious and low fat which could be cooked into many dishes, and free from chemical substance that would affect human health. Furthermore, it provided more nutrition for development of the human body and brain. More importantly, it was easy to buy since fishermen could catch it every day.

Types of processed products from freshwater small-sized fish consumed including fresh fish, salted-dried fish (Trey Brolark), smoked fish (Trey Chha'oeur), fermented fish (Pho'ork) and fish paste (Mam/Pro'hoc). Fresh fish was the most preferably consumed form of fish compared to other types/forms of fish. It was followed by fish paste, smoked fish, salted-dried fish and fermented fish, respectively (Appendix B, Table 3.56).

Consumption on Freshwater Small-sized Fish

Normally, the number of days and times fish consumers bought each type of freshwater small-sized fish products depended on how much they consumed and relied on it, or how much it was important and affordable for them. The study showed that fish consumers bought freshwater small-sized fish products every 3.8 days (for fresh fish) to 104 days (for fish paste) per time. An average buying volume was varied by product, which was 0.7 kg per time for fresh fish, 0.7 kg per time for salted-dried fish, 3.1 skewers per time for smoked fish, 5.7 kg per time for fermented fish, and 7.6 kg per time of fish paste. An average distance to buy these products ranged from 116.6 to 231 m away. On average, the price of fresh fish and salted-dried fish was the same, which was USD 0.9 per kg. This was because salted-dried fish was normally processed from not-so-fresh fish with smaller size. Furthermore, the price of smoked fish was USD 0.3 per skewer; the price of fermented fish was USD 1.6 per kg; and the price of fish paste was USD 1.7 per kg (Appendix B, Table 3.57). The price of these processed products might be higher from June to September when freshwater small-sized fish were scarce, but could be lower from November to March when freshwater small-sized fish were abundant.

Fish consumers were asked to provide scores from 1 to 10 (1-4: bad; 5: medium; 6-10: good) to consumption on freshwater small-sized fish in both fresh and processed forms. The result indicated that over half of them (55.3%) marked from 6 to 10, meaning that freshwater small-sized fish consumed was good.

Beyond this, fish consumers were also posed to mark from 1 to 10 on some factors in order to reveal their opinion when they bought and consumed fresh and processed freshwater small-sized fish. Those factors included fish species, quantity, size, price, distance/place to buy the products, convenience in buying the products, packaging of the products after bought, support given by fish sellers, and sellers' behaviors. The

result showed that fish species, size, distance/place to buy the products, packaging and support given by sellers was just medium for them. However, they thought that fish quantity (more abundance), price (low), convenience in buying fish (since the price was low, it was easy to buy fish), and behaviors of the sellers were quite good.

Trend of Consumption of Freshwater Small-sized Fish

Overall, more than 50% of consumer household respondents thought that the quality, convenience and information on the supply and use of freshwater small-sized fish in both fresh and processed forms was medium. However, only fresh freshwater small-sized fish was considered good in convenience in consuming by most of the household respondents (Appendix B, Table 3.58).

Comparing the consumption of freshwater small-sized fish and its processed products in 2011-2012 to that before 2011, it was seen that buying volume, fish size, quality, convenience in consuming fish, and information on the supply and use on fish was unchanged (by 52.7% to 70.2% of the respondents). However, the price of fish was decreased (43.1%), except smoked fish, which remained unchanged (51.3%) (Appendix B, Table 3.59).

Value Chain Analysis and Marketing Channel of Freshwater Small-sized Fish

Fishermen

There were many ways in which fishermen could sell their fish. They could: 1) carry the fish to markets and sell it directly to end consumers, 2) carry the fish to landing sites and sell it to fish collectors/middlemen/wholesalers, 3) sell the fish to fish collectors/middlemen/wholesalers at fishing grounds, 4) bring the fish to the villages and sell it to fish collectors/middlemen/wholesalers, or 5) sell the fish directly to neighboring consumers at home. According to the study, 73.4% of fisher household respondents chose ways number 2, 3 and 4, respectively, to market their fish, whereas only 26.6% chose ways number 1 and 5 (Appendix B, Table 3.60).

Before being sold, fish was partly kept for household consumption (fresh and processed forms) 3.2% of total volume of fish caught per year. It was then sold to various types of buyers including local fish collectors/middlemen/traders (25.6%), processors (21.7%), end consumers (18%), fish collectors/middlemen/traders from other provinces (15.9%), fish and animal farmers (fish/ animal feed) (14%), and exporters (1.6%) (Appendix B, Table 3.61).

Trend of freshwater small-sized fish distribution (numbers of buyers and buying volume) was reported unchanged by 50.4% of fisher household respondents. However, 37.8% of them said the trend was increased, while 11.9% said the trend was decreased (Appendix B, Table 3.62).

Fish Traders

As mentioned above, two types of fish forms - fresh and processed - were traded by fish traders in this study. Therefore, supplying and demanding sources of each form of fish might be different, to some extent.

Supplying sources of fresh fish encompassed fishers, fish collectors/middlemen and wholesalers. Moreover, some fish traders could catch fish by themselves, but volume of fish caught (8.4% of total volume traded per year, (2011-2012) was less than volume of fish bought from the above sources. Annually, 33.6% of volume of fish traded was bought from fishers, 32.7% from fish collectors/middlemen, and 25.4% from wholesalers (Appendix A, Figure 3.2). Of the various sources,

fishers were considered the most important because they were permanent fish suppliers for fish traders throughout the whole year. Furthermore, fish sold by fishers was fresh and of good quality. Traders felt it easy to buy fish from fishers and the fish was bought at lower price than that bought from fish collectors/middlemen/wholesalers. Additionally, it was easy to order fish from fishers, since they were loan borrowers and thus obliged to sell fish to the traders (loan providers). In addition, they were living near fishers' houses, so it was much easier to buy fish from them. Nevertheless, for some traders buying fish from bag nets/dai operators illustrated that bag net operators were their only main fish suppliers due to the recent cancellation of fishing lots and no other large fishing gears could be used for catching the fish, except bag nets.

Most of the fish bought was retailed to end consumers (25.6%). Also, it was sold to processors 19.2%, local retailers 17.7%, fish collectors/middlemen/wholesalers 15.2%, fish and crocodile farmers and animal feed processors 15.2%, and exporters 7.1% (Appendix A, Figure 3.3). Of these demanding sources, only end consumers and local retailers were regarded the most important because they were permanent buyers; fish was sold with immediate payment in cash; and fish traders could obtain higher profit (fish was priced the last stage of payment).

Processed freshwater small-sized fish sold was either processed by fish traders themselves or bought from others. In the case that it was processed by traders, the supplying sources of fresh fish for processing were fishermen (45.2% of total volume of fresh fish bought for processing), fish collectors/middlemen (38.4%) and wholesalers (16.4%) (Appendix A, Figure 3.4). However, in case that they did not process fish by themselves, the supplying source of the processed products was processors.

Processed freshwater small-sized fish included salted-dried fish, smoked fish, fermented fish and fish paste. Buyers of these processed products could be collectors/middlemen/wholesalers, local retailers and end consumers. Overall, around 43% of the products were sold to collectors/ middlemen/wholesalers, 34% to local retailers, and 23% to consumers (Appendix B, Table 3.63).

Fish exporters

Like fish traders, two types of fish forms – fresh and processed forms – were exported by fish exporters. There were only two supplying sources of fresh freshwater small-sized fish, including fishermen and fish collectors/middlemen. More than half of the fresh fish (60%) was supplied by fish collectors/middlemen, whereas less than half (40%) was supplied by fishermen (Appendix A, Figure 3.5). The important supplying source of fresh fish was fish collectors/middlemen because fish was brought in place (exporting companies), so fish exporters did not need to go further or hire laborers to collect fish from those collectors/middlemen or fishermen. Moreover, the fish selling price by those collectors/middlemen was lower than the market price since those collectors/middlemen borrowed money from exporters and had to sell fish to the exporters.

All the fish was then transported and sold to Thai fish collectors/middlemen (66.7% of the total exported volume) and to Thai wholesalers (33.3%) at Cambodia-Thailand land border point. Next, the fish was loaded by these collectors/middlemen and wholesalers into Thailand before distributed to some markets and restaurants in that country.

There were two types of processed freshwater small-sized fish such as salted fish and fish paste. Supply sources of these processed products were processors and collectors/middlemen. All of the salted fish was bought from collectors/middlemen, while all of the fish paste was bought from processors. After purchase, the products were transported and sold to Thai middlemen at the countries border point before entering Thailand.

Fish processors

Fishers, fish collectors/middlemen and other fish processors were supplying sources of fresh freshwater small-sized fish for processing. Of these various sources, about 75% of the total buying volume was from collectors/middlemen, followed by other fish processors (19%) and fishers (6%) (Appendix B, Table 3.64).

All processed products from freshwater small-sized fish, except fish sauce, were proportionately kept for household consumption (0.5% to 5% of the total production volume). The rest was sold to different types of buyers including collectors/middlemen, wholesalers/retailers, other fish processors and end consumers. The study showed that nearly all of salted fish (86%) and smoked fish (99%), and all of fish sauce (100%) were sold to wholesalers/retailers. Moreover, almost all of fermented fish was sold to collectors/middlemen (49.9%) and wholesalers/retailers (49.6%). Furthermore, nearly 90% of fish paste was sold to wholesalers/retailers (37%), collectors/middlemen (28%) and end consumers (24%), respectively (Appendix B, Table 3.65).

Fish consumers

Supplying sources of freshwater small-sized fish to end consumers were fishers, retailer processors, own catch (fresh fish) and own process (processed fish). These sources could vary by forms (fresh and processed forms) and type of processed products. However, generally, most of the products (fresh and processed) consumed was bought from retailers (30%), followed by fishers (23%), own processed (23%), processors (16%), and own catch (8%) (Appendix B, Table 3.66).

Figure 3.6 shows mapping of the value chain of freshwater small-sized fish in the LMB of Cambodia. Freshwater small-sized fish was both traded in domestic markets and exported (fresh and processed) to neighboring countries – Vietnam and Thailand. Of the total volume of the small-sized fish in the chain, 2.2% was exported to the above two countries, while 97.8% was traded in domestic markets. 3.2% of the fish was kept by fisher households for consumption. Fish collectors/middlemen/wholesalers played an important role by buying 41.5% of the fish from fishers before selling on to various combinations of other chain actors, including processors and retailers. Processors handled an estimated 30.5% of the fish in the chain. Moreover, less than 20% of the fish was directly retailed by fishers to end consumers. 14% of the fish was directly sold by fishers to fish/animal/crocodile farmers. 1.6% of the fish was sold to Vietnamese processors living in the area, and would be then exported to Vietnam by these processors. Of the total volume of the fish in the chain, around 73% was used for human consumption, whereas about 24% was used as feed for fish, animals and crocodile culture in the country. This figure was not very different from a study done by So et al. (2007) which revealed that around 85% of the total dai freshwater small-sized fish production in 2006-2007 in Tonle Sap River was locally utilized for human food in both fresh and processed forms, and for fish/animal feed; the rest was exported, in particular to Vietnam in both fresh and half-processed forms for human consumption and animal feed, respectively.

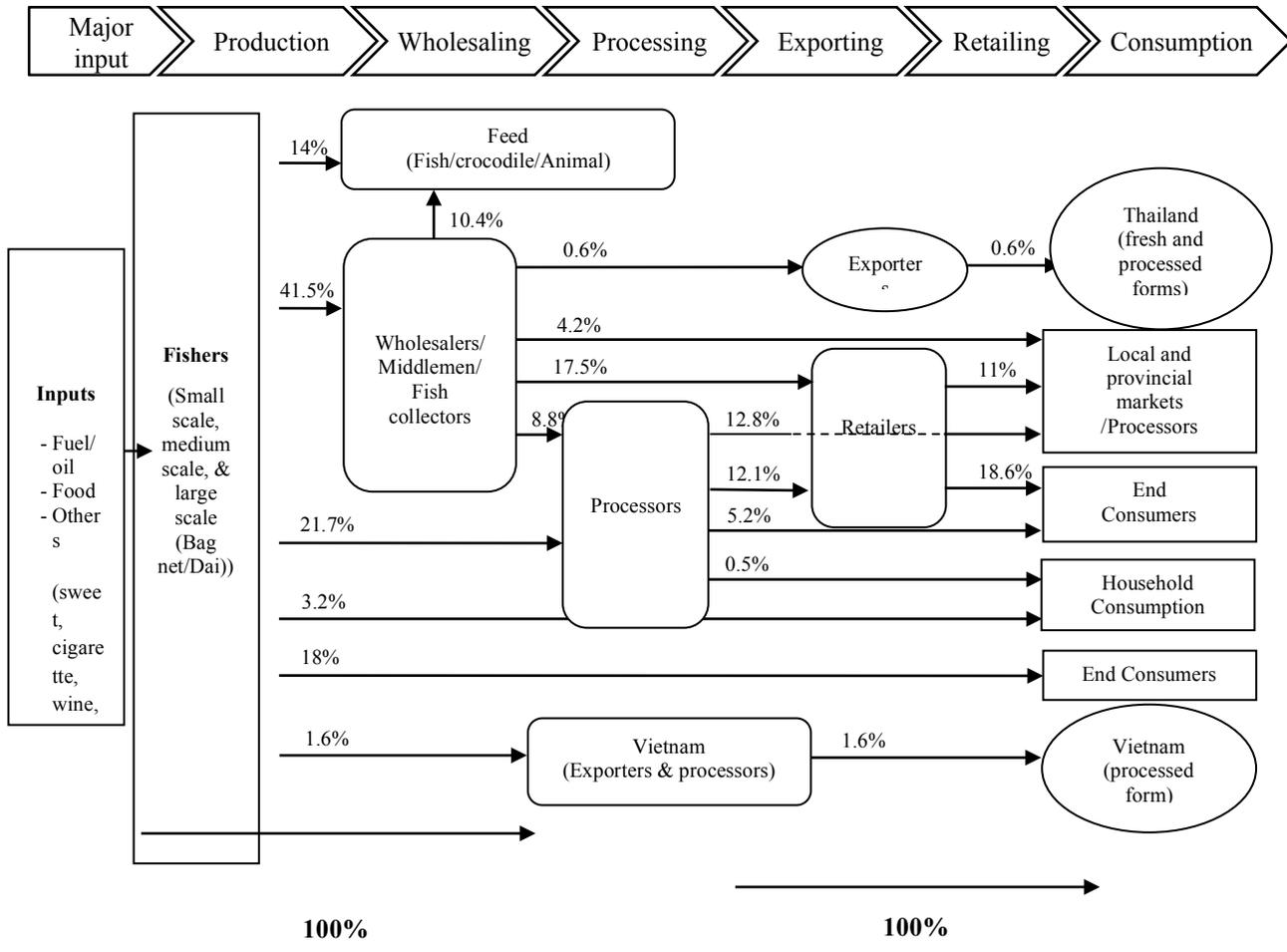


Figure 1. Mapping of the value chain of freshwater small-sized fish in the LMB of Cambodia.

Perception and Business Plan and Challenges/Constraints of Chain Actors

Perception and Business Plan

Fishermen

Fishing activity was considered a primary occupation of fishermen. It was a job that did not require much capital or much skill/knowledge. It was such a good opportunity that they were living near fishing grounds where they could go fishing all the time without spending much time and much cost on the trip. Besides keeping and processing the catch for household consumption, fisher households could take some advantages by selling the surplus for income to support their families, to send their children to school and to pay for medical care. Additionally, the fish could be used as fish feed by fisher households who cultured fish and this could reduce some parts of expenses on fish feed.

Fish Traders

Fish trade was considered easy work because it did not need much capital investment and the traders could get more profit. Most of them could earn more income to support their families. As reported, it was rarely lost because the fish left over from being sold could be processed for the next sale or even used as fish or animal feed. And, it was a great opportunity for some traders living near or along fishing grounds and fish supplying sources where the trade from everywhere was gathered. As a result, more than half of the trader household respondents still wanted to keep the business while over 25% planned to expand it in the future (Appendix B, Table 3.67). Besides the above-mentioned advantages and opportunities of the fish trade, more than half of the household respondents did not plan to change (reduce or expand) the business because they had experience as well as skill in fish trade, and trading fish was regarded as the primary occupation by some respondents. They did not have other jobs to do or enough time to spend on the fish trade. Additionally, some traders wanted to expand the business, but could not due to some constraints, including: limited capital, not enough volume of fish and processed fish demanded, and little change of fish price (wild) in markets. Furthermore, one-quarter of the respondents planned to expand the business in order to get more profit and improve their living conditions.

Fish Exporters

Fish export was one of many careers. While some fish exporter household respondents considered fish export the main occupation in their families, some respondents regarded it as additional or secondary occupation in their families. However, no matter whether it was the main or additional job, it was considered an easy job which brought about profit and household income to support the family. In contrast, nearly all of the household respondents (80%) planned to reduce the business because of the scarcity of fish, making its price increase (Appendix B, Table 3.68). It was difficult to sell the processed products and pay for informal fees. Moreover, sometimes they made a loss that made them felt tired with the business.

Fish Processors

Fish processing was considered by fish processors as an easy business because they had skills in this business. Besides spending low capital investment, fish processed products were easy to be sold since processors had a lot of permanent consumers. As reported, volume of small-sized fish was abundant for processing and it was such a great opportunity that fish processors who were living near fish supplying sources where they did not have to spend much cost on transportation and informal fee payment, and could avoid much weight loss of fish and fish degradation before being processed. Moreover, they could make use of and augment value of small-sized fish left over from markets, regarded as waste fish in some

areas, through value added products. In addition, for fish processors, processing fish helped them gain additional income, which could improve their living condition. More than this, via fish processing they could help society reduce poverty by providing jobs to the poor. As far as fish processors were concerned, development trends of the freshwater small-sized fish processing industry in the coming time was supposed to increase by 54.5% of fish processor household respondents (Appendix B, Table 3.69). This was due to the fact that fresh freshwater small-sized fish, used as raw materials for fish processing, was abundant, and processed products of small-sized fish were easier to sell than that of big-sized fish. And, fish processors spent less capital on processing small-sized fish. When asked about future changes in the processing of freshwater small-sized fish, 63.7% of the household respondents planned to change the business, of which 36.4% planned to reduce while 27.3% planned to expand the business (Appendix B, Table 3.70). Most of them wanted to reduce the business because they lacked capital (for middle-scale processors) to buy raw materials as well as modern machines (for beheading fish and pumping fish up into the house) to process more small-sized fish and with good quality. Moreover, there was also lack of labor to do the work. The number of buyers, if not decreased, at least remained the same. Fish processing was thought of as a tiring job. Sometimes fish processors got lost in the business when price of fish and processed fish was changed unexpectedly. Therefore, some of processors wanted to find a new job. Nevertheless, 36.4% of the household respondents planned to have no change in the business due to the fact that they own processing equipment and a suitable place for stocking the processed products. Moreover, because numbers of buyers remained the same, and numbers of labor and capital was low, it was expected that the business was only maintained, not expanded.

End Consumers

In the future, there would be no change in consumption of fresh and processed freshwater small-sized fish by nearly 70% of fish consumer households (Appendix B, Table 3.71). This was because fresh and processed freshwater small-sized fish was affordable (having low price) and was an important source of animal protein. Moreover, it was easy to buy since it was always available everywhere. Furthermore, fresh small-sized fish could be used to process into many types of products including fish paste and fermented fish, etc.

Challenges/Constraints

There were many problems faced by the chain actors in operating their business. The chain actors described those problems as follows:

Fishermen

For most of fisher households, fishing was their only job since they were living along or on the river. There were a lack of alternative livelihood activities and opportunities to find additional income to support their families. Moreover, they lacked labor that could help them during fishing. They could not depend on fishing while the volume of fish caught was not regular. After they caught fish, they had difficulty selling it since its price competed with cultured fish imported from neighboring countries. Furthermore, as reported, the number of fishermen was increasing at the same time that fishing grounds became narrow, lessening the normal area of fishing grounds that each fisher used to fish, and decreasing the volume of fish catch per fishing effort. Cases of unofficially being asked for money by local authorities were common. Additionally, the globally increasing price of goods, especially gasoline, and natural phenomena such as storms and heavy rains also affected and threatened their fishing activities.

Fish Farmers

Some fish fingerlings used by fish farmers were caught from nature and were difficult to find, making its price high. Therefore, increase in price of fingerling was one of many problems for fish farmers. Another

problem, there was shortage of freshwater small-sized fish for fish feed, particularly during closed season. Demand on using the small-sized fish for fish feed was increasing, so fish farmers had to compete with each other to get the small-sized fish. In addition, the small-sized fish was scarce, which resulted in an increase in its price. Furthermore, consumption demand for domestic cultured fish declined and its price also decreased and became unstable because domestic cultured fish competed with lower-priced imported cultured fish mainly from Vietnam and Thailand. Consequently, fish farmers faced difficulties selling their fish. Also, it was a little bit difficult for them to do permission letter for fish culture and stocking license. Besides this, they lacked capital to standby and expand their business. Usually, there was disturbance from competent local authorities who came to ask for money. Normally, increasing price of equipment and other raw materials used in fish farming would more or less affect fish farmers.

Fish Traders

Availability of freshwater small-sized fish for selling was the only important thing for fish traders. Therefore, having no or not enough small-sized fish for selling was their big problem. Fish traders had to spend much time traveling and waiting, and compete with other fish traders to buy fish for selling. In some cases, they had to provide loan in advance to fish suppliers like fishers and fish collectors to get the fish. Moreover, consumption demand on the small-sized fish was made known decreased compared to big-sized fish. Besides competing with the domestic big-sized fish, it was also challenged by imported cultured fish, which made its price lower and changed irregularly. Hence, fish traders had difficulties selling and sometimes they could get low profit or even sell at a loss. Furthermore, some formal-fee payments like administrative costs, annual taxes, seasonal taxes and payments on security, environment and utilities, and informal-fee payments affected the business of fish trade, to some extent.

Fish Exporters

Fish exporters were also confronted with some of the same problems that fish traders experienced. In addition to the above problems, fish exporters met some more difficulties related to the instability of freshwater small-sized fish supply and demand. Reportedly, market demand on the small-sized fish from Thailand was decreased because they could culture the fish by themselves in their country. And, the price of the small-sized fish exported was set by buyers. This meant that although fish exporters had fish for selling, they were not the ones who determined the price of their products. Even more, in some circumstances, their products were sold on credit. Regarding conservative techniques to maintain quality of the products and reduce so much weight loss during exporting, it was still limited. Additionally, every year fish exporters had much expense due to labor costs and taxes on income.

Fish Processors

Volume of freshwater small-sized fish was usually not stable. It was regularly available only a few months in open season. Because of this, some fish processors encountered no or not adequate small-sized fish for processing for most of the time. Furthermore, price of the small-sized fish was not stable, so price of the processed small-sized fish also changed. Additionally, consumption demand as well as selling volume of the processed products declined due to the fact that some consumers could process the fish into their preferable preserved products by themselves. Moreover, fish processors were lack of processing techniques and modern processing machines, such as fish beheading machines, etc. More importantly, there was competition for the products from different fish processors in markets and there was no market support on the products. Also, informal-fee payment during processing and transporting was high and thus affected fish processors.

Major Suggestions for Upgrading the Value Chain of Freshwater Small-sized Fish

In order to upgrade the value chain as well as to improve marketing and management solutions of freshwater small-sized fish in the LMB of Cambodia, some major suggestions/recommendations are proposed as follows:

Training in fisheries law should be done to make sure that all fishermen clearly understand what is in the law in order to know their privileges and how to obtain the right to fish to avoid being cheated by any illegal officials. Moreover, there should also be enforcement of the fisheries law, especially of fishing activities to eliminate illegal and over-fishing that led to the depletion of fisheries resources, and fish trade and export.

The government should limit imported volume of cultured fish into Cambodia that would compete with wild fish and domestic cultured fish in terms of price. The government should strictly determine and set out a clear regulation on when there should be import and export of fish into and out of the country in order to have a balance between supply and demand on fish within the country. To do so, quality of products should be controlled and ensured to build the trust of consumers.

The procedure for obtaining licenses for fish culture, stocking, loading, trading and export should be simplified and sped up.

Techniques for fish hatcheries and producing pelleted fish feed by using locally available natural resources without using small-sized fish should be introduced to fish farmers.

There should be support from the government by providing price information of fresh and processed products of fish (cultured and wild) in markets, intervening price of the products, and finding more market opportunities of the products (export markets).

Fish processors should form associations to ensure that their products are sold at the same price and to avoid market competition. The government should also support them through policy-making, providing processing techniques/skills for good quality processing, and establishing quality control institution to standardize the processed products that would broaden both domestic and export market opportunities for the processed products.

Products should be processed into final products before being exported so that more value can be added, and more job opportunities can be created for Cambodian people, so as to reduce migration for work to other places or other countries.

Establishment of micro-credits or financial organizations providing loans with low interest rates should be more encouraged and motivated.

Law enforcement should be strengthened by eliminating unimportant or informal-fee payment during business transactions along the chain. Furthermore, all formal-fee payments determined by the law should be taken or charged at a reasonable amount of money (e.g. 5% of income for exporters).

More livelihood activities and vocational skills should be created and provided to all people as well as the chain actors, especially to fishers in order to reduce fishing pressure and earn additional income to better their living conditions.

SUMMARY AND CONCLUSION

Summary

Freshwater small-sized fish is considered a crucial and irreplaceable foodstuff (source of animal protein) for Cambodian people, especially for the poor. More than ensuring food security for the nation, freshwater small-sized fish provides job opportunities and household income to millions of people through fishing, fish farming, trading, processing and exporting activities. The study on the Value Chain Analysis of Freshwater Small-Sized Fish in the Lower Mekong Basin (LMB) of Cambodia was conducted with three main objectives: 1) to describe and analyze the situation of stakeholders participating in value chain of freshwater small-sized fish; 2) to analyze the value chain; and 3) to propose improvements for upgrading the value chain for improved marketing and management solutions.

The study was undertaken in four provinces, namely Kandal, Kampong Chhnang, Battambang and Siem Reap provinces, and Phnom Penh city. Stakeholders relevant to the value chain of freshwater small-sized fish were categorized into 6 different groups: fishermen, fish farmers, traders, exporters, processors and end consumers. In total, 206 samples were purposively selected and interviewed by using 6 different types of questionnaires. Key informant persons (KIP), such as officers of municipal and provincial fisheries administration cantonment and local authorities, in each selected study area were also interviewed. Not only primary data received through interviewing with targeted samples and KIP but also secondary data derived from various sources like government and NGOs was needed in this study. The primary data, once completed, checked and cleaned, was installed and analyzed in MS Access.

Fishermen were the only supply sources of freshwater small-sized fish. Normally, the value chain of small-sized fish mostly exists in the open season, especially during peak period from November to February when the small-sized fish are abundant. However, the months might vary across the provinces. Because 70% of fisher households went fishing for household consumption and sale, about 90% of the fish caught was for sale and only 10% was kept for own consumption. Around 24,753 kg of the small-sized fish were caught per household in the last open season (2011-2012), in which 23,233 kg were caught in the peak period and 2,124 kg were caught in the low period of open season. Moreover, 300 kg of the small-sized fish were caught in last closed season (2011-2012). Totally, at least 24,918 kg of the small-sized fish were caught per household last year, and 49 fish species (including juveniles of commercially important and big-sized fish species). The price of the small-sized fish varied by species and season but ranged from USD 0.1 to 1.3 per kg. At least 17 species of fish were found being cultured in either ponds or cages. The types of fish feed used for fish culture included freshwater small-sized fish (both fresh and dried forms), marine small-sized fish, commercial/ pellet feed, rice bran and other additional feeds. Nearly half of fish farmers (45%) use freshwater small-sized fish as fish feed. On average, volume of feed used for fish culture was 54,686.4 kg per crop per household, most of which was freshwater small-sized fish (31%). The use of freshwater small-sized fish as fish feed was reported increased (40% of fish farmer households), particularly last year (2011-2012) because of the abundance of freshwater small-sized fish. Probably 38 fish species of freshwater small-sized fish were traded. On average, the traded volume of fresh freshwater small-sized fish was 1,922 kg per day per household (2,001 kg per day in open season and 57 kg per day in closed season). Fresh small-sized fish was priced from USD 0.2 to 1 per kg. Moreover, the average volume of processed small-sized fish sold was 56.2 kg per day (57 kg during open season and 27 kg during closed season). Types of processed freshwater small-sized fish traded included salted-dried fish (USD 0.8/kg), smoked fish (USD 4./4kg, or 0.33/skewer), fermented fish (USD 1./kg), and fish paste (USD 1.1/kg). Export of freshwater small-sized fish was done in both fresh and processed forms. 10 species of freshwater small-sized fish were exported. Average exported volume of freshwater small-sized fish was 1,527 kg per day (1,556 kg/day during open season, and 50 kg/day during closed season). By excluding juveniles of big-sized fish species, price of fresh

freshwater small-sized fish ranged from USD 0.23 to 1.75 per kg. Processed freshwater small-sized fish exported included salted fish and fish paste. The average exported volume of processed small-sized fish was 14,792 kg per day (15,000 kg/day in open season and 4,000 kg/day in closed season). Price of salted fish was USD 0.45 per kg and fish paste was USD 0.55 per kg. There were five types of processed freshwater small-sized fish produced by processors including: salted-dried fish, smoked fish, fish sauce, fermented fish and fish paste. On average, volume of processed freshwater small-sized fish produced was 210,957 kg per year and sold out 5,158 kg per time. The price of the processed products was very similar for salted-dried fish, fermented fish and fish paste, which was USD 1 per kg, except smoked fish USD 0.3 per skewer and fish sauce USD 0.5 per liter. Freshwater small-sized fish was bought every 3.8 days (for fresh fish) to 104 days (for fish paste) per time. An average buying volume of the products was 0.7 kg per time for fresh and salted-dried fish (USD 0.9/kg), 3.1 skewers per time for smoked fish (USD 0.3/skewer), 5.7 kg per time for fermented fish (USD 1.6/kg), and 7.6 kg per time for fish paste (USD 1.7/kg).

For the marketing channels of freshwater small-sized fish, fish collectors/middlemen/wholesalers absorbed 41.5% of the total volume of the small-sized fish supplied by fishermen. Processors handled 30.5% of the fish in the chain before processing and supplying to various chain actors. Just less than 20% of the fish was sold directly by fishers to end consumers in retail markets. Besides being kept for household consumption, the rest of the small-sized fish was sold as feed to fish/animal/crocodile farmers (14%) and Vietnamese processors living in the areas (1.6%) by fisher households. Only 0.6% of the fish was exported to Thailand by fish exporters/exporting companies in both fresh and processed forms (semi-final processed products).

Some suggestions/recommendations were proposed in order to upgrade the value chain of freshwater small-sized fish. Clear regulations on the appropriate time the fish should be imported and exported into and out of the country should be strictly determined and set out in order to balance between supply and demand on fish within the country. Procedure of obtaining licenses for fish culture, stocking, loading, trade and export should be simplified and sped up. Techniques for fish hatcheries and producing pellets or fish feed by using locally available natural resources without using small-sized fish should be introduced and given to fish farmers. There should be support from the government by providing price information of fresh and processed products of fish (cultured and wild) in markets, intervening price of the products, and finding more market opportunities of the products (export markets). Processed products should be processed into final products before being exported so that more value can be added, and more job opportunities can be created. Establishment of micro-credit or financial organizations providing loans with low interest rates should be encouraged and motivated. Furthermore, there law enforcement should be strengthened by eliminating unimportant or informal fee payments during business transactions along the chain.

Conclusion

There were seven main groups of actors engaged in the value chain of freshwater small-sized fish in the LMB of Cambodia: fishers, fish farmers, fish collectors/middlemen, wholesalers, processors, exporters and retailers. Many business transactions took place through several marketing channels with different combinations of chain actors before freshwater small-sized fish (fresh and processed forms) could reach end consumers. Fishermen were the only supplying source of freshwater small-sized fish to various groups of actors in the chain, of whom, fish collectors/middlemen/wholesalers played a vital role in delivering the largest volume of the small-sized fish to other chain actors. Most of the small-sized fish were traded in the country and only a small proportion was exported to Vietnam and Thailand in both fresh and processed forms (semi-final processed products). Nearly three-quarters of the small-sized fish were marketed for domestic human consumption. Compared to before 2011, volume of the small-sized

fish caught and traded had remarkably increased in 2011 - 2012. Nevertheless, this increase brought difficulties to some traders in selling their fish because the price was accordingly decreased.

It is true that freshwater small-sized fish are a household income source for the families not just for fishers alone but for all chain actors including fish collectors/middlemen, wholesalers, retailers, exporters and processors, and other relevant stakeholders who directly and indirectly benefited from the business. However, the study found that these actors were highly dependent on the small-sized fish, which always varied by season and were abundant only in a short period. Therefore, they would be more vulnerable if they relied solely on the small-sized fish. By taking into account some difficulties encompassing the lack of capital and labor forces, this condition had limited plans for business expansion of most chain actors. Additionally, although freshwater small-sized fish was abundant in a few days during peak period of open season, there was tradeoff between the trade and use of freshwater small-sized fish for human consumption and for fish/animal/crocodile feed due to the fact that more than one-quarter of the small-sized fish traded in domestic markets were used as feed for fish, animals and crocodile culture. Since the study showed that the use of the small-sized fish as feed increased compared to the past few years, this might influence and affect volume and availability of the small-sized fish traded for human consumption that might also have bad impact on small-scale fish traders in the chain.

Supposing that freshwater small-sized fish used for fish culture was more profitable than that used for human consumption, it was not a sustainable way of development. Therefore, using freshwater small-sized fish for human consumption would be a better choice for the sustainable use of freshwater small-sized fish which could ensure food security, sustainable job opportunities, and income of chain actors and related stakeholders.

To sustain and develop the value chain of the small-sized fish in the LMB of Cambodia, appropriate plans and measures should be carefully and considerably made and implemented with collaboration of all chain actors, local communities and authorities, government, NGOs and other functional organizations on strictly determining a clear regulation on allowance of import and export of fish into and out of the country to balance between supply and demand on fish in the country. There should also be support from the government by providing price information of fresh and processed fish (cultured and wild fish) in markets, intervening fish price, and finding more market opportunities of the products (external markets). Processed products should be processed into the final one before exported so that more value could be added, and more job opportunities could be generated. Establishment of financial organizations with low interest rates should be encouraged and motivated. Law enforcement should be strengthened by eliminating unimportant/informal-fee payment during business transaction along the chain.

REFERENCES

- Ahmed, M., Hap, N., Ly, V., and M. Tiongco (1998) *Socioeconomic Assessment of Freshwater Capture Fisheries of Cambodia*. Report on A Household Survey. Project for Management of Freshwater Capture Fisheries of Cambodia. Department of Fisheries, Cambodia; Danish International Development Assistance (DANIDA); and Mekong River Commission (MRC). Phnom Penh, Cambodia. 185p.
- FAO (1999) *Data collection and statistics*. Food and Agriculture Organization (FAO), Rome, Italy.
- FiA (2007) *Fisheries Statistics*. Fisheries Administration. Ministry of Agriculture, Forestry and Fisheries. Phnom Penh, Cambodia.
- FiA (2002) *Fisheries Statistics and Data/Information 1981-2001*. Fisheries Administration. Ministry of Agriculture, Forestry and Fisheries. Phnom Penh, Cambodia.

FiA (2010) *Statistic of Inland, Marine and Aquaculture Production (1993-2009)*. Data Base. Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries. Phnom Penh, Cambodia.

Hortle, K. G., S. Leing and J. Valbo-Jorgesen (2004) *An Introduction to Cambodia's Inland Fisheries*. Mekong Development Series No. 4. ISSN 1680-4023. Mekong River Commission, Phnom Penh, Cambodia. 41p.

Leng, S. (2006) *Dai Fish Catches in 2005 – 2006 along Tonle Sap River*. Fisheries Magazine 8. Phnom Penh, Cambodia. 25p.

So, N., Eng, T., Souen, N., and Hortle, K. (2005) *Use of Freshwater Low-value Fish for Aquaculture Development in the Cambodia's Mekong basin*. Regional Workshop on Low-value and Trash Fish in the Asia-Pacific Region.

So, N., Leng, S.,V., and Kura, Y. (2007) *Study of the Catch and Market Chain of Low Value Fish along Tonle Sap River, Cambodia – Implications for Management of Their Fisheries*. A preliminary study. Consultancy Report for WorldFish Center's Greater Mekong Region. Inland Fisheries Research and Development Institute (IFReDI), Fisheries Administration (FiA). Ministry of Agriculture, Forestry and Fisheries. Phnom Penh, Cambodia. 55p.

Vo, T. T. L., Simon, B., Le, X. S., Hap, N., and Nguyen, T. K. (2009) *Value Chains for Sustainable Mekong Fisheries: The case of Pangasius hypophthalmus and Henicorhynchus /Labiobarbus spp. in Vietnam and Cambodia*. Project Number 6289. Final Scientific Report. The Sustainable Mekong Research Network (SUMERNET). 42p.

APPENDIX A

LIST OF FIGURES

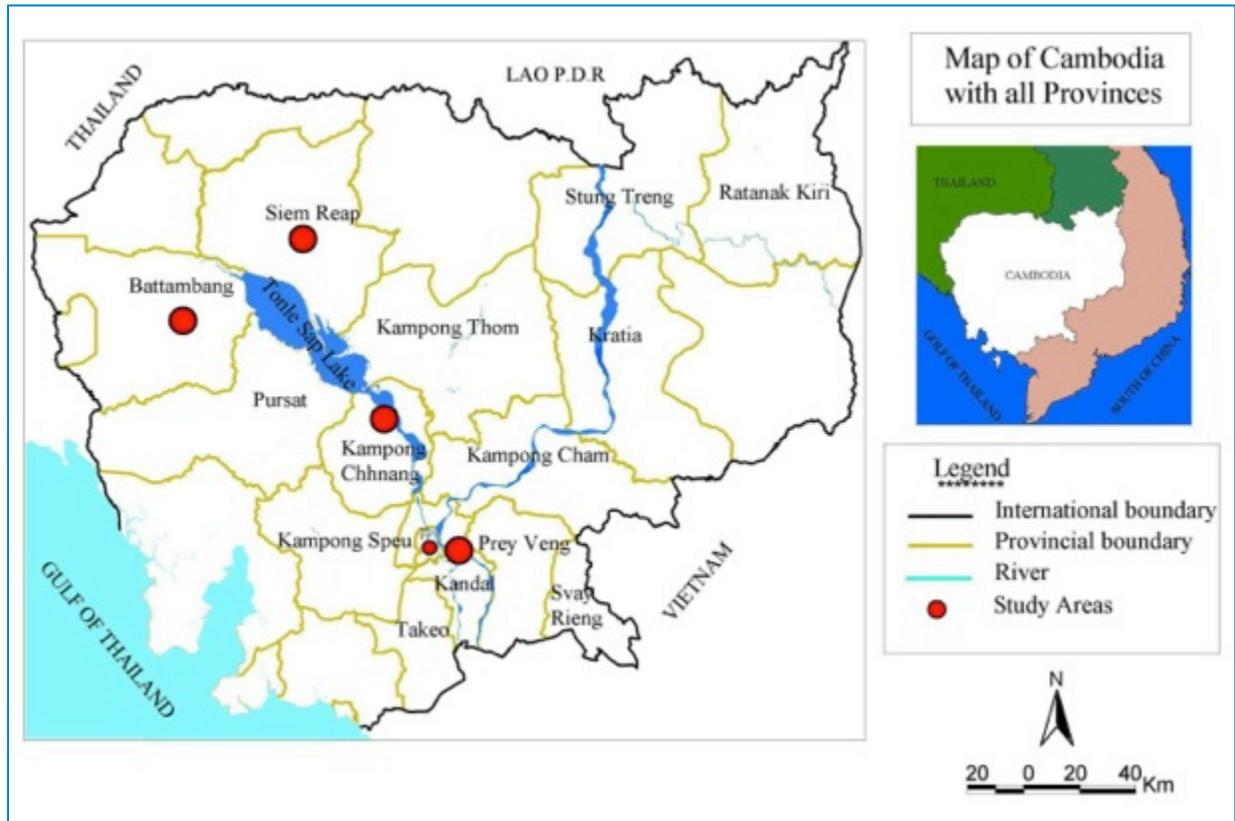


Figure 2.1: Map of Cambodia showing the study areas in the selected provinces and city.

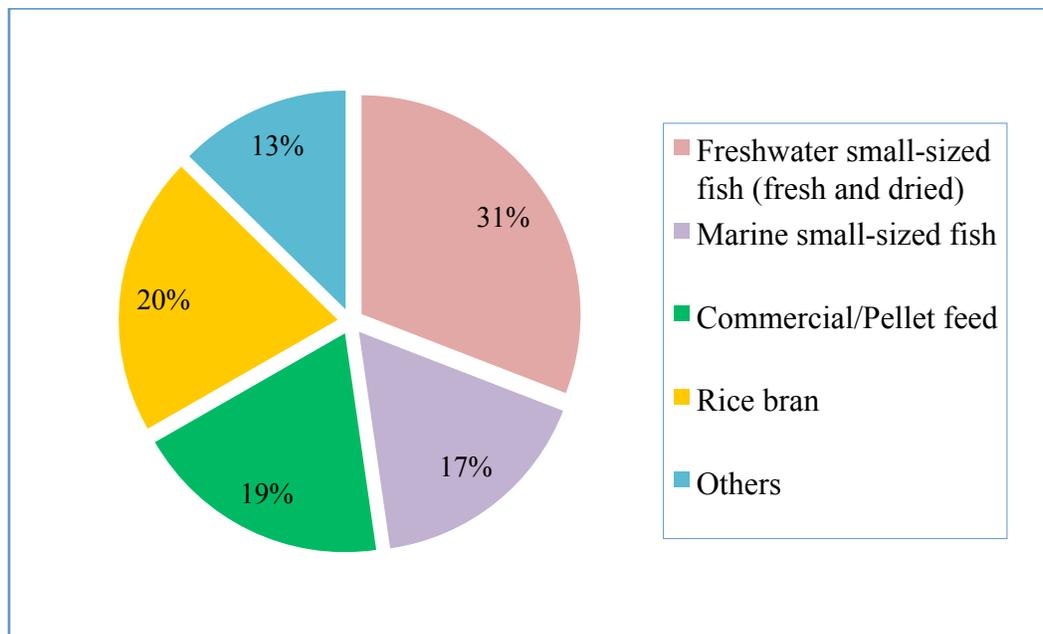


Figure 3.1: Percentage of types of feed used for fish culture.

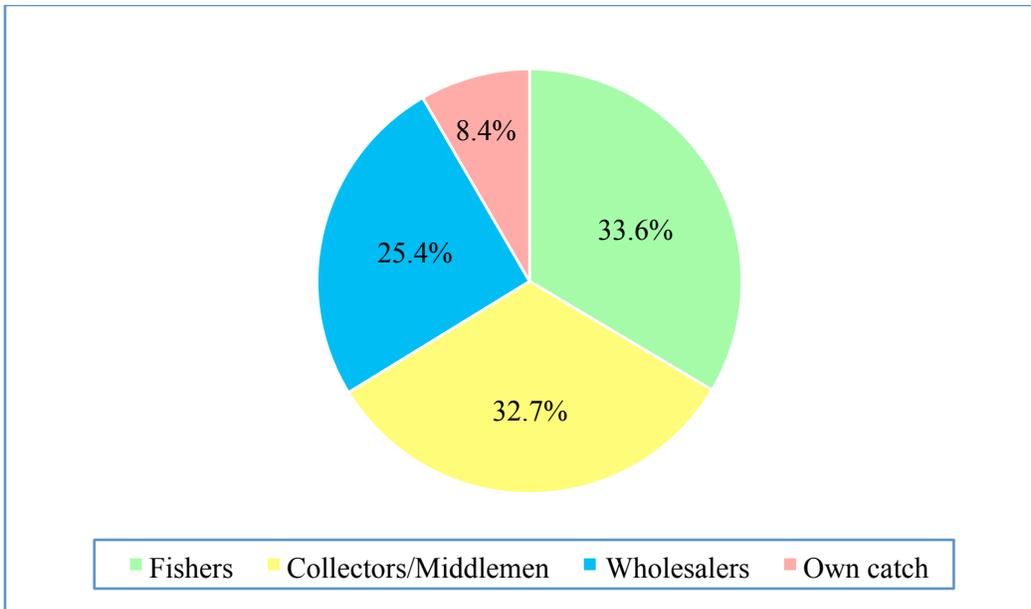


Figure 3.2: Percentage of supplying sources of fresh freshwater small-sized fish (% of volume) (fish traders).

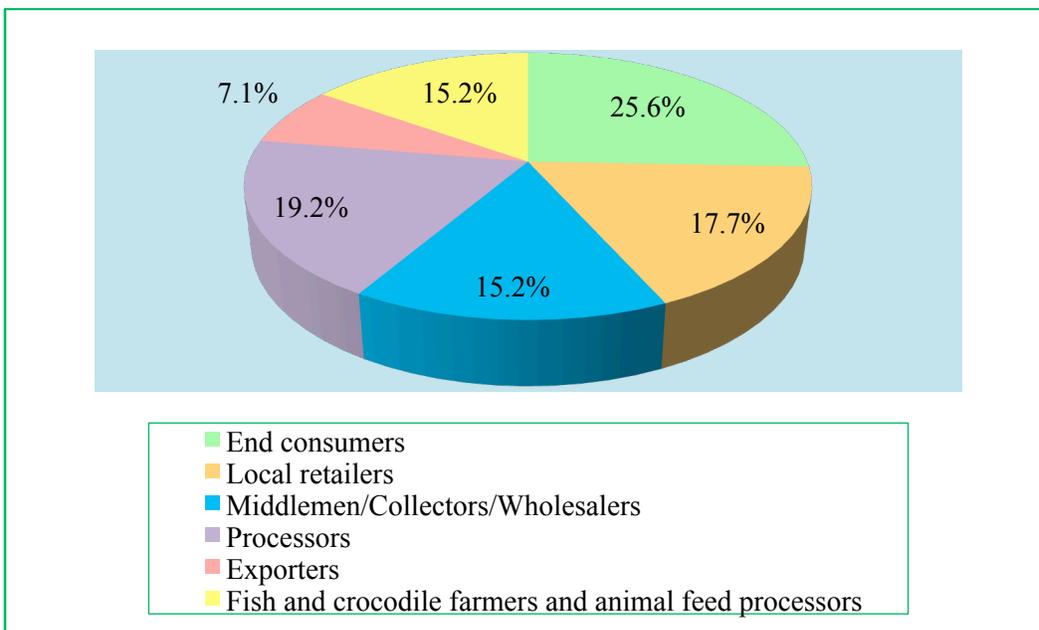


Figure 3.3: Percentage of demanding sources of fresh freshwater small-sized fish (% of volume) (fish traders).

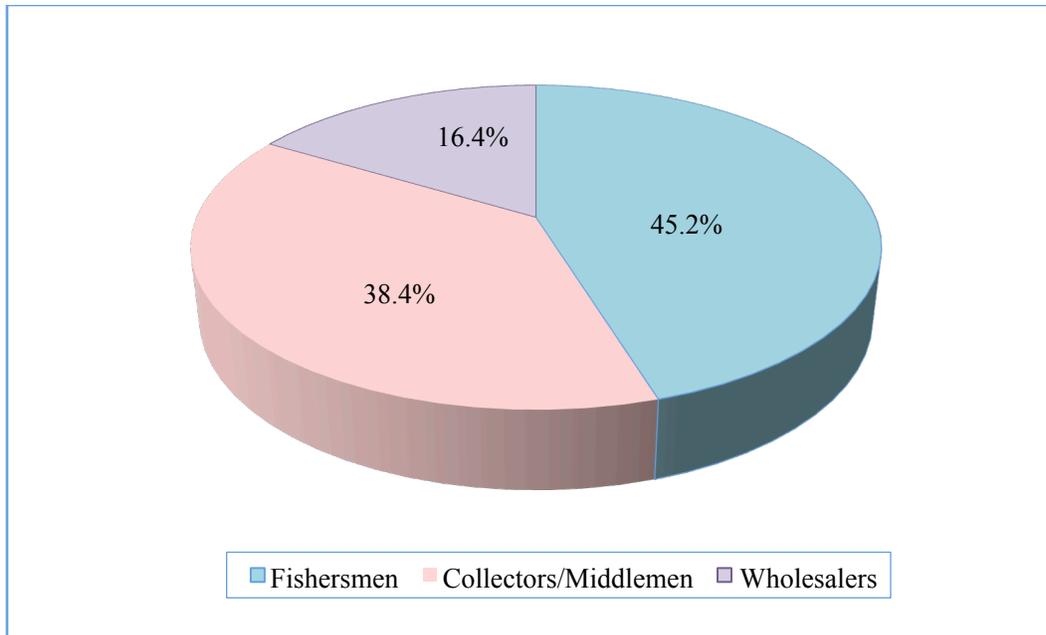


Figure 3.4: Percentage of supplying sources of fresh freshwater small-sized fish for processing (% of quantity) (fish traders).

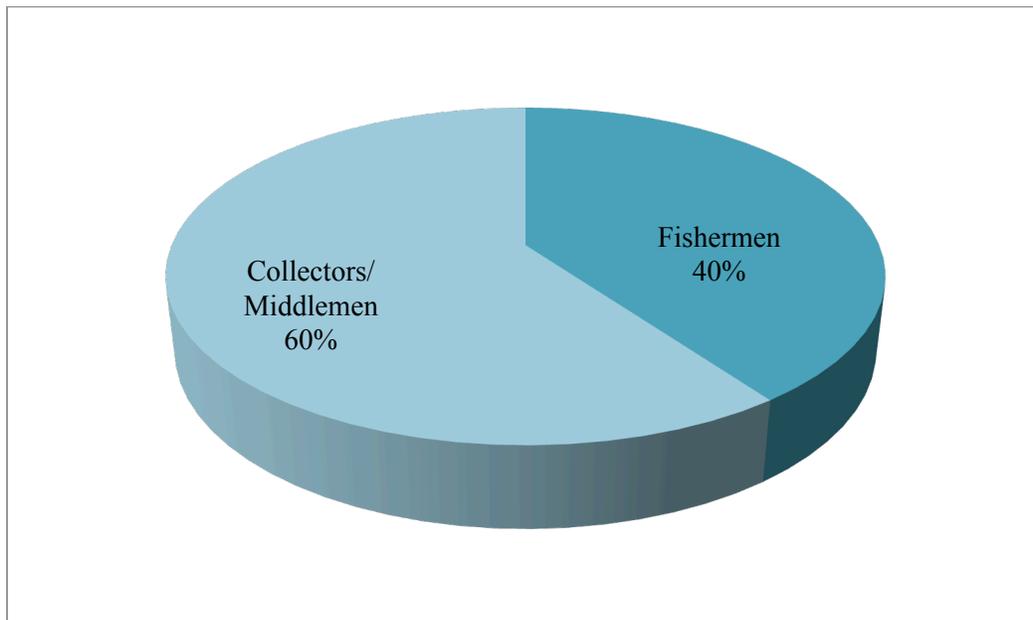


Figure 3.5: Percentage distribution of supplying sources of fresh freshwater small-sized fish (% of volume) (fish exporters).

APPENDIX B

LIST OF TABLES

Table 2.1: Number of sample households by stakeholder and province/city.

Province/City Stakeholders	Phnom		Kampong	Battam	Siem	Total
	Penh	Kandal	Chhnang	Bang	Reap	
1. Fishermen	10	10	10	10	10	50
2. Fish Farmers	13	17	10	-	-	40
3. Traders	10	16	11	6	7	50
4. Exporters	1	-	1	1	2	5
5. Processors	2	2	3	3	1	11
6. End Consumers	10	10	10	10	10	50
Total	46	55	45	30	30	206

I. General Situation and Livelihood Activities of Chain Actors in the Value Chain

1.1 Fishermen

Table 3.1: Age group distribution of respondent households by sex in all provinces.

Age group (years)	Male		Female		Both	
	No.	(%)	No.	(%)	No.	(%)
20 - 30	5	10	4	8	9	18
31 - 40	9	18	3	6	12	24
41 - 50	12	24	3	6	15	30
51 - 60	8	16	3	6	11	22
61 and above	3	6	-	-	3	6
Total	37	74	13	26	50	100

Table 3.2: Average years of experiences in fishing by sex and type of fishing activities.

Type of fishing	Male (n=37)			Female (n=13)			Both (n=50)		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
Small scale	25.4	2	50	19.2	2	33	23.8	2	50
Large scale/Bag Net (Dai)	16.5	14	19	-	-	-	16.5	14	19
All	24.9	2	50	19.2	2	33	23.5	2	50

Table 3.3: Seasonality of fishing per year by type of fishing activities in all provinces.

Description	Small scale		Large scale/Bag net		All	
	No.	(%)	No.	(%)	No.	(%)
Open season	13	26	2	4	15	30
Whole year	34	68	-	-	34	68
Occasionally	1	2	-	-	1	2
Total	48	96	2	4	50	100

Table 3.4: Name of months fishers frequently go fishing for freshwater small-sized fish by season in all provinces.

Name of months	Open Season								Closed Season			
	General Fish Species				FSSF* Species				General Fish Species		FSSF*	
	Peak Period		Low Period		Peak Period		Low Period		Species		Species	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
January	43	25.4	8	3.5	38	29.9	8	4.3	-	-	-	-
February	32	18.9	18	8.0	25	19.7	16	8.7	-	-	-	-
March	16	9.5	33	14.6	11	8.7	30	16.3	-	-	-	-
April	7	4.1	41	18.1	4	3.1	30	16.3	-	-	-	-
May	-	-	48	21.2	-	-	34	18.5	-	-	-	-
June	-	-	-	-	-	-	-	-	34	24.8	28	24.1
July	-	-	-	-	-	-	-	-	34	24.8	30	25.9
August	-	-	-	-	-	-	-	-	34	24.8	29	25.0
September	-	-	-	-	-	-	-	-	35	25.5	29	25.0
October	10	5.9	40	17.7	4	3.1	29	15.8	-	-	-	-
November	28	16.6	21	9.3	18	14.2	20	10.9	-	-	-	-
December	33	19.5	17	7.5	27	21.3	17	9.2	-	-	-	-
Total	169	100.0	226	100.0	127	100.0	184	100.0	137	100.0	116	100.0

Note: * FSSF= Freshwater Small-sized Fish

Table 3.5: Types of fishing grounds where fishers access to by season in all provinces.

Fishing grounds	Open season		Closed season		Both	
	No.	(%)	No.	(%)	No.	(%)
Great Lake	15	23.4	8	20.5	23	22.3
Tonle Sap River	32	50.0	19	48.7	51	49.5
Mekong River	5	7.8	-	-	5	4.9
Bassac River	2	3.1	-	-	2	1.9
Small rivers/lakes (connected to Tonle Sap, Bassac and Mekong rivers)	3	4.7	3	7.7	6	5.8
Inundated forests	5	7.8	7	17.9	12	11.7
Canals	2	3.1	2	5.1	4	3.9
Total	64	100.0	39	100.0	103	100.0

Table 3.6: Detailed information on fishing activities by season in all provinces.

Description	Open Season								
	Peak Period			Low Period			Closed season		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
No. of months in fishing activities (month)	3.3	2	7	4.5	1.0	6	3.9	1.0	4.0
No. of days in fishing activities (day)	22.2	6	30	20.9	3.0	30	18.3	4.0	30.0
Amount of fish (general species) caught per day (kg/day)	656.1	8	15,000	190.2	3.0	7,500	6.4	0.6	20.0
Percentage of FSSF (%)	77.5	5	100	53.6	-	100	68.7	15.0	100.0
Income from fishing activities per day (USD/day)	164.4	2	5,000	38.8	0.8	875	5.9	0.8	16.6
Percentage of income from FSSF (%)	66.6	2	100	43.2	-	100	61.0	7.7	100.0
Other income excluding fishing (USD/day)	9.9	-	250	10.4	-	250	8.1	-	100.0
Total income per day (USD/day)	174.4	2	5,250	49.2	0.8	1,125	12.4	0.8	100.0

Note: * Exchange rate: USD 1 = 4,000 Riel

Table 3.7: Species, quantity and price of FSSF caught per day in the last seasons (2011-2012).

Fish species		Open season				Closed season		All	
		Peak Period		Low Period		Qty.	Pric e	Qty.	Pric e
Scientific Name	Khmer	Qty.	Pric e	Qty.	Pric e	Qty.	Pric e	Qty.	Pric e
1. <i>Labiobarbus spp.</i>	Ach Kok	52.6	0.2	1.9	0.5	0.6	0.6	35.0	0.3
2. <i>Puntius orphoides</i>	Ampil Tum	3.0	0.2	-	-	-	-	3.0	0.2
3. <i>Cynoglossus feldmanni</i>	Andat Chhke*	4.0	1.5	1.6	1.8	-	-	2.3	1.5
4. <i>Clarias spp.</i>	Andeng*	3.8	0.5	1.4	0.7	0.2	0.5	2.6	0.7
5. <i>Puntius rhombeus</i>	Angkat Prak Bandoul	4.4	0.4	2.0	0.8	0.5	0.4	3.0	0.5
6. <i>Clupeichthys spp.</i>	Ampov	3.0	1.0	25.1	0.8	-	-	25.8	0.8
7. <i>Opsarius koratensis</i>	Changva	5.4	0.4	1.2	0.8	0.8	1.3	1.8	0.8
8. <i>Rasbora spp.</i>	Changva Moul	72.0	0.8	9.0	0.9	1.5	0.6	27.9	0.8
9. <i>Albulichthys albuloides</i>	Chhkok Tituy*	0.3	0.3	-	-	0.3	0.5	0.3	0.4
10. <i>Cyclocheilichthys spp.</i>	Chhkok*	11.7	0.5	6.4	0.6	1.9	0.8	7.9	0.6
11. <i>Hemibagrus spp.</i>	Chhlaing*	9.8	0.8	3.7	1.2	0.5	0.8	5.2	0.9
12. <i>Macragnathus spp.</i>	Chhlonh*	0.5	0.4	0.3	0.8	2	0.4	0.4	0.5
13. <i>Hypsibarbus spp.</i>	Chhpin*	4.5	0.2	2.2	0.5	0.5	0.7	2.6	0.5
14. <i>Pteropangasius pleurotaenia</i>	Chhveat Chonlourn	27.8	0.6	1.7	0.6	1.3	1.0	21.4	0.7
15. <i>Coilia spp.</i>	Moan	20.1	0.3	6.0	0.3	1.0	0.6	5.6	0.4
16. <i>Puntioplites spp.</i>	Chorkeng* Chunteas	12.7	0.5	3.7	0.8	1.4	1.0	7.6	0.7
17. <i>Parachela spp.</i>	Phloulk	5.2	0.3	3.6	0.7	2.9	0.7	3.6	0.5
18. <i>Barbodes spp.</i>	Ka Hae* Ka Hour/Kul	-	-	0.5	0.8	0.5	0.8	0.5	0.8
19. <i>Catlocarpio siamensis</i>	Raeng*	2.0	0.5	-	-	-	-	2.0	0.5
20. <i>Labeo chrysophekadion</i>	Kaek* Kanchanh	9.3	0.2	1.0	0.6	0.3	0.6	6.3	0.4
21. <i>Parambassis spp.</i>	Chrass	17.6	0.1	13.4	0.3	1.5	0.4	8.3	0.3
22. <i>Mystus spp.</i>	Kanhchos	11.2	0.6	6.8	0.9	1.4	1.0	6.2	0.8
23. <i>Yasuhikotakia spp.</i>	Kanhchrouk Kantrong	25.3	0.6	7.6	0.7	0.3	1.3	23.2	0.7
24. <i>Parambassi wolffi</i>	Preng	1.2	0.1	-	-	0.3	0.3	0.8	0.2
25. <i>Pristolepis fasciata</i>	Kantrorb*	0.8	0.3	5.2	0.3	0.8	0.3	3.7	0.3
26. <i>Arius spp.</i>	Ka'ork	-	-	1.0	1.0	-	-	1.0	1.0
27. <i>Pangasius conchophilus</i>	Kae/Pra Kae*	-	-	2.0	1.0	-	-	2.0	1.0
28. <i>Polynemus multifilis</i>	Kom Pream	4.3	0.8	2.8	1.2	0.1	0.9	3.7	0.9
29. <i>Amblyrhynchichthys truncatus</i>	Kombot Chromors	3.5	0.2	13.7	0.7	0.1	0.8	14.0	0.7

Fish species		Open season				Closed season		All	
		Peak Period		Low Period		Qty.	Pric e	Qty.	Pric e
Scientific Name	Khmer	Qty.	Pric e	Qty.	Pric e	Qty.	Pric e	Qty.	Pric e
30. <i>Trichogaster spp</i>	Kompleanh	4.7	0.3	1.6	0.5	1.0	0.5	2.6	0.5
31. <i>Kryptopterus moorei</i>	Kompleav Kralang/Proul	-	-	1.0	1.0	-	-	1.0	1.0
32. <i>Cirrhinus microlepis</i>	*	72.4	0.3	1.1	0.4			70.9	0.4
33. <i>Anabas testudineus</i>	Kranh	1.1	0.6	0.3	0.8	1.0	0.7	0.9	0.7
34. <i>Cosmochilus harmandi</i>	Krapol Bay/ Chhkok Kdar*	6.0	0.9	-	-	-	-	6.0	0.9
35. <i>Wallago attu</i>	Krapot/Sanday *	0.3	0.2	-	-	-	-	0.3	0.2
36. <i>Ompok bimaculatus</i>	Kromorm*	7.5	0.9	1.0	1.3	-	-	5.3	1.1
37. <i>Osteochilus lini</i>	Kros	15.3 274.	0.3	2.7	0.4	1.0	0.6	8.4 131.	0.4
38. <i>Dangila spp.</i>	Khnorng Veng	0	0.3	33.3	0.5	1.1	0.6	2	0.3
39. <i>Thynnichthys thynnoides</i>	Linh	19.5	0.3	6.3	0.5	0.6	0.5	17.5	0.4
40. <i>Hyporhamphus limbatus</i>	Phtoung	1.4	1.2	0.5	1.9	-	-	1.0	1.3
41. <i>Pangasius larnaudiei</i>	Pou*	10.0	0.7	1.5	0.9	-	-	6.7	0.9
42. <i>Boesemania microlepis</i>	Promah*	3.4 918.	0.3	1.0	0.2	-	-	2.2 464.	0.2
43. <i>Acantopsis spp.</i>	Reus Chek*	0	1.0	10.0	1.3			0	1.1
44. <i>Henicorhynchus lobatus</i>	Riel Angkam	415.		148.				267.	
45. <i>Henicorhynchus siamensis</i>	Riel Tom	1	0.2	5	0.5	1.0	0.7	9	0.4
46. <i>Notopterus notopterus</i>	Slat*	5.0	0.4	-	-	-	-	5.0	0.4
47. <i>Paralaubuca riveroi</i>	Sleuk Reussey	8.0 297.	0.5	0.5 400.	1.1	-	-	4.3 335.	0.8
48. <i>Cyclocheilichthys spp.</i>	Sraka Kdarm	0	0.2	7	0.6			8	0.3
		3.1	0.3	0.5	0.5	0.4	0.9	3.0	0.4
Total		586. 7	0.4	177. 1	0.7	4.5	0.8	365. 8	0.6

Note: * Juvenile of commercially important fish species
Exchange rate: USD 1 = 4,000 Riel

Table 3.8: Average quantity of fish catch per year during last year (2011-2012).

Fish species	Open season (kg/season)			Closed season (kg/season)	Total (kg/year)
	Peak period	Low period	Total		
All fish species (big & small-sized fish)	27,732.1	4,063.9	31,230.0	490.6	31,550.4
Small-sized fish	23,232.7	2,124.1	24,752.7	300.2	24,918.1

Table 3.9: Top 10 species of freshwater small-sized fish by percentage of frequency of catch in all provinces during last year (2011-2012).

N°	Open season		Closed season		All			
	Species	Peak Period (%) (n=50)	Species	Low Period (%) (n=50)	Species	(%) (n=50)	Species	(%) (n=50)
1	Riel	10.2	Riel	8.5	Riel	3.9	Riel	22.6
2	Chorkeng*	6.6	Chorkeng*	6.3	Chorkeng*	3.2	Chorkeng*	16.1
3	Kanhchos	4.6	Kanhchos	4.6	Kanhchos	2.9	Kanhchos	12.2
4	Kros	4.4	Kros	4.1	Kros	2.9	Kros	11.4
5	Kanhchrouk	4.4	Chhkok*	3.4	Komphleanh	1.9	Kanhchrouk	9.7
6	Khnorng Veng	2.7	Khnorng Veng	2.7	Chhkok*	1.0	Chhkok*	6.3
7	Kaek*	2.9	Komphleanh	2.4	Chhveat	0.7	Khnorng Veng	6.1
8	Chhkok*	2.7	Chhveat	1.9	Kranh	0.7	Chhveat	5.4
9	Chhveat	2.9	Kaek*	1.7	Chunlournh Moan	0.7	Kaek*	5.4
10	Komphleanh	2.4	Kam Pream	1.7	Chhlonh*	0.7	Komphleanh	4.9
	Total	43.8		37.5		18.7		100.0

Note: * Juvenile of commercially important fish species

Table 3.10: Top 10 species of freshwater small-sized fish by volume caught per day in all provinces during last year (2011-2012).

N°	By volume			By price		
	Species	Total catch (kg/day)	Price (USD/kg)	Species	Total catch (kg/day)	Price (USD/kg)
1	Reus Chek*	464.0	1.1	Andat Chhke*	2.3	1.5
2	SleukReussey	335.8	0.3	Phtoung	1.0	1.3
3	Riel	267.9	0.4	Reus Chek*	464.0	1.1
4	KhnorngVeng	131.2	0.3	Kromorm*	5.3	1.1
5	Kralang*	70.9	0.4	Kae/PraKae*	2.0	1.0
6	Ach Kok	35.0	0.3	KomPhleav	1.0	1.0
7	ChangvaMoul	28.1	0.9	Kaork	1.0	1.0
8	BandolAmpov	25.8	0.8	Pream	3.7	0.9
9	Kanhchrouk	23.2	0.7	Pou*	6.7	0.9
10	Chhveat	21.4	0.7	Chhlaing*	5.2	0.9

Note: * Juvenile of commercially important fish species

Table 3.11: Trend of volume of fish catch in the last season (2011-2012) compared to that before 2011.

Trend	Open season							
	Peak Period		Low Period		Closed season		All	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
For general fish species								
Decreased	7	14	7	14	5	14.3	19	14.1
Unchanged	5	10	6	12	6	17.1	17	12.6
Increased	33	66	32	64	21	60.0	86	63.7
Increased much	5	10	5	10	3	8.6	13	9.6
Total	50	100	50	100	35	100.0	135	100.0
For small-sized fish species								
Decreased	6	12	8	16	5	14.3	19	14.1
Unchanged	5	10	5	10	5	14.3	15	11.1
Increased	34	68	32	64	23	65.7	89	65.9
Increased much	5	10	5	10	2	5.7	12	8.9
Total	50	100	50	100	35	100.0	135	100.0

Table 3.12: Trend of price of fish in the last season (2011-2012) compared to that before 2011.

Trend	Open Season							
	Peak Period				Low Period			
	No.	(%)	No.	(%)	Closed Season		All	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
For general fish species								
Decreased much	1	2	1	2	1	2.9	3	2.2
Decreased	35	70	35	70	22	62.9	92	68.1
Unchanged	3	6	3	6	3	8.6	9	6.7
Increased	11	22	11	22	9	25.7	31	23.0
Total	50	100	50	100	35	100.0	135	100.0
For small-sized fish species								
Decreased much	1	2	1	2	1	2.9	3	2.2
Decreased	34	68	34	68	21	60.0	89	65.9
Unchanged	4	8	4	8	4	11.4	12	8.9
Increased	11	22	11	22	9	25.7	31	23.0
Total	50	100	50	100	35	100.0	135	100.0

1.2 Fish Farmers

Table 3.13: Age group distribution of respondent households by sex in all provinces.

Age group (years)	Male		Female		Both	
	No.	(%)	No.	(%)	No.	(%)
20 - 30	5	12.5	0	0.0	5	12.5
31 - 40	8	20.0	1	2.5	9	22.5
41 - 50	13	32.5	2	5.0	15	37.5
51 - 60	7	17.5	3	7.5	10	25.0
61 and above	1	2.5	0	0.0	1	2.5
Total	34	85.0	6	15.0	40	100.0

Table 3.14: Average years of experiences in fish farming by sex and type of fish farming system in all provinces.

Types of fish farming systems	Male (n=34)			Female (n=6)			Both (n=40)		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
Pond	5.3	3	10	7.8	3	19	6.1	3	19
Cage	11.8	2	31	3.0	3	3	11.4	2	31
All	9.9	2	31	7.0	3	19	9.5	2	31

Table 3.15: Percentage of fish farmers culturing fish by type of farming systems in all provinces.

No.	Fish Species		Pond		Cage		All	
	Scientific name	Khmer name	No.	(%)	No.	(%)	No.	(%)
1	<i>Pangasianodon Hypophthalmus</i>	Pra Thom	5	6.4	11	14.1	16	20.5
2	<i>Pangasius Bocourti</i>	Pra Khchao	-	-	8	10.3	8	10.3
3	<i>Hemibagrus Wyckioides</i>	Khcha	-	-	8	10.3	8	10.3
4	<i>Wallago attu</i>	Sanday	-	-	6	7.7	6	7.7
5	<i>Brachirus spp.</i>	Andat Chhke	-	-	1	1.3	1	1.3
6	<i>Channa Micropeltes</i>	Chhdaur	9	11.5	6	7.7	15	19.2
7	<i>Clarias spp.</i>	Andeng	2	2.6	-	-	2	2.6
8	<i>Pangasius Conchophilus</i>	Kae/Pra Kae	-	-	8	10.3	8	10.3
9	<i>Pangasius Larnaudii</i>	Pou	-	-	5	6.4	5	6.4
10	<i>Leptobarbus Hoeveni</i>	Proloung	-	-	2	2.6	2	2.6
11	<i>Barbonymus Gonionotus</i>	Chhpin	-	-	1	1.3	1	1.3
12	<i>Barbonymus Schwanenfeldii</i>	Ka Hae	-	-	1	1.3	1	1.3
13	<i>Cirrhinus microlepis</i>	Prourl	-	-	1	1.3	1	1.3
14	<i>Osteochilus Melanopleurus</i>	Krum	-	-	1	1.3	1	1.3
15	<i>Henicorhynchus Siamensis</i>	Riel Tom	-	-	1	1.3	1	1.3
16	<i>Pseudolais Pleurotaenia</i>	Chhveat	-	-	1	1.3	1	1.3
17	<i>Cyclocheilichthys spp.</i>	Chhkok	-	-	1	1.3	1	1.3
Total			16	20.5	62	79.5	78	100.0

Table 3.16: Average volume of fingerlings by species and type of fish culture per cycle.

No.	Fish Species	Pond	Cage	All
1	Sanday	-	2,194.3	2,194.3
2	Khcha	-	2,259.3	2,259.3
3	Andat Chhke	-	3,000.0	3,000.0
4	Pra	59,166.7	3,746.2	21,247.4
5	Pou	-	8,090.9	8,090.9
6	Chhdau	1,777.8	2,416.7	2,033.3
7	Pra Khchao	-	6,277.8	6,277.8
8	Kae	-	8,400.0	8,400.0
9	Andeng	250,000.0	-	250,000.0
10	Proloung	-	2,750.0	2,750.0
11	Chhkok	-	4,500.0	4,500.0
12	Proul	-	3,000.0	3,000.0
13	Krum	-	1,800.0	1,800.0
14	Chhpin	-	12,000.0	12,000.0
15	Riel Tom	-	8,000.0	8,000.0
16	Chhveat	-	1,800.0	1,800.0
17	Ka Hae	-	12,600.0	12,600.0
	All (per species)	38,812.5	4,925.7	11,230.2
	Total (All species)	41,400.0	13,792.0	24,145.0

Table 3.17: Characteristics of fish farming by type of culture systems.

Description	Pond	Cage	All
Area/Volume of aqua/fish culture (m ³ /hh.)	12,306.4	165.7	4,718.4
No. of ponds/cages (unit/hh.)	1.1	1.7	1.5
No. of crops or cycles/year (time/year)	1.1	0.9	1.0
Time for each crop or cycle (month)	9.8	13.8	12.3
No. of fingerlings stocked (head)	41,400.0	13,792.0	24,145.0

Table 3.18: Average volume of fingerlings by species and type of fish culture per cycle.

No.	Fish Species	Pond	Cage	All
1	Sanday	-	2,194.3	2,194.3
2	Khcha	-	2,259.3	2,259.3
3	Andat Chhke	-	3,000.0	3,000.0
4	Pra Thom	59,166.7	3,746.2	21,247.4
5	Pou	-	8,090.9	8,090.9
6	Chhdaur	1,777.8	2,416.7	2,033.3
7	Pra Khchao	-	6,277.8	6,277.8
8	Kae/Pra Kae	-	8,400.0	8,400.0
9	Andeng	250,000.0	-	250,000.0
10	Proloung	-	2,750.0	2,750.0
11	Chhkok	-	4,500.0	4,500.0
12	Proul	-	3,000.0	3,000.0
13	Krum	-	1,800.0	1,800.0
14	Chhpin	-	12,000.0	12,000.0
15	Riel Tom	-	8,000.0	8,000.0
16	Chhveat	-	1,800.0	1,800.0
17	Ka Hae	-	12,600.0	12,600.0
	Total	41,400.0	13,792.0	24,145.0

Table 3.19: Average price of fingerlings (USD/head) by type of fish culture systems.

No.	Fish Species	Pond	Cage	All
1	Sanday	-	0.39	0.39
2	Khcha	-	0.30	0.30
3	Andat Chhke	-	0.13	0.13
4	Pra Thom	0.02	0.16	0.12
5	Pou	-	0.14	0.14
6	Chhdaur	0.09	0.05	0.07
7	Pra Khchao	-	0.12	0.12
8	Kae/Pra Kae	-	0.08	0.08
9	Andeng	0.03	-	0.03
10	Proloung	-	0.06	0.06
11	Chhkork	-	0.15	0.15
12	Prourl	-	0.11	0.11
13	Krum	-	0.16	0.16
14	Chhpin	-	0.16	0.16
15	Riel Tom	-	0.16	0.16
16	Chhveat	-	0.11	0.11
17	Ka Hae	-	0.20	0.20
	All	0.06	0.17	0.15

Table 3.20: Type of fingerlings selected to be cultured by fish species in all provinces.

No.	Fish species	Wild		Hybrid/Hatchery		All	
		No.	(%)	No.	(%)	No.	(%)
1	Sanday	5	5.8	1	1.2	6	7.0
2	Khcha	1	1.2	8	9.3	9	10.5
3	Andat Chhke	1	1.2	-	-	1	1.2
4	Pra	6	7.0	12	14.0	18	20.9
5	Pou	7	8.1	4	4.7	11	12.8
6	Chhdaur	-	-	15	17.4	15	17.4
7	Pra Khchao	6	7.0	3	3.5	9	10.5
8	Kae/Pra Kae	7	8.1	-	-	7	8.1
9	Andeng	-	-	1	1.2	1	1.2
10	Proloung	2	2.3	-	-	2	2.3
11	Chhkork	1	1.2	-	-	1	1.2
12	Prourl	1	1.2	-	-	1	1.2
13	Krum	1	1.2	-	-	1	1.2
14	Chhpin	1	1.2	-	-	1	1.2
15	Riel Tom	1	1.2	-	-	1	1.2
16	Chhveat	1	1.2	-	-	1	1.2
17	Ka Hae	1	1.2	-	-	1	1.2
	All	42	48.8	44	51.2	86	100.0

Table 3.21: Percentage distribution of sources of fingerlings in all provinces.

No	Sources	Own captured (wild)	Fishers (wild)	Hatcheries farms/stations	Nursery sites	Other fish farmers	Imported (Vietnam, Thailand)	All
1	Sanday	-	50.0	-	-	50.0	-	100
2	Khcha	25.0	-	-	25.0	25.0	25.0	100
3	Andat Chhke	-	100.0	-	-	-	-	100
4	Pra Thom	15.8	11.8	19.7	19.7	18.1	14.8	100
5	Pou	10.0	15.0	-	25.0	25.0	25.0	100
6	Chhdaur	-	29.1	-	-	-	70.9	100
7	Pra Khchao	13.0	16.1	-	24.7	21.4	24.7	100
8	Kae/Pra Kae	25.0	33.3	-	-	41.7	-	100
9	Andeng	-	-	-	-	50.0	50.0	100
10	Proloung	50.0	-	-	-	50.0	-	100
11	Chhkork	-	-	-	-	100.0	-	100
12	Prourl	-	-	-	-	100.0	-	100
13	Krum	-	-	-	-	100.0	-	100
14	Chhpin	-	-	-	-	100.0	-	100
15	Riel Tom	100.0	-	-	-	-	-	100
16	Chhveat	100.0	-	-	-	-	-	100
17	Ka Hae	-	-	-	-	100.0	-	100
	All	19.9	15.0	1.2	5.6	46.0	12.4	100

Table 3.22: Percentage of fish farmers choosing types of fish feed for their fish farming.

Types of fish feed	No.	(%)
Freshwater small-sized fish (Fresh and dried)	40	44.9
Marine trash fish	12	13.5
Commercial/Pellet feed	6	6.7
Rice bran	24	27.0
Others*	7	7.9
Total	89	100.0

Note: *Others*: bone & head of Pra, fish & chicken intestine, fish sauce germ, Kapok flour, & water spinach.

Table 3.23: Percentage of fish feed supplying sources.

Type of fish feed	Caught (%)	Bought (%)	Total
Freshwater small-sized fish (Fresh and dried)	49.8	50.2	100
Marine trash fish	-	100.0	100
Commercial/Pellet	-	100.0	100
Rice bran	50.0	50.0	100
Others*	50.0	50.0	100
All	30.0	70.0	100

Note: *Others*: bone & head of Pra, fish & chicken intestine, fish sauce germ, Kapok flour, & water spinach.

Table 3.24: Trend of types of fish feed used for fish farming over the past 5 years.

Trend	No.	(%)
Decreased	5	12.5
Unchanged	29	72.5
Increased	6	15.0
Total	40	100

Table 3.25: Trend of volume of freshwater small-sized fish used as fish feed over the past 5 years.

Trend	No.	(%)
Decreased	9	22.5
Unchanged	15	37.5
Increased	16	40.0
Total	40	100

Table 3.26: Trend of price of freshwater small-sized fish used as fish feed over the past 5 years.

Trend	No.	(%)
Decreased much	1	2.5
Decreased	23	57.5
Unchanged	5	12.5
Increased	11	27.5
Total	40	100

1.3 Fish Traders

Table 3.27: Age group distribution of respondent households by sex in all provinces.

Age group (years)	Male		Female		Both	
	No.	(%)	No.	(%)	No.	(%)
20 – 30	3	6	8	16	11	22
31 – 40	11	22	2	4	13	26
41 – 50	8	16	9	18	17	34
51 – 60	4	8	4	8	8	16
61 and above	1	2	0	0	1	2
Total	27	54	23	46	50	100

Table 3.28: Average year experiences in fish trade by sex and type of traders in all provinces.

Type of traders	Male			Female			Both		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
Fish collectors/Middlemen	15.8	4	33	11.0	3	19	14.8	3	33
Wholesalers	15.1	3	50	17.8	1	33	15.8	1	50
Retailers	8.3	7	10	16.1	3	35	14.8	3	35
All	14.6	3	50	16.0	1	35	15.2	1	50

Table 3.29: Average volume of fresh fish traded per day (kg/day) by season in all provinces (2011-2012).

Description	Open season			Closed season	All
	Peak Period	Low Period	All		
Both freshwater and marine fish	2,781.5	491.8	2,316.2	115.5	2,176.7
Freshwater fish (all species)	2,779.3	488.5	2,314.0	115.5	2,157.9
Freshwater small-sized fish	2,438.5	108.8	2,001.0	57.0	1,921.9

Table 3.30: Average volume of fresh freshwater small-sized fish traded per day (kg/day) by season and species (2011-2012).

Fish Species		Open	Closed	
Scientific name	Khmer name	season	season	All
1. <i>Henicorhynchus spp.</i>	Riel	1,438.6	11.7	1,415.3
2. <i>Mystus spp.</i>	Kanhchos	52.6	22.4	46.2
3. <i>Trichogaster spp.</i>	Komphleanh	108.4	32.8	94.6
4. <i>Thynnichthys thynnoides</i>	Linh	911.4	5.2	907.2
5. <i>Dangila spp.</i>	Khnorng Veng	37.5	2.0	30.6
6. <i>Cyclocheilichthys spp.</i>	Sraka Kdarm	6.0	5.6	5.8
7. <i>Clupeichthys spp.</i>	Bandol Ampov	550.4	-	550.4
8. <i>Yasuhikotakia spp.</i>	Kanhchrouk	113.9	0.2	110.6
9. <i>Osteochilus lini</i>	Kros	57.2	11.2	54.2
10. <i>Paralauca riveroi</i>	Sleuk Reussey	617.9	-	617.8
11. <i>Labiobarbus spp.</i>	Ach Kok	550.8	1.9	543.5
12. <i>Coilia spp.</i>	Chunloun Moan	28.1	-	28.1
13. <i>Anabas testudineus</i>	Kranh	27.1	16.1	24.0
14. <i>Puntius rhombeus</i>	Angkat Prak	18.6	0.3	18.6
15. <i>Parachela spp.</i>	Chanteas Phlouk	302.0	-	302.0
16. <i>Kryptopterus moorei</i>	Komphleav	133.7	-	133.7
17. <i>Hyporhamphus limbatus</i>	Phtoung	3.8	-	2.6
18. <i>Acantopsis spp.</i>	Reus Chek*	8.1	-	8.1
19. <i>Opsarius koratensis</i>	Changva	21.7	-	21.7
20. <i>Parambassis spp.</i>	Kanhchanh Chrass	118.7	-	118.7
21. <i>Rasbora spp.</i>	Changva Moul	7.8	-	7.8
22. <i>Cirrhinus microlepis</i>	Kralang*	239.4	5.5	234.5
23. <i>Pangasius conchophilus</i>	Pra Kae/Kae*	1.2	-	1.2
24. <i>Ompok spp.</i>	Tror Oan*	0.5	3.0	1.8
25. <i>Trichogaster pectoralis</i>	Kanthor*	55.7	20.9	51.1
26. <i>Hypsibarbus spp.</i>	Chhpin*	28.1	23.7	24.6
27. <i>Puntioplites spp.</i>	Chorkeng*	60.1	28.1	49.2
28. <i>Cyclocheilichthys spp.</i>	Chhkork*	13.4	7.9	11.5
29. <i>Pristolepis fasciata</i>	Kantrorb*	11.0	4.8	9.4
30. <i>Labeo chrysophekadion</i>	Kaek*	2.1	-	2.1
31. <i>Pangasianodon hypophthalmus</i>	Pra*	2.0	-	2.0
32. <i>Pteropangasius pleurotaenia</i>	Chhveat*	0.3	-	0.2
33. <i>Pangasius larnaudiei</i>	Pou*	1.2	-	1.2
34. <i>Hemibagrus spp.</i>	Chhlaing*	1.8	0.6	1.9
35. <i>Barbodes spp.</i>	Kahae*	0.5	-	0.5
36. <i>Belodontichthys truncates</i>	Klang Hai*	1.0	-	1.0
37. <i>Notopterus notopterus</i>	Slat*	6.5	-	4.8

38. <i>Micronema apogon spp.</i>	Kes*	2.9	0.3	2.6
Total		2,001.0	57.0	1,921.9

Note: *: Juvenile of commercially important fish species

Table 3.31: Average price of fresh freshwater small-sized fish (USD/kg) by season (2011-2012).

Fish Species		Open season		Closed season		All	
Scientific name	Khmer name	B. price	S. price	B. price	S. price	B. price	S. price
1. <i>Henicorhynchus spp.</i>	Riel	0.3	0.4	0.8	1.0	0.4	0.5
2. <i>Mystus spp.</i>	Kanhchos	0.5	0.6	0.8	0.9	0.6	0.7
3. <i>Trichogaster spp.</i>	Komphleanh	0.2	0.3	0.5	0.6	0.4	0.5
4. <i>Thynnichthys thynnoides</i>	Linh	0.5	0.7	1.0	1.1	0.6	0.7
5. <i>Dangila spp.</i>	Khnangveang	0.4	0.4	1.0	1.1	0.4	0.5
6. <i>Cyclocheilichthys spp.</i>	Srorka Kdarm	0.3	0.4	0.4	0.6	0.3	0.4
7. <i>Clupeichthys spp.</i>	Bandol Ampov	0.2	0.3	-	-	0.2	0.3
8. <i>Yasuhikotakia spp.</i>	Kanhchrouk	0.4	0.5	0.3	0.4	0.4	0.5
9. <i>Osteochilus lini</i>	Kros	0.5	0.6	0.6	0.7	0.5	0.6
10. <i>Paralaubuca riveroi</i>	Sleuk Reussey	0.3	0.3	-	-	0.3	0.3
11. <i>Labiobarbus spp.</i>	Ach Kok	0.3	0.4	1.1	1.3	0.5	0.6
12. <i>Coilia spp.</i>	Chunlounh Moan	0.2	0.3	-	-	0.2	0.3
13. <i>Anabas testudineus</i>	Kranh	0.5	0.6	0.7	0.8	0.6	0.7
14. <i>Puntius rhombeus</i>	Angkat Prak	0.3	0.4	0.6	0.9	0.3	0.4
15. <i>Parachela spp.</i>	Chanteas Phlourk	0.3	0.4	-	-	0.3	0.4
16. <i>Kryptopterus moorei</i>	Komphleav	0.3	0.3	-	-	0.3	0.3
17. <i>Hyporhamphus limbatus</i>	Phtoung	0.3	0.3	-	-	0.3	0.3
18. <i>Acantopsis spp.</i>	Reus Chek*	0.5	0.7	-	-	0.5	0.7
19. <i>Opsarius koratensis</i>	Changva	0.3	0.5	-	-	0.3	0.5
20. <i>Parambassis spp.</i>	Kanchanh Chrass	0.1	0.2	-	-	0.1	0.2
21. <i>Rasbora spp.</i>	Changva Moul	0.3	0.4	-	-	0.3	0.4
22. <i>Cirrhinus microlepis</i>	Kralang*	0.2	0.3	0.8	0.9	0.4	0.5
23. <i>Pangasius conchophilus</i>	Pra Kae/Kae*	0.8	0.9	-	-	0.8	0.9
24. <i>Ompok spp.</i>	Tror Oan*	0.2	0.5	0.8	0.9	0.5	0.7
25. <i>Trichogaster pectoralis</i>	Kanthor*	0.9	1.0	0.9	1.0	0.9	1.0
26. <i>Hypsibarbus spp.</i>	Chhpin*	0.5	0.6	0.5	0.6	0.6	0.6
27. <i>Puntioplites spp.</i>	Chorkeng*	0.5	0.7	0.8	0.9	0.6	0.8
28. <i>Cyclocheilichthys spp.</i>	Chhkok*	0.4	0.5	0.6	0.7	0.4	0.6
29. <i>Pristolepis fasciata</i>	Kantrorb*	0.5	0.6	0.5	0.7	0.5	0.6
30. <i>Labeo chrysophekadion</i>	Kaek*	0.3	0.4	-	-	0.3	0.4
31. <i>Pangasianodon hypophthalmus</i>	Pra*	0.2	0.5	-	-	0.2	0.5
32. <i>Pteropangasius pleurotaenia</i>	Chhveat*	0.6	0.7	-	-	0.6	0.7
33. <i>Pangasius larnaudiei</i>	Pou*	0.8	0.9	-	-	0.8	0.9
34. <i>Hemibagrus spp.</i>	Chhlaing*	0.5	0.8	1.8	2.0	0.7	1.0
35. <i>Barbodes spp.</i>	Kahae*	0.2	0.5	-	-	0.2	0.5
36. <i>Belodontichthys truncatus</i>	Klang Hai*	0.2	0.5	-	-	0.2	0.5
37. <i>Notopterus notopterus</i>	Slat*	0.5	0.6	-	-	0.5	0.6

38. <i>Micronema apogon spp.</i>	Kes*	0.4	0.5	0.5	0.6	0.4	0.6
All		0.4	0.5	0.7	0.8	0.4	0.6

Note: *: Juvenile of commercially important fish species; B.: Buying; S.: Selling; Exchange rate: USD 1=4,000 Riel

Table 3.32: Trend of fresh freshwater small-sized fish traded in 2011-2012.

Description	Trend (%)					
	Volume (n=50)	Size (n=50)	Price (n=50)	Quality (n=50)	Convenience (n=50)	Information (n=50)
Decreased	28	10	64	6	50	12
Unchanged	10	68	16	54	22	48
Increased	50	20	20	40	28	40
Increased much	12	2	-	-	-	-
Total	100	100	100	100	100	100

Table 3.33: Average volume of processed fish traded per day (kg/day) by season in all provinces (2011-2012).

Description	Open season			Closed season	All
	Peak period	Low period	All		
Processed freshwater fish (all species)	59.7	52.2	57.8	28.3	57.2
Processed freshwater small-sized fish	58.7	51.0	56.9	26.9	56.2

Note: Quantity of **smoked fish** was converted into kilogram by multiplying number of skewer with average weight of smoked fish per skewer (in average, 1 skewer = 7.5 g or 0.075 kg).

Table 3.34: Average volume of processed freshwater small-sized fish traded per day (kg/day) by type of products and season (2011-2012).

Volume of products	Type of processed products				All
	Salted-dried (Brolark)	Smoked (Chha'eur)	Fermented (Pha'ork)	Paste (Pro'hoc)	
Volume traded in open season (kg/day)	-	12.9	23	39.5	56.9
Volume traded in closed season (kg/day)	5	4.1	15	14.4	26.9
All	5	10.2	24	39.5	56.2

Note: Quantity of **smoked fish** was converted into kilogram by multiplying number of skewer with average weight of smoked fish per skewer (in average, 1 skewer = 7.5 g or 0.075 kg).

Table 3.35: Average price of processed freshwater small-sized fish (USD/kg) by type of products and season (2011-2012).

Description	Type of processed products			
	Salted-dried (Brolark)	Smoked (Chha'eur)	Fermented (Pha'ork)	Paste (Pro'hoc)
<i>In open season</i>				
Buying price (USD/kg)	-	3.7	0.8	0.7
Selling price (USD/kg)	-	4.0	1.5	1.0
<i>In closed season</i>				
Buying price (USD/kg)	0.5	4.5	0.7	0.9
Selling price (USD/kg)	0.8	5.0	1.6	1.3
<i>All</i>				
Buying price (USD/kg)	0.5	4.1	0.8	0.8
Selling price (USD/kg)	0.8	4.4	1.5	1.1

- * **Note:**
- Exchange rate: USD 1 = 4,000 Riel
 - Quantity of **smoked fish** was converted into kilogram by multiplying number of skewer with average weight of smoked fish per skewer (in average, 1 skewer = 7.5 g or 0.075 kg)
 - Average price of smoked fish ranges from USD 0.28 to 0.38 per skewer

Table 3.36: Trend of processed freshwater small-sized fish traded (2011-2012).

Description	Trend (%)					
	Volume (n=5)	Size (n=5)	Price (n=5)	Quality (n=5)	Convenience in trading (n=5)	Information on trading (n=5)
Decreased much	-	-	-	-	-	-
Decreased	41.7	-	16.7	-	16.7	-
Unchanged	25.0	91.7	41.7	91.7	8.3	41.7
Increased	33.3	8.3	33.3	8.3	75.0	58.3
Increased much	-	0.0	8.3	-	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0

1.4 Fish Exporters

Table 3.37: Age group distribution of respondent households by sex.

Age group (years)	Male		Female		Both	
	No	(%)	No	(%)	No	(%)
20 - 30	0	0	1	20	1	20
31 - 40	1	20	1	20	2	40
51 - 60	1	20	1	20	2	40
Total	2	40	3	60	5	100

Table 3.38: Average years of experiences in fish export by sex.

Type of fish	Average years of experiences in fish export (no. year)								
	Male			Female			Both		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
All fish species	17	5	29	11.3	5	22	13.6	5	29
Small-sized fish	14	5	23	11.3	5	22	12.4	5	23
All	15.5	5	26	11.3	5	22	13	5	26

Table 3.39: Average volume of fresh freshwater small-sized fish traded per day (kg/day) by season (2011-2012).

Description	Open season			Closed season	All
	Peak period	Low period	All		
Volume of fresh freshwater fish (all species) (kg/day)	3,166.7	1,100.0	2,728.5	250	2,672.2
Volume of fresh freshwater small-sized fish (kg/day)	1,900.0	233.3	1,556.3	50	1,526.9

Table 3.40: Average volume of fresh freshwater small-sized fish exported per day (kg/day) by species and season (2011-2012).

Fish Species		Open season	Closed season	All
Scientific name	Khmer name			
1. <i>Henicorhynchus spp.</i>	Riel	267.4	-	267.4
2. <i>Mystus spp.</i>	Kanhchos	623.9	-	623.9
3. <i>Trichogaster spp.</i>	Kompleanh	891.3	-	891.3
4. <i>Yasuhikotakia spp.</i>	Kanhchrouk	471.6	-	446.9
5. <i>Puntiplites spp.</i>	Chorkeng*	445.7	-	445.7
6. <i>Kryptopterus moorei</i>	Kompleav	148.2	10	121.6
7. <i>Acantopsis spp.</i>	Reus Check*	534.0	-	534.0
8. <i>Macragnathus spp.</i>	Chhlonh*	267.0	-	267.0
9. <i>Notopterus notopterus</i>	Slat*	102.6	40	90.5
10. <i>Coilia spp.</i>	Chunlounh Moan	445.7	-	445.7
Total		1,556.3	50	1,526.9

Note: * Juvenile of commercially important fish species

Table 3.41: Average price of fresh freshwater small-sized fish (USD/kg) by species and season (2011-2012).

Fish Species		Open season		Closed season		All	
Scientific name	Khmer name	B. price	S. price	B. Price	S. price	B. price	S. price
1. <i>Henicorhynchus spp.</i>	Riel	0.3	0.4	-	-	0.3	0.4
2. <i>Mystus spp.</i>	Kanhchos	0.4	0.5	-	-	0.4	0.5
3. <i>Trichogaster spp.</i>	Kompleanh	0.3	0.3	-	-	0.3	0.3
4. <i>Yasuhikotakia spp.</i>	Kanhchrouk	0.6	0.8	-	-	0.6	0.8
5. <i>Puntiplites spp.</i>	Chorkeng*	0.4	0.5	-	-	0.4	0.5
6. <i>Kryptopterus moorei</i>	Kompleav	1.5	1.6	1.8	1.9	1.7	1.7
7. <i>Acantopsis spp.</i>	Reus Check*	1.4	1.6	-	-	1.4	1.6
8. <i>Macragnathus spp.</i>	Chhlonh*	0.9	1.1	-	-	0.9	1.1
9. <i>Notopterus notopterus</i>	Slat*	0.8	1.0	2.8	2.9	1.8	1.9
10. <i>Coilia spp.</i>	Chunlounh Moan	0.2	0.2	-	-	0.2	0.2
Total		0.7	0.9	2.3	2.4	1.0	1.1

Note: * Juvenile of commercially important fish species

Exchange rate: USD 1 = 4,000 Riel

Table 3.42: Trend of fresh freshwater small-sized fish exported in 2011-2012 compared to that before 2011.

Description	Trend (%)						
	Volume (n=3)	Size (n=3)	Price (n=3)	Quality (n=3)	Convenience in exporting (n=3)	Information on exporting (n=3)	All (n=3)
Decreased much	-	-	-	-	33.3	-	5.6
Decreased	33.3	-	66.7	-	33.3	-	22.2
Unchanged	-	66.7	-	100	33.3	66.7	44.4
Increased	33.3	33.3	33.3	-	-	33.3	22.2
Increased much	33.3	-	-	-	-	-	5.6
Total	100.0	100.0	100.0	100	100.0	100.0	100.0

Table 3.43: Average volume of processed freshwater small-sized fish exported per day by season and type of product (2011-2012).

Description	Salted (Brolark)	Fish paste (Pro'hoc)	All
Volume exported in open season (kg/day)	20,000	10,000	15,000
Volume exported in closed season (kg/day)	4,000	-	4,000
All	19,584	10,000	14,792

Table 3.44: Average price of processed freshwater small-sized fish exported (USD/kg) by season and type of product (2011-2012).

Description	Salted (Brolark)	Fish paste (Pro'hoc)	All
In open season (USD/day)			
Buying price	0.28	0.40	0.34
Selling price	0.45	0.55	0.50
In closed season (USD/kg)			
Buying price	0.30	-	0.30
Selling price	0.50	-	0.50
All			
Buying price	0.29	0.40	0.34
Selling price	0.48	0.55	0.51

* **Note:** Exchange rate: USD 1 = 4,000 Riel

1.5 Fish Processors

Table 3.45: Age group distribution of respondent households by sex in all provinces.

Age group (years)	Male		Female		Both	
	No.	(%)	No.	(%)	No.	(%)
31 - 40	1	9.1	0	0.0	1	9.1
41 - 50	0	0.0	5	45.5	5	45.5
51 - 60	1	9.1	2	18.1	3	27.3
61 and above	2	18.2	0	0.0	2	18.1
Total	4	36.4	7	63.6	11	100.0

Table 3.46: Average years of experiences in fish processing by sex and type of fish processing operation.

Type of fish processing	Average years of experiences in fish processing activities (no. year)								
	Male			Female			Both		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
Household	12	12	12	22.6	10	32	18.6	10	32
Private company	24	24	24	6	6	6	12	6	24
All	15	12	24	18	6	32	16.8	6	32

Table 3.47: Duration for processing freshwater small-sized fish per year by type of products in 2011.

Description	Type of products						
	Salted-dried	Smoked	Fermented	Paste	Fish sauce	All	
No. of months (month/year)	10	2.5	4.7	4.4	12	5.7	
No. of days (day/month)	30	9	15.7	19.3	25	18.7	
Time of one processing cycle (day/time)	1.5	2	62.0	44.3	1	30.7	

Table 3.48: Volume of raw materials for fish processing, and final products (kg) per year.

Volume	Avg.	Min.	Max.
Raw materials			
All raw materials (kg/year)	358,360	900	888,360
Freshwater small-sized fish (kg/year)	208,400	900	500,000
Final products			
All final products (kg, L/year)	237,448	300	900,000
Final small-sized fish products (kg, L/year)	210,957	300	900,000

Note: Volume of fish sauce: 1 L = 1 kg

Table 3.49: Species, volume and price of freshwater small-sized fish bought per month in 2011.

Fish species		Volume (kg/month)			Buying price (USD/kg)		
Scientific name	Khmer name	Avg.	Min.	Max.	Avg.	Min.	Max.
1. <i>Henicorhynchus spp.</i>	Riel	112,654.0	450	420,000	0.36	0.15	0.88
2. <i>Mystus spp.</i>	Kanhchos	5,000.0	5,000	5,000	0.25	0.25	0.25
3. <i>Trichogaster spp.</i>	Komphleanh	79,719.4	180	380,000	0.40	0.20	0.55
4. <i>Thynnichthys thynnoides</i>	Linh	90,000.0	90,000	90,000	0.25	0.25	0.25
5. <i>Clupeichthys spp.</i>	Bandoul Ampov	2,000.0	2,000	2,000	0.38	0.38	0.38
6. <i>Yasuhikotakia spp.</i>	Kanhchrouk	8,357.0	1,714	15,000	0.25	0.25	0.25
7. <i>Osteochilus lini</i>	Kros	1,750.0	1,750	1,750	0.55	0.55	0.55
8. <i>Paralaubuca riveroi</i>	Sleuk Reussey	15,620.0	4,000	30,000	0.30	0.15	0.50
9. <i>Cyclocheilichthys spp.</i>	Chhkok*	1,750.0	1,750	1,750	0.55	0.55	0.55
10. <i>Labiobarbus spp.</i>	Ach Kok	15,000.0	15,000	15,000	0.25	0.25	0.25
11. <i>Coilia spp.</i>	Chunlournh Moan	500.0	500	500	0.38	0.38	0.38
12. <i>Pteropangasius pleurotaenia</i>	Chhveat	3,036.5	500	5,573	0.75	0.38	1.13
13. <i>Parachela spp.</i>	Chunteas Phlouk	20.0	20	20	0.25	0.25	0.25
Total		145,286.4	200	420,000			

Note: * Juvenile of commercially important fish species

Exchange rate: USD 1 = 4,000 Riel

Table 3.50: Volume of final processed products (kg) per year by type of products.

Volume	Avg.	Min.	Max.
Salted-dried fish (Trey Brolark)	242,466.7	9,000	500,000
Smoked fish (Trey Chha'oeur)	7,100	300	20,000
Fermented fish (Pho'ork)	17,800	1,000	48,000
Fish paste (Mam/Pro' hoc)	113,729	1,500	320,000
Fish sauce (Teuk Trey)	900,000	900,000	900,000

Note: Conversion ratio of the products is:

- **1:0.5** for salted dried fish
- **1:0.075** for smoked fish
- **1:0.4** for fermented fish
- **1:0.3** for fish paste
- **1:3** for fish sauce

Table 3.51: Detailed information on selling processed freshwater small-sized fish per year by type of products in 2011.

Description	Type of products					
	Salted-dried	Smoked	Fermented	Paste	Fish sauce	All
No. of selling months (month/year)	10.0	2.5	4.7	7.9	12.0	7.6
No. of selling times (time/month)	22.5	22.5	25.0	16.6	25.0	17.1
Volume sold (kg/time)	175.0	559.0 ^a	426.7	6,661.1	8,000.0	5,157.6
Average selling price (USD/kg)	1.0	0.3 ^b	1.0	0.9	0.5	0.8

Note: a: no. of skewer (1 skewer = 0.075 kg)
b: price per skewer

Table 3.52: Trend of fish processing for raw materials in 2011-2012 compared to that before 2011.

Trend	Type of products					
	Fresh	Salted-dried	Smoked	Fermented	Paste	All
Type of product						
Decreased	22.2	-	-	-	-	12.5
Unchanged	22.2	33.3	-	-	-	18.8
Increased	33.3	66.7	100	100	100	56.3
Increased much	22.2	-	-	-	-	12.5
Total	100.0	100.0	100	100	100	100.0
Supply/Demand						
Unchanged	44.4	66.7	-	-	-	37.5
Increased	33.3	33.3	100	100	100	50.0
Increased much	22.2	-	-	-	-	12.5
Total	100.0	100.0	100	100	100	100.0
Volume						
Decreased	33.3	33.3	-	-	-	25.0
Unchanged	11.1	33.3	-	-	-	12.5
Increased	44.4	33.3	100	100	100	56.3
Increased much	11.1	-	-	-	-	6.3
Total	100.0	100.0	100	100	100	100.0

Table 3.53: Trend of fish processing for processed products in 2011-2012 compared to that before 2011.

Trend	Type of products					
	Salted-dried	Smoked	Fermented	Paste	Fish sauce	All
Type of product						
Decreased	50	100.0	-	37.5	-	41.2
Unchanged	50	-	100.0	37.5	-	41.2
Increased	-	-	-	12.5	100	11.8
Increased much	-	-	-	12.5	-	5.9
Total	100	100.0	100.0	100.0	100	100.0
Supply/Demand						
Decreased	50	66.7	66.7	25.0	-	41.2
Unchanged	50	33.3	33.3	50.0	-	41.2
Increased	-	-	-	12.5	100	11.8
Increased much	-	-	-	12.5	-	5.9
Total	100	100.0	100.0	100.0	100	100.0
Volume						
Decreased	50	66.7	100.0	50.0	-	58.8
Unchanged	50	33.3	-	12.5	-	17.6
Increased	-	-	-	25.0	100	17.6
Increased much	-	-	-	12.5	-	5.9
Total	100	100.0	100.0	100.0	100	100.0

1.6 Fish Consumers

Table 3.54: Age group distribution of respondent households by sex in all provinces.

Age group (years)	Male		Female		Both	
	No	(%)	No	(%)	No	(%)
20 - 30	3	6	6	12	9	18
31 - 40	3	6	7	14	10	20
41 - 50	10	20	4	8	14	28
51 - 60	7	14	7	14	14	28
61 and above	1	2	2	4	3	6
Total	24	48	26	52	50	100

Table 3.55: Volume of freshwater small-sized fish consumed per year (kg/year) by type of consumers and province.

Province	Fishermen			Non-Fishermen			Both		
	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
Kampong Chhnang	244.1	19	494.2	228.8	87.3	576	238.0	19	576
Battambang	-	-	-	107.4	24.0	174	107.4	24	174
Siem Reap	174.1	120	244.0	167.0	24.0	286	169.8	24	286
Kandal	233.5	90	480.0	364.0	364.0	364	259.6	90	480
Phnom Penh	262.6	26	480.0	275.8	24.0	921	267.7	24	921
All	231.0	19	494.2	195.8	24.0	921	213.4	19	921

Table 3.56: Preferable type of processed freshwater small-sized fish by type of consumers.

Type of product	Fishermen		No-fishermen		All	
	No.	(%)	No.	(%)	No.	(%)
Fresh fish	25	13.6	22	12.0	47	25.5
Salted-dried fish	18	9.8	15	8.2	33	17.9
Smoked fish	17	9.2	18	9.8	35	19.0
Fermented fish	19	10.3	13	7.1	32	17.4
Fish paste	20	10.9	17	9.2	37	20.1
Total	99	53.8	85	46.2	184	100.0

Table 3.57: Detailed information on purchasing and consuming freshwater small-sized fish by type of products.

Description	Type of products				
	Fresh	Salted-dried	Smoked	Fermented	Paste
Frequency of buying products (day/time)	3.8	4.1	49.2	88.6	104.1
Distance to buy products (m)	172.7	191.9	231.0	125.5	116.6
Volume of products bought per time (kg/time)	0.7	0.7	3.1 ^a	5.7	7.6
Average price per kg (USD/kg)	0.9	0.9	0.3 ^b	1.6	1.7
Highest price per kg (USD/kg)	1.3	1.3	0.4 ^b	1.9	2.0
Lowest price per kg (USD/kg)	0.4	0.5	0.3 ^b	1.3	1.4

Note: a: no. of skewer (1 skewer = 0.075 kg)

b: price per skewer

Table 3.58: Perception of consumers on freshwater small-sized fish by type of products.

Description	Type of products (%)					All
	Fresh (n=50)	Salted-dried (n=50)	Smoked (n=50)	Fermented (n=50)	Paste (n=50)	
Quality						
Bad	6.4	6.1	5.1	3.1	-	4.3
Medium	48.9	66.7	56.4	59.4	56.8	56.9
Good	40.4	27.3	35.9	34.4	37.8	35.6
Very Good	4.3	-	2.6	3.1	5.4	3.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Convenience in consuming						
Bad	6.4	9.1	7.7	3.1	2.7	5.9
Medium	36.2	51.5	48.7	53.1	51.4	47.3
Good	46.8	36.4	38.5	40.6	40.5	41.0
Very Good	10.6	3.0	5.1	3.1	5.4	5.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Information on supply and use						
Bad	12.8	12.1	7.7	6.3	5.4	9.0
Medium	46.8	57.6	53.8	65.6	59.5	55.9
Good	38.3	30.3	38.5	28.1	35.1	34.6
Very Good	2.1	-	-	-	-	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.59: Trend of freshwater small-sized fish consumption by type of products.

Trend	Type of products					All
	Fresh (n=50)	Salted-dried (n=50)	Smoked (n=50)	Fermented (n=50)	Paste (n=50)	
Buying volume						
Decreased	14.9	18.2	15.4	15.6	10.8	14.9
Unchanged	57.4	66.7	69.2	65.6	62.2	63.8
Increased	27.7	15.2	15.4	18.8	27.0	21.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Size						
Decreased	6.4	9.1	10.3	6.3	5.4	7.4
Unchanged	68.1	63.6	76.9	75.0	67.6	70.2
Increased	23.4	24.2	12.8	18.8	24.3	20.7
Increased much	2.1	3.0	-	-	2.7	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Price						
Decreased	46.8	45.5	23.1	56.3	45.9	43.1
Unchanged	23.4	27.3	51.3	31.3	32.4	33.0
Increased	29.8	27.3	25.6	12.5	21.6	23.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Quality						
Decreased	4.3	6.1	5.1	6.3	2.7	4.8
Unchanged	68.1	60.6	66.7	71.9	73.0	68.1
Increased	27.7	33.3	28.2	21.9	24.3	27.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
Convenience in consuming						
Decreased	6.4	6.1	2.6	6.3	2.7	4.8
Unchanged	48.9	51.5	59.0	50.0	54.1	52.7
Increased	38.3	39.4	28.2	37.5	35.1	35.6
Increased much	6.4	3.0	10.3	6.3	8.1	6.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Information on supply and use						
Decreased much	2.1	-	-	3.1	2.7	1.6
Decreased	8.5	15.2	10.3	3.1	5.4	8.5
Unchanged	59.6	57.6	59.0	56.3	48.6	56.4
Increased	27.7	24.2	28.2	34.4	37.8	30.3
Increased much	2.1	3.0	2.6	3.1	5.4	3.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

II. Value Chain Analysis and Marketing Channel of Freshwater Small-sized Fish

2.1 Fishermen

Table 3.60: Methods used by fishers to market their fish by type of fishing in all provinces.

Description	Small scale		Large sale/Bag net		All	
	No.	(%)	No.	(%)	No.	(%)
Carry to markets and sell directly to consumers	9	14.1	-	-	9	14.1
Carry to landing sites and sell to wholesalers	17	26.6	1	1.6	18	28.1
Middlemen/collectors buy the fish from fishing grounds	14	21.9	2	3.1	16	25.0
Middlemen/collectors buy the fish from villages	13	20.3	-	-	13	20.3
Sell fish directly to neighboring consumers at home	8	12.5	-	-	8	12.5
Total	61	95.3	3	4.7	64	100.0

Table 3.61: Percentage of freshwater small-sized fish distribution (% of volume) and by season in all provinces.

Types of fish buyers	Open season		Closed season	All
	Peak period	Low period		
Consumption (food)	2.3	2.5	4.4	3.2
End consumers	12.5	17.8	19.7	18.0
Local fish traders/collectors/middlemen	29.8	22.8	24.6	25.6
Provincial traders/collectors/middlemen	13.0	22.2	25.7	15.9
Fish farmers (animal/fish feed)	15.3	11.1	25.7	14.0
Processors	25.1	22.2	-	21.7
Exporter	1.9	1.4	-	1.6
Total	100.0	100.0	100.0	100.0

Table 3.62: Trend of freshwater small-sized fish distribution by season in all provinces.

Trend	Open Season							
	Peak Period		Low Period		Closed season		All	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Decreased	7	14	6	12	3	8.6	16	11.9
Unchanged	23	46	26	52	19	54.3	68	50.4
Increased	19	38	17	34	13	37.1	49	36.3
Increased much	1	2	1	2	-	-	2	1.5
Total	50	100	50	100	35	100.0	135	100.0

2.2 Fish Traders

Table 3.63: *Percentage distribution of demanding sources of processed freshwater small-sized fish by type of products (2010-2011).*

Source of buyers	Type of processed products				All (n=50)
	Salted-dried (n=50)	Smoked fish (n=50)	Fermented (n=50)	Fish paste (n=50)	
End consumers	40	10	23.9	27.7	23.1
Local retailers	60	90	31.3	29.8	33.7
Middlemen/Collectors/Wholesalers	-	-	44.8	42.6	43.3
Total	100	100	100.0	100.0	100.0

2.3 Fish Processors

Table 3.64: Supplying sources of freshwater small-sized fish per month in 2011 (% of volume).

Fish species		Supplying sources				Total
		Fishers	Collectors/ Middlemen	Other processors		
Scientific name	Khmer name					
1. <i>Henicorhynchus spp.</i>	Riel	4.2	6.0	6.3	16.5	
2. <i>Mystus spp.</i>	Kanhchos	-	-	6.3	6.3	
3. <i>Trichogaster spp.</i>	Kompheanh	2.1	5.8	6.3	14.2	
4. <i>Thynnichthys thynnoides</i>	Linh	-	6.3	-	6.3	
5. <i>Clupeichthys spp.</i>	Bandoul Ampov	-	6.3	-	6.3	
6. <i>Yasuhikotakia spp.</i>	Kanhchrouk	-	6.3	-	6.3	
7. <i>Osteochilus lini</i>	Kros	-	6.3	-	6.3	
8. <i>Paralauca riveroi</i>	Sleuk Reussey	-	6.3	-	6.3	
9. <i>Cyclocheilichthys spp.</i>	Chhkok	-	6.3	-	6.3	
10. <i>Labiobarbus spp.</i>	Ach Kok	-	6.3	-	6.3	
11. <i>Coilia spp.</i>	Chunlournh Morn	-	6.3	-	6.3	
12. <i>Pteropangasius pleurotaenia</i>	Chhveat	-	6.3	-	6.3	
13. <i>Parachela spp.</i>	Chunteas Phlouk	-	6.3	-	6.3	
Total		6.3	74.8	18.9	100.0	

Table 3.65: Percentage distribution of demanding sources of processed freshwater small-sized fish (% of volume) by type of products.

Description	Type of products					All
	Salted-dried	Smoked	Fermented	Paste	Fish sauce	
Household consumption	4.7	1	0.5	1.1	-	1.4
End consumers (direct selling)	9.3	-	-	23.8	-	15.3
Collectors/Middlemen	-	-	49.9	27.5	-	30.6
Wholesalers/Retailers	86.0	99	49.6	36.6	100	40.5
Other processors	-	-	-	11.0	-	12.2
Total	100.0	100	100.0	100.0	100	100.0

2.4 Consumers

Table 3.66: *Percentage distribution of supplying sources of freshwater small-sized fish by type of products (% of volume).*

Supplying sources	Type of products					
	Fresh	Salted-dried	Smoked	Fermented	Paste	All
Fishers	20.8	25.0	20.8	24.7	24.4	23.1
Retailers	35.5	36.2	27.7	24.3	25.9	29.9
Processors	-	-	28.6	25.5	22.6	15.3
Own catch	43.7	-	-	-	-	8.7
Own process	-	38.8	22.8	25.5	27.1	22.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

III. Perception and Challenges/Constraints of Chain Actors

Table 3.67: Plan of traders in the trade of fresh and processed freshwater small-sized fish.

Plan	No.	(%)
Change		
Expand	13	26
Reduce	9	18
No change	27	54
Others	1	2
Total	50	100

Table 3.68: Plan of exporters in the trade of fresh and processed freshwater small-sized fish.

Plan	No.	(%)
Change (reduce)	4	80
No change	1	20
Total	5	100

Table 3.69: Perception of processors on development trend of freshwater small-sized fish processing industry in the coming time.

Perception	No.	%
Decrease	2	18.2
Unchanged	3	27.3
Increase	6	54.5
Total	11	100.0

Table 3.70: Plan of processors for major changes in processing of freshwater small-sized fish.

Plan	No.	(%)
Change		
Expand	3	27.3
Reduce	4	36.4
No change	4	36.4
Total	11	100.0

Table 3.71: Plan on consumption of fresh/processed small-sized fish in the coming time.

Plan	No.	%
Change	16	32
No change	34	68
Total	50	100