Role of low value fish for consumption and possible interactions/conflicts with the aquaculture in Cambodia

by

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Abstract

Cambodia is among the poorest countries in the world. The majority of the population depend heavily upon fish resources for their livelihood, and sustainable management of ecosystems providing these resources is therefore utterly important i.e. a matter of life and death. Almost all fish species are consumed and small species have a lower market value compared to larger species; as such they are more accessible to poor people.

From September to December of 2007, an interview study was conducted among three different occupation groups (fish farmers, fishermen and rice farmer) in four Cambodian provinces: Kampong Chhnang, Kampong Cham, Prey Veng and Kandal. The aim was to investigate how dependent these people are on Low Valued Fish (LVF) as a food source, and if there are conflicts between the rural populations fish needs and the growing aquaculture industry in the country.

Kampong Chhnang had the highest average fish consumption among all occupation groups at 1,4 kg fish/week per household member, with fishermen consuming the highest amount (2,1kg/week/pers). Prey Veng had the lowest consumption among all occupation groups at 0,76 kg fish/week per household member and rice farmers had the smallest consumption (0,67kg/week/pers). The most common LVF (low valued fish) directly consumed among all occupation groups were *Trey Riel*, but other LVF species such as *Trey Linh*, *Trey Kros*, *Trey Sleuk Russei*, *Trey Arch Kok* and *Trey Khnang Veng* were also frequently consumed. Fish paste (prohok) is an important protein source for many Cambodians and this paste consists, to a large extent, of small fish species such as *Trey Riel*. The amount of LVF needed to produce 1kg prohok varied between the provinces, from 2,4 kg in Kampong Cham to 1,94 kg in Prey Veng. The same LVF species, either being consumed or used in prohok, are commonly used as feed in fish aquaculture operations (and crocodile farming). Due to growing demand of low valued fish for human consumption it is urgent to find ways for the aquaculture industry to develop without negative effects on food fish availability.

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1. Introduction

Cambodia has 13,8 million inhabitants (CIA 2007) and is among the poorest countries in the world (Bonheur and Lane 2002). Forty percent of the population is below poverty line and 50 percent is less than 21 years old, 90 % of the nations poor live in the countryside and lack often both basic infrastructure and education. Of the rural population in Cambodia lives 43 % below the poverty line (Baran et al, 2007). A majority of the population depend heavily upon natural resources for their livelihood, and sustainable management of ecosystems providing these are therefore utterly important i.e. a matter of life and death (Bonheur and Lane 2002). (CIA 2007), and as the population in Cambodia is growing an increasing pressure on the natural resources is an inevitable result (Bonheur and Lane 2002).

The Mekong river basin sustains a very diverse ecosystem with a highly productive freshwater fish fauna. Of the basins 1,200 indigenous fish species, 500 of them are found in Cambodia and contribute significantly to the everyday diet of millions of people (Roos et al. 2006). This fishery is of great importance to the vast majority of people in Cambodia, especially for the rural poor population providing employment, income and food security (CFDO-IMM 2005). Even though almost all fish species are consumed; small species are generally less preferred than larger species. Consequently, small fish species generally have a lower market value compared to larger fish and are therefore more accessible as a protein source to poor people, particularly in seasons of high production (Roos et al. 2006). Funge-Smith et al. (2005) defines low value fish (LVF) generally as "fish that have a low commercial value by virtue of their low quality, small size or low consumer preference. They are either used for human consumption (often processed or preserved) or used for livestock/fish, either directly or through reduction to fish meal/oil." Some fish become low value after harvest due to poor handling, something that in many cases can be avoided by simple means (Funge-Smith et al. 2005). However, Low value fish is of high ecological value despite its low economic value, intensive fishing of these can alter the aquatic ecosystem resulting in loss of larger and more commercial important fish species, so called high value fish (HVF) (Funge-Smith et al. 2005). This is also a problem in Cambodia where the fish catches are mostly composed of small-size fish like juvenile commercial fish species and the catch rate of HVF species is declining (pers comm. So Nam 2008). In general, the fisheries provide a livelihood for at least 2 million people and a huge amount of these are involved in

some aspect of post-harvest activities such as handling fish directly after capture or through processing, storage and transportation (CFDO-IMM 2005).

Besides the use of low value fish for human consumption this resource also is used in aquaculture to feed carnivorous and omnivorous fish species (Naylor et al. 2001; Naylor and Burke. 2005). Mainly marine low valued fish are being used as aquaculture feed but in Cambodia 97% of the low valued fish for aquaculture are freshwater fish (Nam et al. 2005). Giant snakehead (Channa micropeltes) is the most popular cage cultured fish species in Cambodia. Giant snakehead is a strict carnivore and culture mainly depends on low value fish for feed, constituting 60-100 % of the total feed used (Nam et al. 2005). Aquaculture is an important provider of employment, income and food in many developing countries and has therefore been encouraged (Funge-Smith et al. 2005). Unfortunately, such policy may create an even higher pressure on the finite low value fish resource (Funge-Smith et al. 2005). This can negatively impact the poor population that is depending on low valued fish for their livelihood and as food (Funge-Smith et al. 2005). In order to sustain future supplies of low value fish, the government in Cambodia banned snakehead culture in 2004 (CFDO-IMM 2005) and the law was implemented in 2005 (PRIAC 2006). In the Asia-Pacific region prices of low value fish are increasing due to higher demand and over-exploitation (resulting in declining catches). Thus, there is a need to find an alternative form of aquaculture e.g. farmed species not made up of these fish resources (Funge-Smith et al. 2005) and it is important to fully understand the interactions between capture fisheries and aquaculture in order to create effective management (Naylor et al. 2001; Funge-Smith et al. 2005). There is an initiative in Cambodia that soon will start regarding finding alternative feed sources for Snakehead and other cultivated carnivorous fish species (pers comm. So Nam 2008).

1.1 Tonle Sap Lake

One of Cambodia's most important natural resources is the Tonle Sap Lake (Bonheur and Lane 2002). 1.25 million of Cambodia's inhabitants live in the five provinces bordering the Tonle Sap Lake i.e. Pursat, Kampong Chhnang, Battambang, Siem Reap and Kampong Thom (Navy et al. 2006). The unique ecosystem of Tonle Sap Lake, with a vast diversity of biological resources, has long been a key element in Cambodia; combining ecological, social and economical factors (Bonheur and Lane 2002). The lake covers an area of 250,000 hectares during the dry season and is the largest freshwater lake in Southeast Asia (Bonheur and Lane 2002).

The lake interacts with the Mekong, and during monsoon season water flows into the lake and the area increases to 1.25 million hectares, covering both forest and agriculture land (Bonheur and Lane 2002). The resulting wetland becomes an ideal place for breeding, feeding and spawning for an immense diversity of life (Bonheur and Lane 2002). A wide range of species, many being threatened globally, live in habitats the lake provides e.g. snakes, birds, crocodiles, mammals and fish (Bonheur and Lane 2002).

The lake is a very important food source providing 75 percent of the protein intake for the entire Cambodian population (the estimated annual fish catch is between 289,000 and 431,000 tonnes) (Bonheur and Lane 2002). Cambodia's freshwater capture fisheries is ranked fourth worldwide after China, India and Bangladesh (if assuming an annual production of 300,000-400,000 tonnes). Cambodia has the most inland intensive fishery in the world (20 kg fish caught per inhabitant per year) when dividing the catch between the people who can consume the harvest (Baran et al. 2007). Studies, made in the Tonle Sap area, have estimated that persons living in the fishing communities consume 67 kg raw fish per person per year (Roos et al. 2006). Tonle Sap Lake's ecosystem is thought to be one of the most productive inland fisheries in the world, due to a continual flow of water and nutrients (Ahmed et al. 2006). Of the total inland fisheries production in Cambodia, it is estimated that 60 percent originates from the Tonle Sap Lake; the value is approximated to US\$ 150-250 million (Navy et al. 2006). The total national gross domestic product (GDP) of Cambodia is US\$ 2,800 million (MAFF 2007) with the total fisheries sector contributing between 11,7 -16 % (Baran et al. 2007).

In a study undertaken by Rab et al. 2006, fishing habitats were investigated in villages in the three provinces: Kampong Chhnang, Kandal and Siem Reap (Rab et al. 2006). The villages were divided into three different types: fishing villages, fishing cum farming villages and farming villages. The study revealed that for all villages no matter the type, the primary occupation of the household head, was fishing and that the secondary occupation was normally associated with fish culture, fish processing, and fish farming or labouring (Rab et al. 2006). This implies that all villages highly depend on fishing, fish culture or fish processing for their livelihood. Access to other income-generating occupations than fishing and farming, were relative to level of education. Households with low level of education were therefore heavily depended of the recourses from the Tonle Sap Lake (Rab et al. 2006).

During the peak period a large amount of the fish caught is processed into fish paste (prohok), fermented fish (pha-ork), sweet fish (mum), smoked fish and fish sauce (Baran et al. 2007). A large amount of the Cambodian population is dependent on these products made earlier in the year when the closed season comes and the supplies of fish for sale are low (CFDO-IMM 2005). Prohok has been produced in Cambodia and the wider region for centuries, with data going back as far as 4000 years in Thailand (CFDO-IMM 2005). In a survey done in 2004, McKenney and Tola estimated that the average consumption of prohok in Cambodia in 2002 was 10,1 kg/person and in 2003 15,7 kg/person (Baran et al. 2007). It is estimated that the annual prohok production in the country by a subsistence producer is somewhere between 17,500-25,000 mt, and fishing households is believed to be the largest producers at 15,000-20, 000mt (CFDO-IMM 2005). The prohok producing methods can, on a local scale, differ to suit specific tastes. In general small fish species such as Trey Riel are used to produce the prohok. There are two commercial prohok products made in Cambodia, one is the more expensive boneless paste and the other one is a bony paste that the average/poor population consumes (CFDO-IMM 2005). Prohok, together with fish sauce, is an important product that contributes to food security in both fishing and non-fishing communities (CFDO-IMM 2005).

Also the agriculture land area surrounding the Tonle Sap Lake is very productive and important to the Cambodian economy. In addition to providing food, fuel and income for the rural population Tonle Sap Lake is home to small ethnic groups in Cambodia (Bonheur and Lane 2002). Also people not living close to the Tonle Sap Lake collect its aquatic resources; people from hill tribes use these resources for own domestic consumption. This is widespread but poorly reported (CFDO-IMM 2005).

1.2 The need of LVF for consumption among the poor population in Cambodia

The population in Cambodia suffers by poor health and malnutrition, often the diet do not give them enough micronutrients such as vitamin A, iron and zinc. Low intake of these micronutrients can cause retarded growth and mental development in children. Other vulnerable population groups, such as women at the reproductive age, can be affected by high morbidity rate and increased risk of early death (Roos et al. 2006). The reasons for the poor nutritional quality of the diet are the lack of diversity and the low intake of animal source food (Roos et al. 2006). It is considered that small amount of animal food drastically

improves the nutritional quality of diets otherwise dominated by staple food. Due to this fish is a nutritionally important food in Cambodia (Roos et al. 2006).

Staple food such as rice does not contain enough amounts of most vitamins and minerals to meet human need (Thilsted, S.H. et al. 2005), therefore fish is an irreplaceable animal source food for large population groups and it is often considered to be "the poor mans animal food" (Roos et al. 2006).

The main aim of this study was to map the consumption pattern of low valued fish in different occupation groups, as well as in different geographical areas in Cambodia. Different occupation groups were compared within a province, between provinces and also between different regions around the Tonle Sap Lake, upper and lower Mekong River and the Bassac River area. The fact that relatively few efforts has been made involving consumption pattern of only low valued fish makes this an important contribution to food security discussions in Cambodia. It is, however, not only important to find out about the dependency on low valued fish as food but also its importance as an income source. The results of this study on low valued fish will be linked to on-going aquaculture activities in Cambodia.

2. Methods

The data collection for this study was gathered in Cambodia from September of 2007 to December of 2007. Fieldwork consisted of interviews with people from four different provinces and representing three different occupations all of which were dependent on LVF (Low Valued Fish) as a food source. The occupation groups interviewed were fish farmers, subsistence fishermen and rice farmers. The provinces participating were Kampong Chhnang (CHN), representing the southern part of Tonle Sap Lake, Kampong Cham (CH) and Prey Veng (PV), representing the upper and lower Mekong River and finally, Kandal (KD), representing the Bassac River (Fig 1). Due to the location of Kampong Chhnang at the Tonle Sap Lake, combined with the fact that the province contains the largest area covered by bodies of water, it can be assumed that this is the province that consumes the most fish at low prices. The total agricultural land area of Prey Veng is 63,49%, so it can be assumed that this province has a high number of farmers and that fish consumption in this province is lower than in e.g. Kampong Chhnang. Specific data on water cover is also missing for this province, which may indicate that this province is not so fish dependent. Further, it can be assumed that Kandals closeness to Phnom Penh implies more livelihood options and that people living in Kandal therefore are fewer dependants on fishery and agriculture.

The interviews were performed with the help from a Khmer translator from Inland Fisheries Research and Development Institute (IFReDI) and local field guides from the different provinces.

Due to unrealistic and unreliable answers from the interviewed in Kampong Chhnang, with respect to the questions relating to the prohok consumption, this province is omitted from the results concerning prohok consumption. The reason for omitting these results are due to that Kampong Cham, Prey Veng and Kandal had a prohok production ranging from 21.88 kg – 31.67 kg/year and household, while Kampong Chhnang had a production of 226 kg prohok/year and household. This amount of prohok is very high and it was only for family consumption not for selling, therefore Kampong Chhnang is going to be absent when it is most likely that there were some kind of misunderstanding due to the language barrier.

The data was assembled in a Microsoft Access database for later qualitative and statistical analysis.



Fig. 1: A map of Cambodia with the four provinces that were visited, Kampong Chhnang (CHN), Kampong Cham (CH), Prey Veng (PV) and Kandal (KD). (https://www.cia.gov/library/publications/the-world-factbook/geos/cb.html).

2.1 The questionnaire

The semi-closed questionnaires (Appendix 1) used for the study mainly addressed six major areas concerning general information such as household size and the amount of fish consumed in total, other areas were, subsistence consumption of LVF, selling of LVF, if the consumption pattern and availability of LVF had changed during the past four years (to see some correlation to the ban of farming Giant Snakehead) and finally if there were some problems associated to the occupation activities. The different areas of interests were focused on general information such as household size and age, consumption - where the amount and species of LVF consumed were of certain interest. It also covered selling activities and consumption pattern changes. The last part of the questionnaire was open ended and the respondents were able to reflect by them self's about problems that they have faced and suggestions to improve their household income.

The questionnaire was tested on two households in Kandal before the main survey; these two has not been used in this report. To help the interviewed people to communicate correct fish species a document with photos of the most common fish species was used (Appendix 2). The fish species had different numbers, which made the identification easier and not so time consuming.

The households were very willing to participate in the interviews, despite that it was hard to get them to talk in the open-ended part of the questionnaire. There were also some communication problems and misunderstandings due to the language barrier.

3. Results

In this survey a total of 109 households were interviewed; 25 in Kampong Chhnang, 27 in Kampong Cham, 30 in Prey Veng and 27 in Kandal (for more details see Table 1).

Occupation	Kampong Chhnang	Kampong Cham	Prey Veng	Kandal
Fish farmer	5	8	10	7
Fishermen	10	9	10	10
Rice farmer	10	10	10	10

Table 1: Number of household interviewed divided on the different occupation groups and provinces.

Total	25	27	30	27

The household size in the different provinces ranged from 1 - 10 persons per family, Kandal had the highest average number of household members with 5,59 members/household, Prey Veng had the lowest at 4,67 members/household and then came Kampong Chhnang and Kampong Cham at 5,56 and 4,93 members/household respectively (see Table 2). In general, all fish farmers lived on floating houses; some subsistence fishermen also lived on floating houses but many also lived in houses on land. All the households were relatively close to water bodies or to the river. All rice farmers had own houses on land a bit further away and not in direct contact with the water.

Mainly the head of the household was interviewed, 61 (56%) of the 109 interviewed where a male and 48 (44%) of them were females; if this person was unavailable the second highest person in the household was interviewed. Field guides from the different provinces helped in selecting the households to be interviewed.

3.1 Fish consumption

Fish consumption for the different provinces is shown in figure 1. The subsistence fishermen in Kampong Chhnang had the highest consumption of fish (2.1 kg/week/household member). This was 2-3 times more compared to subsistence fishermen in other provinces. Rice farmers in Prey Veng had the lowest consumption (0.67kg/week/household member) among all occupation groups and provinces. Kampong Chhnang is the province with the average highest total consumption (1,40 kg/week/household member) and Prey Veng is the province with the lowest average total consumption (0,76kg/week/household member) (see table 2).



Fig.1: The average amount of consumed fish in kg during one week and household member in the different occupation groups in Kampong Chhnang, Kampong Cham, Prey Veng and Kandal.

	Fish consumption (kg/week/pers)	Average household size
Kampong Chhnang		
Fish farmer	1,2	5
Fishermen	2,1	5,9
Rice farmer	0,89	5,6
Total	1,40	5,56
Kampong Cham		
Fish farmer	1,1	5,63
Fishermen	0,79	4,44
Rice farmer	0,99	4,9
Total	0,96	4,93
Prey Veng		
Fish farmer	0,80	4,9
Fishermen	0,80	5
Rice farmer	0,67	4,1
Total	0,76	4,67
Kandal		
Fish farmer	0,98	6,9
Fishermen	0,71	5,2
Rice farmer	0,81	5,1
Total	0,83	5,59

 Table 2. Fish consumption in kg/week/household member and the average household size among the different occupation groups and in total in the different provinces.

3.2 Dominating fish species consumed

In Kampong Chhnang Trey Riel (*Henicorynchus sp*) is the most frequent LVF consumed among the different occupation groups (50 % of the fish farmers, 78% of the fishermen and 60% of the rice farmers) (Fig. 2a). 50 % of the fish farmers eat HVF (high valued fish) such as Trey Pra (*Pangasianodon hypophthalmus*), Trey Kaek (*Morulius chysophekadion*) and Trey Chdor (*Channa micropeltes*). Fishermen also frequently consume other HVF such as Trey Kanh Chrooch (*Mystus sp*) and rice farmers eat a lot of Trey Linh (*Thynnichthys thynnoides*).

Also in Kampong Cham, riel is the most dominating LVF- species among the occupation groups. 63 % of the fish farmers, 67 % of the fishermen and 80 % of the rice farmers consumes Trey Riel most frequently (Fig 2b). Fish farmers in this province also eat, besides Trey Riel, Trey Khnang Veng (*Danglia sp, Cf. Cuvieri*) regularly, and fishermen also consume a significant amount of Trey Arch Kok (*Danglia sp, Cf. Lineuta*). 30 % of the rice farmers in this province eat Trey Pra more frequently than Trey Riel, a fish that is a high valued species.

In Prey Veng the pattern differs from the other two provinces. Fish farmers in this province consume Trey Sleuk Russei (*Paralaubuca typus*) most frequently but they also consume Trey Riel, Trey Kanh Chrooch and Trey Linh. The fishermen in Prey Veng mostly eat Trey Linh but also some Trey Riel, and the rice farmers in Prey Veng consume Trey Kros (*Osteochilus waandersi*) and Trey Riel most frequently (2c).

In Kandal, 67 % of the fish farmers, 80% of the fishermen and 80 % of the rice farmers consume Trey Riel most frequently (2d). The fish farmers also eat some Trey Khnang Veng, fishermen consume some Trey Sleuk Russei and the rice farmers consume some HVF as Trey Chpin (*Hypsibabus sp*), Trey Pra and Trey Chdor.

For a complete list of all fish species that were consumed se appendix 3.





a) Kampong Chhnang

b) Kampong Cham



c) Prey Veng

d) Kandal

Fig. 2: The most frequently consumed LVF- species among the different occupation groups in the provinces a) Kampong Chhnang, b) Kampong Cham, c) Prey Veng and d) Kandal.

3.3 Prohok consumption

The average consumption of prohok in Kampong Cham among all occupation groups were 31.33kg prohok/year, in Prey Veng the average consumption were 31,67 kg prohok/year and in Kandal the average consumption among all occupation groups were 21,88 kg prohok/year (Fig. 3). Households in Kampong Cham use more LVF when they produce their prohok, compared households in Prey Veng. Kampong Cham households use approx. 75,76 kg LVF to produce 31,33 kg prohok, the same number for households in Prey Veng is approximately 61 kg LVF to produce 31,67 kg prohok. The households in Kandal use 43,5 kg LVF to produce 21,88 kg prohok (Fig. 3). In order to produce 1 kg Prohok the demand for LVF in the different provinces varies.

In Kampong Cham 2,4 kg LVF is needed to produce 1 kg prohok, where as in Prey Veng the number is 1,93 kg LVF and in Kandal 2,0 kg LVF to produce 1 kg prohok.



Fig. 3: The amount of prohok consumed per year in the different provinces and the amount of LVF used to produce it.

Fish farmers in Kampong Cham consume most Prohok (Fig. 4) averaging 9,91 kg prohok/household member and year. The rice farmers have the second highest consumption and they consume 5,77 kg prohok/household member and year. The group that has the smallest consumption is the fishermen they consume 1,80 kg prohok/household member and year (Fig. 4).

In Prey Veng, the rice farmers are the group that consumes the most prohok; they consume 8,39 kg prohok/household member and year. The fish farmers consume 6,46 kg prohok/household member and year and the fishermen consume 2,00kg prohok/household member and year (Fig. 4).

In Kandal the rice farmers have the highest consumption of prohok and consumes 5,69 kg prohok/household member and year. The second highest consumption has the fishermen that consume 3,94 kg prohok per household member and year. The lowest consumption group is the fish farmers on an annual consumption on 2,38 kg prohok/household member and year (Fig. 4).



Fig. 4: Amount of prohok the different occupation groups consumes in the different provinces during a year.

3.4 The cost of LVF, accessibility and markets

The price for the different fish species varied widely between the minimum and maximum price paid for them. The species with the widest price range were Kanh Chrooch (*Mystus sp*) which had a cost of between 1 000-11 000 riel/kg (Table 1). There were differences between the provinces regarding how much the different occupation groups needed to pay for the fish. In general, the rice farmers paid more for their fish than the fish farmers, the fishermen rarely paid, due to own catches. Prices did not differ much between the different provinces as only Prey Veng had somewhat lower prices on many of the fish species (for a more detailed description see appendix 4).

Table 3: The most common LVF species c	onsumed and the average price	? (Riel/kg) paid for t	them in the four p	provinces and the potentia	l average price
paid for a mix of the species.					

Species	Kampong Chhnang (Riel/kg)	Kampong Cham (Riel/kg)	Prey Veng (Riel/kg)	Kandal (Riel/kg)
Riel sp				
Fish farmers	650	1686	1929	3450
Fishermen				5000
Rice farmers	4389	5444	3375	5071
Kanh Chrooch				
Fish farmers	2250	3750	2929	7900
Fishermen		6000		7667
Rice farmers	4020	4833	3583	8875
Sleuk Russei				
Fish farmers	1500	2950	2083	4700
Fishermen				4000
Rice farmers	3356	4500	2083	4600
Kros				
Fish farmers	1250		1563	3600
Fishermen				6500
Rice farmers	3400	3929	3000	4500
Khnang Veng				
Fish farmers	1750	4500		2800
Fishermen				4667
Rice farmers	3714	4300	1500	5300
Linh				
Fish farmers	1750	2457	1469	3500
Fishermen				4500
Rice farmers	5875	4786	2063	7000
Arch Kok				
Fish farmers	1500			3500
Fishermen				6000
Rice farmers	3000	4875	1200	4500
Average cost for LVF-mix	2743	4155	2231	5125

Most fish farmer (57%) buys their fish at the local market, but some (37%) also fish themselves besides buying from markets. A few fish farmers (6%) only eat fish that they catch themselves (Fig. 5). Most of the fishermen (79%) only consume fish that they have fished themselves and a few (21%) also go to market sometimes if they haven't got enough fish or if they want certain fish specie (Fig. 5). The rice farmers in the four provinces mainly buy fish from the market (83%), and only few (15%) do own fishing (for specific species such as e.g. Trey Ros or Trey Kantrop) (Fig. 5). A small amount (2%) of the rice farmer's only conduct fishing (Fig. 5), these people had water bodies close to their home and were rather small families with not so many children.



Fig 5: How the different occupation groups in the provinces Kampong Chhnang, Kampong Cham, Prey Veng and Kandal get hold of their fish, through fishing, buying or both.

The pattern with respect to how people obtain their fish differs from province to provinces. Most fish farmers in Kampong Chhnang (80%) buy their fish from the local market, the rest (20%) only conduct own fishing in order to get fish. In Kandal the pattern is a bit different, the majority of the fish farmer (71%) conduct some own fishing together with buying fish from local market and no one only fish.

Fishermen in Kampong Chhnang and Prey Veng excluded fish for their own consumption and no one buy fish. In Kampong Cham and Kandal the fishermen conduct their own fishing and also go to the local market to buy fish. Rice farmers in Kampong Chhnang and Kampong Cham (90% and 80% respectively) go mostly to the market or buy fish from traders in a small amount (10% and 20% respectively) they conduct also some of their own fishing. In Prey Veng and Kandal the majority of the rice farmers (70% and 71% respectively) buy fish from local market or from traders. In Kandal as many as 50% of the rice farmers only conduct own fishing in order to get fish, the number in Prey Veng are 10%. A small amount of the rice farmers in Prey Veng and Kandal (20% and 10% respectively) besides going to the market also do some own fishing in order to get fish (Table 2).

Kampong Chhnang	Buy (%)	Fishing (%)	Both (%)
Fish farmer	80	20	
Fishermen		100	
Rice farmer	90		10
Kampong Cham			
Fish farmer	63	13	25
Fishermen		67	33
Rice farmer	80		20
Prey Veng			
Fish farmer	60		40
Fishermen		100	
Rice farmer	70	10	20
Kandal			
Fish farmer	29		71
Fishermen		50	50
Rice farmer	71	50	10

 Table. 4: How the different occupation groups get hold of their fish
 divided on the different provinces.

3.5 Availability of LVF during the past four years

In Kampong Chhnang, 73% of all interviewed household had experienced a decrease in the amount of LVF during the last four years. Only 27% experienced an increase or no change (Fig. 7a). Among fish farmers, 63% had noticed a decrease and 33% noticed an increase (Fig. 7b). 56% of the fishermen in Kampong Chhnang experienced a decrease in the availability of LVF and 11% experienced an increase. 33% thought that it was more or less the same amount of LVF now as for four years ago (Fig. 7c). Among the rice farmers, 90% experienced a decrease in the amount of LVF and the rest noticed an increase (Fig. 7d). Fish farmers often based their answers not only on actual catches in the river/lake, but also on

market availability, compared to fishermen who based their answers only on actual catches. The rice farmers noticed differences in the market and a few also thought that the LVF had become more expensive due to reduced availability.



Fig.7: The experienced changes in availability of LVF during the last four years in Kampong Chhnang among, a) all three occupation groups, b) fish farmers, c) fishermen and d) rice farmers.

In Kampong Cham, 33% of all interviewed households experienced a decrease in the amount of LVF during the past four years. 56% experienced an increase and 11% experienced no change for the last four years (Fig. 8a). Among the fish farmers in Kampong Cham 25% experienced a decrease in the amount of LVF, 37,5% experienced an increase and 37,5% no change compared to four years ago (Fig. 8b). 22% of the fishermen in this province had noticed a decrease in the availability of LVF. However, 78% noticed an increase (Fig. 8c). Among the rice farmers in Kampong Cham, 50% had experienced a decrease in the amount of LVF during the past for years and 50% has experienced an increase (Fig. 8d).





Fig.8: The experienced changes in availability of LVF during the last four years in Kampong Cham among, a) all three occupation groups, b) fish farmers, c) fishermen and d) rice farmers.

In Prey Veng, 43% of the entire interviewed household experienced a decrease in the amount of LVF during the past four years, 37% experienced an increase and 20% no change (Fig. 9a).

40% of the fish farmers in this province thought that the availability of LVF had decreased, 20% thought that it has increased, and 40% reported no change (Fig. 9b). Among the fishermen in this province, 50% experienced a decrease in LVF availability, 40% experienced an increase, and 10% thought that it was the same availability as for four years ago (Fig. 9c). 40% of the rice farmers experienced a decrease in the amount of LVF during the past four years, 50% experienced an increase and 10% reported no change (Fig. 9d).



Fig.9: The experienced changes in availability of LVF during the last four years in Prey Veng among, a) all three occupation groups, b) fish farmers, c) fishermen and d) rice farmers.

In Kandal, 81% of all interviewed households experienced a decrease in the availability of LVF during the past four years, 15% experienced an increase and 4% no change (Fig. 10a). 83% of the fish farmers had noticed a decrease in the availability and 17% experienced same availability of fish the last four years (Fig. 10b). Among the fishermen in Kandal, 70% had experienced a decrease in the availability of LVF and 30% experienced an increase (Fig. 10c).

90% of the rice farmers in this province experienced a decrease in the amount of LVF, and 10% experienced an increase (Fig. 10d).



a)





Fig. 10: The experienced changes in availability of LVF during the last four years in Kandal among, a) all three occupation groups, b) fish farmers, c) fishermen and d) rice farmers.

3.6 Importance of LVF

The reason for eating LVF in the four provinces is often associated with the household economy (Fig. 11). 37% of the interviewed household said that LVF is cheap and that they can save money by eating it. 19% of the households eat LVF and kept the HVF for selling in order to buy rice or fishing equipment. It was mainly fishermen that reported in this way, but also some rice farmers involved in fishing activities. Only 5% of the households said that they eat LVF because it is natural fish and they don't want to eat cultivated fish. 26% of the households said that they don't have enough money to by HVF. 5% of the interviewed eat LVF when they can't get hold of HVF.

8% of the interviewed households answered something else, e.g. they have eaten LVF for a long time and like the taste of it, its good for the health etc. (Fig. 11).



Fig. 11: Different reasons for eating LVF in the four provinces Kampong Chhnang, Kampong Cham, Prey Veng and Kandal among all occupation groups.

4. Discussion

The reason for that Kampong Chhnang is the province with the highest consumption of fish among all four provinces an occupation groups can be due to the fact that Kampong Chhnang is situated in the southern part of Tonle Sap Lake and probably being a more extensive fishing community compared to the other provinces. Only 33% of the land area is agricultural land and small water bodies cover 12% of the province land area (MAFF (b), 2008), which makes it the province with the smallest amount of agricultural land and the larges amount of water. The province population density (76 pers/km²), which was the lowest among all four provinces (MAFF (b), 2008), probably contributes to the large proportion of fish/person in this province. Prey Veng was the province with the lowest fish consumption; this can probably be explained by the fact that more than half of the land area (63,49%) is agricultural land. There aren't either any specific data on water resources in the province (MAFF(c), 2008), which illustrate that the province is an agriculture area.

When comparing fish consumption between the different occupation groups the fish farmers and fishermen generally had the highest consumption. In Prey Veng, fishermen had the highest consumption (together with the fish farmer) among the occupation groups. Due to this, the province is highly populated (density of 209,98 pers/km²) in combination with a few water bodies. This can lead to that the average fish/person in the province is smaller that in the other provinces, and to the finding that the fishermen and fish farmer eat more fish than the rice farmers who consumes more rice instead.

The fish farmer in Prey Veng consume the same amount of fish as the fishermen, something that could indicate that they, besides consuming farmed fish, also consume fish from own fishing activities.

The total annual consumption of fresh fish among all the interviewed were 51,35 kg/person/annual, this is in line with the study *Cambodia Post-Harvest Fisheries Overview* (CFDO-IMM 2005) in 2005 were they estimated the annual consumption of fresh fish to 43,5 kg/person/annual.

In Kampong Chhnang many fish farmers (50%) besides eating Trey Riel also eat high valued fish species such as Trey Pra (*Pangasianodon hypophthalmus*), Trey Kaek (*Morulius chysophekadion*) and Trey Chdor (*Channa micropeltes*). They don't buy HVF species, which indicates that they take fish from their cages, and eat or trade them to other species. Fish farmers in Kampong Cham mainly eat LVF- species and instead rice farmers in this province (30%) eat Trey Pra more frequently then Trey Riel. This can indicate that the fish farmers keep the high valued fish they get when they fish to put in their aquaculture or sell it to get more money to buy cheaper fish for. 20% of the rice farmers in Kampong Cham conducted some kind of own fishing and it is possible that they then catch some of the HVF-species during these activities. The rice farmers in Kampong Cham also buy some HVF-species, the cost of Trey Pra in Kampong Cham among rice farmers were almost the same and in some cases even cheaper than the LVF species (appendix 4). This can indicate that Trey Pra is more accessible than some LVF species, perhaps due to a more extensive farming of Trey Pra.

The most frequently consumed LVF species in Prey Veng were Trey Sleuk Russei among fish farmers; Trey Linh among fishermen and rice farmers consumes Trey Kros most frequently. Reasons for this could be associated with the fact that these fishes are more abundant in this province and the people in Prey Veng may prefer these species.

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No one eats a significant amount of some HVF- species, this could be due to Prey Veng limited fishing water and that the province population doesn't have the money to buy these fish species.

In a study made by Camber (in prep, Role of low value fish in aquaculture in Cambodia after ban on cultivating Giant Snakehead- *Socioeconomic impact assessment*) it is shown that 61% of the interviewed fish farmers give LVF as fish feed to their omnivorous and carnivorous fish species, among the most common LVF species to give as fish feed in cultivations are Trey Riel, Trey Linh and Trey Khnang Veng (due to these facts it can be competition concerning these LVF- species were two interest groups will compete with each other about this resource). This data indicates that even though there is a ban on the farming of the carnivorous specie Giant Snakehead, a lot of LVF species goes to the aquaculture and something needs to be done to prevent a future conflict.

The prohok consumption is almost the same in Kampong Cham and Prey Veng, yet in Kandal they eat slightly less prohok. Prohok is often consumed by poorer population groups, which may indicate that Kandal is a province with better economy than the other two. When comparing the different occupation groups, fish farmers in both Kampong Cham and Prey Veng consume more prohok than the fishermen. This is surprising, as this group often is richer due to the fact that they earn more money from their farming activities than both fishermen and rice farmers, and prefer other food fish. All provinces use different amount of fresh LVF to produce 1 kg of prohok, which may be due to different quality, demands on the final product. If a lot of fish is used to produce 1 kg of prohok it will probably be of better quality because it is more of the main ingredient (fish) in it. This further strengthen the argument that people in Prey Veng, using the lowest amount of fresh fish to produce 1 kg of prohok, may be poorer compared to the other provinces.

The total annual prohok consumption among all occupation groups and provinces were 5,13 kg/pers/annual, this is a significant smaller amount than Baran (2007) has estimated were the annual consumption of prohok were 10,1 kg/pers/annual. These differences can be explained by the fact that maybe different occupation groups were interviewed, which may influence the results, this study was also of short duration and not so many people were interviewed. Probably the study of Baran is more close to the reality than this study, due to a very limited time frame and inexperience with these kinds of studies.

In general the rice farmers needed to pay more for their fish, which can be due to the fact that they live further away from the water bodies, resulting in more expensive prices of fish. Many rice farmers also bought their fish from trader that came to their houses, probably charging more for the fish compared to market prices.

No fishermen in Kampong Chhnang and Prey Veng purchased fish; in Kampong Chhnang this can indicate that the provinces is a extensive fishing community and they don't need to buy fish to survive. In Prey Veng, this can further show that the area is more focused on agricultural activities and less in fishing. In Kampong Cham all fishermen that buy fish from markets buy HVF- species, probably species that they do not fish themselves but prefer to consume.

The reason that fisherman in Kandal and Kampong Cham buy fish from the market can be attributed to the fact that these groups of people have some alternative occupation. They hasn't as much time as before fishing, so instead they earn more money and can buy fish. In Kandal, it can indicate that due to its closeness to the capital, Phnom Penh, they can charge more money for their fish and buy other fish species that are more preferred.

Camber (in prep. Role of low value fish in aquaculture in Cambodia after the ban on cultivating Giant Snakehead- *Socioeconomic impact assessment*. 2008) writes that the average price for a mix of LVF as aquaculture feed cost approximately 800-riel/kg mix. The cost of this is much lower than the cost of LVF for human consumption, which has an average cost among all provinces, occupation groups and the most common species consumed at 3563 riel/kg. This can be due to the fact that the people buying fish for consumption often buy the species separately, which will make it more expensive due to that some one needs to separate the species from each other. This could be a potential conflict due to that the LVF- mix is much cheaper than the separate species for consumption. It is then most likely that the aquaculture owner has the advantage over the ones who want to buy LVF for consumption. Due to this aquaculture practice, they farm high valued fish species that are expensive to buy at the market, and this results in a better economy for them than the fishermen and rice farmer despite their need to buy LVF as fish feed due to a larger income.

The general perception among all provinces was that the availability of LVF had decreased during the past four years; it was only the households in Kampong Cham that thought that the availability had increased. When looking at the availability of LVF the different occupation

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groups bases their answer on different sources, e.g. fishermen from actual catches, fish farmers from market and catches and rice farmers from traders or market. This leads to diverse answers because all people have different perceptions. Due to that fisherman based their answers on actual catches; it reflects how the fish stock is changed. The other occupation groups based their answers mostly on market availability. Those answers can reflect if the fish stock is either declining or increasing but, but as well, if the fish go somewhere else e.g. for export to other countries, etc. It is hard to see any pattern among the occupation groups and the provinces in this question.

4.1 Challenges in the future

The communities around Tonle Sap Lake will face several challenges for sustaining their livelihoods in the future. They are very dependent on the aquatic resources the area provides, and it is difficult to predict how different changes will affect them. When looking at ecological and environmental perspectives, they are vulnerable to both short- and long-term climatic variations that will affect rainfall, flood levels and duration, and changes in the size of flooded forest areas (Navy et al. 2006). Changes like this can also be induced by human activities such as dam construction, deforestation and land development (Navy et al. 2006). The ecological conditions are also vulnerable to the use of pesticides in agriculture and in aquaculture. There are also other activities that can lead to income reduction to the communities in this area and increased pressure on the aquatic resources: for example the use of illegal and destructive fishing gears and over fishing (Navy et al. 2006). Economic interests, population growth, poverty, agriculture, tourism, housing and governance deficiencies are all challenges to a sustainable exploitation of the Tonle Sap area (Bonheur and Lane 2002). In the Tonle Sap area the catch per effort has decreased the last six decades and small migratory and non-migratory species increases in the catches while larger migratory species have significantly declined (Baran, 2001). As government employees are often under qualified and need to have jobs cause their wage is too low, also the governance is inferior (Bonheur and Lane 2002). The group of people that is most affected is the poor people with low education that lives near the water and whose livelihoods have long been dependent on these resources. These people have not the same opportunity to switch to an alternative occupation, e.g. aquaculture activities (Navy et al. 2006). The growing demand of LVF as fish feed, both international and national is therefore a big problem among these people, likely not being able to pay for it when the demand and prices increases.

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A potential problem could be an increasing export of LVF to Vietnam, which will lead to a net loss of LVF for the Cambodian people. It is also important to start some kind of cooperation among the countries in the Mekong River Basin area in order to get an accurate management of the resource due to that large population groups in Cambodia are dependent on LVF as a free protein source and also as a health provider. Due to increased aquaculture activities it is important in an early state to address the potential problems associated with this kind of activity and try to find solutions for them. Decision makers should be aware of the problems and try to make decision that both the environment and the Cambodian population can benefit from.

Many people in Cambodia suffer from "the hidden hunger" which is associated with micronutrient malnutrition. People suffer from this are not visibly hungry but the food they eat does not fulfil their nutrient requirements (Thilsted, S.H. et al. 2005). This complaint can decrease if the diet contains some portion of animal protein. In Cambodia today fish is not considered to be included in programs to improve the health problem that is associated with micronutrient malnutrition (Roos et al. 2006). To what extent the people in Cambodia are aware of the benefits of eating fish is hard to know. One first step in order to solve the widespread health problems in the country is to include fish in the health programs. This may create a pressure to at least keep the LVF in the country so the Cambodian people can benefit from it.

There are also many opinions (some resulting in violent conflicts) about how the fisheries should be allocated and regulated (Bonheur and Lane 2002). When the population is growing rapidly, even small-scale use constitutes a potential threat, and strategies for maintaining the viability of the Tonle Sap ecosystem need to be made (Bonheur and Lane 2002). This requires extensive knowledge about the many diversified ecological and social interactions (Bonheur and Lane 2002). Complete information about this unique aquatic ecosystem need to be provided for policymakers, so that the benefits and values of the ecosystem are not undertaken when legalisation is made (Rab et al. 2006).

5. Conclusion

The population in Cambodia is growing and the demand of low valued fish as a food source (in different forms) for both humans and animals is also most likely to grow within the coming years. Reasons for eating LVF is, in 82% of the interviewed answers, associated with

some kind of economical reason. This implies that this resource has a great value for the majority of the Cambodian population. Therefore it is urgent to manage the resources that the Tonle Sap and Mekong areas provide to the population with in a god manner so that it can meet the demand of the growing population as well as the growing exports market. If nothing is done there can be situations in the future where there aren't enough low valued fish for all interest groups. Then, it is most likely that the group of people that will be most affected are the poor people that depend on the resource as a free protein source. For this people, it will be a matter of life and death.

Some of the LVF species over which there could be a potential conflict about in the future are Trey Riel, Trey Linh and Trey Khnang Veng, this because many people in Cambodia consume these fish species and they are also used in a large extent as fish feed for the aquaculture. The price of LVF has increased during the past years and it is most likely that this is going to continue due to the growing demand of LVF, especially as an export product (fish feed) to neighbouring countries. This can result in lower availability and higher prices of LVF for the Cambodian people, creating a conflict where in the rural poor people in Cambodia are not able to catch as much fish they did before, in the same time and, as well, lack the means to purchase fish. This is most likely going to affect the poor population that only fish for own consumption the most because they don't sell any fish and can not take advantage of the increased LVF prices.

The consumption pattern of LVF varies between different occupation groups and location in Cambodia. This is important to investigate in order to be able to manage the different areas in ways that is best for the specific site.

This study reveals that if researches are going to be able to manage this in a proper way they need an estimate of how important this resource is for the people in different areas in Cambodia. Some kind of co-operation is needed among the different countries in the Mekong River Basin in order to manage the resource in a good manner. If these issues can be addressed in an early stage it is much easier, less expensive and saving more human lives, than if waiting until the point where resources are fully exploited.

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Appendix 1

Questionnaire – Importance of low valued fish for consumption in Cambodia.

1-General information

a. Interviewed

b.

c.

-Name:
-Date & Time:
-Sex (M=male, F=female):
-Age:
Address -Village name:
-Commune:
-District name:
-Province:
Household and income -How many people are there in your household?Men,women,children
-What is your main occupation?
Rice farmer: Subsistence fisher: Fish farmer:

2- Consumption

What is the amount of low value fish (see picture).....(%) and high value fish.....(%)?

b. What is the consumed low value fish used for?

Use	Proportion (kg)
Food, human	
Fish feed	
Animal feed	
Selling	

3- Subsistence consumption

No.	Fish species	Proportion (kg)	Size (cm)	Quality (fresh/not fresh)
1	Riel			
2	Sleuk Russei			
3	Kros			
4	Kanh Chrooch			
5	Khnang Veng			
6	Linh			
8	Arch Kok			
Others				

a. What low value fish species (see picture) and quality does your household consume?

b. Where does the consumed low value fish come from?

.

-Buy:....

Where?

Local market/ Landingsite/	Proportion	How often (times/month)?	
Fishermen	(kg)	Wet season	Dry season
1.			
2.			
3.			
4.			
5.			

c. What do you pay for the bought fish?

No.	Fish species	Riel/kg
1	Riel	
2	Sleuk Russei	
3	Kros	
4	Kanh Chrooch	
5	Khnang Veng	
6	Linh	
8	Arch Kok	
Others		

d.	How is the	e low value fish	preserved in a	vour household?
ч.	110 10 10 110		preserveum	your nouschold:

Fish form	Proportion (kg)	How many months/year	Why?
Fresh			
Fish paste (prohok)			
Dry fish			
Fermented fish (Pha-ork)			
Smoked fish			
Others			

e. Preservation methodology?

No.	Fish species	Preservation method
1	Fish paste	
2	Dry fish	
3	Fermented fish	
4	Smoked fish	
Others		

f. How much fresh fish takes it to produce 1 kilo of the different products?

No.	Product	Amount of fresh fish used
1	- Fish paste (Prohok)	
2	- Sun dried fish	
3	- Fermented (<i>Pha-ork</i>) fish	
4	- Smoked fish	
Others		

4- Selling

a. In what form do you sell your low value fish, how much will you charge for it and who buys it?

No.	Form	Charge (riel/kg)	Buyer (locals, traders, fish farmers etc)
1	Fresh fish		
2	Fish paste		
3	Dry fish		
4	Fermented fish		
5	Smoked fish		
6	Fish sauce		
7	Fish feed		
8	Animal (duck/chicken/pig) feed		
Others			

b. Do you know were your sold fish ends up?

Selling site	Specify (What provinces, countries etc)
Local market	
To other provinces	
External	
Other	

5- Consumption pattern change

a. How much low value fish goes to the different consumption groups and to what cost?

Consumption group	2004 (kg)	2006 (kg)	Costs 2004 (riel)	Costs 2006 (riel)
Subsistence				
Selling				
Aquaculture				
Other				

b. Do you know of the ban of farming giant snakehead?.....Have you noticed any difference in getting hold of low valued fish after the ban?

c. What are your ideas of using low valued fish as a food source?

6-Other information

a. Are there any problems you are facing or have faced regarding your fishing or fishing related activities or fish culture activity for generating household income and enhance food security?

•	

 $\boldsymbol{b}.$ Any suggestions to improve your household income and food security?

Inte	erviewed by:			
Ver	Verified by:			

Appendix 2

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Photos of the most common fish species that were used during the interviews.



Kanhchos	Mystus mysticetus M. albolineatus	
Kompleanh	Trichogaster trichopterus T. microlepis	













Appendix 3

Tables showing the different species that were consumed and cost of them in the different provinces and among the occupation groups. **Kampong Chhnang**

Fish species (Khmer name)	Scientific name	Fish farmer	Fishermen	Rice farmers
Riel	Henicorynchus sp	500-1 000	-	1 500-8 000
Kanh Chrooch	Mystus sp	2 000	-	2 500-6 000
Sleuk Russei	Paralaubuca typus	500	-	1 000-6 000
Kros	Osteochilus waandersi	1 000	-	1 000-6 000
Khnang Veng	Danglia sp, Cf. Cuvieri		-	3 000-6 000
Linh	Thynnichthys thynnoides	1 000	-	3 500-8 000
Arch Kok	Danglia sp, Cf. Lineuta	1 500	-	3 000
Pra (HVF)	Pangasianodon hypophthalmus	-	-	-
Kantrop	Pristolepis fasciata	-	-	-
Kaek (HVF)	Morulius chysophekadion	-	-	-
Ros (HVF)	Channa striata	-	-	-
Kompream	Polynemus multifilis	-	-	-
Chpin (HVF)	Hypsibabus sp	-	-	-
Chveat	Pangasius sp	-	-	-
Po	Pangasius larnaudiel	-	-	-
Hemibagrus spilopterus (HVF)	Hemibagrus spilopterus	-	-	-
Kompleanh	Trichogaster microlepsi	-	-	-
Chdor (HVF)	Channa micropeltes	-	-	-
Kantrang Preng	Parambassi wolffi	-	-	-
Kranh	Anabas testudineus	-	-	-
Kombot Chramos	Amblyrhynchichthys truncatus	-	-	-
Ka hae	Barbodesschwanefeldi	-	-	-

Kampong Cham

Fish species (Khmer name)	Scientific name	Fish farmer	Fishermen	Rice farmer
Riel	Henicorynchus sp	400-3 000	-	3 000-8 000
Kanh Chrooch	Mystus sp	3 000-5 000	6 000	2 000-8 000
Sleuk Russei	Paralaubuca typus	1 000-8 000	-	2 000-6 000
Kros	Osteochilus waandersi	-	-	2 000-5 000
Khnang Veng	Danglia sp, Cf. Cuvieri	500-9 000	-	2 000-6 000
Linh	Thynnichthys thynnoides	500-7 000	-	4 000-7 000
Arch Kok	Danglia sp, Cf. Lineuta	-	-	3 500-7 000
Pra (HVF)	Pangasianodon hypophthalmus	3 500-4 500	5 000	3 000-6 000
Kantrop	Pristolepis fasciata	3 000-8 000	-	7 000
Kaek (HVF)	Morulius chysophekadion	2 500	-	4 000-9 000
Ros (HVF)	Channa striata	-	-	8 000-12 000
Kompream	Polynemus multifilis	-	-	-
Chpin (HVF)	Hypsibabus sp	4 000-9 000	10 000	3 500-10 000
Chveat	Pangasius sp	6 000	-	-
Ро	Pangasius larnaudiel	4 000-6 000	-	4 500
Hemibagrus spilopterus (HVF)	Hemibagrus spilopterus	-	10 000	8 000
Kompleanh	Trichogaster microlepsi	-	-	3 000
Chdor (HVF)	Channa micropeltes	7 000-10 000	12 000	6 000-15 000
Kantrang Preng	Parambassi wolffi	-	-	-
Kranh	Anabas testudineus	4 000-5 000	-	-
Kombot Chramos	Amblyrhynchichthys truncatus	-	-	-
Ka hae	Barbodesschwanefeldi	-	-	-

Prey Veng

Fish species (Khmer name)	Scientific name	Fish farmer	Fishermen	Rice farmers
Riel	Henicorynchus sp	1 000-5 000	-	2 000-5 000
Kanh Chrooch	Mystus sp	1 000-4 000	-	1 500-5 000
Sleuk Russei	Paralaubuca typus	1 000-5 000	-	1 500-3 000
Kros	Osteochilus waandersi	1 000-4 000	-	2 000-5 000
Khnang Veng	Danglia sp, Cf. Cuvieri	1 500	-	1 500
Linh	Thynnichthys thynnoides	500-3 000	-	1 500-3 000
Arch Kok	Danglia sp, Cf. Lineuta	-	-	600-1 500
Pra (HVF)	Pangasianodon hypophthalmus	3 000-4 000	-	-
Kantrop	Pristolepis fasciata	4 000-7 000	-	-
Kaek (HVF)	Morulius chysophekadion	-	-	-
Ros (HVF)	Channa striata	10 000	-	7 000-10 000
Kompream	Polynemus multifilis	-	-	-
Chpin (HVF)	Hypsibabus sp	3 000-7 000	-	3 000-8 000
Chveat	Pangasius sp	-	-	-
Po	Pangasius larnaudiel	-	-	-
Hemibagrus spilopterus (HVF)	Hemibagrus spilopterus	-	-	7 000
Kompleanh	Trichogaster microlepsi	-	-	-
Chdor (HVF)	Channa micropeltes	7 000-10 000	-	7 000
Kantrang Preng	Parambassi wolffi	5 000	-	-
Kranh	Anabas testudineus	4 000	-	1 000-5 000
Kombot Chramos	Amblyrhynchichthys truncatus	-	-	4 000
Ka hae	Barbodesschwanefeldi	-	-	7 000-8 000

Kandal

Fish species (Khmer name)	Scientific name	Fish farmer	Fishermen	Rice farmer
Riel	Henicorynchus sp	2 000-5 000	5 000	4 000-8 000
Kanh Chrooch	Mystus sp	6 000-10 000	6 000-10 000	6 000-11 000
Sleuk Russei	Paralaubuca typus	2 000-8 000	3 000-5 000	4 000-5 000
Kros	Osteochilus waandersi	2 000-8 000	5 000-8 000	3 000-6 000
Khnang Veng	Danglia sp, Cf. Cuvieri	2 000-4 000	3 000-6 000	4 000-6 000
Linh	Thynnichthys thynnoides	3 000-4 000	3 000-6 000	6 000-8 000
Arch Kok	Danglia sp, Cf. Lineuta	3 000-4 000	6 000	3 000-6 000
Pra (HVF)	Pangasianodon hypophthalmus	3 000-6 000	5 000-8 000	4 000-6 000
Kantrop	Pristolepis fasciata	-	8 000	-
Kaek (HVF)	Morulius chysophekadion	-	-	-
Ros (HVF)	Channa striata	12 000	-	10 000
Kompream	Polynemus multifilis		-	-
Chpin (HVF)	Hypsibabus sp	4 000-8 000	5 000-8 000	7 000-10 000
Chveat	Pangasius sp	-	-	6 000
Ро	Pangasius larnaudiel	-	-	-
Hemibagrus spilopterus (HVF)	Hemibagrus spilopterus	-	7 500	6 000-7 000
Kompleanh	Trichogaster microlepsi	-	-	-
Chdor (HVF)	Channa micropeltes	12 000-15 000	-	12 000
Kantrang Preng	Parambassi wolffi	-	-	-
Kranh	Anabas testudineus	1 000-8 000	5 000-6 000	4 000-6 000
Kombot Chramos	Amblyrhynchichthys truncatus	-	_	-
Ka hae	Barbodesschwanefeldi	8 000	6 000	7 000-10 000