

## SOCIOECONOMICS AND LIVELIHOOD VALUES OF TONLE SAP LAKE FISHERIES

The importance of fisheries of the Tonle Sap Lake is indisputable, given the high contribution of about 60 percent to the total inland fisheries production. What may not be well recognized is the importance of Tonle Sap aquatic ecosystem to the livelihoods of over one million people living in and around the areas who rely heavily, if not entirely, on the resources. This synopsis draws on recent studies to provide estimates of values of fisheries and aquatic resources to local communities in the five provinces bordering the Tonle Sap Lake, i.e., Siem Reap, Battambang, Pursat, Kampong Chhnang and Kampong Thom. The synthesis reveals that all households in these areas engage in diverse income generating and livelihood activities, including fishing, fish processing, fish marketing, fish culture, farming, daily labour and firewood collection, regardless of their primary occupation. The gross annual household income from direct consumptive uses for all fisheries-dependent households in the five provinces is estimated at US\$233 million. Only about one-third of this is captured in households with income less than US\$1,000, which constitute about 72 percent of all households. These low-income households are mainly small-scale, subsistence fishers and farmers with high

livelihood dependency on the Tonle Sap Lake. Clearly, their livelihood concerns, such as secured access to resources, and basic rights to food security, jobs, education and health care, should be emphasized in discussions about sustainable management of Tonle Sap Lake fisheries and aquatic ecosystems.



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Department of Fisheries

Inland Fisheries Research and Development Institute (IFReDI)



For sustainable development of inland fisheries in Cambodia



## SYNOPSIS

# SOCIOECONOMICS AND LIVELIHOOD VALUES OF TONLE SAP LAKE FISHERIES

HAP NAVY  
SENG LEANG  
RATANA CHUENPAGDEE

Made possible by:

**ADB**

**ADB TA 4563-CAM**  
Capacity-Building of Inland Fisheries Research  
And Development Institute (Phase 2)

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Hap Navy  
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# About IFReDI

The Inland Fisheries Research and Development Institute (IFReDI) was established in October 2002 by virtue of Declaration No. 357 of the Ministry of Agriculture, Forestry and Fisheries as a research and development institute under the supervision of the Department of Fisheries (DoF).

## Vision

Sustainable development of Cambodia's inland aquatic resources for the country's food, security, and economic prosperity.

## Mission

To provide scientific information and technical support for the sustainable development and management of inland living aquatic resources in Cambodia, based on biological and socioeconomic research.

## Goals

- . Scientific research collection, analysis and dissemination of biological and socioeconomic data;
- . Development and upgrading of national capacity for the rational management of inland fisheries;
- . Maximization of the income of fishermen and farmers;
- . Sustainable utilization of the fishery resources.



186 Norodom Blvd., Tonle Basak, Chamkar Morn, Phnom Penh, Cambodia,  
PO Box 582, Tel/Fax: (855) 23 220 417  
E-mail: [info@ifredi.org](mailto:info@ifredi.org) Website: [www.ifredi.org](http://www.ifredi.org)

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Hap Navy<sup>1</sup>  
Seng Leang<sup>2</sup>  
Ratana Chuenpagdee<sup>3</sup>

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<sup>1</sup> Chief of Socio-economics Division, Inland Fisheries Research and Development Institute, Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh, Cambodia

<sup>2</sup> Officer, Inland Fisheries Research and Development Institute, Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh, Cambodia

<sup>3</sup> Adjunct Scientist, WorldFish Center, Phnom Penh, Cambodia

# Contents

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List of Tables, figures .....	iii
Acknowledgments .....	iv
Abstract .....	v
1. Introduction .....	1
2. Tonle Sap Lake communities, their activities and other characteristics.....	1
3. Livelihood strategies and dependency.....	5
4. Values of fisheries and aquatic resources.....	7
5. Issues and challenges in sustaining fishing livelihoods.....	12
6. Conclusion.....	15
References .....	17

## LIST OF TABLES AND FIGURES

### Tables

Table 1 Percentage of households involved in fishing.....	2
Table 2 Average annual catch per household and utilization of catch.....	3
Table 3 Percentage of households involved in different income generating activities.....	4
Table 4 Importance of common property resources.....	6
Table 5 Percentage distribution of male and female heads of household.....	6
Table 6 Estimates of average annual household income from all sources.....	9
Table 7 Total 'gross' income for aquatic resource-dependent households of the Tonle Sap Lake .....	10
Table 8 Consumption values of fisheries .....	11
Table 9 Summary of responses required to address challenges in sustaining livelihoods.....	14

### Figures

Figure 1 Different kinds of values associated with Tonle Sap aquatic ecosystem.....	7
Figure 2 Percentage distribution of households by income level.....	8
Figure 3 Percentage distribution of number of households and estimated gross annual income.....	10

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# Abstract

## **SOCIOECONOMICS AND LIVELIHOOD VALUES OF TONLE SAP LAKE FISHERIES**

by

**Hap Navy, Seng Leang, Ratana Chuenpagdee**

The importance of fisheries of the Tonle Sap Lake is indisputable, given the high contribution of about 60 percent to the total inland fisheries production. What may not be well recognized is the importance of Tonle Sap aquatic ecosystem to the livelihoods of over one million people living in and around the areas who rely heavily, if not entirely, on the resources. This synopsis draws on recent studies to provide estimates of values of fisheries and aquatic resources to local communities in the five provinces bordering the Tonle Sap Lake, i.e., Siem Reap, Battambang, Pursat, Kampong Chhnang and Kampong Thom. The synthesis reveals that all households in these areas engage in diverse income generating and livelihood activities, including fishing, fish processing, fish marketing, fish culture, farming, daily labour and firewood collection, regardless of their primary occupation. The gross annual household income from direct consumptive uses for all fisheries-dependent households in the five provinces is estimated at US\$233 million. Only about one-third of this is captured in households with income less than US\$1,000, which constitute about 72 percent of all households. These low-income households are mainly small-scale, subsistence fishers and farmers with high livelihood dependency on the Tonle Sap Lake. Clearly, their livelihood concerns, such as secured access to resources, and basic rights to food security, jobs, education and health care, should be emphasized in discussions about sustainable management of Tonle Sap Lake fisheries and aquatic ecosystems.

## 1. Introduction

This synopsis aims to describe the socio-economic characteristics of fishing communities around the Tonle Sap Lake, to summarize information on the economic and livelihood values of the fisheries to these communities, and to identify key issues that might be considered in sustaining their livelihoods. The synopsis draws largely from recent studies on socioeconomics and livelihood of fisheries resources in the Tonle Sap Lake,<sup>4</sup> particularly the report by Rab *et al.* (2005) and Ahmed *et al.* (1998), both of which provide baseline socioeconomic information about communities at two different time periods<sup>5</sup>. The present summary focuses on the five provinces bordering the Tonle Sap Lake, i.e., Siem Reap, Battambang, Pursat, Kampong Chhnang and Kampong Thom<sup>6</sup>. We first describe Tonle Sap Lake communities and their fishing, fishing-related, and other income generating activities. Next, we summarise overall livelihood strategies as well as their dependency on aquatic resources. We then draw inference about the 'values' or importance of fisheries and other aquatic resources based on the household surveys conducted by Rab *et al.* (2005)<sup>7</sup>. We conclude with key issues and challenges in sustaining the livelihoods of the communities.

## 2. Tonle Sap Lake communities, their activities and other characteristics

Fisheries have long been central to Cambodian lifestyles, particularly to communities living in and around the Tonle Sap Lake. Fisheries from Tonle Sap areas contribute about 60 percent of Cambodian total inland fisheries production (Baran, 2005), or between 200,000 to 218,000 tonnes based on average productions from 2001-2003 (DOF, 2004), with landed values between US\$150-250 million<sup>8</sup> (MAFF-CNMC, 2003).

According to the study conducted in 1995, titled "*Socio-economic assessment of freshwater capture fisheries of Cambodia*" (Ahmed *et al.*, 1998), there were about 1.17 million people in the five provinces (comprising 145 fishing communities and 195,000 fishing families) who depended on fisheries and other aquatic resources for food and livelihoods. In 2003, the population was estimated to have increased to 1.25 million (Rab *et al.*, 2005).

***Fisheries have long been central to Cambodian lifestyle, particularly to about 1.25 million people living in the five provinces around the Tonle Sap Lake who depend on fisheries and other aquatic resources for food, income and livelihoods.***

Fishing is generally categorized into three types: family fishing (or small-scale), middle-scale fishing and large-scale fishing (or fishing lot)<sup>9</sup>. Brief descriptions of these fisheries are provided below with estimates of production in 1995, as reported in Ahmed *et al.* (1998), based on household surveys of 867 family fishing, 84 middle-scale fishing and 6 fishing lot, considered actively involved in fishing at the time of the survey. It is worth noting, however, that the estimates from 1995 are likely to be starkly different from current figures considering the recent fisheries reforms that may have resulted in the increase of number of fishing households.

### (i) Family (or small-scale) fishing.

*This is practiced in about every household around the Tonle Sap and is usually carried out by family members using small gears, such as gill nets and bamboo fence traps. Family fishing does not require license and it can take place all-year round. Considerable amount of catches are used*

<sup>4</sup> Tonle Sap Lake is used here to emphasize the focus of the synopsis on the lake area and its floodplains, and not Tonle Sap River that connects the Lake to the Mekong River. The terms 'the Tonle Sap Lake' and 'the Tonle Sap' are used interchangeably in the report.

<sup>5</sup> The areas covered in Rab *et al.* (2005), i.e., Kampong Chhnang, Siem Reap and Kandal, is a sub-set of what was covered in Ahmed *et al.* (1998), which also included Kampong Thom, Battambang, Pursat, Kampong Cham and Phnom Penh. The Ahmed *et al.* (1998) study was conducted in 1995-1996, while that of Rab *et al.* (2005) was undertaken in 2003-2004.

<sup>6</sup> Banteay Meanchey is excluded from the synopsis because the bordering area to the Tonle Sap Lake is very small compared to the other five provinces.

<sup>7</sup> Figures presented in the synopsis were re-analyzed from raw data obtained in the survey conducted by Rab *et al.* (2005) to include information on only two provinces, i.e., Kampong Chhnang and Siem Reap; they thus are different from what was reported in Rab *et al.*

<sup>8</sup> The exchange rate used in this study is US\$1 = 4,000 Riel.

<sup>9</sup> See detailed description of each fishing type in Baran (2005).

for home consumption. Of all households actively involved in fishing, 90 percent are small-scale operators. In 1995, about 85,000 households engaged in family fishing, with an estimated average annual production of 0.7 tonnes per household. Over two-thirds of the harvest from this type of fishing originated from Kampong Chhnang and Batambang provinces.

(ii) Middle-scale fishing.

This is for commercial purpose and is allowed only during October to May, when the water level in the Tonle Sap begins to recede and the floodplain area is decreasing in size. Under current regulations, license is no longer required for middle-scale operations. Gill nets are the main gear of middle-scale fishers. The number of middle-scale fishing households in the five provinces in 1995 was about 9,000, each one making an average catch of about 5.3 tonnes per annum.

(iii) Large-scale fishing or fishing lot.

This is operated under a two-year lease system using gears that can cover large areas such as bamboo barrage traps and seine nets. In 1995, the average annual

year round by small-scale fishers.

According to Rab *et al.* (2005), villages around the Tonle Sap Lake may be categorized based on level of fishing activities of households, i.e., fishing, fishing cum farming and farming villages. Overall, 'fishing' villages refer to villages with 80-90 percent of households considering fishing as their primary occupation, 'farming' villages are those with at least 80 percent of households engaged in farming, while 'fishing cum farming' villages are those with households relying on fishing during the wet season and farming during the dry season. Based on the 2003-2004 survey of 270 households in Kampong Chhnang and Siem Reap provinces (Rab *et al.*, 2005), almost all households in fishing villages and about 66 percent of fishing cum farming households fished all year round (Table 1).<sup>10</sup> In farming villages, on the other hand, almost half of the households fished during closed season, when the water is high and farming is inactive.

As previously stated, the type of fishing gears used varies by type of fishing operation, fishing ground and targeted species. Gill nets are commonly used in family fishing as they are considered a relatively low-cost gear, suitable for catching many fish species in

**Table 1 Percentage of households involved in fishing at different time of year by type of village**

Involvement in fishing	Kampong Chhnang			Siem Reap			Both		
	Fishing	farming	Farming	Fishing	farming	Farming	Fishing	farming	Farming
Closed season	2	7	49	0	4	44	1	6	47
Opened season	7	13	0	2	22	9	4	18	4
All year	89	71	18	98	60	31	93	66	24
Occasional or not at all	2	9	33	0	13	16	1	11	24

Notes: n = 45 in each village type in each province

production per fishing lot was estimated to be 54.1 tonnes.

Fishing takes place in the Tonle Sap Lake, as well as in small rivers, inundated forests and flooded rice fields. Fishing in rice fields occurs mainly during closed season (June to September). Other fishing grounds are used

different fishing grounds. Thus, about 73 percent out of 270 households surveyed (from 62 percent in farming villages to 84 percent in fishing villages) owned gill nets (Rab *et al.*, 2005). The most important species in terms of quantity (between 13 to 36 percent of total catches) for all types of fishing is carp (treyl, *Henicorhynchus spp.*). Other important

<sup>10</sup> All tables in this synopsis are based on the re-analysis of the survey data by Rab *et al.* (2005)

species are snakehead fish, catfish and other cyprinids.

Some difference in average annual catch per household between Kampong Chhnang and Siem Reap can be observed (Rab *et al.*, 2005). Annual catches of households in fishing villages in both provinces were much greater than those of households in fishing cum farming and farming villages (i.e., about 75 percent of total catches came from fishing villages). Comparison by province of average annual catch per household in fishing and fishing cum farming villages shows that the catches of those in Siem Reap doubled those in Kampong Chhnang (Table 2). This suggests that there were more middle-scale fishing and more fishing lots in Siem Reap. The reverse was found, however, for households in farming villages where catches were higher in Kampong Chhnang.

Utilization of catches varies between types of villages and provinces. For example, Rab *et al.* (2005) reported that among predominately fishing villages in Kampong Chhnang and Siem Reap, an average of 80 percent of total catches is sold fresh, 9 percent is sold as fish feed, 8 percent is processed, while the remaining 3 percent is for home consumption. Note, however, that percentage of catches for home consumption is considerably higher in farming villages (about 34 percent) than in fishing and fishing cum farming villages (Table 2). The relatively low catch and high proportion of catches for home consumption suggest that fishing in farming villages is mainly small-scale.

Fish processing activities may be classified, based largely on the scale of operation, as: 1) traditional or a family scale, for home consumption; 2) commercial scale, with 40-60 workers, mainly for local market; and 3) industrial scale, for international markets. The most important processed products, in terms of quantity produced, are semi-final fish paste (73 percent) and fish paste (13 percent), locally called *prahoc*. These products are sold at prices (about US\$0.35/kg) lower than those of fermented and smoked fish (US\$0.60-0.70/kg) which are produced in much smaller quantity.

Similar to utilization of catches, farming households retain almost all of their processed products (about 95 percent) for home consumption and sell the rest. Fishing households, on the other hand, sell 91 percent of processed products (Rab *et al.*, 2005). Although 63 percent of the 270 surveyed households reported fish processing as one of their economic activities, only 16 percent of them earn income from fish processing. It is also worth noting that participation of women and children in fish processing activities is relatively high compared to direct fishing. For example, women comprise about 80 percent of fish processing plant workers.

Aquaculture is another economic activity that is gaining importance among communities living in and around the Tonle Sap Lake. In some fishing villages, Rab *et al.*, (2005) found that nearly half of the households are engaged in fish-rearing operations. The main types of aquaculture in the Tonle Sap are cage and pen culture of a number of fish species,

**Table 2 Average annual catch per household and utilization in Kampong Chhnang and Siem Reap by type of village**

Utilization of catches (kg)	Kampong Chhnang			Siem Reap		
	Fishing	farming	Farming	Fishing	farming	Farming
Home consumption	136	172	150	723	240	128
Sold fresh	7,402	1,166	347	11,369	4,597	121
Fish processing	67	30	16	1,884	113	4
Fish feed	592	889	44	1,449	73	1
Annual catch per household	8,197	2,257	557	15,425	5,023	254
Utilization of catches (%)	Fishing	Farming	Farming	Fishing	Farming	Farming
Home consumption	2	7	49	0	4	44
Sold fresh	7	13	0	2	22	9
Fish processing	89	71	18	98	60	31
Fish feed	2	9	33	0	13	16

including *trey chdor* (giant snakehead, *Channa micropeltes*), *trey pra* (sutchi catfish, *Pangasianodon hypophthalmus*), *trey po* (spot pangasius, *Pangasius larnaudii*) and *trey ros* (snakehead murrel, *C. striata*), and farming of crocodiles. Fish raised in many households come from live catch of fry or fingerling, which are kept in bamboo pens or in cages under their floating houses, fattened and sold when demand is high.

Overall, fishing and fishing-related activities are important for the majority of households in the Tonle Sap Lake. It should be noted, however, that despite high involvement in fishing and fishing-related activities, many households may still consider rice farming as their primary occupation. For instance, about 72 percent of 2,544 households in the five provinces surveyed in Ahmed *et al.* (1998) reported rice farming as their primary occupation while only 12 percent considered fishing as their main activity. This could be because on average almost 90 percent of the house-

as main source of protein and fall back against crop failure (McKenny and Tola, 2002).

Table 3 shows the range of income generating and livelihood activities of all households - fishing, fish processing, fish marketing, fish culture, daily labour, business and firewood collection. It is important to note that, even in farming villages, equal numbers of households derive income from fishing activities. In other words, these villages are rather homogenous in terms of main sources of livelihoods, and thus are evenly vulnerable to sudden environmental changes (Keskinen, 2003), discussed below. Given the occupational pluralism that characterizes Tonle Sap Lake communities, livelihood consideration has to take into account the dependency of people on fisheries and the entire aquatic ecosystem.

In terms of demographic characteristics of the Tonle Sap communities, many studies report an average household size of six, headed

**Table 3 Percentage of households involved in different income generating activities by village type**

Sources of income	Type of village		
	Fishing	Fishing cum farming	Farming
Fishing	100	89	80
Fish culture	48	19	2
Fish trading	10	7	3
Net/gear making	2	2	0
Farming	21	69	78
Fuel wood collection	46	51	52
Bamboo & cane work	2	1	1
Livestock raising	30	24	28
Daily labor	24	19	19
Government/NGO	13	12	9
Money lending	1	1	4
Motor taxi/boat driving	0	2	1
Shop/small business	20	19	30
Others	3	2	2

holds built their houses on land. Among those who built houses on water, the number in Kampong Chhnang, Battambang and Kampong Thom provinces were highest at about 7 percent (Ahmed *et al.*, 1998). Reported primary occupation (in terms of income and time allocated) may not be the best indicator of the importance of, and livelihood dependency on, aquatic resources since many people are involved in subsistence fishing, either on a daily or part-time basis. Indeed, for many households, fishing is important not as an income generating activity, but

mainly by male member, with about 65-70 percent of all household members in the working age range of 11-60 years old (Ahmed *et al.*, 1998; Rab *et al.*, 2005; Israel *et al.*, 2005). The main ethnic origin of household members is Khmer, with Chinese, Vietnamese and Cham as minority groups. The overall education and literacy rate is low; for example, as much as 20-25 percent of household members have no formal education. The low education level applies particularly to female heads of household and female household members. As a result, female-headed households have lower

income, thus lower socioeconomic status, than male-headed households (Keskinen, 2003). When comparing between different types of households, the level of education of household members in fishing villages is lower than that of farming villages (Rab *et al.*, 2005). This could be attributed to the fact that many of these fishing families live in floating houses and thus have limited access to school.

***Households around the Tonle Sap Lake are distinguished by their occupational pluralism, implying that livelihood consideration has to take into account the dependency of people on fisheries and the entire aquatic ecosystem.***

Like most households in other rural areas, the households around the Tonle Sap Lake have poor living conditions. They have limited access to basic amenities such as water for drinking and cooking. Ownership of assets and level of debts show different patterns between household types. As some fishing households build their houses on boats, cages and stilts over water, they own less land and the value of their houses is lower than that of farming villages (e.g., land areas owned by fishing households was only about 25 percent of those owned by farming households).

Fishing households have higher expenditures than farming households because of the nature of their equipment - e.g. boats and engine for fishing and transportation, generator for fish processing, and mobile phone for communication. Thus, the overall level of assets of fishing households is higher than those of farming households. However, because they incur more expenses for consumables, fishing households consequently have greater debts than fishing cum farming and farming households. Their main source of borrowed money are relatives, friends, traders and local money lenders - not financial institutions (Rab *et al.*, 2005).

***Fishing households tend to have higher percentage of expenditure on consumables compared to fishing cum farming and farming households. Thus more fishers are in debt, borrowing mainly from relatives, friends, traders and local money lenders -- generally not from financial institutions.***

### **3. Livelihood strategies and dependency on aquatic resources**

While the term 'fisheries-dependent' households may be used generally to refer to most households in the Tonle Sap Lake, it is recognized that the degree of dependency varies between types of villages due to their locations or proximity to the waters. The categorization used in Rab *et al.* (2005) suggests that 'fishing villages' have the highest degree of dependency on fisheries resources and 'farming villages' are the least dependent. This is evidenced by the difference in the time spent fishing: 4.55 person-hours per day per household for fishing villages vs. 2.07 person-hours for farming villages during closed season. Those located along the waters and in inundated forests have better access to fishing grounds and thus depend highly on fishing, while those with access to agricultural lands are naturally more involved in farming activities (Ahmed *et al.*, 1998). Similarly, households located within six meters of elevation from mean water level rely more heavily on aquatic resources than those in higher elevations and in urban areas (Keskinen, 2003). Furthermore, a study (ADB, 2005) using the zoning model adopted by the Tonle Sap Biosphere Reserve Project shows that people living in the core zone (with high degree of protection) rely more heavily on aquatic resources and, thus, are more concerned with renewable natural assets than those living in the buffer zone (areas designated for sustainable development) and in the transition zone (areas with relatively high degree of economic activity). This last study also emphasizes the importance of agriculture for people in the core and buffer zones.

***The majority of households in the Tonle Sap Lake maybe referred to as 'fishing-dependent', although the degree of dependency varies between village types (e.g., fishing, fishing cum farming, farming) and due to their locations or proximity to the waters.***

The diversification of income generating and subsistence activities is an important livelihood strategy for the majority of the people living around the Tonle Sap Lake, regardless of primary occupation, gender, age and education. The importance of aquatic resources is emphasized when considering that activities such as gathering of aquatic plants, non-aquatic and wild animals, water birds and

firewood take place on a daily basis to support basic needs of these rural communities. For example, all households collect firewood for cooking and fish processing and the majority of households rely on collection of morning glory, baringtonia leaves (or trouy rang) and water lily for household consumption. These two activities, as well as use of rivers for transportation, were considered most important by the households surveyed in Rab *et al.*'s study (Table 4). Access to and utilization of these

earn income, including from fishing or farming, or both. Typically, women are not directly involved in fishing, but they are key actors in the supply chain of aquatic products, in fish culture and in the maintenance of fishing gears (Israel *et al.*, 2005; McKenney and Tola, 2002; Keskinen, 2003). This traditional gender division of activity is not apparent in households headed by females where comparable number of female heads of households reported similar primary occupations as male

**Table 4 Importance of common property resources based on the report of uses by surveyed households in Kampong Chhnang and Siem Reap**

Level of importance	% households using resources	Common property resources
Very high	>80	Firewood, morning glory
High	>60	Barringtonia leaves (trouy rang), water lily, serbania flower (phkasnor)
Medium	>30	Garcinia (Sundane), water (for transportation), rat, mollusc, snails/crabs, lotus and lotus roots
Low	>10	Mat making materials, Garmcinia loureri fruits (sleuk sundane), water spinach (kanchhet), animal grazing, swamp eels, traditional medicine, recreation, snakes, toads
Very low	<10	Wild animals/birds, saomao prey, bamboo/canes, turtles

common property resources is thus a critical factor in sustaining livelihoods, particularly the livelihoods of people with little or no alternatives. The declining trend in accessibility and availability of products and benefits derived from common property resources, especially inundated forests and big rivers and lakes, was indicated in 1995 (Ahmed *et al.*, 1998), and in the more recent study (Keskinen, 2003). Some of the reasons for this trend, in addition to overfishing which directly impacts fishing livelihoods, are changes in environmental conditions, population growth and habitat destruction (Keskinen, 2003).

***Diversification of income generating and subsistence activities is an important livelihood strategy for the majority of the people living around the Tonle Sap Lake, regardless of primary occupation, gender, age and education.***

Traditional gender roles have a bearing on livelihood strategies. Women continue to bear the main responsibilities for home-making and child rearing, although they also collect food, vegetables and other common property resources for home consumption. Men, on the other hand, often work outside the house to

heads of household (Table 5). When necessity requires and opportunities present themselves, women, often together with their children, go fishing in rivers using small gill nets. In other words, female involvement in fishing may likely be higher than traditionally understood since much of their activity, which is aimed at provisioning for the household, is 'invisible'.

***Access to, and utilization of, common property resources is a critical factor in sustaining people's livelihood, particularly those with little livelihood alternatives.***

Is fishing a preferred lifestyle or is it the only livelihood option? The study by Ahmed *et al.* (1998) revealed that some of the main reasons for people's involvement in fishing are inherited family tradition, part of traditional food collection for home consumption, and provision of cheap food source. According to Keskinen (2003), more than 60 percent of the surveyed households living further away from the Tonle Sap Lake indicated the ability to change from fishing to other occupations, while those living closer to water bodies are less able to change. Considering that about

**Table 5 Percentage distribution of male and female heads of household by type of occupation and village type**

Type of occupation	Fishing		Fishing cum farming		Farming	
	Male	Female	Male	Female	Male	Female
Fishing	82	89	68	70	12	8
Fish trading	-	-	3	-	-	-
Fish culture	9	-	-	-	-	-
Farming	5	5	24	30	86	92
Laborer	-	-	1	-	-	-
Government/NGO job	1	5	1	-	3	-
Teaching	-	-	1	-	-	-
Others	-	-	1	-	-	-

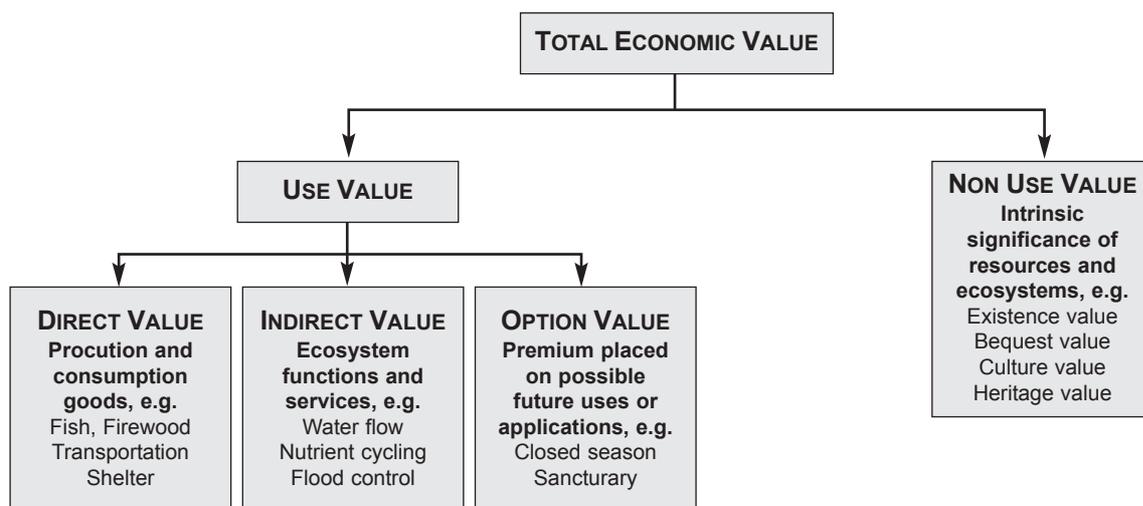
40-60 percent of households adjoining the Tonle Sap Lake live below poverty line (ADB, 2005), it is important to acknowledge the importance of livelihood diversification and alternative employment opportunities outside the fisheries sector.

*Female involvement in fishing may likely be higher than traditionally understood since much of their activity is often 'invisible'.*

as to sustaining rural livelihoods, particularly where dependency on resources is high, as in the case of Tonle Sap Lake communities. 'Total' values of aquatic ecosystem can be considered in terms of use and non-use values (Figure 1). Among use values are direct use, indirect use and option values. 'Direct use' values are obtained from production, consumption and sale of resources, such as through fishing, farming and firewood collection, as well as non-consumptive uses such as energy, shelter, transportation and recreation. 'Indirect use' values are derived from ecological functions and services provided by aquatic resource systems in terms of, for example, use of flooded forests as natural fish nurseries and spawning and foraging grounds, maintenance of water quality, flow and storage, flood control and storm protection, nutrient retention and micro-climate stabilization. 'Option value' is value of preserving the option to use the resources in

#### 4. Values of fisheries and aquatic resources

Information about values of fisheries and aquatic resources is useful to determine the extent to which resources contribute to the country's economic and social welfare, as well



**Figure 1 Different kinds of values associated with Tonle Sap aquatic ecosystem**

the future, for example, in putting aside protected areas. The other type of values, 'non-use', are intrinsic values such as 'existence' values derived from the knowledge that something is there, regardless of current or future use possibilities, and 'bequest' value associated with the desire to set aside resources for future generations. Non-use values are less tangible and more difficult to estimate than direct and indirect use values and thus are seldom considered in management decisions. In fact, valuation of natural resources is often aimed at capturing direct use values, which is already a challenging task, considering that 'total values' are likely to be higher than the estimates (see, for example, Ratner *et al.* (2004), on wetlands values). Overall, while it may be desirable to provide 'dollar figures' as estimates of values, the difficulty in valuation of natural resources makes it more suitable to infer values of the resources by assessing resource uses and accessibility and their importance to local livelihoods.

One approach to obtain net economic values (NEV) of fisheries, aquatic and other common property resources is by estimation of total revenues from production and sale of these products. Total costs of production are then subtracted from total revenues. Another approach is to indirectly estimate values from

reported 'gross' household income from different activities. While these data alone are not the indication of total values of resources, they reflect the importance of resources in terms of income dependency. In a survey of rural communities involved in subsistence and small-scale commercial fishing activities, these two estimates of values are likely to be similar, especially since when asked about income from various activities, respondents tend to first think of the amount they produce and the prices obtained. As in the calculation of NEV, cost information is needed to turn gross income into net income. This information, however, is generally difficult to obtain. Estimation of NEV is therefore not attempted here.

Using data from household surveys conducted by Rab *et al.* (2005), direct use values of Tonle Sap Lake fisheries and aquatic resources are estimated based on reported annual household income from all sources. Estimates of individual household income are provided by 'level' of income (or wealth category) to differentiate the size and scale of activities (Table 6). The difference in average annual household income between the highest income level and the lowest income level is vast, but the gap is particularly wide in fishing villages. Further, income per household differs slightly between village

**Table 6 Estimates of average annual household income (US\$) from all sources, categorized by level of income, by village type, by province**

Average annual household income (US\$)									
Income level	Kampong Chhnang			Siem Reap			Both		
	Fishing	Fishing cum farming	Farming	Fishing	Fishing cum farming	Farming	Fishing	Fishing cum farming	Farming
≤1,000	412	414	406	655	580	432	533	466	418
1,001 - 2,000	1,254	1,221	1,296	1,320	1,322	1,451	1,289	1,302	1,398
2,001 - 5,000	2,548			3,655	3,345	3,525	2,991	3,345	3,525
> 5,000	6,448			9,617	5,445		8,349	5,445	
Number of households									
Income level	Kampong Chhnang			Siem Reap			Both		
	Fishing	Fishing cum farming	Farming	Fishing	Fishing cum farming	Farming	Fishing	Fishing cum farming	Farming
≤1,000	26	42	42	26	19	37	52	61	79
1,001 - 2,000	11	3	3	12	12	4	23	15	7
2,001 - 5,000	6			4	11	4	10	11	4
>5,000	2			3	2		5	2	
	45	45	45	45	44*	45	90	89	90

\* one sample (outlier) was removed.

types and provinces, with households in fishing villages having the lowest level of income and households in Kampong Chhnang with lower income in all categories than those in Siem Reap. Also shown in Figure 2, the majority of households in these two provinces, especially in Kampong Chhnang, earn less than US\$1,000 per year. In both cases, there are more households in the low income level in farming villages than in fishing villages.

The 'direct use' values (gross) reported in Table 6 are based on income of individual household. An estimation procedure is used to calculate total direct use values for all 'aquatic resource-dependent' households in the five provinces. The term is used here to recognize the broader importance of the Tonle Sap Lake beyond direct benefit from fishing. It is important to note that these estimates are the 'minimum' values at best (or on the lower end

in the five provinces are considered 'fishing' communes, with the highest percentage (55 percent) in Kampong Chhnang and the lowest in Siem Reap (31 percent). Using these proportions, the total population depending on aquatic resources of the Tonle Sap is estimated at about 1.25 million (based on an average household size of six), suggesting about 2 percent growth rate from 1995 data reported in Ahmed *et al.* (1998). Average income at the individual household level from these two provinces (by income category) is used to estimate income for the other three provinces, assuming that estimates for Kampong Chhnang represent households on the lower end of the income range, while those for Siem Reap represent the higher end (Table 6). Note also that, for simplification, income is averaged for all village types. Table 7 shows the calculation of total 'gross' annual income for all aquatic resource-dependent

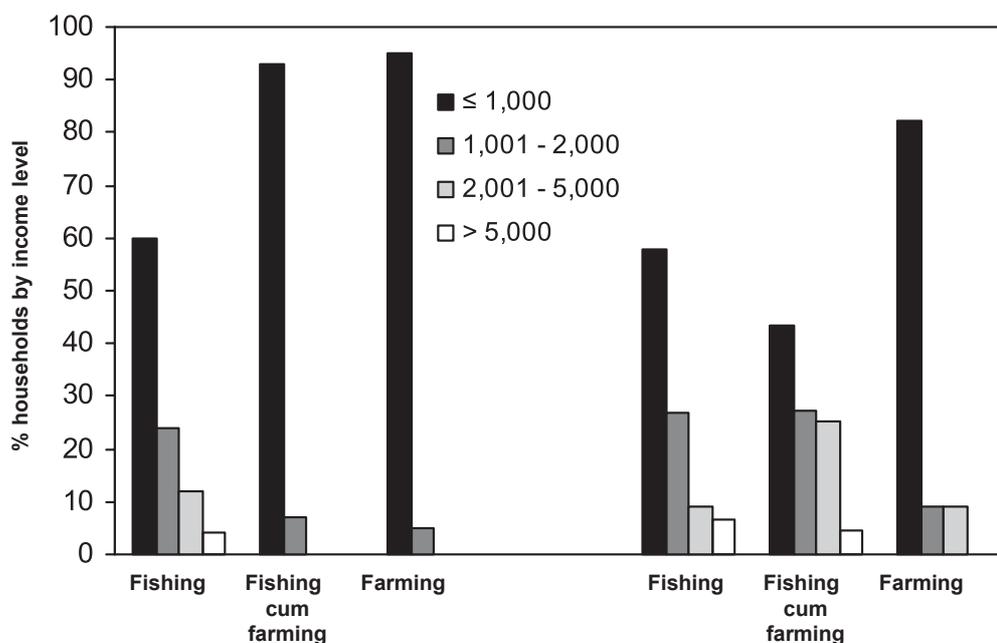


Figure 2 Percentage distribution of households by income level for each village type

of the income range), considering that a good proportion of products from various activities are for home consumption. Some suggestions on how to adjust these estimates are discussed below.

First, the number of households in each province is obtained from 2002 census (UNDP, 2003) and the proportions of aquatic resource-dependent households in each province are based on Ahmed *et al.* (1998). On average, about 42 percent of communes

households for the five provinces around the Tonle Sap Lake. Estimates for the other three provinces (Battambang, Pursat and Kampong Thom) are based on average values between Kampong Chhnang and Siem Reap.

Overall, US\$215 million is estimated as gross annual income for these communities, indicating thus a 'portion' of direct use values and importance of aquatic resources to Tonle Sap communities. This implies per capita income per annum of about US\$172, based on the

**Table 7 Total 'gross' income for aquatic resource-dependent households of the Tonle Sap Lake**

a) Average annual income per household (US\$)

Income level	Kampong		
	Chhnang	Siem Reap	Both
≤1,000	409	556	470
1,001 - 2,000	1,229	1,364	1,321
2,001 - 5,000	2,548	3,508	3,287
>5,000	6,448	7,531	6,897

b) Percentage distribution of households by income level

Income level	Kampong		
	Chhnang	Siem Reap	Both
≤1,000	83	61	72
1,001 - 2,000	12	21	16
2,001 - 5,000	4	14	9
>5,000	1	4	3

c) Estimated number of aquatic resource-dependent households by income level

Income level	Kampong				Kampong Thom	Total
	Chhnang	Siem Reap	Battambang	Pursat		
≤1,000	39,742	24,630	32,384	27,309	26,924	150,988
1,001 - 2,000	5,746	8,479	7,196	6,069	5,983	3,3473
2,001 - 5,000	1,915	5,653	4,048	3,414	3,365	18,395
>5,000	479	1,615	1,349	1,138	1,122	5,703
Total	47,882	40,376	44,978	37,929	37,394	208,560

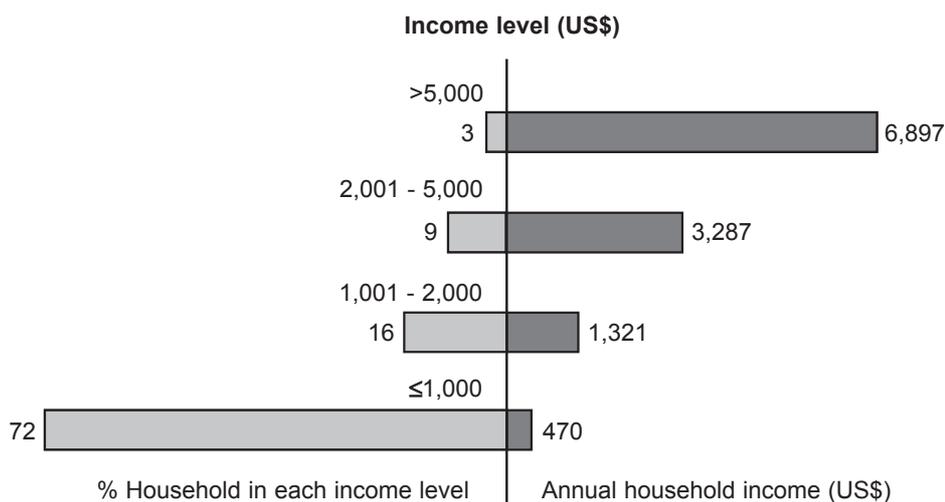
d) Estimated 'gross' income for all households by province (million US\$)

Income level	Kampong				Kampong Thom	Total
	Chhnang	Siem Reap	Battambang	Pursat		
≤1,000	16.2	13.7	15.2	12.8	12.7	70.6
1,001 - 2,000	7.1	11.6	9.5	8.0	7.9	44.1
2,001 - 5,000	4.9	19.8	13.3	11.2	11.1	60.3
>5,000	3.1	12.2	9.3	7.8	7.7	40.1
Total	31.3	57.2	47.3	39.9	39.4	215.1

estimate number of about 209,000 households with an average size of six. When considering household income by income level, the situation is stark for the majority of households, as over 70 percent of all households earn income of only about US\$470, or per capita income of about US\$78 (Figure 3). Put differently, about 12 percent of households (with annual income above US\$2,000) capture almost half of the total gross income from all households. Most likely, households with average income less than US\$1,000 are small-scale, subsistence fishers and farmers who rely heavily, if not entirely, on aquatic resources for their livelihoods, while those earning high income are middle-scale fishers and fishing lot owners. The disparity in income distribution between households is a serious problem that needs to be addressed.

***Diversification of income generating and subsistence activities is an important livelihood strategy for the majority of the people living around the Tonle Sap Lake, regardless of primary occupation, gender, age and education.***

In addition to values estimated from reported household income (from production and sale), values of fisheries for home consumption are added. Based on utilization of catches in Table 2 and the average price of fish at US\$0.25 per kilogram, about US\$63 is estimated as an annual average consumption value per household. The total consumption value for all households is thus about US\$13 million (Table 8). Adding this proportion to the households



**Figure 3 Percent distribution of number of households and estimated gross annual income by income level**

gross income results in an estimate of about US\$228 million for direct consumptive use values of fisheries and aquatic resources of the Tonle Sap Lake.

For Tonle Sap Lake communities whose livelihood strategies signify a diverse range of income generating and subsistence activities,

benefits from utilization of common property resources are added to the above gross income. Based on Rab *et al.* (2005), about US\$26 per household on average (highest for fishing village at US\$42 and lowest for farming village at US\$16) are obtained from collection of aquatic plants and animals. While this value is small, it is significant for people in

**Table 8 Consumption values of fisheries**

a) Average total annual household consumption of fisheries catches\*

Province	Average home consumption (kg)			
	Fishing	Fishing cum farming	Farming	All
Kampong Chhnang	136	172	150	153
Siem Reap	723	240	128	364
Average				258

(\* data from table 2)

b) Average total values per household (average unit price is about US\$0.25/kg)

Province	Consumption values (US\$)			
	Fishing	Fishing cum farming	Farming	All
Kampong Chhnang	33	42	37	37
Siem Reap	177	59	31	89
Average				63

c) Total consumption values from fisheries for all aquatic-dependent households

Province	Consumption values (million US\$)
Kampong Chhnang	1.8
Siem Reap	3.6
Battambang	2.8
Pursat	2.4
Kampong Thom	2.4
Total	13.0

the lower income level, contributing about 2-6 percent to income from main economic activities. The estimated value of common property resources for aquatic resource-dependent households with income less than US\$2,000 in the five provinces is about US\$5 million, giving the estimated total direct 'consumptive' use value (gross) of Tonle Sap Lake aquatic resources of about US\$233 million.

***The estimates reported here are, at best, the 'minimum' direct use values of the Tonle Sap Lake. Ecological, social and other economic values of the Tonle Sap and the overall wetlands ecosystems need to be captured and discussed in the design of natural resource management policy to reflect the importance of these resources to the people's livelihoods.***

Estimation of average annual household income by income level, as done here, allows differentiation of livelihood dependency of communities around the Tonle Sap Lake. Overall, it can be stated that the majority of the people living around the Tonle Sap are highly dependent on aquatic resources. Their low income level makes them more vulnerable than those in the higher income levels. It is important to underscore, however, that estimates reported here are based on several assumptions and do not include indirect uses and other values of the Tonle Sap Lake. At best, these are the 'minimum' values and should be used only to indicate the importance of fisheries and aquatic resources to the people of the Tonle Sap Lake. Another limitation is the use of data from surveyed households in Kampong Chhnang and Siem Reap to provide the estimates for the other three provinces. More detailed study is required in order to improve these estimates. Note that this can be a simple exercise, for example, of conducting field surveys of households in the other three provinces mainly to obtain the proportion of households in different village types.

It is important to re-emphasize that consideration thus far is focused primarily on eliciting a fraction of economic values of fisheries and aquatic resources of the Tonle Sap Lake. Ecological and social values of these resources have not been captured. More importantly, fisheries and aquatic resources

are only a portion of the overall wetlands ecosystems of the Tonle Sap Lake that comprise of rivers, streams, lakes, rice fields, inundated flooded areas and other areas that are either seasonally or permanently covered by water. Ecological, social and economic values of these wetlands are vast and, therefore, need to be included in the discussion, particularly in the consideration of people's livelihoods, their resource dependency, in the design of resource use policy and in decision-making processes (Bonheur *et al.*, 2005).

## **5. Issues and challenges in sustaining fishing livelihoods**

Aquatic resource-dependent communities around the Tonle Sap Lake face several challenges in sustaining their livelihoods. From ecological and environmental perspectives, they are vulnerable to short- and long-term climatic variations affecting, for example, changes in the amount of rains, flood level and duration, and changes in the size of flooded forest areas. Such changes can also be induced by human activities, such as dam construction, deforestation, use of pesticides in agriculture and land development. One direct consequence of these natural and anthropogenic changes on fisheries and aquatic resources is the loss of spawning grounds and habitats, which results in reduction of catches. Other kinds of activities with adverse impacts on fisheries catches, and thus income to communities, are use of illegal and destructive fishing gears and overfishing. Other developments, including aquaculture, agriculture, tourism and housing, may also cause loss of flooded forest and degradation to the health of Tonle Sap aquatic ecosystems.

Along with the above, Tonle Sap Lake communities are faced with social and economic challenges. As commonly found around the world, population growth, social and economic conflicts due to declining resources, increasing fishing pressure, changes in ownership and access (to resources and markets), and gender and ethnic inequality are some of the issues faced in sustaining livelihoods of people living in and around the Tonle Sap. Conflicts between user groups are further aggravated by seasonal fishers whose occupation of parts of the lake during fishing season and whose frequent use of illegal fishing techniques cause direct competition with local communities

(MAFF-CNMC, 2003). Finally, alternative employment may not be an option for most people whose livelihoods have long been depended on uses of the fisheries, aquatic and common property resources. Constraints such as low education and poor transportation further inhibit opportunities for other income generating activities (Israel *et al.*, 2005).

Another major challenge to sustaining fisheries livelihoods is the governance and institutional arrangements required to implement the recent fisheries policy reforms. Since its introduction in October 2000, about 440 community fisheries organizations have been established through the initiative of the Department of Fisheries (DOF), and with support from various fisheries and environmental-related non-governmental organizations. Impacts of such reforms on poverty reduction and food security, which are parts of the key goals, have been largely discussed and the first 'official' round of assessment was conducted in 2003/2004 in three provinces, Kampong Cham, Pursat and Takeo, by Community Fisheries Development Office (CFDO) and others (see details in CFDO and DFID, 2004). In general, the assessment reveals positive changes in poverty reduction for the majority of poor people, particularly small-scale fishers, farmers and fish traders, with increasing income and job opportunities. Initial improvement in food security may not be sustained, however, considering high competitions and decline in resource base. Alternative livelihoods need to be further explored in order to reduce pressure on uses of fisheries and aquatic resources. CFDO and DFID (2004) also recommend capacity building and strengthening of communities and institutions to manage the fisheries and facilitate the process. This point is emphasized in other studies (e.g., Keskinen, 2003; Israel *et al.*, 2005), as the reforms took place so rapidly that many communities and institutions may not be ready to cope with all the changes, and the legislative framework required for implementation and enforcement has not yet been established.

The three types of challenges presented above, i.e., ecological and environmental, social and economic, and policy and management, deserve further discussion. In November 2004, some 40 participants from key government units in charge of fisheries, e.g., DOF, Provincial Offices and CFDO, as well as non-governmental organizations convened to consider what responses are

needed to address these challenges. The summary of their recommendations is provided in Table 9. From ecological and environmental perspectives, key issues identified by workshop participants are related to loss of habitats and flooded forests, impacts of fishing gears and other developments. There is a need for research to assess impacts of activities, including the use of illegal fishing gears on fisheries resources and aquatic ecosystems. Of particular interest is the consideration for critical habitats and the suggestion to establish sanctuaries, possibly with no fishing zones, at the community level (i.e., with community involvement). This initiative might also be useful in preventing poaching and in addressing law enforcement problems in existing sanctuaries (MAFF-CNMC, 2003; Baran *et al.*, in press).

***Main challenges in sustaining fishing livelihoods are related to ecological and environmental aspects (e.g., stakeholders conflicts, limited livelihood options), and policy and management aspects (e.g., effective participation of stakeholders).***

Key issues concerning socioeconomics and livelihoods of Tonle Sap Lake communities are conflicts between stakeholders (specifically migrant and seasonal fishers with their use of illegal fishing gears), limited access to market and credits and lack of alternative livelihoods. Recommended as important responses to address these concerns are systematic and comprehensive research and data collection of basic social and economic information such as changes in fishing patterns, catches, catch composition, employment, migration of fishers, ethnic difference, and other livelihood characteristics. Research to improve market access, contribution of fish in people's nutrition, and post-harvest productions were also discussed. Further, a suggestion was made to examine the changing roles of women in the new context of community fisheries, for example, their increased participation in economic activities or in decision-making.

As emphasized above, further work is required to improve the estimates of values of fisheries and aquatic resources, by incorporating other use and non-use values, as well as considering the relationship between ecosystem and livelihoods. Given the disparity in

**Table 9 Summary of responses required to address challenges in sustaining livelihoods of the people living in and around the Tonle Sap Lake**

<b>Factors/key issues</b>	<b>Research/Actions needs</b>
<b>1. Ecological/environmental aspects</b>	
Lack of information about critical habitats and functions of sanctuaries	Need to conduct research on critical habitats to provide appropriate protection and to establish sanctuaries at local level, possibly with no fishing zone
Use of potentially harmful and destructive fishing gears	Need to identify which gears are destructive, especially gears previously not allowed, as well as to determine the impacts on fish population
Impacts of upstream dams on Tonle Sap Lake fisheries	Need to determine the extent of changes in hydrology of Mekong River and its impact on the fisheries
Decrease in flooded forests	Need to conduct ecosystem research to assess impacts of decreasing flooded forests on fisheries
Conflicts between irrigated agriculture, fisheries, aquaculture and other uses	Need to assess impacts of different uses on Tonle Sap aquatic ecosystems, as well as their viability and roles in sustainable poverty reduction
<b>2. Socioeconomics aspects</b>	
Incompatible methods of data collection and analysis	Need to encourage use of similar data collection method and analysis in order to observe changes and trends
Conflicts due to diverse ethnicity of Tonle Sap Lake communities (e.g., Khmer, Vietnamese, and Cham)	Need to collect basic information to differentiate, for example, number of fishers, means of livelihood, approaches to conflict resolution, for each ethnic group
Conflicts between seasonal migrant fishers and local communities	Need to understand motivation and pattern of migration, impacts of resource use, as well as define (and obtain consensus on) use rights regime
Limited access to market at a commune level and to small-scale credits (resulting in high indebtedness to middlemen)	Need to understand market access and marketing system, nature and sources of credits and net income for small-scale fishers
Lack of technical skills and capital for improvement of post-harvest sector	Need to develop new methods and techniques to improve post-harvest products, including value-added
Lack of alternative livelihoods	Need to explore livelihood options that correspond to communities' needs and aspirations
Vitamin deficiency among fishing communities	Need to identify ways to improve contribution of fish to nutrition in diet
Lack of understanding of the changing roles of women in the context of community fisheries	Need to examine changes in access to resources for women and their contribution to fishing, investigate if new skills are required, and support their participation in decisions and economic activities

<b>3. Policy and management</b>	
Impacts of laws and policies on people's livelihood in fisheries and other sectors	Need to conduct research on impacts of one natural resource law on another and examine their compatibility
Lack of awareness about law, rules, and regulations, particularly among new migrants	Need to consider a new definition for 'subsistence fishing' to correspond to the changes brought about by increasing fishing pressure and improve awareness
Lack of incentives to join natural resource management groups	Need to raise awareness especially among seasonal migrants with no adjacency and tie to resources
Effectiveness of Community Fisheries	Need to assess whether the decentralization process is working, e.g., in relation to benefit sharing, inclusion/exclusion issues, based on existing practices
Impacts of World Trade Organization (WTO)	Need to examine the likely impacts of WTO on inland fisheries and small-scale fishers of Tonle Sap Lake, e.g., whether it will promote commercialization, change the nature of trade and increase demand

household income among small-scale fishers, middle-scale fishers and fishing lot owners, and the varying degree of livelihood dependency on Tonle Sap Lake ecosystem, more studies are required to obtain a better understanding of values and to address the existing disparity.

In terms of policy and management, the identified needs included the understanding of impacts of laws and regulations on people's livelihoods, the compatibility of different natural resource laws and the need for new definitions (e.g., of subsistence fisheries) to correspond with changes in fishing patterns and gear uses. Effectiveness of the policy reforms needs to be critically assessed, particularly in terms of benefit sharing and stakeholders' inclusion/exclusion issues. Finally, there is a need to examine the likely impacts of WTO policies on inland fisheries and small-scale fishers of the Tonle Sap Lake in promoting commercialization, changing the nature of trade, and increasing demand.

## **6. Conclusion**

Fishing is an important activity for the majority of households in the Tonle Sap Lake, representing more than one-third of people's primary occupation. The importance of Tonle Sap aquatic ecosystems lies beyond catches from fisheries, however, as people living in

and around the Tonle Sap Lake engage in diverse income generating and livelihood activities, including farming, collection of firewood and uses of common property resources. Indeed, occupational pluralism is an important socioeconomic characteristic of Tonle Sap Lake communities, implying that livelihood considerations need to take into account the dependency of people on the entire aquatic ecosystem.

The estimated values from direct uses of fisheries and aquatic resources show the vast disparity between households with differing income levels. While the gross annual income from direct uses for all fisheries-dependent households in the five provinces is estimated at US\$233 million, only one-third is captured in households with income less than US\$1,000. These low-income households, earning per capita income of about US\$78, comprise about 70 percent of all households. They are mostly small-scale, subsistence fishers and farmers who rely heavily on aquatic resources for their livelihoods. The values and importance of Tonle Sap aquatic ecosystem are even more significant to these people given the scarcity of employment alternatives.

Considering that at least 50 percent of all inland fisheries come from small-scale and rice field fisheries (MAFF-CNMC, 2003), and based on the importance of fisheries and

aquatic resources to the livelihoods of more than a million people living in and around the Tonle Sap Lake, as shown in this report, serious considerations and direct efforts are required to ensure that their livelihoods are not compromised. The recent fisheries policy reforms, with their focus on community-based resource management, are critical steps, which need to be supported by appropriate institutional arrangements and governance systems. This may imply a shift of research and policy focus from addressing poverty and livelihood problems from resource perspectives (e.g., overfishing) to governance perspectives (e.g., an understanding of the socio-institutional mechanisms governing people's access to resources (Béné, 2003)). An interactive governance framework that involves actions and participation from all stakeholders to solve societal problems and to create opportunities (Kooiman *et al.*, 2005) is an example of a system that might be worth pursuing. It corresponds well with the 'Sustainable Livelihood Approach' that

integrates natural, social, physical, financial and human components in the formulation of policy, institutions and processes, based on the context of sustainability, vulnerability and poverty (see [www.livelihoods.org](http://www.livelihoods.org)).

Key research and policy considerations are provided to address challenges in ecological, social, economic and governance aspects of Tonle Sap Lake aquatic ecosystems. These include enhancing knowledge about the ecosystem and the relationship between ecological and livelihood importance, and understanding of social dynamics of stakeholders, including migrant and seasonal fishers and fishers of various ethnic groups to address issues related to conflicts of resource use and access. Research on improving estimates of values of Tonle Sap Lake fisheries and aquatic ecosystems by incorporating other use and non-use values is required. Finally, policy considerations are needed to address the existing disparity in income among aquatic resource-dependent households.

#### **Suggested research and policy considerations:**

- *Increasing knowledge about the ecosystem, e.g., the relationship between loss of habitats and flooded forests, impacts of fishing gears and other activities on the health and productivity of the Tonle Sap Lake;*
- *Understanding social dynamics of stakeholders, including migrant, seasonal fishers and fishers of various ethnic groups, to address issues related to use of illegal and harmful gears, stakeholders conflicts, resource access, and market;*
- *Increasing awareness about the existing disparity in income among households;*
- *Improving estimates of values of Tonle Sap Lake fisheries and aquatic ecosystems by incorporating other use and non-use values;*
- *Exploring livelihood options, strategies and alternatives to assess impacts of various activities and of different policy options, in order to ensure food security and quality of life;*
- *Understanding roles and contributions of women to income generation and sustaining livelihoods, as well as in management and decision-making process; and*
- *Examining the effectiveness of the recent policy reforms, particularly in terms of benefit sharing and stakeholders' inclusion/exclusion issues, in order to make necessary adjustment in institutional arrangement and governance structure.*

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