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**“Development of Alternatives to the Use of Freshwater Low Value Fish for
Aquaculture in the Lower Mekong Basin of Cambodia and Vietnam:
Implications for Livelihoods, Production and Markets “**

Investigation 5 – Phase 2

**VALUE CHAIN ANALYSIS OF SNAKEHEAD FISH IN THE LOWER
MEKONG BASIN OF CAMBODIA**

CAMBODIA - Country Report

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LIST OF ABBREVIATIONS

| | | |
|---------|---|--|
| FGD | : | Focus Group Discussion |
| FiA | : | Fisheries Administration |
| G | : | Gram |
| GIZ/GIZ | : | Deutsche Gesellschaft für Technische/Intenational Zusammenarbeit |
| HH. | : | Household |
| IFReDI | : | Inland Fisheries Research and Development Institute |
| Kg | : | Kilogram |
| KIP | : | Key Informant Person |
| LMB | : | The Lower Mekong Basin |
| MRC | : | Mekong River Commission |
| M4P | : | Making Markets Work Better for the Poor |
| NAV | : | Net Added Value |
| NGO | : | Non-Government Organization |
| P. | : | Pangasius |
| USD | : | The United State Dollar |
| WF | : | WorldFish Center |
| % | : | Percent |
| / | : | Per |

PART I

INTRODUCTION

1.1 Background

Cambodia is a mostly landlocked country located on the peninsula of Mainland Southeast Asia. It lies between latitudes 10 to 15 degrees north and longitudes 102 to 108 east. Cambodia has an area of 181,035 km². It is bounded by Thailand in the west and northwest, Laos in the north, and Vietnam in the east and southeast, and Gulf of Thailand in the southwest (Appendix Figure 1.1).

Cambodia is covered by forest, water bodies and rice fields. Among the water bodies, the fishing zone of freshwater covers about 1,687,000 hectares, which contribute to make the fisheries sector as an important sector for the national economy (Ahmed and Touch, 1996). At the local level, fisheries has historically been the important occupation for Cambodian people as over 2 millions of them are directly and indirectly associated with inland fishery activities (Rab et al., 2006). Giving more evidence, fish constitutes about 75% of the animal protein intake for the Cambodian households and most of it comes mainly from freshwater fisheries in both fresh and processing form (Hap, 1999), which is considered to be the most productive inland fisheries of the world, contributing around 60% of the country commercial fisheries production (Ahmed et al., 1998).

Besides inland fisheries, aquaculture, which contributes around 10% of the total inland fish catch, also plays an important role and is considered to have great potential for augmenting fish production in Cambodia (Rab et al., 2006). Moreover, fisheries and aquaculture is believed to have enormous potential to provide the poor people with more food, better nutrition and increased incomes. Globally, aquaculture has expanded at an average annual rate of 8.90% since 1970, making it the fastest-growing food production sector. It now provides about half of all fish for human consumption. With half of all wild fish stocks now harvested to full capacity and a quarter over-exploited, we can expect aquaculture's share of fish production to increase further. This can benefit poor people by improving their food security and nutrition, creating jobs, stimulating economic growth and offering greater diversification of their livelihoods (WF, 2008).

Within the freshwater aquaculture model in Cambodia, cage culture represents the highest percentage of about 70% of aquaculture production while pond culture covers only 30%. The most important and high profit fish species in cage culture system in Cambodia is Chhdaur (Giant Snakehead, *Channa Micropeltes*) (So et al., 2005). Giant snakehead is commonly raised in cages in and along the Mekong River, the Great Lake Tonle Sap and Tonle Sap River (Hap and Pomeroy 2010). As originated in Cambodia, cage culture increased to 4,493 cages in 2004 being operated in the Mekong Basin, including the Tonle Sap Great Lake (42%), the Tonle Sap River (17%), the upper stretch of the Mekong River (19%), lower stretch of the Mekong River (14%) and Bassac River (7%) (So et al., 2005). Moreover, in Cambodia cage culture of giant Snakehead was started in 1990s. During 1991 to 1993, there were only a few of households who were interested in culturing giant snakehead, but from 2001 to 2005, this numbers increased very fast throughout the country such as in the Great Lake Tonle Sap, along Tonle Sap River, Mekong and Bassac River (Hap et al., 2006). However, the farming of the fish species heavily depends on wild indigenous fishes both for seed and feed while the wild fish stock in freshwater bodies of the delta has been rapidly depleted due to many reasons (Sinh,

2005). Fish products from cage culture are sold to domestic and international market in both fresh and processed forms (Hap et al., 2006). Snakeheads for human consumption in Cambodia are mainly from wild fish capture. Wild snakeheads are traded via the border of Cambodia and Thailand while cultured snakeheads are imported from downstream areas of Vietnam in a small proportion (Loc et al., 2007).

So far, market channel as well as value chain of giant snakehead and common snakehead have not been studied. Therefore, it is a need to conduct a study covering all of the aspects of snakehead fish industry in the Lower Mekong Basin. The results of this study will be useful for management and any further development of snakehead industry, as well as contribute to the food security, job creation and marketing of fish products in the Lower Mekong Basin.

1.2 Research Objectives

The general objective of the study is to conduct a value chain analysis of snakeheads in the Lower Mekong Basin of Cambodia in order to propose major solutions for a further development of snakehead industry with the regards given to the main stakeholders in the study areas. The specific objectives are:

1. To describe and analyze the situation of the actors participating in snakehead industry;
2. To analyze the cost-benefit distribution of the snakehead value chain; and
3. To propose improvements for upgrading this chain so that it is sustainable in the long term.

PART 2

RESEARCH METHODOLOGY

2.1 Scope of the Study

The period of the study was conducted from September 2009 to September 2011 in four provinces, namely Kandal, Kampong Chhnang, Kampong Thom and Siem Reap and Phnom Penh city (Appendix Figure 2.1). The study covered in four provinces and Phnom Penh city, 8 districts, 20 communes and 37 villages were selected for the data collection. The study was focused on the fishers who fish freshwater wild fish, especially snakehead/giant snakehead, the farming of snakehead/giant snakehead farmers, the traders, processors and end consumers. In total, 465 samples were interviewed in the four selected provinces, and Phnom Penh city which included 120 fishers, 75 fish farmers, 75 traders, 21 processors, 161 end fish consumers and village/commune head/fisheries of officers.

2.2 Methods of Data Collection

This study collected both secondary and primary data. The secondary data and information is derived from government and other sources to complement primary data collection and observations. The primary data was collected through individual interviews with key stakeholders such as fishers, fish farmers, processors, traders, and end fish consumer who involved in the snakehead/giant snakehead fish value chain.

The tools of data collection were based on two steps. First step, the research team focused on the available of the secondary data from relevant institutions and agencies in order to better understand of the real context had been done so far. Second step was based on the data collection at field level with targeted key stakeholders by using semi-structured and structured questionnaire for interview to obtain information.

- Secondary data collection was done using the available information and reports from relevant institutions such as Inland Fisheries Research and Development Institute (IFReDI), Fisheries Administration (FiA), Provincial Fisheries Administration, Mekong River Commission (MRC), WorldFish Center, Sumernet, and other related agencies.
- Key Informant Person (KIP): Using semi-structured for interviews with KIP were made between the research team members and provincial fisheries administration, local officers at village and district level of selected provinces and;
- Household individual interview: Using structured questionnaire for interview with selected households was conducted by using a set of 5 questionnaires which were designed. Pre-tested was also used before interviewing in each target groups. There were 5 target groups of households in this study such as fishers, fish farmers, traders, processors and end consumers. These target groups households were selected based on criteria of small, medium and big level.

2.3 Methods of Data Analysis

All data and information collected were stored in the Access software program to secondary data were synthesized. Furthermore, data analyses were conducted by using the two sources of collected data in each of part of the results and discussion (FGD, KIPs, individual interview).

The descriptive analysis was used to describe the secondary data and to present the characteristics of the target groups. Cross-tabulation was made to describe and to compare the data within and between the group households. Comparative analysis was made to compare the mean value between the groups.

The framework for value chain analysis was based on the references from Michael Porter (1985), Making Markets Work Better for the Poor - M4P (2007), and Deutsche Gesellschaft für Technische/International Zusammenarbeit (GTZ or GIZ). The share of product distribution among actors in the value chain diagram was as follows:

- Processed products were converted into raw materials for calculations;
- Amount of output products of an actor was the amount of input products for next actor following the chain;
- Total input products of the first actors were 100% and total output products of the last actors must equal 100%. The amount of inputs and outputs of each actor must be equal;
- The converted products between the actors at the same level were not accounted for in the value chain diagram.

The following indicators are calculated for a cost-benefit distribution of the chain:

- Added value = Selling price – Purchase price including added cost;
- Net added value = Value added – Cost added;
- Total cost of fisher or fish farmer of snakeheads = Variable cost (i.e. fuel, seed, feed and other expenses) + Fixed cost + Added cost;
- Added cost of traders and processors included transportation cost, hiring cost, hired vehicle cost, and preservation cost;
- All indicators were calculated based on the conversion into one kilogram snakehead;
- Total net income of each actor = Net added value * Average yield of products produced or traded in a year.

The descriptive analysis was conducted using the secondary data to present the characteristics of the target groups. Frequency, percentage, mean, standard deviation, and range were used in the comparative analysis. Cross-tabulation was used to compare the major differences in actors between linkages. The benefits and costs of the involved actors were analyzed in order to help to recommend the most appropriate improvements to the value chain of snakehead in the delta region.

PART 3

RESULTS AND DISCUSSIONS

3.1 Description Chain Actors of Snakeheads

3.1.1 Small-Scale Fishers of Snakeheads

3.1.1.1 Socio-demographic Characteristics of Fisher Households

Age, Gender, Education and Experience of Respondents

Appendix Table 1 shows age group distribution of small scale fisher households by sex and selected provinces in the study areas. The age ranged from 19 to 65 years, with an average 44.21 years. The highest percentage age group of fishers were between 41 to 50 years (38.89%), followed by 31 to 40 years (24.1%) and 51 to 60 years (22.2%). Of the total sample, female respondents were only about 5%. This implies that, male respondents or male headed households more actively involved in fishing activity than female household members, and majority of them were between 31 to 60 years (86%).

Overall, the most common level of education attained by fisher household head was participation in primary schooling. The highest percentage education level of fisher was primary school about (53%), whereas (27%) had received no education and only (2%) was finished upper secondary school. In general, male had higher education than female (see detail information in Appendix Table 2). This implies that the majority (69%) education level of fisher headed household of snakeheads had completed at least some schooling.

In general, the selected fisher household of snakeheads had extensive experience in fishing activities. The average years of experience was about 20 years, with ranged from 3 to 45 years. However, males and females had similar year experiences in fishing activity. In Appendix Table 3, show an average year experience with different level of education.

Occupation of Fisher Household Heads

Overall, primary occupations of fisher households in the study areas were fishing, fish culture and rice farming. The higher percentage of households' major occupation was fishing (82%). The rest involved in rice farming (16%) and fish culture (2%). This shows that most of the sample households in the study areas had fishing as the main occupation. However, those primarily engaged in fish culture and rice farming activities also had fishing as a secondary occupation. The major secondary occupation was rice farming (25%), fishing (19%), petty trading/small business (17%), fish culture (14%) and daily wage (9%). The rest were involved in fish trading, fishing gear making, animal raising, fire wood collection, and motor taxi etc (Appendix Table 4).

Fishing Grounds

There are many different type of fishing places where fisher households normally go fishing in the study areas, such as Great Lake Tonle Sap, Tonle Sap River, Mekong River, small lakes, inundated forest and canal/stream etc. Amongst these fishing places, the majority of fishing ground was sample households went to fish were Small river/Lake connected to Tonle Sap River, Bassac River, Mekong River (43%), Great Lake Tonle Sap and along Tonle Sap River

(49%) and the rest were inundated forest, rice field and canal/stream. Appendix Table 5 shows the percentage of sample households by fishing ground by fishing season in the study area.

3.1.1.2 Size of Households Member and Labors Involving in Fishing Activities

The average member of sample fisher households was 6 persons, which ranged from 2 to 9 persons. However, an average member of female and male was the same of 2.9 persons and 3 persons, respectively (Appendix Table 6). Moreover, an average family labor of the sample households in the study areas was 3.4 persons, with ranged from 2 to 9 persons. The results indicated that the average number of male and female were similar, 1.8 persons and 1.5 persons, which had the same ranged from 1 to 6 persons (Appendix Table 7).

An average size of family labor involved in fishing activity was high in both seasons (2.3 persons), ranging from 1 to 7 persons. Whereas the average hired labor was higher in open season (7.1 persons) ranging from 1 to 13 persons compared to other season. In general, number of male labors was higher than female labors, including family and hired labors (Appendix Table 8). This implies that small-scale fishers do fishing at all times of the year with restrictions mainly on the fishing efforts for example, type of gear and mesh size and use only family labor, whereas middle-scale and large-scale fishers are permitted to fish only during the open season and use both family and hired labor for fishing operations.

3.1.1.3 Major Operating Cost on Fishing Activities

Major operating cost in fishing activities were included fuel/oil, food expenditure, hired labor, interest on borrowed money, taxes, and other expenses - cigarette, wines etc. Operating cost varies in accordance with season, clearly defined as open and close season. Generally, in open season, average total operating cost on fishing activities per day per household was USD 23.3 and USD 9.0 in close season. Moreover, fishers spent more money on hired labor and taxes items. An average number of family labors were around 3 persons in each season. If they hired labor it would cost about USD 3 per day per person in the study areas. Appendix Table 9 shows detail information on major operating cost in fishing activities by season. Generally, fishers had higher expenses in open season because they spent more time for fishing activity compared to closed season. If fisher used only family labors, the input cost would be decreased. This due to there was high cost of hired labors in the study areas as well as in the country.

3.1.1.4 Cost on Buying and Repairing Fishing Gears/Equipments

Several fishing gears were found in the study areas such as gillnet (Mong), seine net (Oun), cast net (Somnanh), Hook and line (Santuch), horizontal cylinder trap (Lorb), bamboo fence (Prourl), and vertical cylinder trap/vertical hanging vase trap (Tom). Amongst of these fishing gears, bamboo fence and trap, gill net, hook and line were commonly used in the study areas. An average of bamboo fence was 29, followed by gillnet (18), horizontal cylinder trap (11), hook and line (6), seine net (6), and cast net (1). Generally, an average cost per unit of seine net was highest (USD 1,369), annual maintenance cost was USD184.4, with expected life of about 6 year. Followed by bamboo trap was USD 62 per unit, maintenance cost was USD 21 per year with expected life of 3 year. Moreover, fishing boat and machines cost were also high, USD 435 and USD 380, respectively (Appendix Table 10). This mean, if people want to do fishing activity, they need capital to buy some fishing gears according to their fishing ground and equipment as fishing boat, machine.

3.1.1.5 Production of Wild Snakeheads Caught

The fishing calendar of inland fisheries in Cambodia is divided into two seasons: Open (October to May) and Closed (June to September). Generally, during open season consists of peak period and low period of fish caught the same as snakehead species. Based on the results of the study shows that the peak period of wild snakehead was from October to February and low period was March to May during open season.

Overall, an average day per month and number of month for fishing activity was the same during open and closed season. This implies that the fisher sample households in the four selected provinces study areas are living depend on fishing activity and fishing is the main occupation. The result shows that the average fish caught per day was higher in open season (44.6 Kg) and only 8.8 Kg in closed season. Specifically for snakehead, quantity of fish caught was 7.6 Kg in open season and only 0.5 Kg in closed season. Whereas, the average income from fishing activity with all species in open and closed season were USD 39.2, ranged from USD 1.4 to 782.4 and USD 11.8, ranged from USD 0.5 to 87.5, respectively. Specific to snakeheads, in open season was USD 11 and in closed season was USD 4.4. Moreover, the average total sample household income, including fishing and non-fishing activity was USD 46.6 per day with ranged from USD 1.4 to 785 in open season and USD 13.8 with ranged from USD 0.5 to 152 in closed season (Appendix Table 11).

Size of snakeheads caught by the sample fisher households was not different between open and closed season. Size of wild snakeheads was categorized into three types: size 1, size 2, and size 3. An average size of fish of size 1 was 0.7 Kg/fish, size 2 was 0.4 Kg/fish and size 3 was 0.2 Kg/fish in open and closed season. Overall, it ranged from 0.2 to 2 Kg/fish and size of fish was bigger during closed season. Regarding to trend of caught fish size of wild snakeheads, about 54% of the sample fisher households responded that size of snakeheads was decreases, 39% was responded unchanged and only 7% said that the size of snakeheads was increased.

Over half of fisher households who responded that size of snakehead would decrease revealed some reasons such as 1) numbers of fishers were increasing; 2) not only size of fish but also quantity of fish was also decreased because of illegal fishing; 3) due to the fact that water level either in river or lake became shallow, feed for fish was not enough and fish might not be able to migrate for breeding and grow well and the last, growth rate of fish did not simultaneously support to and was not suitable for population growth and consumption demand.

Controversially, very few of fisher households said that size of snakeheads would increase because in close season fish was not allowed to be caught, so it could grow well. Moreover, because it was decreased in using illegal fishing gears like mosquito net, electro fishing gear, so fish can breed and grow well. Furthermore, water level in river or lake was higher compared to that last year (2009). Another point, it was observed that there were more small fish in rivers or lakes than in the previous years.

3.1.1.6 Price of Snakeheads

An average price of snakeheads got by fisher was lower price than wholesaler and retailer price. Selling price of snakeheads for fisher was higher during low period of open season (March to May) (USD 1.8/Kg) and closed season (June to September) (USD 1.7/Kg), whereas lowest price during open season (October to February) (USD 1.6/Kg). This implies that the average price of snakehead was similar between open and closed season.

Regarded to trend of fish price, the result show that about 80% of the sample households said that price of all fish species and snakeheads were increased. Majority of fisher households

responded that, the reason for increasing price of snakeheads as well as of other fish species due to the decrease of total fish catch as well as fish stock in the natural resources from day to day, population growth (high fish consumption demand) and the high price of fuel/oil.

3.1.1.7 Marketing and Distribution of Snakeheads

Appendix Table 12 shows the marketing channels for snakeheads sold by fisher sample households. Overall, the total caught of capture snakeheads by sample household was sold to local fish traders (27%), local processors (22%), traders from other provinces (20%), and own sale at the village and local market (24%) and the rest kept for household consumption (7%). During open season, most of snakeheads (65%) was sold to local fish traders/collectors and local processors and other traders from other province or outsider of the village. Whereas, during closed season majority of fish caught (74%) was sold to trader from other provinces, local traders and local processors. Furthermore, around 21.5% of snakeheads was own sales. In addition, there was no direct selling of fresh snakeheads to supermarkets or restaurants. This implies that, the main buyers of capture snakeheads were local people who used to buy or collect fish and distribute to other traders, buyers according to market demands.

3.1.1.8 Credit System for Fishers

In Cambodia, borrowing and lending of money are common practices in the rural areas. However, for small scale sample fisher household in the study areas, majority (69.4%) borrowed money to support the fishing operation, such as for buying fishing gears/equipments, fuel, etc. Only (30.6%) used their own money for fishing activity.

The common sources of funds were private bank, fish collects/traders, Micro-credit/finance (NGOs), local money lenders, and friends/relatives without interest. Majority (98%) source of loan for sample fishers in the study areas were private bank, micro-credit/finance NGOs, local money lenders, and fish collectors/traders. However, only (8%) borrowed money from their friends/relatives without interest to finance their fishing operation (Appendix Table 13).

Normally, an average amount of loan was USD 1,138.6, ranged from USD 20 to 20,000. The average interest rate for the loan was (5%) per month, which ranged from (1%) to (35%) per month. Furthermore, average loan duration was 10 months with ranged from 2 months to 3 years (Appendix Table 14). The purpose of getting loan was mostly to buy fishing gears and boat engines. Besides this, it was used for buying rice, paying on medical treatment, sending children to school, buying inputs and cattle/cow for farming, and running a small business.

3.1.1.9 Advantages, Difficulties and Solutions of Small-Scale Fishers

Although fishing activity brought fishermen some hardship and risk, it was still a good choice for them. Moreover, fishing was still the main occupation for household heads and as an additional job for household members to support the families. Moreover, it was very important for daily fish and food consumption, which consists of high protein and nutrition food for them. In addition, it is not only food supply but they could earn some money by selling fish to support their families and send their children to school. Beside this, they could also catch wild small fish for culture as well.

However, there were some difficulties encountered to fishers. One of which was the shortage of fishing grounds for small-scale fishing activity. In some cases, it was very competitive to have places for fishing. Second, it was the decrease of fish catch and wild fish stock in rivers, resulting from illegal and over fishing. Third, it was high cost of inputs, mainly on fuel, food,

fishing gears and informal-fee payments. Another thing, it was lack of capital.

To deal with the lack of fishing grounds, some of fishers had to find new places for fishing in spite that it was far from home. Another thing, some fishers changed to culture fish in complement to wild fish which was deficient. Additionally, some fishers had borrowed money from the banks, micro-finance institution or local money lender in the village with high interest rate to buy fishing gears and pay on other inputs.

3.1.1.10 Perception for the Future Plan of Fisher on Fishing Activity

Appendix Table 15 shows perception of sample fisher households on fishing activities in the future. Related to fishing ground/fishing areas for fishing activities, type of fishing gears/equipments, number of labors involved in fishing activities, fishing techniques, time for fishing, fish marketing, changing career are encompassed in the perception of fisher households. The results shows that, most of fisher households (about 67% to 90%) would not change in all factors, whereas only (10% to 33%) of them wanted to change and extend the fishing ground, increase number of fishing gears/equipments, number of labors involved in fishing activities, fishing techniques, time for fishing activities, to extend in fish marketing and want to change from fishing to other job or possible alternative livelihood. Overall, most of them satisfied with their careers as fishers. This implies that majority of sample fisher households would not change their habit or career on fishing activity. This may be they inherited or got this career from their parents or grandparents. They may also have no alternative job or livelihood activities in those areas, and other skills.

3.1.2 Farmers of Snakeheads

3.1.2.1 Socio-demographic Characteristics of Fish Farmer Households

Gender, Age, Education and Experience of Snakehead Farmers

The total sample of snakehead farmers is 75 households. Of this, 65 samples were in Kandal province and only 10 samples were in Siem Reap province. Based on what have found in the study, there were only these two provinces where snakehead culture was practiced in specific areas such as pond and cage culture. An average age of farmer household head was 41 years, with ranged from 20 to 61 years. Appendix Table 16 shows age group distribution of heads of fish farmer households by sex. According to the table, majority of fish farmer household heads were male (76%). Furthermore, most of the household heads (both male and female) aged from 31 to 40 years old (29.33%) and from 41 to 50 years old (29.33%). This may be within these ages they had good experiences on fish culture, management and capital.

Overall, the highest percentage of fish farmer household heads finished their study at primary school (53.33%), whereas the lowest completed upper secondary school (1.33%). Most of the household heads studied at primary school were male (34.67%) (Appendix Figure 2). This implies that majority of educational level of fish farmer household heads were primary and secondary.

Normally, heads of fish farmer households who had more experience in fish farming were educated at primary school (7.58 years) and at secondary school (7.40 years). Moreover, male heads of households had higher fishing experience than female-headed households. This implies that fishing experience of fish farmer household heads was not necessarily related to their educational background (Appendix Table 17).

3.1.2.2 Size of Household Members and Labors Involving in Farming Activities

An average size of fish farmer household was about 5.17 persons, with ranged from 2 to 10 persons. Within this, male were about 2.65 persons, ranged from 1 to 6 persons, and female were 2.52 persons, ranged from 0 to 7 persons, since some households did not consist of female member (Appendix Table 18).

Nearly all of fish farmer households (94.67%) did not hire laborers to work in fish farming. Instead, all work was done by family labors, in which female shared around 50.83% to the total number of family labors. However, only few of fish farmer households (5.33%) hired more laborers. Thus, in average, number of family labors involving in fish farming per household was 3.20 persons, ranged from 1 to 8 persons. In this number, male was 1.57 persons, ranged from 0 to 4 persons, and female was 1.63 persons, ranged from 0 to 5 persons. Additionally, average number of hired labors for fish farming per household was 1.75 persons, ranged from 1 to 2 persons (Appendix Table 19).

3.1.2.3 Production of Snakeheads

Farm Design

Only two types of farming systems of snakeheads - pond and cage farming systems - were found practicing in the study areas. Before being sold out to markets, snakeheads needed to come across a few steps of hatching, nursing and growing. However, what have been found here, fish was raised from only nursery until growth out. Generally, for nursery, each fish farmer household could possess around 1 pond or cage (sized 29.36 m³ for pond and 7.39 m³ for cage). Average dept of water containing in the pond was 1.52 m and in the cage was 0.80 m. Average number of crop/cycle at which fries of snakeheads could be nursed in pond and cage was the same which was only 1 time per year. Moreover, a crop/cycle of a pond lasted only 48.73 days, while that of a cage lasted up to 72.47 days. Within the above mentioned volume and water depth, a pond could store around 2,850 heads of fish fries and a cage could hold about 5,118.42 heads of fish fries. Nonetheless, in term of growth, pond and cage might be varied from the former to some extent.

In general, average number of ponds or cages available in each fish farmer household was only one (sized nearly 441 m³ for pond and 20.60 m³ for cage). Average depth of water either in a pond or a cage was almost the same (about 2 m for pond and 1.86 m for cage). In addition, snakeheads could only be grown 1 time/year no matter it was fed in a pond or a cage. Average number of days per crop/cycle of raising fish in a pond was 240.41 days; while in a cage was 225.30 days. Moreover, with the aforementioned volume and water depth, a pond could hold around 2,093.94 heads (fish) of fingerlings and a cage could bear about 2,715.48 heads (fish) of fingerlings (Appendix Table 20).

Average size of areas for fish farming, if compared to the past, remained unchanged until now no matter fish was nursed or grown in a pond or a cage. Moreover, most of the species cultured was hybrid snakeheads, followed by giant snakehead.

Snakehead Culture Techniques

Normally, pond and cage were prepared by most of snakehead farmers in May, June, and July for nursery, and in September for growth. For nursery, average period from preparation to stocking was around 2.3 days and water in pond was usually exchanged in every 9 days with rate of water exchange 44.8%/time. Furthermore, for growth, average period from preparation

to stocking was about 4.1 days and water in pond was exchanged in every 10.8 days with rate of water exchange 43.3%/time (Appendix Table 21).

In general, fish fries were mostly nursed in June, July and September. It was then applied into a pond in July and September, and a cage in October and December for growing after becoming fingerlings. Average stocking size of fries for being nursed was from 2.07 grams/head (in a pond) to 3.28 grams/head (in a cage). Moreover, average stocking size of fingerlings for being grown was from 31.36 grams/head (in a pond) to 52.12 grams/head (in a cage) (Appendix Table 22). Most of the cases, average stocking size of fries and fingerlings (either in a pond or a cage) remained the same since the past till now.

Cost of Production

Production cost of fish farming covered 2 types of costs: variable and fixed cost. Variable cost included preparation and operational cost. In this context, preparation cost was expense on clearing grass and liming. Operational cost encompassed expenses on buying broods, fish feed, hiring laborers, water exchange (for fish farming in ponds), disease and water treatment, transportation and communication. Furthermore, fixed cost focused on construction cost (with depreciation cost), tax, rent of location, repair or maintenance on the equipments and interest expense. Construction cost referred to expenses on buying equipments and digging ponds or making cages. Thus, average variable cost of each snakehead fish farmers per cycle (year) was USD 2,686.35 and average fixed cost was around USD 340.34. Hence, average total cost was about USD 3,026.69/cycle.

Supplying Sources of Fries/Fingerlings of Snakeheads

Supplying sources of fries and fingerlings of snakeheads included fishermen, nursery sites, fish farmers and importation from Vietnam. Nearly all of fish farmers used fries and fingerlings that were imported from Vietnam (95.7% of the household for nursery, and 89.3% of the households for growth) (Appendix Table 23).

Since average stocking size of fries and fingerlings varied by pond and cage, its average buying price was also different, to some extent. Overall, average buying price of fries was about USD 0.04/head and of fingerlings was USD 0.22/head.

Feed for Fries/Fingerlings of Snakeheads

Appendix Table 24 shows percentage of feed types for snakeheads by type of farming system. Feed for fries and fingerlings, generally encompassed fresh water trash fish, marine trash fish, head and bone of P. Catfish, fresh water crab, commercial/pellet feed, and other feed such as corn and soybean. Average quantity of feed for fries per fish farmer household was about 593 Kg/cycle, in which fresh water trash fish highly contributed about 35.73%, followed by marine trash fish and pellet feed, respectively. Furthermore, average quantity of feed for fingerlings per household was about 5,434 Kg/cycle, in which fresh water trash fish still actively involved around 46.43%, followed by marine trash fish and pellet feed, respectively.

Overall, not all feed mentioned above was totally bought. Some feed was naturally found by fish farmer households from river or lake nearby. It included fresh water trash fish and golden apple snails. Majority of feed for fries was fresh water trash fish (79.84%), while the rest was golden apple snails (20.16%). Moreover, the highest percentage of feed for fingerlings was still fresh water trash fish (70.78%), whereas the remaining was golden apple snails (29.22%) (Appendix, Table 25). Additionally, types and amount of feed used in fish farming had no

change at all from the past until now.

Price of feed for fries and fingerlings was not very different. In average, buying price of feed for fries was about USD 0.33/kg, ranged from USD 0.15 to 0.50. Moreover, average buying price of feed for fingerlings was around USD 0.32/Kg, ranged from USD 0.15 to 0.48 (Appendix, Table 26). Furthermore, price of fish feed, no matter it was natural or man-made, tended to keep on increasing from the past until now and this trend might continue to the future.

Harvesting of Snakeheads

Habitually, most of fish farmer households started to harvest fingerlings in September (for a pond) and October (for a cage). Thus, these two months were the suitable time for fish farmers to harvest fingerlings. After applying these fingerlings into a pond or cage for growing, they had to wait for around 5 to 6 months for fish to be mature and caught for selling in April. Normally, size of fingerlings and snakeheads was categorized into three classes. For fingerlings, average size 1 was 66.82 g/fish; size 2 was 45.71 g/fish; and size 3 was 30.48 g/fish. In average, size of fingerlings was around 46.19 g/fish, ranged from 20 to 100 g/fish. Furthermore, for mature snakeheads, average size 1 was 1.13 Kg/fish; size 2 was 0.74 Kg/fish; and size 3 was 0.46 Kg/fish. Hence, average size of snakeheads caught for selling was 0.78 Kg/fish, ranged from 0.33 to 1.50 Kg/fish. Average annual production of fingerlings per fish farmer household was around 2,442 fish, in which the majority was size 2 (42.62%), followed by size 1 (36.4%) and size 3 (21%). Moreover, average annual production of snakeheads per fish farmer household was about 1,800 Kg, in which size 2 shared the highest percentage (40.67%), followed by size 1 (29.67%) and size 3 (29.67%) (Appendix, Table 28 and 29).

Marketing and Distribution of Snakeheads

It was obvious that fingerlings, after being nursed, were not sold out to markets. Instead, all of them were grown in either a pond or cage, and would be caught for selling when they became mature snakeheads. Frankly, within total quantity of production per cycle, largest number of snakeheads was sold out to local fish traders (38.8%). It was also sold to wholesalers (31%), to traders from other provinces (18.4%) and own sale in markets (8.3%). Moreover, only less of it was kept for household consumption (3.5%) (Appendix, Figure 3 and Table 30). Snakeheads were mostly sold out without any classification.

Price of snakeheads varied in virtue of fish size. Generally, average selling price of size 1 at farm gate was about USD 2.06/Kg; size 2 was USD 1.97/Kg; and size 3 was USD 1.90/Kg. Thus, regardless of its size, average selling price of the fish was USD 1.98/Kg, ranged from USD 1.50 to 2.50 (Appendix, Table 31). Trend of selling price of snakeheads from the past until now was no time decreased. Hence, it kept on increasing from day to day and could possibly continue augmenting to the future.

3.1.2.4 Credit System for Snakehead Farmers

According to the study, more than 50% of fish farmer households received loan from outsiders to run their business, whereas nearly half of them had their own capital and did not get any support from others. Loan providers for snakeheads farming were village lenders, banks, micro-credit institutions, NGOs and others. Based on the findings, village lenders played an important role in providing loans to most of fish farmers (63.3% – 69.2%). Normally, average amount of loan for nursery was USD 915, ranged from USD 50 to 7,000. The loan lasted only

2.06 months in average, with 3.80% of interest rate per month. In addition, average amount of loan for growth out was USD 865.82, ranged from USD 50 to 7,000. The duration of loan was 6.44 months with interest rate 3.57% per month (Appendix Table 32 and 33).

3.1.2.5 Advantages, Difficulties and Solutions of Snakehead Farmers

Fish culture via nursery and growth out brought many advantages to fish farmers. First of all, broods of snakeheads were cheaper than fingerlings. Therefore, feeding fish by starting from broods (nursery) was more profitable. Second, culturing fish provided not only fish for household consumption but also for sale for income to support the families. Third, farming fish could be a good job for women since it was done at home or near home. Thus, while taking care the families, women could also do some activities to earn more income for the households.

However, there were some difficulties faced by fish farmers. One of them was fish feed. It was true that feed used for snakeheads farming was mostly trash/low value fish, so most of fish farmers were difficult to find or afford to buy it since it now was scarce and its price was high. Frankly, there was also some man-made feed (pellet feed) for fish, yet its price was also high and could be hardly affordable for fish farmers. Another problem was the limitation of appropriate technologies of raising fish. As a result, rate of fish death from uncontrollably infected diseases was high. Furthermore, lack of capital was still a problem for most of fish farmers.

In order to cope with the death rate of fish, fish farmers put more efforts on the farming by frequently exchanging water (ponds) and using medicines, both modern and traditional medicine, to cure disease-infected fish. However, this method did not always work.

3.1.2.6 Future Plan for Snakeheads Production

Majority of snakeheads farmers would choose hybrid snakeheads (93.3%) for future snakeheads production. This was because fries of hybrid snakeheads were always available whenever wanted unlike fries of wild snakeheads. Moreover, hybrid snakeheads were easier to feed and grew faster than wild snakeheads did. Another thing, hybrid snakeheads could be more resistant to infected diseases. Furthermore, in which farming system (pond or cage) hybrid snakeheads culture was practiced depended on location and place where fish farmers were living (inland or on the river).

Concerning with production techniques and activities of culturing snakeheads, including volume of location, farming system, fish species, stocking density, feed, time to harvest, and fish distribution, the highest percentage of fish farmer households did not have any plan to change. The reason was the limitation of capital, mainly related to expansion of farming system. Moreover, fish species used every day was growing fast and space in farming system with daily-applied feed was good enough for fish to grow.

3.1.3 Snakehead Traders

3.1.3.1 Socio-demographic Characteristics of Trader Households

Gender, Age, Education and Experience of Snakehead Traders

Appendix Table 34 shows age group distribution of fish trader household heads by sex. According to the table, majority of fish trader household heads were between 41 and 50 years

old (33.85%), in which most of them were female. However, only few of fish trader household heads were above 60 years old (3.08%). Of the total sample respondents, the highest percentage was female (87.69%), while the lowest was male (12.31%).

There were four educational levels in which respondent households obtained such as: illiterate, primary, secondary, and upper secondary schools. Most of the respondent households finished their study at primary school (44.62%), while few had studied at upper secondary school (Appendix, Table 35).

Appendix Table 36 shows average year of trading experience of fish traders with their educational background by sex in all provinces. Overall, experience of fish traders in the trade was between 2 to 31 years. In average, fish trader households who were illiterate/uneducated had the highest experience in trading fish (18.41 years), while those who had the highest educational background –upper secondary school- had the lowest experience in trading fish (4.33 years).

3.1.3.2 Size of Household Members and Labors Involving in Snakeheads Trade

Overall, average numbers of fish trader households' members in the study areas were 4.24 persons, ranged from 1 to 9 persons. Within this number, male were about 2.04 persons and female were around 2.20 persons. Moreover, average number of the household members who were engaged in fish trade was 2.06 persons, ranged from 1 to 6 persons, in which male was about 0.75 person and female was around 1.31 person. Furthermore, according to the study, majority of fish trader households did not hire labors (86.15%), while few of them did (13.85%). Generally, average number of hired labors for each trader household was 2 persons, ranged from 1 to 3 persons, in which male was 1.50 persons and female was 1.50 persons (Appendix, Table 37).

3.1.3.3 Trading Activities and Trend of Snakeheads

Normally, fish was traded at landing sites, markets or homes. Sometimes fish was also traded nomadically. The study revealed that most of trader households traded fish at local markets (76.92%), while least of them traded fish at homes (4.62%) (Appendix, Table 38).

Fish trader households did not buy and sell fish in year round. They traded fish, mainly snakeheads only around 10.7 months per year, ranged from 2 to 12 months. Additionally, average number of day involving was only 24.3 days/month, ranged from 3 to 30 days. Average quantity of fish (both fresh water and marine fish) traded per day by each trader household was 94.7 Kg, in which about 93.1 Kg was fresh water fish.

Supplying sources of fresh snakeheads and snakehead processed products encompassed fishers, farmers, retailers, middlemen/whole traders, processors and importers. In term of fresh snakeheads, most of giant snakehead was bought from middlemen/whole traders (27.69%) and fishing lot owners (26.08%). Moreover, most of common snakehead was bought from processors (25.47%) and middlemen/whole traders (21.45%). For snakehead processed products, large quantity of salted-dried fish was supplied by middlemen/whole traders (34.09%) and processors (32.58%). Furthermore, fermented fish/paste was mostly supplied by processors (31.75%), retailers (31.75%), and middlemen/whole traders (30.16%) (Appendix, Table 39).

Generally, quantity, size and price of snakeheads and snakehead processed products were different in accordance with time of trade. Overall, snakeheads were abundant from January to February, but scarce from June to July. In addition, snakehead processed products were

plenteous from February to March, but shortage from April to September (from April to July for fermented fish/paste and from July to September for salted-dried fish).

Overall, average quantity of snakeheads traded per day by fish trader household was 127.04 Kg (55.37 Kg for giant snakehead and 71.67 Kg for common snakehead). Moreover, average quantity of snakehead processed products traded per day by fish trader household was 16.09 Kg (11.09 Kg for salted-dried snakehead and 5 Kg for fermented snakehead fish/paste). Furthermore, average size of snakeheads traded was between 0.56 to 1.30 Kg/fish, and of snakehead processed products was between 0.53 to 0.62 Kg/fish. Average buying price of snakeheads was from USD 2.42 to 2.85/Kg, and of snakehead processed products were between USD 3.68 to 7.50 Kg. In addition, average selling price of snakeheads was between USD 2.70 to 3.16/Kg, and of snakehead processed products were from USD 4.33 to 8.75/Kg. Additionally, rate of weight loss for snakeheads during the trade was around 3.78%, and for snakehead processed products was between 4.20 to 12.83% of total quantity of snakeheads and snakehead processed products traded (Appendix, Table 40). It can be said that, regardless of weight loss and total costs on trading activities, salted-dried snakehead was the prioritized product for trader households to obtain more net profit, followed by fermented snakehead fish/paste.

Customers of snakehead traders included end consumers, retailers, middlemen/whole traders, processors, exporters, supermarket and restaurant. Annually, largest quantity of fresh snakeheads and its preserved products were directly and respectively sold to end consumers and retailers in local areas (Appendix, Table 41). In addition, most of snakeheads and snakehead processed products sold were cultured snakeheads.

Trend of quantity of snakeheads traded has been unchanged from past until now, but trend of quantity of salted-dried wild snakeheads and fermented snakehead fish/paste (both wild and cultured) decreased, and trend of quantity of salted-dried cultured snakeheads increased. Moreover, trend of percentage of fresh wild giant snakehead fish, salted-dried wild snakeheads and fermented snakehead fish/paste from past until now decreased, while of fresh cultured giant snakehead and fresh common snakehead (both wild and cultured) and salted dried culture snakehead remained unchanged until now. Furthermore, trend of fish size for fermented cultured snakehead fish/paste decreased in comparison with that in the past. Trend of fish size of fresh snakeheads, salted-dried snakeheads and fermented wild snakehead fish/paste stood still until now. Another thing, trend of price of snakeheads and snakehead processed products increased, compared to that in the past.

Quality of snakeheads as well as its processed products was good and this goodness remained unchanged from the past until now according to most of trader households. Moreover, convenience in trading snakeheads now was medium and this convenience was unchanged in comparison with that in the past. However, convenience in trading its preserved products was mostly bad now and this seemed to decrease. Another thing, regarding to information which related to the trade of snakeheads and its processed products, it was, most of the cases, still good.

3.1.3.4 Costs on Snakeheads Trade

The sample fish trader households in this study were selected from different scales of trader households including small, medium and large scales. As aforementioned, fish was traded nomadically, at home, at local market and at landing site, and involvement of trader households in fish trade was mostly at local market. Normally, average size of areas for trading fish at the markets was 3.16 m² with average cost on construction/rent about USD 744.32 and

on buying equipments USD 207.51. Average tax on the trade in the market was USD 80.80 per annum. Furthermore, average areas at which fish was traded at landing site was approximately 10.55 m², with USD 1,920.36 on construction cost/rent, USD 751.38 on equipments and USD 195.81 on annual tax. Additionally, at home an average area for fish trade was around 60.33 m². The average cost on construction/rent was USD 125 and on equipment was USD 300. There was no tax paid on fish trade at home. One more thing, average trading area for some trader households who nomadically traded fish was 1.20 m². Average cost on construction/rent was USD 18.75 and on equipments was USD 40.13. Annually, average tax on fish trade was USD 57.79.

Normally, cost on fish trade covered variable and fixed costs. There are variable costs for fish trader household and these include expenses on labor wage, transportation, conservation, utility, communication, and other expenses. Moreover, fixed cost on the trade referred to expenses on trading site construction and machinery (depreciation cost). Furthermore, expenses on tax, maintenance, and interest on borrowed money were also taken into account in fixed cost. Hence, average variable cost on the trade for trader household was USD 44,449.65/year and average fixed cost was USD 1,279.59/year. Therefore, average total cost of fish trader household on the trade was USD 45,729.24/year. This implies that fish traders need the average capital for fish trade around USD 45,730/year.

3.1.3.5 Support to Snakehead Traders

Business of fish trade required a lot of money, but not all fish traders had enough capital. Besides depending upon loan from banks, those fish traders also received some supports from fish supplying sources via buying fish on credit. Moreover, places where fish was sold were also organized under intervention from market officers. Furthermore, at the same time, fish traders also provided some supports to their buyers. For instance, any buyers who bought more fish would be given free charge of fish transportation to their areas. In addition, fish price was discounted whenever fish was bought by their daily customers. Even more, fish could be sold on credit to their customers who could not afford to buy it.

3.1.3.6 Difficulties and Solutions for Trading Snakehead

There were some difficulties to which fish traders confronted in the business. Firstly, amount of fish, especially wild fish were not enough for them to buy and supply to markets. Sometimes because fish was scarce, most of fish traders had to do price auction. The one could offer higher price would get fish for selling. As a result, fish would be unavoidably sold at higher price and this made fish traders received only little profit. Another thing, price of fish was not fixed. It always changed from one trader to another, so it was hard set one exact price. Furthermore, quality degradation, weight loss and death rate were always the important cases happened to fish, especially during loading to markets. This could not be fully controlled by fish traders since their knowledge on fish conservation was still limited. Moreover, fish traders seemed to spend more money on business operation mainly on transportation. Furthermore, capital was still a problem in the business transaction.

In order to handle not-good-quality and dead fish, some fish traders put some ice to freeze the fish and some processed it into salted-dried fish, fermented fish, and fish paste. However, some traders decided to sell it out at lower or lost price.

3.1.3.7 Future Plan for Snakehead Trade

Majority of fish traders did not plan to change their business since trading fish was their family careers and they had experiences in fish trade for many years. Another thing, by trading fish, they could earn some money to support the families. Moreover, because running the business for many years, most of them had permanent buyers who always kept buying fish from them. One more thing, they could not change to other kinds of business since their capital was limited.

3.1.4 Processors of Snakehead

3.1.4.1 Socio-demographic Characteristics of Snakehead Processors

Gender, Age, Education and Experience of Snakehead Processors

The highest percentage of processor household heads was female (70%). Appendix Table 42 shows age group distribution of processor household heads by sex. According to the table, majority of processor household heads aged 41 to 50 years old (35%), of which female represented around 25%, while male had only 10%. However, very few of processor household heads aged 20 to 30 years old (10%).

There were only two educational levels – primary and secondary schools – in which heads of processor households obtained. The highest percentage of them was educated at secondary school (60%). Within this number, female shared around 40%, while male contributed only 20% (Appendix, Table 43).

In average, heads of processor households who were educated at secondary school had higher experience in fish processing (13 years) than those who completed primary school (12 years). Regardless of educational background, female-headed processor households had average processing experience about 14.4 years, higher than male-headed processor households did (8.3 years). This implies that female-headed processors were more familiar and had more experience in processing fish than male-headed processors did (Appendix, Table 44).

3.1.4.2 Size of Household Members and Labors Involving in Processing Activities

Average numbers of processor household members in labor age were 4.7 persons, ranged from 2 to 12 persons. Of these numbers, male members were about 2.3 persons, ranged from 1 to 6 persons. Female members were around 2.5 persons, ranged from 1 to 6 persons (Appendix, Table 45).

Totally, average number of household members in labor age which involved in fish processing was only 3.3 persons, in which male was 1.9 persons and female was 1.8 persons. Normally, fish processing required much work and time. Thus, some processor households could not completely do the processing work by themselves. As a result, nearly half of them hired more workers. In average, each processor household hired 2.1 persons, varied from 1 to 6 persons. Of these hired numbers, male was 2 persons and female was 2 persons (Appendix, Table 46).

3.1.4.3 Supplying Sources and Quantity of Snakeheads

Snakehead processed products were preserved from wild and cultured snakeheads. Appendix Table 47 shows percentage distribution of supplying sources of fresh snakeheads for snakeheads processing. The supplying sources included fishers, fishing lot owners, fish

farmers, middlemen, wholesalers, other processors, retailers, and imported from Vietnam. According to the table, majority of wild snakeheads was supplied by other fish processors (28.7%), followed by middlemen (25.7%) and wholesalers (24.1%). Furthermore, for cultured snakehead fish, the highest percentage of it was from Vietnam (30.1%), followed by fish farmers (24.9%).

Overall, average distance to buy wild snakeheads was from 7.4 to 8 km with 2.6 to 3.9% of weight loss through transportation. In addition, average distance to buy cultured snakeheads was 3.8 to 15 km with 3.9 to 5% of weight loss via loading.

According to the study, snakeheads were processed into salted-dried snakeheads and fermented snakehead fish/paste. Commonly, processors involved in snakeheads processing only 4 to 9 months/year. Fresh snakeheads were usually bought around 6 to 40.2 times per month and about 270.8 to 425.7 kg/times. Moreover, average size of snakeheads bought varied from 0.5 to 1 kg/fish with average buying price about USD 1.9 to 2.5/kg. Annually, snakeheads could be processed into salted-dried fish about 126.37 times in average with cycle period around 2 days. Furthermore, fermented snakehead fish/paste could be processed only 2 times/year with cycle duration of about 90 days/time.

Based on what have found in the study, not all processor households processed only snakehead fish. Average quantity of fresh fish (all fish species, including *Chhdaur and Raws* “snakehead”, *Ondaeng* “walking catfish”, and *Chhveat Doung* “shortbarbel pangasius”) and ingredients (salt, sugar, soup powder, garlic, and ginger) bought per year by each processor household was 8,876.2 Kg. Within raw materials used, fresh snakeheads used for processing consisted of about 5,858.8 Kg, accounting for 66% of all raw materials used for fish processing.

3.1.4.4 Cost of Snakehead Processing

Cost of snakehead fish processing encompassed variable cost, which also included operational cost, and fixed cost. Generally, variable cost covered expenses on buying fresh snakeheads, ingredient, hiring laborer, transportation, conservation, communication, and utility. Furthermore, fixed cost was expenses on construction works, machineries, tax, location, maintenance and interest. Construction works here referred to payment on buying materials and building shelves for keeping fish after cleaned, and sun deck and balcony for drying fish. Machineries for processing fish included machine for beheading fish, machine for shaking fish when cleaned, and water pumping machine. Taxes referred to payment for business operation and environment. Location rent was expense on hiring processing place.

According to the study, only few of processors had to pay for location since they came from other provinces in order to process fish in a definite time, and would go back to their provinces when the processing period was finished. Generally, expense on construction works and machineries mainly referred to its depreciation cost per year, while tax and location rent were the expenses paid once per annum.

Therefore, average variable cost of snakeheads processing per processor household was around USD 9,582.2/year and average fixed cost was about USD 605.65/year. Thus, average total cost of each processor household was USD 10,187.83/year.

3.1.4.5 Products of Snakeheads

As aforementioned, there were 2 types of products processed from snakehead fish. They were

salted-dried snakeheads (Trey Ngeat) and snakehead fish paste with bone less (Phra hoc), including fermented snakeheads (Mam). Salted-dried snakeheads were divided into 2 types: whole and headless salted-dried fish. Moreover, fermented snakehead fish/paste had only 1 type which was boneless fermented fish/paste. Most of processor households processed snakeheads into salted-dried fish (95%), whereas few of them processed snakeheads into fermented fish/paste (5%). In addition, according to observation, there was also a kind of fish products preserved from snakeheads such as salted fish cheek - made from fish cheek (Thpal Trey).

Normally, each processor spent around 9.32 (for salted-dried snakeheads) to 12 months (for fermented snakehead fish/paste) per year to sell out snakehead fish processed products. Annual total production of snakehead processed products per processor household was approximately 2,388 Kg (with average conversion ratio 2.5:1), in which 92.07% was salted-dried snakeheads and 7.93% was fermented snakehead fish/paste. Additionally, average selling amount of salted-dried snakeheads per time was 27.79 Kg with average selling price about USD 6.01/Kg. Moreover, average selling quantity of fermented snakehead fish/paste was 0.50 Kg/time with average selling price USD 4.25/Kg.

3.1.4.6 Consumer Sources of Snakehead Products

Buyers of snakehead processed products were middlemen, wholesalers, retailers (mainly in Phnom Penh), end consumers, and super markets and restaurants. After processed, all of fermented snakehead fish/paste was sold directly to end consumers in markets. However, for salted-dried snakeheads, most of it was sold to retailers in Phnom Penh (22.3%) and end consumers (22.2%). Moreover, only less of it was kept for household consumption (9.9%) (Appendix, Figure 4).

3.1.4.7 Credit System for Snakehead Processors

To get the business started and to make it in smooth progress, outside supports are needed in order to strengthen and expand the business. According to the study, there were many involvements of outside organizations as well as institutions in the business of processing snakehead fish. All of them were: financial organizations/banks/loan providers, local authorities, universities/institutions, market management officers, market managers, fish suppliers, buyers/consumers, and others.

In this context, support from financial organizations/banks/loan providers referred to the support in term of money lent to processors with interest for financial organization or banks, and without interest for loan providers, who were mostly traders/wholesalers/retailers of snakehead preserved products. Moreover, the support from local authorities and universities/institutions meant the support via extending appropriate fish processing techniques, etc, which could help processors improve their income.

The support from market management officers included guarding the shops mainly at night time, guaranteeing for security at day time, and cleaning around the shops to make sure that the products, sellers and buyers in the markets were safe, and the selling of products was going hygienically and smoothly. Additionally, the support from market managers referred to the support in building market infrastructure, and organizing and arranging shops in markets to ensure that all kinds of the products, not mainly only fish processed products, could be easily found and purchased.

The support from fish suppliers was specifically about money loan when fish was bought. This meant that money was not immediately given by processors to fish suppliers when the fish was sold.

Finally, the support from buyers/consumers meant the support in term of their preference on the fish processed products and thus, they often bought those products from processors.

However, in reality, the possibility and accessibility to grant the supports from the above organizations/institution was limited, to some extent. Based on what have found in the study, most of processor households (55%) responded that there was support from banks and loan providers to the processing business in their areas, but not many of them (30%) accessed to it. Although loan was mostly provided but not often received, it was rare that all processor household could obtain this support. Nevertheless, according to perception of processors, even though not many of them could get this support and it was not frequently accessed to, it was still good because it was one of effective sources on which processor households could depend to sustain their business.

Likely, there was no much support from local authorities, universities/institutions, market management officers, market managers, and others to the business of snakehead processors. Moreover, only few of processor households (5%) said that there was support from fish suppliers to their business in which many of them (60%) could receive this support.

However, few of them (35%) responded that there was no support from fish suppliers in their areas. Those who accessed to such kind of supports answered that they were frequently provided and thought that, most of the case, it was medium.

Beside this, most of processor households (65%) also granted the support from buyers/consumers. Those who received this support said that it was frequently provided, mainly when the processed products were sold out to those consumers. In processors' opinion, this support was only medium.

3.1.4.8 Advantages, Difficulties and Solutions of Processing Snakehead

Generally, processing snakeheads is a good activity that allows most of processor households to get high profit to support their family and to sustain their business. It is also a type of activity mainly to meet domestic market demand on snakehead processed products. Moreover, processing and processed products of snakeheads shared the largest quantity in processed products compared to other fish species. Besides sold for profit to support household expenditures, snakehead processed products were also kept for daily consumption. Moreover, processing snakeheads was a near-home job, so processors could have time staying at home and at the same time, earned more income for the family.

However, processing snakeheads might bring to processors some difficulties. First of all and most of the cases, it was the price of fresh/live fish which was steadily increasing. This led to the hardship of affording fresh/live fish for processing. Second, it was difficult for processors to process fish into a good product since their knowledge and technique in processing was still limited. Third, after fish were preserved, especially into salted-dried fish, processors found it hard to conserve its quality due to their knowledge about maintaining the product quality after processed was still low. Also, they faced difficulties selling out the products. Fourth, the mean and way in which the products were packed and loaded to markets was still problems for some processor households.

Besides these difficulties, some processors confronted to some troubles regarding to their own health. It was known that processing fish needed much time and laborers. Some of processor

households, because laborers could not be hired as many as needed, were tired as they had to spend all day long processing fish and selling the products. Furthermore, not all snakehead fish could produce good products. When quality of fish used for processing was not good, the products were not good as well. This caused problem when selling out the products. Besides the above difficulties, processors also encountered some more difficulties such as loss weight of fish when becoming processed fish, cheating from buyers, lack of capital, and high interest rate.

When problems arrived, some processor households had some solutions to deal with it, while few of them did not. However, not all solutions were effective. The solution for them was that although price of fresh/live fish was very high, they still ended up with buying it, or else they would not have fish for processing. In contrast, some processors chose not to buy fish for processing. Moreover, in order to increase quality of products, either before or after processing, some processors increased processing technique, used processing machine, froze the products or continued to process it into fermented products, and used some conservative substances and material for protection. To cope with the shortage of laborers to serve in processing work, most processors hired more laborers. Additionally, to deal with low-quality products some processors needed to sell it out at low price, even though sometimes it was lost.

3.1.4.9 Future Development Trend of Snakeheads Industry

When asked about perception of processor households on trend of snakehead fish industry in term of numbers of processors and quantity of snakehead processed in the upcoming time, most of them said that it would decrease (55%), while 35% said it would be unchanged and 10% said it would increase. Over half of them said the trend would decrease because fish was scarce, leading to augmentation of fish price. In addition, selling fish processed products was quite competitive since there were many sellers, and they could not get good profit.

3.1.4.10 Future Plan for Processing Snakehead

Future plan of processors on snakeheads processing is very important because it can reflect to sustainability of business of snakeheads processing and snakehead processed products in markets. When asked about their plan on snakeheads processing, half of processors responded that they would change their processing, while half more said they would not. Among those who would change their processing, only few of them chose to increase the processing amount for more income and only if there was demand from traders, whereas most of them chose to decrease or stop processing because fresh fish was scarce so they could not afford to buy it for processing. Moreover, it was not profitable; they did not have enough capital; they were getting older and older so they could not do the processing work for longer time; they wanted to reduce some expenses on labors; their children were busy to study; and they wanted to run other small business like opening groceries stores, etc.

In contrast, half of processor households did not plan to change their work due to the fact that processing snakehead fish was their main job and it was easy for them to sell their products after processed for some profit. Furthermore, the location on which their business was settled was good and suitable for processing work. Besides this, there were no other jobs that fitted to them, yet if there had been any, they did not have enough resources as well as capital to start the new business.

3.1.5 Snakehead Consumers

3.1.5.1 Socio-demographic Characteristics of Snakehead Consumers

Gender, Age, Marital Status, and Educational Background of Snakehead Consumers

Most of respondent households were female (80.60%), while few of them were male (19.40%). Appendix Table 48 shows age group distribution of respondent households by sex. According to the table, majority of them aged from 41 to 50 years old (30.60%), while the minority was more than 60 years old (7.50%).

The highest percentage of respondent households were married (87.31%), most of which were female (69.40%). In contrast, only few of consumer households were divorced (4.48%) (Appendix, Table 49).

Most of respondent households were educated at primary school (47%), most of which were female (36.57%) (Appendix, Table 50).

Generally, average numbers of household members for consumer household was around 5.81 persons, ranged from 2 to 11 persons. Within this number, average numbers of male members were about 2.82 persons, and female were around 2.99 persons. Moreover, average numbers of family members in labor age in each consumer household were only 3.68 persons, ranged from 2 to 9 persons. Along with this, male members were about 1.83 persons, and female were 1.85 persons (Appendix, Table 51). This implies that the average household member and number of family in labor age of male and female was the same.

3.1.5.2 Socio-Economic Activity of Snakehead Consumers

More than half of consumer households were living in rural areas, yet the rest was living in urban and sub-urban areas.

Livelihood activities of consumer households were cultivating rice, planting crop, feeding animal, fishing, culturing fish, trading, working as hired labor, and working in offices. Normally, average numbers of household members in each consumer household involving in these activities were from 1.36 to 3.24 persons. Additionally, each consumer household engaged in these activities from 4.49 to 12 months per year. Another thing, average annual production cost, mainly on rice farming, crop planting, animal raising, fishing, or fish farming, was varied depending upon each production practice. Thus, in average, it was around USD 4,030 and net income granted (from each activity for each household) was about USD 2,155.20 per year.

Totally, each consumer household monthly spent around USD 180.37 on household expenditure, in which about USD 87.56 was paid on foodstuff. Moreover, within the expense on foodstuff, perhaps USD 31.22 was spent on fresh water fish, in which approximately USD 13.67 was paid on snakeheads.

In average, fresh water fish was bought about 17.97 times/month and 0.93 Kg/time with average buying price of USD 1.86/Kg. Furthermore, snakeheads were bought around 6 times/month (since number of times snakeheads were bought equaled 33.45% of number of times fresh water fish was bought) and 0.90 Kg/time with average buying price of USD

2.54/Kg. Compared to other types of meat and marine fish, fresh water fish as well as snakeheads were more often bought and consumed. Moreover, it was bought in larger quantity per time after chicken (1.27 Kg/time) (Appendix, Table 52).

3.1.5.3 Information and Trend of snakeheads and snakehead products Consumption

The sample consumer households selected in this study were fishers, fish farmers, non-fishers and non-fish farmers. For fisher consumer households, the average annual quantity of fish caught were approximately 5,815.9 Kg, in which wild snakeheads contained around 330 Kg (229 Kg for common snakehead and 101 Kg for giant snakehead). On average, size of wild common snakehead was 0.41 Kg/fish which could be sold at USD 1.79/Kg, and of wild giant snakehead was 0.52 Kg/fish which could be sold at USD 1.92/Kg. Moreover, for fish farmer consumer households, average total production of fish culture with all types of fish species per year was about 1,830.7 Kg, in which giant snakehead was 1,576.8 Kg. Average size of cultured giant snakehead was 0.58 Kg/fish and with this size it could be sold out at USD 2.2/Kg (Appendix, Table 53).

Annually, fisher consumer households kept around 128.2 Kg of wild snakehead for household consumption, while fish farmer consumer households kept only about 11.9 Kg of cultured giant snakehead for household consumption.

Snakeheads were neither bought nor consumed every day. Habitually, live snakeheads were bought by consumer households once in every 8.44 to 12.63 days with average quantity from 0.76 to 1.70 Kg/time. Average distance to buy live snakeheads, from home to markets, was about 1.35 to 1.63 Km. Furthermore, snakehead processed products were bought once in every 21 to 32.60 days. The average quantity bought per time was around 0.9 Kg and average distance to buy those products was 1.64 to 2.11 Km (Appendix, Table 54). Quantity of snakeheads bought and consumed in both live and preserved forms, mostly seemed to have no change from the past until now.

Supplying sources of snakeheads and snakehead processed products were fishermen, fish farmers, middlemen, wholesalers, retailers, processors and own capture. Regardless of own capture, middlemen (20.43%), retailers (19.83%) and wholesalers (18.65%) were the main supplying sources of live snakeheads to consumers, respectively followed by fishers and fish farmers. However, for snakehead preserved products, it was mostly bought from retailers (35.45%) and processors (33.12%) (Appendix, Table 55).

In average, size of live giant snakehead bought from markets by consumers was 0.95 Kg/fish, with price of USD 2.92/Kg. The price would increase to USD 3.35/Kg when the fish was scarce (in April, May and July). In addition, average size of live common snakehead bought was 0.49 Kg/fish, with average price of USD 2.31/Kg. This price could augment to USD 2.75/Kg when there was no many snakeheads in markets. Moreover, average size of salted-dried snakeheads was 0.40 Kg/fish, with average price of USD 6.27/Kg. Furthermore, average size of fermented snakehead fish paste was 0.54 Kg/fish, with average price of USD 3.51/Kg (Appendix, Table 56).

If compared to the past, size of live snakeheads and its processed products were unchanged up to now. However, what gradually changed was its price which kept on increasing from day to day. Moreover, in consumer's perception, quality of live snakeheads and its products were good for them, and this good quality remained the same from the past until now. Another thing, both live snakeheads and its products were mostly easy to be handled and consumed, and this easiness continued to the present. Furthermore, information related to supply and demand of live snakeheads and its products could be known by consumers and the accessibility to this information was unchanged until now.

Generally, it was fact that majority of consumer households consumed snakeheads in live or fresh form (72.37%), while some of them used it in processed form (salted-dried, smoked and fermented) (27.63%). In addition, in consumers' perception, around 64.48% of them preferred consuming live/fresh snakeheads to using snakehead processed products (35.52%) (Appendix Figure 5 and 68, and Table 57 and 58).

3.1.5.4 Difficulties and Solutions of Snakehead Consumers

There were some difficulties for consumer households in using snakeheads. One of them was its quantity to meet consumption demand of consumers. Since now natural fish was scarce and consumers preferred using wild snakeheads than cultured snakeheads, the amount of wild snakeheads could impossible meet their demand. Another thing, it was reported that most of snakeheads, especially wild snakeheads was bought by traders or wholesalers in order to supply to big markets in city where those fish was intended to be offered at higher price. Hence, this took away the fish from consumers mainly lived in rural and sub-urban areas. Furthermore, price of snakeheads was increasing everyday and compared to that of other fish species it was even higher. Moreover, snakeheads bought from markets were not properly weighed by sellers and this was a problem putting more pressure on consuming snakeheads while its price was already increasing.

To deal with the deficiency of quantity and increasing price of snakeheads, most of consumer households changed to buy other fish species or meat cheaper and more available for them.

3.1.5.5 Future Changes on Consumption of Snakeheads and Snakehead Products

Since price of snakeheads went on increasing every day and it was expected to continue, some consumer households who had limited income would no longer bought snakeheads from markets. Alternatively, they would buy other fish species, especially small fish, and meat like pork, beef, chicken or egg. Moreover, some consumers would turn to culture or fish snakeheads by themselves. In contrast, some consumers would not change their behavior on using snakeheads although it was scarce and its price was high. This because that it was delicious (provided more energy and had less bone) and easy to be processed.

3.2 Marketing Channels and Cost-Benefits Distribution of Chain Actors

3.2.1 Marketing Channels of Chain Actors for Fishers

The marketing channels of wild snakeheads in Cambodia were quite simple because the majority of them were sold only for domestic market and consumption. The data from analyzing for the Lower Mekong Basin (LMB) of Cambodia was emphasized only on the region, so the caught snakeheads that were transported to other region (Phnom Penh city, and other provinces) were not calculated in the value for final consumption. Currently, the value chain for caught snakeheads in the LMB of Cambodia is focused mainly on eleven marketing channels:

Channel 1: Fishers -> Retailers -> Consumers

Channel 2: Fishers -> Retailers -> Restaurant -> Consumers

Channel 3: Fishers -> Wholesalers -> Retailers -> Consumers

Channel 4: Fishers -> Wholesalers -> Retailers -> Restaurant -> Consumers

Channel 5: Fishers -> Wholesalers-> Processors -> Retailers -> Consumers

Channel 6: Fishers -> Wholesalers -> Processors -> Retailers -> Restaurant -> Consumers

Channel 7: Fishers -> Wholesalers -> Processors -> Consumers

Channel 8: Fishers -> Wholesalers -> Processors -> Restaurant -> Consumers

Channel 9: Fishers -> Wholesalers -> Processors -> Phnom Penh city

Channel 10: Fishers -> Wholesalers -> Wholesalers in Phnom Penh city

Channel 11: Fishers -> Wholesalers -> Restaurant -> Consumers

Furthermore, the cost-benefit analysis for the value chain of wild snakeheads was emphasized on two main channels, including channel 3 (consumption in the LMB of Cambodia) and channel 10 (consumption in Phnom Penh city). In addition, channel 5 was also analyzed to examine the cost-benefit for when processors were factored in. Remarkably, all types of snakehead products in channel 3, 5 and 10 were converted into raw materials or fresh fish for the economic analysis.

Channel 3: The production cost for fishers for 1 kg of snakehead in term of raw materials was USD 0.57/Kg, with a selling price for the collectors of about USD 1.62/Kg. The net added value (NAV) was USD 1.05/Kg (50.24% of net added value of the chain). Retailers bought snakeheads from the wholesalers at a price of USD 2.11/Kg. The net added value made up USD 0.47/Kg and accounted for 22.49% of total net value added for the chain. The retailers sold fish to consumers at a price of USD 2.93/Kg with a NAV of USD 0.57/Kg, which made up 27.27% of total NAV of the whole chain three.

Channel 5: The added costs and net added value for this channel were converted for one kg of raw material or fresh snakehead. The dried and fermented snakeheads were sold at USD 2.65/Kg and the profit made was USD 0.39/Kg (about 18.1% of net added value of the chain). NAV of channel five was higher than that of channel three (USD 2.16/Kg compared to USD 2.09/Kg) because of a higher net value added of the processor and retailers.

Channel 10: The local wholesalers provided a large amount of snakeheads (made up 22.1% of total raw snakehead in the LMB) to the wholesalers in Phnom Penh city. The NAV of this channel was USD 1.52/Kg and the profits for farmers (accounted for 69.08% of net value added) were higher than that of the wholesalers (30.92%).

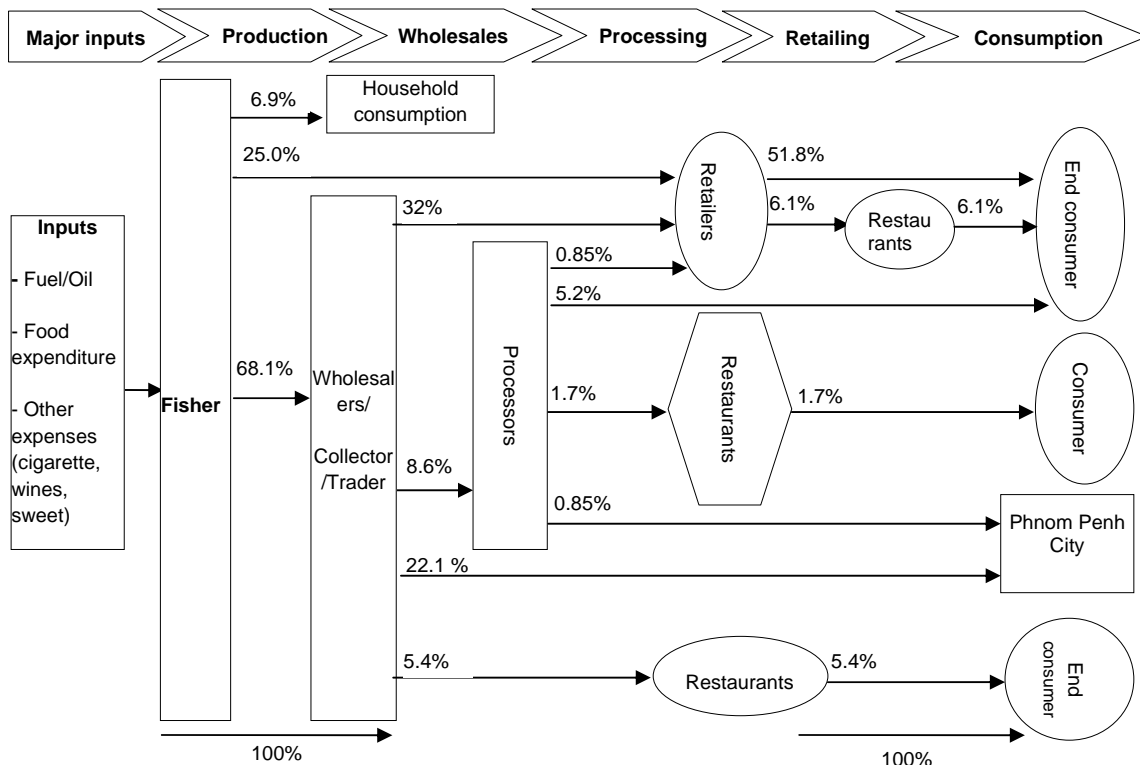


Figure 3.2.1: Mapping of the value chain of captured snakeheads in the LMB of Cambodia

3.2.2 Cost-Benefits Distribution of Chain Actors for Fishers

The profit distribution for the chain actors, however, was differed when the annual profit of each actor was used. The percentages of net added value/agent/year for wholesalers of channel 3, 5 and 10 were 90.54%; 88.72%; and 96.83%, respectively. The fishers received the highest profit per kilogram but they caught the smallest amount of fish earning them less profit than the other groups. Most snakehead products were sold in domestic markets. The amount of caught snakeheads decreased in the dry season and close season, causing increase in the price of snakeheads. Furthermore, most fishers said during this season they had more problems such as fishing sites far from home, spend much money on fuel oil, catching small amount, and overgrowth of fishers resulting in negative profit of their career.

Table 1: Distribution of costs and benefits of chain actors for fishers.

| Channel 3: Fishers -> Wholesalers -> Retailers -> Consumers | | | | | |
|--|----------------|--------------------|-------------------|------------------|--------------|
| Description | Fishers | Wholesalers | Processors | Retailers | Total |
| Selling price | 1.62 | 2.11 | | 2.93 | |
| Buying costs | 0.57 | 1.62 | | 2.11 | |
| Added costs | - | 0.02 | | 0.25 | |
| Net added value | 1.05 | 0.47 | | 0.57 | 2.09 |
| % of net added value | 50.24 | 22.49 | | 27.27 | 100.00 |
| Production/HH/year (ton) | 1.41 | 96.36 | | 5.70 | |
| Total profit (USD/year) | 1,480.50 | 45,289.20 | | 3,249.00 | 50,018.70 |
| % of NAV/HH/year | 3.0 | 90.54 | | 6.50 | 100.00 |
| Channel 5: Fishers -> Wholesalers -> Processors -> Retailers -> Consumers | | | | | |
| Selling price (USD) | 1.62 | 2.11 | 2.65 | 3.11 | |
| Buying costs (USD) | 0.57 | 1.62 | 2.11 | 2.65 | |
| Added costs | - | 0.02 | 0.15 | 0.25 | |
| Net added value | 1.05 | 0.47 | 0.39 | 0.25 | 2.16 |
| % of net added value | 48.61 | 21.76 | 18.06 | 11.57 | 100.00 |
| Production/HH/year (ton) | 1.41 | 96.36 | 2.40 | 2.50 | |
| Total profit(USD/year) | 1,480.50 | 45,289.20 | 1,776.00 | 2,500.00 | 51,045.70 |
| % of NAV/HH/year | 2.90 | 88.72 | 3.48 | 4.90 | 100.00 |
| Channel 10: Fishers-> Wholesalers -> Phnom Penh City | | | | | |
| Selling price | 1.62 | 2.11 | | | |
| Buying costs | 0.57 | 1.62 | | | |
| Added costs | - | 0.02 | | | |
| Net added value | 1.05 | 0.47 | | | 1.52 |
| % of net added value | 69.08 | 30.92 | | | 100.00 |
| Production/HH/year (ton) | 1.41 | 96.36 | | | |
| Total profit (USD/year) | 1,480.50 | 45,289.20 | | | 46,769.70 |
| % of NAV/HH/year | 3.17 | 96.83 | | | 100.00 |

3.2.3 Marketing Channels of Chain Actors for Fish farmers

The marketing channels of cultured snakehead in Cambodia were quite similar to that of wild snakeheads because the majority of them were sold only for domestic consumption. Therefore, the value chain for cultured snakeheads in the Lower Mekong Basin of Cambodia is concentrated mainly on eleven marketing channels:

Channel 1: Farmers -> Retailers -> Consumers

Channel 2: Farmers -> Retailers -> Restaurant -> Consumers

Channel 3: Farmers -> Wholesalers -> Retailers -> Consumers

Channel 4: Farmers -> Wholesalers -> Retailers -> Restaurant -> Consumers

Channel 5: Farmers -> Wholesalers-> Processors -> Retailers -> Consumers

Channel 6: Farmers -> Wholesalers -> Processors -> Retailers -> Restaurant -> Consumers

Channel 7: Farmers -> Wholesalers -> Processors -> Consumers

Channel 8: Farmers -> Wholesalers -> Processors -> Restaurant -> Consumers

Channel 9: Farmers -> Wholesalers -> Processors -> Phnom Penh city

Channel 10: Farmers -> Wholesalers -> Wholesalers in Phnom Penh city

Channel 11: Farmers -> Wholesalers -> Restaurant -> Consumers

For the cultured snakeheads, the cost-benefit analysis of value chain was focused on two main channels, including channel 3 (consumption in the Lower Mekong Basin of Cambodia) and channel 10 (consumption in Phnom Penh city). Moreover, channel 5 was also analyzed to examine the cost-benefit for when processors were factored in. Remarkably, all types of snakehead products in channel 3, 5 and 10 were converted into raw materials or fresh fish for the economic analysis.

Channel 3: The production cost for farmers for 1 kilogram of snakeheads in term of raw materials was USD 1.56/Kg, with a selling price for the collectors of about USD 1.98/Kg. The net added value (NAV) was USD 0.42/Kg (38.06% of net added value of the chain). Retailers bought snakeheads from the wholesalers at a price of USD 2.11/Kg. The net added value made up USD 0.11/Kg and accounted for 10% of total net value added for the chain. The retailers sold fish to consumers at a price of USD 2.93/Kg with a NAV of USD 0.57/Kg, which made up 51.94% of total NAV of the whole chain three.

Channel 5: The added costs and net added value for this channel were converted for one kg of raw material or fresh snakeheads. The salted-dried and fermented snakeheads were sold at USD 2.65/Kg and the profit made was USD 0.39/Kg (about 33.33% of net added value of the chain). NAV of channel five was higher than that of channel three (USD 1.17/Kg compared to USD 1.10/Kg) because of a higher net value added of the processor and retailers.

Channel 9: The local wholesalers provided a large amount of snakeheads (made up 28.7% of total raw snakeheads in the LMB of Cambodia) to the wholesalers in Phnom Penh city. The NAV of this channel was only USD 0.53/Kg and the profits for farmers (accounted for 79.20% of net value added) were higher than that of the wholesalers (20.80%).

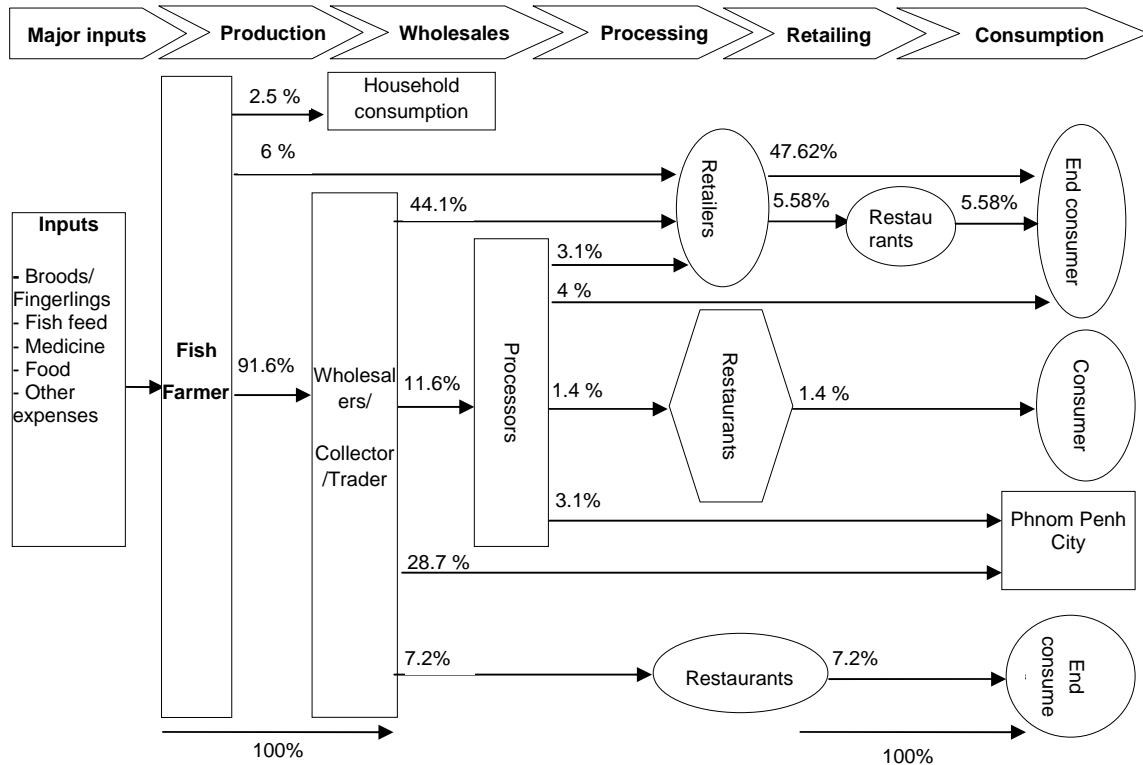


Figure 3.2.2: Mapping of the value chain of cultured snakeheads in the LMB of Cambodia.

3.2.4 Cost-Benefits Distribution of Chain Actors for Fish Farmers

The profit distribution for each chain actor was differed when the annual profit of each actor was used. The percentages of net added value/agent/year for wholesalers of channel 3, 5 and 10 were 72.53%; 67.77%; and 93.36%, respectively. Actually, the retailers received the highest profit per kilogram but they traded the smallest amount of fish earning them less profit than the other groups.

Conventionally, most cultured snakehead products in Cambodia are sold in domestic markets. During flooding season, Cambodian fish farmers abandoned their fish culture (fish culture in pond) or kept their fish until dry season (fish culture in cage) because of decreasing in the price of snakeheads resulting in negative profits for many farmers. In the dry season, the price of snakeheads increases because of less wild fish caught. However, the farmers said that they had more problems with fish diseases and nursing techniques on cultured snakeheads in this season. Therefore, the price of snakeheads was unstable, reflecting an uncertain development in this industry.

Table 2: Distribution of costs and benefits of chain actors for fish farmers.

| Channel 3: Farmers -> Wholesalers -> Retailers -> Consumers | | | | | |
|---|----------------|--------------------|-------------------|------------------|--------------|
| Description | Farmers | Wholesalers | Processors | Retailers | Total |
| Selling price | 1.98 | 2.11 | | 2.93 | |
| Buying costs | 1.56 | 1.98 | | 2.11 | |
| Added costs | - | 0.02 | | 0.25 | |
| Net added value | 0.42 | 0.11 | | 0.57 | 1.10 |
| % of net added value | 38.06 | 10.00 | | 51.94 | 100.00 |
| Production/HH/year (ton) | 1.80 | 96.36 | | 5.70 | |
| Total profit (USD/year) | 756.00 | 10,572.90 | | 3,249.00 | 14,577.90 |
| % of NAV/HH/year | 5.19 | 72.53 | | 22.29 | 100.00 |
| Channel 5: Farmers-> Wholesalers -> Processors -> Retailers -> Consumers | | | | | |
| Selling price (USD) | 1.98 | 2.11 | 2.65 | 3.11 | |
| Buying costs (USD) | 1.56 | 1.98 | 2.11 | 2.65 | |
| Added costs | - | 0.02 | 0.15 | 0.25 | |
| Net added value | 0.42 | 0.11 | 0.39 | 0.25 | 1.17 |
| % of net added value | 35.90 | 9.40 | 33.33 | 21.37 | 100.00 |
| Production/HH/year (ton) | 1.80 | 96.36 | 2.40 | 2.50 | |
| Total profit (USD/year) | 751.92 | 10,572.90 | 1,776.00 | 2,500.00 | 15,600.82 |
| % of NAV/HH/year | 4.82 | 67.77 | 11.38 | 16.02 | 100.00 |
| Channel 10: Farmers-> Wholesalers -> Phnom Penh City | | | | | |
| Selling price | 1.98 | 2.11 | | | |
| Buying costs | 1.56 | 1.98 | | | |
| Added costs | - | 0.02 | | | |
| Net added value | 0.42 | 0.11 | | | 0.53 |
| % of net added value | 79.20 | 20.80 | | | 100.00 |
| Production/HH/year (ton) | 1.80 | 96.36 | | | |
| Profit/kg (USD) | 0.42 | 0.11 | | | 0.53 |
| Total profit (USD/year) | 751.92 | 10,572.90 | | | 11,324.82 |
| % of NAV/HH/year | 6.64 | 93.36 | | | 100.00 |

3.3 Major Suggestions for Upgrading the Value Chain of Snakeheads

Major solutions/suggestions for upgrading the value chain of snakeheads in the LMB of Cambodia toward sustainable development were proposed as follows:

1. To well manage wild snakehead stock and other aquatic resources, specifically to put high pressure and prohibit all illegal fishing, over fishing, or any activity done to harm all these resources in order to make sure that it is sustainable for people consumption demand. This cannot be effectively done unless there is involvement of local people, local authorities and government, incorporated with NGOs and functional organizations.

2. To augment and adopt appropriate technologies of raising snakeheads (including producing fish broods and feed), using pellet feed at affordable price for fish farmers in replacement of trash/low value fish, to reduce rate of fish death and improve quality of fish as much as possible, and to avoid the depletion of trash/low value fish, which has been considered

as the main food for people, especially for the poor. By promoting snakehead fish farming, it is hopefully expected that cultured snakehead fish firstly can be used to sufficiently complement or replace wild snakehead fish which is decreasing, and secondly lower the price of fish to fit people's household income to guarantee that not only rich people but also the poor can access to fish, particularly snakeheads.

3. To have good management of fish traders in order to make information of fish price more clearly and broadly accessible to all chain actors and to prevent price fluctuation. It is vital to ensure that each chain actor can possibly obtain the same benefit to sustain value chain as well as trade of snakeheads.

4. To better manage the quality of fish by introducing proper conservative technologies mainly when loaded to markets in fresh form to cut down rate of fish death and weight loss during business transaction. Moreover, to provide appropriate processing technique to sustain the business of snakehead fish processing and to increase opportunities for domestic and export markets for both fresh and processed forms.

5. To provide more opportunities for the establishment of many financial organizations which tend to offer more loan with low interest rate.

6. To limit or restrict unnecessary and informal-fee payment which usually occur to all chain actors during business transaction.

PART 4

SUMMARY AND CONCLUSION

4.1 Summary

Fisheries is believed to have enormous potential to provide the poor people with more food, better nutrition and increased incomes. Besides this, aquaculture contributing around 10% of the total inland fish catch also plays an important role and is considered to have great potential for augmenting fish production in Cambodia. The study on Value Chain Analysis of Snakeheads in the Lower Mekong Basin of Cambodia was conducted under three main specific objectives: 1) to describe and analyze the situation of the actors involving in snakeheads industry; 2) to analyze the cost-benefit distribution of the snakehead value chain; and 3) to propose improvements for upgrading this chain so that it was sustainable in the long term.

The study was conducted in four provinces, namely, Kandal, Kampong Chhnang, Kampong Thom and Siem Reap, and Phnom Penh city. The study was focused on fishers who fished freshwater wild fish especially snakeheads, farmers of snakeheads, traders, processors and end consumers. A total sample of 465 households from 8 districts, 20 communes and 37 villages were involved in focus group discussion (FGD) and individual interview. The data and information for the study was based on secondary data derived from relevant institutes/agencies, and primary data got from semi-structured interview with key informant person (KIP) and structured interview with targeted sample households using 5 different structure questionnaires.

The study found that there were two important supplying sources of snakeheads which were fishers and fish farmers. With the different sources, snakeheads being traded in markets were clearly defined as wild and cultured snakeheads. Besides fishers and fish farmers, fish collectors/wholesalers, retailers and processors were also chain actors who played important role in delivering snakeheads and snakehead products to markets. Annually, average quantity of wild snakehead sold by fisher households was approximately 7,109.9 Kg with the average selling price of USD 1.14/Kg. Whereas, the average quantity of cultured snakeheads sold by fish farmer household was about 1,799.7 Kg per household per year/cycle, with average selling price about USD 1.9/Kg at farm gate. The highest percentage of wild and cultured snakeheads was sold by fishers and fish farmers to fish traders, including wholesalers and retailers. The average quantity of snakeheads traded per year by fish trader household was around 16,567 Kg with average selling price USD 2.93/Kg. Largest quantity of snakeheads, most of which were cultured snakeheads, were directly and respectively sold to consumers and retailers. Processed products of snakeheads included salted-dried snakeheads (Trey Ngeat), fermented snakeheads (Mam), snakehead fish paste with bone less (Phra hoc), and salted fish cheek (Thpal Trey) made from cheeks of snakeheads. Salted-dried snakeheads were more commonly processed compared to other products of snakeheads. Average quantity of snakehead processed products sold per year by processor household was 2,388 Kg with average selling price about USD 6.01/Kg. Most of the snakehead products were sold to retailers and consumers. The average quantity of snakeheads bought per time by consumer household was ranged from 0.8 to 1.7 Kg with average buying price of USD 2.31 to 2.92/Kg. Furthermore, average quantity of snakehead processed products bought per time by consumer household was around 0.9 Kg with average buying price from USD 3.51 to 6.27/Kg.

The value chain of wild and cultured snakeheads was separately focused on 11 marketing channels. The highest profit of the chain actors in the value chain of wild and cultured snakeheads was going to collectors/wholesalers.

Some difficulties found on the chain actors were: shortage of fishing grounds, decrease of wild fish stock, increase of fish price, high cost of inputs, lack of capital, not enough appropriate production and conservation technologies, limitation of proper technology in processing fish and packaging fish products, low quality of snakehead products to meet international standard, and lack of export markets.

This calls for attention from local people, local authorities, the technical and relevant government institutions, NGOs and relevant agencies to collaboratively manage wild snakehead stock and other aquatic resources, and to simultaneously prohibit all illegal fishing and over fishing on the resources. Proper technology of breeding and raising snakeheads, producing pellet feed, and processing snakeheads should be adopted and promoted. Possibility of obtaining profit must be ensured for all chain actors and conservative techniques of snakeheads and snakehead products during business transaction should be provided. Both fresh and snakehead processed products should be promoted to high quality-oriented products by fisheries policies to increase opportunities for domestic and export markets.

4.2 Conclusion

Marketing channels of snakeheads in Cambodia were very simple since nearly all of snakeheads were sold only for domestic consumption. Market channels of snakeheads were mainly derived from two supplying sources of snakeheads: fishers (wild/capture snakeheads) and fish farmers (cultured snakeheads). In addition, some of cultured snakehead was imported from Vietnam, about 1% of their annual total production - (ranged from 240 to 400 tones). Important chain actors involving in the value chain of snakeheads were fishers, fish farmers, wholesalers, retailers, and processors. The value chain of wild snakeheads was focused on 11 marketing channels. Two most important ones were “Fishers -> Wholesalers -> Retailers -> Consumers” and “Fishers -> Wholesalers -> Wholesalers in Phnom Penh city”. Furthermore, the value chain of cultured snakeheads was also concentrated on 11 marketing channels. Like value chain of wild snakeheads, most important of the value chain of cultured snakeheads were only two: “Fish Farmers -> Wholesalers -> Retailers -> Consumers” and “Fish Farmers -> Wholesalers -> Wholesalers in Phnom Penh city”.

Benefit distribution of the chain actors in the value chain of wild and cultured snakeheads was unequal. For that in value chain of wild snakeheads, the highest amount was going to collectors/wholesalers. The main disadvantages of snakehead fishing were: 1) quantity of snakeheads caught was low that could not meet consumption demand of people in the country; 2) snakehead fishers could not completely depend upon only fishing for their living since snakeheads in nature were getting scarce.

For benefit distribution of the chain actors in value chain of cultured snakeheads, the highest profit was going to collectors/wholesalers. The main disadvantages of snakehead farming were: 1) the widespread and continuation of culturing snakeheads using low-valued fish/trash fish as fish feed which led to the depletion of low-valued fish/trash fish stock, increase price of low value fish, and lack of low value for human, especially for the poor; 2) snakehead culture was currently banned; 3) perception of consumers acceptance on cultured snakeheads consumption was still limited; and 4) most snakeheads fish was preferably consumed in fresh form. Moreover, the main disadvantages of all types of sample households were: 1) lack of

capital; 2) shortage of skill/technology in the business; and 3) lack of experience in the business.

In order to sustainably develop the value chain of snakeheads in the Lower Mekong Basin, there must be an appropriate plan which could be taken into action with collaboration with local people, local authority, government, NGOs, and functional organizations on well manage wild snakehead stock and other aquatic resources, and simultaneously prohibited all illegal fishing and over fishing on the resources. In addition, proper technology of breeding and raising snakeheads, producing pellet feed, and processing snakeheads should be adopted and promoted. Possibility of obtaining profits must be ensured for all snakehead chain actors by accessing to price setting and market information and conservative techniques of snakeheads and snakehead products during business transaction. Moreover, snakeheads and snakehead processed products should be promoted to high quality-oriented products by fisheries policies to increase opportunities for domestic and export markets.

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