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Socioeconomics and Values of Resources in Great Lake-Tonle Sap and Mekong-Bassac Area: Results from a Sample Survey in Kampong Chhnang, Siem Reap and Kandal Provinces, Cambodia

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The WorldFish Center is one of the 15 international research centers of the Consultative Group on International Agricultural Research (CGIAR) that has initiated the public awareness campaign, Future Harvest.

Contents

1 Introduction

The Great Lake-Tonle Sap, the biggest in South Asia and the lower tributary of the Mekong River system, has been providing livelihood opportunities to millions in Cambodia. Monsoon rains, seasonal floods, wetland forests and vegetation, and the nutrient-rich soil have created an ecosystem that allows access of fish and other aquatic animals to abundant nutrition and food resources. Traditionally, the Great Lake is the spawning ground for many fish habitats that migrate through the Tonle Sap River when the Lake expands with floodwaters usually by four to six times its dry season size[1]. It is thought to be the most productive inland fisheries of the world, contributing about 60% of the country's commercial fisheries production (Ahmed et al. 1998). People in and around the Lake receives both economic and noneconomic benefits from it in many ways. Households in the Lake area extract fish, other aquatic animals and vegetations, and collect forest products such as firewood and other indigenous materials that are mostly used as raw materials for house building, fishing and fish processing, and farming activities. In addition to these static resources, the Lake provides a value chain or benefit flows through forward and backward linkages. Forward values are created through trade and marketing of fish and fish products and post-harvest fish handling and processing. The backward values are generated through input demand for fishing and farming activities, such as gearmaking and other fishing and farming-related inputs and services. Lake resources and its backward and forward benefit flows generate income and sustain the livelihoods of the millions of people in and around the Lake and its basin areas. A comprehensive study of the benefits and values of the Great Lake is yet to be done. Although the Great Lake occupies the lion share of the inland fisheries in Cambodia that provides foreign exchange to the government, nutrition, livelihoods and food security to millions living in the Lake area. However, a precise estimate of the benefits and values of the aquatic and nonaquatic resources is lacking.

Although there exist numerous reports, seminar and symposia papers focusing on socioeconomics, livelihoods, marketing and trade on inland fisheries sector, however, few of them are based on primary information and absolutely measure values and benefits of the Great Lake. The pioneering report by Ahmed et al. (1998) is the only available study that was based on household survey of fishing communities and covered fish production, consumption, livelihoods in the fishing communities, and fish marketing

[1] The depth of the Lake rises from 1-2 m in the dry season to 8-10 m during monsoon (McKenney and Tola 2002). In the dry season, the surface area of the Lake shrinks to 2,500-3,000 km^2 from its wetland size, about 10,000-15,000 km^2 during monsoon months from June to October (NEDECO 1998; McKenney and Tola 2002).

pattern at the producer and consumer levels. However, the focus of the study was not concentrated to the Great Lake alone. Although the report provides indicative information relating to the value of the resources, these need to be updated as they are now more than seven years old. Tana and Seang (2002) provide comprehensive information on the fishery sector as a whole, largely based on official and unofficial secondary information with special focus on fish marketing, trade and fish processing from his experiences and observations. However, the report lacks scientific basis to be generalized for policy purposes, although it generates many interesting questions regarding proper working of the system as a whole. Many observers believe that the official estimates of the Department of Fisheries (DOF) are grossly underestimated because of its weak and improper data collection methods. The natural weakness of the data collection system is its incentive to the commercial fisheries to underreport catch. The DOF statistics[2] are mostly based on licensing and leasing system that covers mostly commercial fisheries in 13 provinces (McKenney and Tola 2002) only and there has been no effort to collect data from the remaining 11 provinces (Ahmed et al. 1998). Catches from the ricefield fishery and small-scale indigenous fishery are almost ignored in the data collection efforts of the DOF. However, the official estimate of the DOF jumped by 300%, from 76,000 t in 1988 to 228,000 t in 1999, due to the inclusion of small-scale catch into the national annual production figure of inland fisheries. Nevertheless, there still remains a sharp contrast between the official inland fish production figure and the estimates based on catch assessment and related studies that made a comprehensive effort for a reliable estimate by combining data from different sources[3]. This estimate provides a range of total fish production/ catch between 290,000 and 430,000 t. Currently, this figure is widely used by researchers and policymakers although the estimate still remains indicative only. Much effort is still needed to reach to a conclusive figure in order to assess sustainability of inland fisheries. If it is true that the current catch of fish is higher than that in the previous decades, this is likely to be due to increase in population dependent on fishing and increasing fishing effort in the form of destructive and illegal fishing.

As the Lake provides numerous values and benefits to the people, it is highly unlikely that a single study with a short timeframe will be able to capture all kinds of values of the Lake resources. This study was undertaken as

[2] The DOF estimates of total inland fish production during 1981-1995 fall in the range of 50,000-75,000 t/year (McKenney and Tola 2002).

[3] The estimate combined data from a number of studies (DOF 1999; Gregory 1997; Ahmed et al. 1998) on fish consumption and production that covered commercial and small-scale indigenous fisheries, including ricefield fisheries.

part of capacity building of the newly founded Inland Fisheries Research and Development Institute (IFReDI) and its core staff. Learning-by-doing was one of the approaches to strengthen research capacity of the staff of the Socioeconomic Division. Therefore, the study was designed and implemented in such a way that the staff of the division could be involved and learn the research techniques in a shortest possible time. Therefore, the scope of this study is very limited and was not able to capture all the benefits and values the Lake generates through backward and forward linkages. However, the study is an attempt to capture all possible static benefits and values of the Lake in gross term as the time and resources did not allow collecting detailed information on costs of the households to generate these benefits and values. Although the study will not be able to generate net values of the resources in the Great Lake, it will effectively circumscribe these values that can be used to determine the importance of the resources and will indicate policy dimensions to conserve and sustain these resources. We hope that information generated through this study will fill up the gaps in primary data as mentioned earlier and will provide information to estimate fish production, consumption and the value of other aquatic animals and plants.

2 Scope and Objectives of the Study

Information on the economic values of aquatic resources is extremely important for two reasons (Torrell and Salamanca 2003): first, to determine the extent to which resources contribute to the country's economic and social welfare including gross domestic product (GDP), and second to ensure that policies and development circumscribe these benefits of the resources and address the issues related to their management and conservation. Hence, the need for primary scientific data on the socioeconomics and values attached to aquatic resources in the Tonle Sap area has been identified. The objective of this report is to describe the range and value of benefits derived from aquatic resources by different stakeholders, and to provide a substantive basis for redirecting policies and future development projects into harnessing and sustaining the socioeconomic benefits and resource values in the Tonle Sap area.

Specific research objectives are defined as follows:

- describe demographic and socioeconomic backgrounds of households and their livelihood strategies in general and related to aquatic resources in particular;
- generate information to circumscribe values of the common pool resources in the Great Lake and to determine economic values of livelihood activities in general and those dependent on aquatic resources in particular;
- identify key fish species important for livelihoods among households, and investigate utilization, distribution and marketing channels; and
- provide baseline data for an assessment of the abundance and value of the most important fish species for different stakeholders, which can be assessed over time.

This information will be used to provide input for policymakers, to help ensure policies reflect the true values and issues related to aquatic resources in the Great Lake-Tonle Sap and Mekong-Bassac area. The information in this report will also identify livelihood opportunities and provide cost-benefit information for future development projects.

3 Methodology

3.1. Study Area

Three provinces were selected for household survey in the study. Two provinces were near and around the Great Lake-Tonle Sap area - Kampong Chhnang and Siem Reap - and one province was in Mekong-Bassac Rivers area - Kandal province. Figure 3.1 shows the location of the surveyed village in each province while Table 3.1 provides the names by province, district and commune of the villages covered.

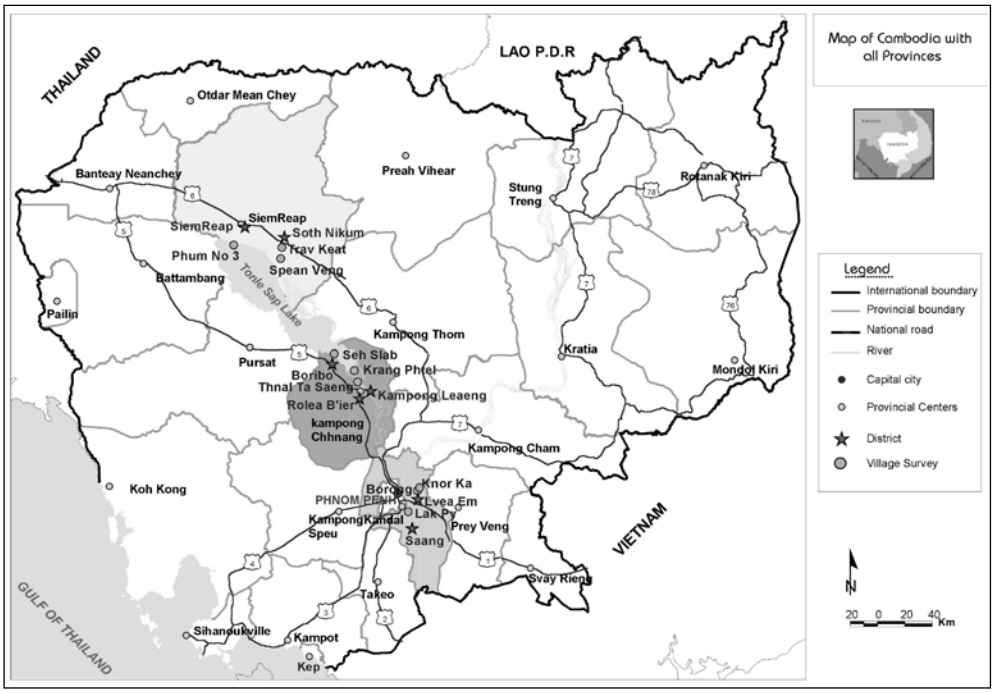

Figure 3.1. Map of Cambodia showing the villages surveyed by study area.

Table 3.1. Provinces, districts, communes and villages covered by the study.

Name of Province	District	Commune	Village
Kampong Chhnang	Kampong Leaeng	Prolay Meas	Krang Phtel
	Boribo	Chhnok Tru	Seh Slap
	Rolea Bier	Svay Chrum	Thnal Ta Saeng
Kandal	Saang	Prasat	Phum Lak Py
	Lvea Em	Barong	Barong
			Knor Ka
Siem Reap	Siem Reap	Chong Kneas	Phum Bey
	Soth Nikum	Kampong Khlaing	Spean Veng
		Dan Run	Trav Keat

3.2. Sample Selection

The sampling and data collection methodology for the household survey is shown in Figure 3.2. From each province, three different types of villages were then selected: fishing, fishing cum farming and farming villages. The fishing villages are those with 80-90% of the population involved fully in fishing and related fishing activities. In general, the people in these villages are landless and a majority live in floating houses. The fishing cum farming villages are villages with 80-90% of population involved in fishing as primary occupation, especially during wet season and in farming as secondary occupation during dry season. The farming villages are those with 80-90% of the people involved in farming, and fishing is undertaken only for home consumption. The study sample originally consisted of 135 households in each province (45 from each village type) for a total sample size of 405 households in the 3 provinces. However, during the actual survey, 5 more households were added in Kandal for a total of 140 households in the province and 410 households overall in the 3 provinces. The households were selected from each village following a stratified random sampling procedure. All the households in each village were ranked

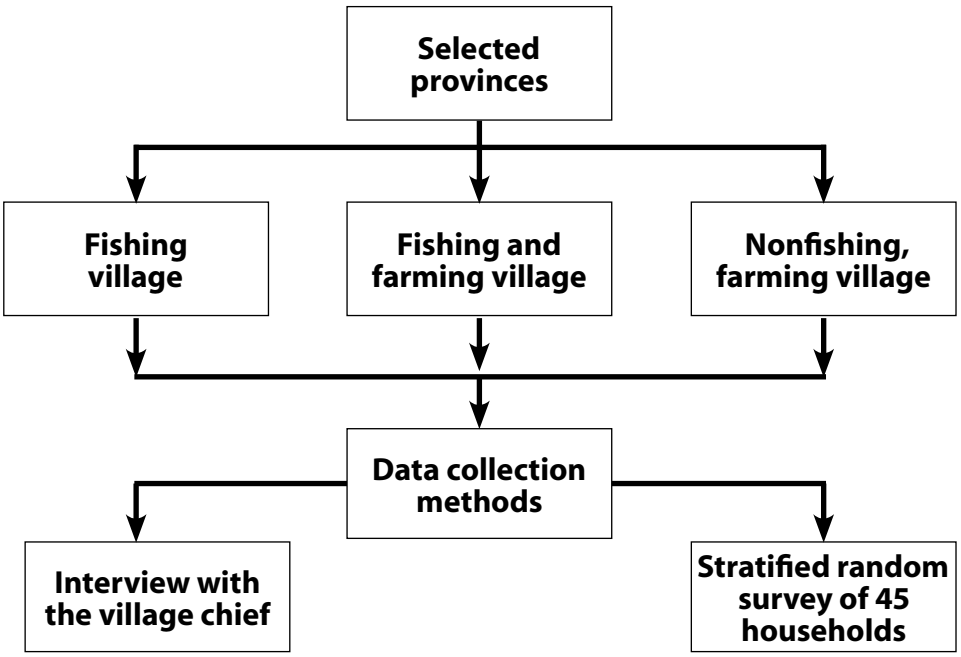

Figure 3.2. Sample selection methodology of the survey.

further using village level information provided by the village heads (see Appendix B) and divided into three wealth categories of poor, medium and rich households (see in Appendix B). Fifteen households were then selected randomly to represent each wealth category (except in Kandal villages where 5 more households were added).

3.3. Analytical Approach

The demographic and socioeconomic analysis done in the study is conducted using mainly descriptive statistics employing the presentation of absolute figures and percentages. The estimation of gross values is conducted based on the economic valuation methodology. Theoretical discussions on economic valuation applied to the natural resources and environment already abound in the literature. More recent works with explanations of the different economic valuation methods applicable in aquatic natural resource environments include Barbier et al. (1996); IIED (1997); De Lopez et al. (2001); and CEMARE and SIFAR (2002).

In general, valuation techniques can be classified as either market or non-market. Market-valuation can generally only estimate direct use values of a resource, and includes methods such as the net economic value (NEV) method, productivity change method, human capital method, opportunity cost method, cost-effectiveness method, preventive expenditures method, replacement cost methods, shadow project method and relocation cost method. Nonmarket valuation can be used to measure the nondirect and nonuse values of a resource, and includes techniques, such as hedonic pricing, travel cost method, contingent valuation and choice modeling. Because nonmarket analysis can be costly and time-consuming, some studies use the benefit transfer approach of valuation. This method involves the adaptation of economic information derived from a specific site(s) under certain resource and policy conditions to assess and analyze management and policy options for a different site.

The valuation method that was originally considered for this is the NEV method. This method is particularly applicable where the direct economic contributions of aquatic resources are being estimated. It has been used in other studies dealing on aquatic resources in Cambodia (Bann 2000a; Bann 2000b; Hap et al. 2001; Roudy 2002). In this current study, the NEV method has great relevance since part of the intention of the valuation activity is capacity building among local government and nongovernment counterparts who are new to economic valuation.

The NEV from an economic activity, such as the exploitation of an aquatic resource, is defined as

$$NEV = TR - TC$$

where *TR* is the total revenue or income, or the quantity of output generated from the exploitation of the resource multiplied by its market price, and *TC* is the total costs that include both the financial (quantity multiplied by the market price of the purchased material inputs; hired labor, paid-for transportation and other purchased cost items) and the nonfinancial costs (quantity and market price of the unpurchased material inputs, household-labor, unpaid-for transportation and other unpurchased cost items). The term "economic" is used to make a distinction from the term "financial" which purely means the accounting of the money costs and returns to production.

The computation of NEV values for numerous aquatic resources-based livelihood activities, however, would require voluminous cost and returns data that take several months to gather through a household survey. Because of this constraint, the study opts to gather data and compute for the gross returns or income for the activities as a beginning work in the process of valuing aquatic resources. This approach was taken since quantity of output and price of output data are relatively easy to generate through a survey and by themselves also provide indications of the absolute and relative importance of aquatic resources-based livelihood activities. In the future, given enough time and resources, the gross values can be compared with cost estimates generated through another survey, or through the use of key informant interviews or other less demanding participatory rural appraisal techniques to have a more complete assessment and generate the NEVs of aquatic resources.

3.4. Data Collection

Both primary and secondary data were used in the study. The primary data were taken from households through the household survey. The sample households were interviewed twice – in the open and closed seasons. The first cycle of data collection included socioeconomic information of head and member of the household; environment, sanitation and energy source; household asset and land ownership; fishing and nonfishing activities;

weekly or monthly fish catch in the closed season; processing and marketing activities; and extraction of other resources and their value for livelihoods. The second cycle of data collection was held in the open season, and was limited to fish catch, marketing and processing activities.

- A detailed questionnaire was prepared for the household survey and was field tested.
- Three teams of data collectors were formed and trained. The questionnaire is shown in Appendix B.
- Using guide questions, the selected village head was interviewed to get general information (Appendix B1).
- The first round of data collection took place in September 2003 (Appendix B2).
- The second round of data collection was conducted in January 2004 (Appendix B3).
- Databases were developed in Access program for entering and storing data, which were then checked and crosschecked.

The secondary data came from government bureaus (DOF, provincial fisheries offices, Mekong River Commission [MRC]) and nongovernment organizations (NGOs) (such as the Cambodia Development Resource Institute [CDRI]). The secondary data and information were mainly background materials used in the study.

4 Demographic and Socioeconomic Characteristics of Households

4.1. Household Size

The average household size of the sample villages is 6.4, although this ranged from 2 to 15 members. The average family size in fishing cum farming and farming villages is slightly larger (6.5 members), as Figure 4.1 shows. However, it is still lower than the national average family size of 9 people, as recorded in the 1998 national statistics (NIS 1998).

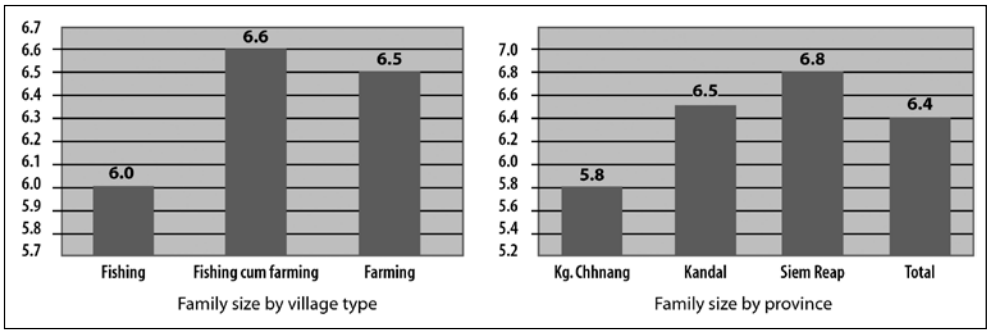

Figure 4.1. Average family sizes by village type and by province.

4.2. Gender

Of the total sample of 410 households, 61 (15%) are headed by a female. This concurs with an earlier socioeconomic survey conducted during 1994-1995 by staff of the Management of Freshwater Capture Fisheries of Cambodia Project (Ahmed et al. 1998), which revealed that about 19% of the households in fishing-dependent communes were headed by female, and a survey conducted during 1993-1994 (NIS 1995), which similarly showed that about 21% of the households in Cambodia were headed by a female. Since fishing and farming activities are generally carried out, or at least initiated, by men, these households are likely to be less well off and may also rely more on other activities for livelihoods.

4.3. Age Distribution of Household Members

The average age of the head of household in this sample was 45 years, and ranged from 20 to 77 years. The majority age group of male and female-headed households was 41-60 years; with 53% and 71%, respectively (Table 4.1). In fishing villages, the average age of the household head was 43 years, with a range from 20 to 73 years. In fishing cum farming villages and farming only villages, the average age was slightly higher at 48 years, with a range of 25-77 years (Figure 4.2). Overall, only 24% of household

members are under the age of 10 years and 76% are aged between 11 and 60 years (Table 4.2). Therefore, most household members are of working age, and participate to some degree with household and/or income-generating activities.

Table 4.1. Age distribution of the household heads by gender and province.

Age Group (Years)	Kampong Chhnang		Kandal		Siem Reap		All	
	Male (n=108)	Female (n=27)	Male (n=125)	Female (n=15)	Male (n=116)	Female (n=19)	Male (n=349)	Female (n=61)
< = 20	0.93	0.00	0.00	0.00	0.00	0.00	0.29	-
21-30	17.59	7.41	14.40	0.00	10.34	0.00	14.04	3.28
31-40	25.93	18.52	20.80	13.33	22.41	5.26	22.92	13.11
41-50	30.56	37.04	28.80	60.00	27.59	21.05	28.94	37.70
51-60	18.52	29.63	23.20	20.00	29.31	47.37	23.78	32.79
61 and above	6.48	7.41	12.80	6.67	10.34	26.32	10.03	13.11

Table 4.2. Age distribution of the household heads by gender and village type.

Age Groups (Years)	Fishing Village (n=140)		Fishing cum Farming Village (n=135)		Farming Village (n=135)	
	Male (n=114)	Female (n=27)	Male (n=123)	Female (n=12)	Male (112)	Female (n=22)
< = 20	0.88	0.00	0.00	0.00	0.00	0.00
21-30	21.93	7.41	10.57	0.00	9.82	0.00
31-40	24.56	7.41	23.58	16.67	20.54	18.18
41-50	27.19	40.74	32.52	41.67	26.79	31.82
51-60	17.54	37.04	22.76	33.33	31.25	27.27
61 and above	7.89	7.41	10.57	8.33	11.61	22.73
Total	81.42	19.28	91.11	8.88	82.96	16.29

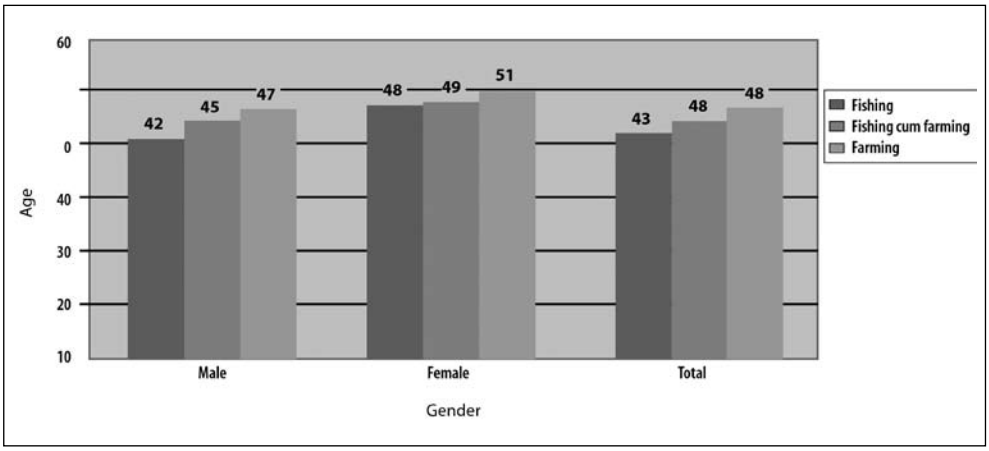

Figure 4.2. Average age of the household head by village type and gender.

Table 4.3. Age distribution of all household members by gender.

Age Groups (Years)	Male (%) (n=1,246)	Female (%) (n=1,343)	Total (%) (n=2,589)
Below 5	9.71	10.50	10.12
6-10	16.05	12.66	14.29
11-15	16.13	16.68	16.42
16-30	31.62	28.52	30.01
31-45	12.28	14.74	13.56
46-60	10.67	11.76	11.24
Above 60	3.53	5.14	4.36
Total	100.00	100.00	100.00

4.4. Education of Household Members

Overall, the most common level of education attained by the household head was less than three years (69%), whereas 13% of household heads had received no education (Figure 4.3). In fishing villages, a greater proportion of household heads received no education (19%), compared to fishing cum farming and farming only villages (7% and 13%, respectively). This may be due to the sample fishing villages being located in floating houses, where there is less opportunity to go to school (Figure 4.4). This implies that there is greater opportunity and access for schooling in farming and fishing cum farming villages, compared to fishing villages. However, Khmer ethnicity had higher education compared to other ethnicities (Appendix A, Table 1). Moreover, the head of household who had high education can earn more income compared to one who had low education (Appendix A, Table 2).

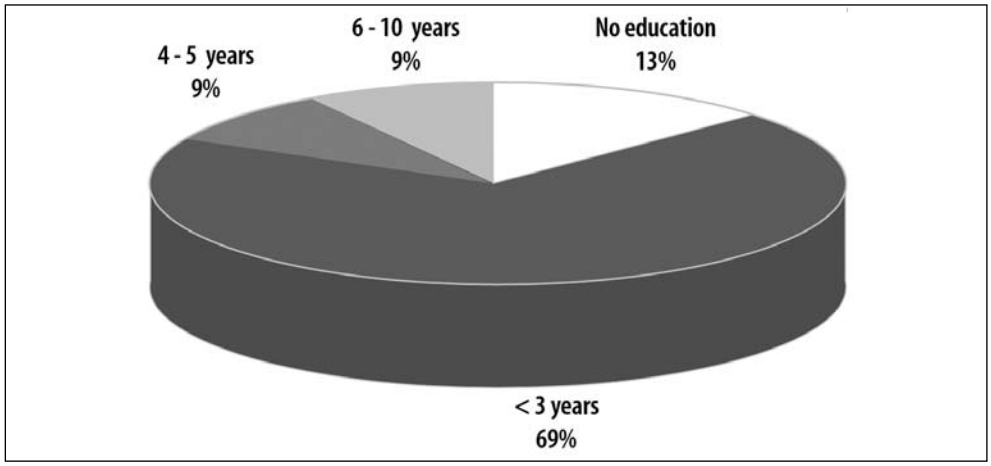

Figure 4.3. Overall education levels of the household head.

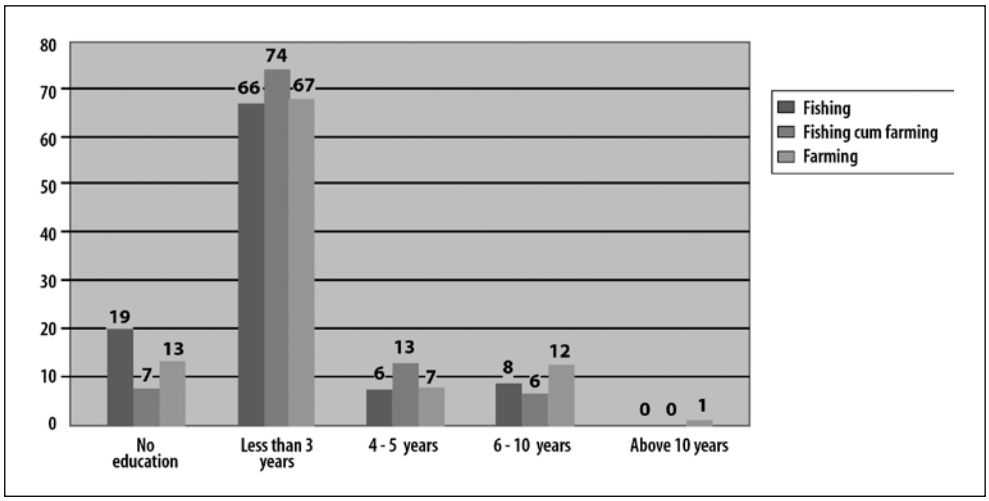

Figure 4.4. Education levels of household head by village type.

Overall, 85% of all household members in the study areas attended school for between one and ten years (Figure 4.5). The results in Table 4.4 show that for all villages, female household members have a higher level of no education (29%) compared to males (21%), in all village types (Figure 4.6). This indicates that, as is general in Cambodia, men receive a greater level of education compared to women. This also implies that women have less opportunity for schooling, often because they are required to work at home.

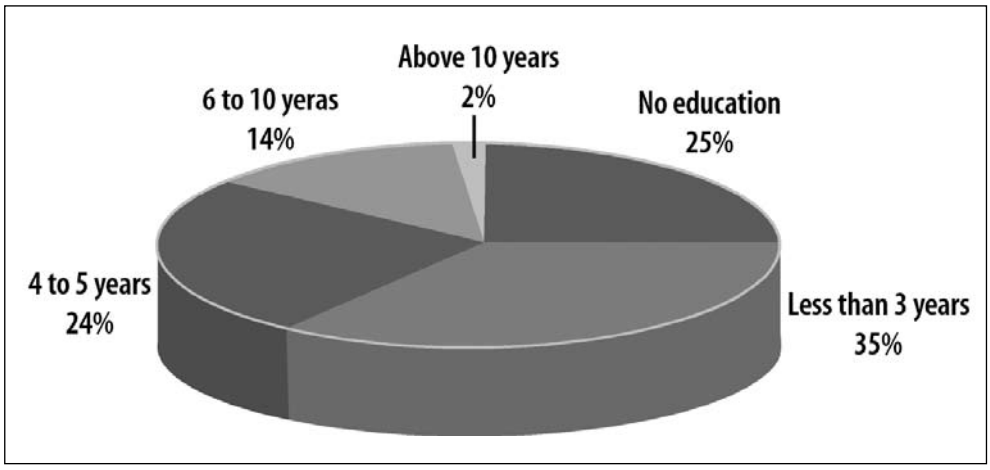

Figure 4.5. Education levels attained by household members.

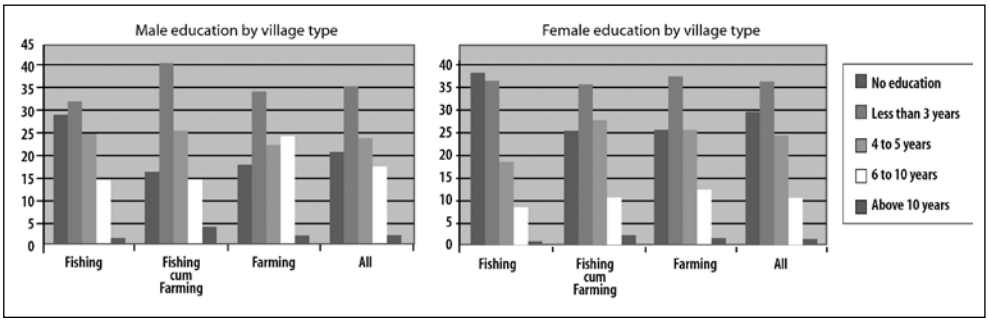

Figure 4.6. Education levels of all household members by gender and village type.

Table 4.4. Education levels of all household members by gender and village type.

Level of Education	Fishing Village (%)		Fishing cum Farming Village (%)		Farming Village (%)		All Villages (%)	
	Male (n=392)	Female (n=437)	Male (n=433)	Female (n=447)	Male (n=415)	Female (n=441)	Male (n=1,240)	Female (n=1,325)
No education	28.83	37.30	16.40	25.27964	17.59	24.49	20.73	28.98
1-3 years	31.63	35.70	40.42	34.90	34.22	36.73	35.56	35.77
4-5 years	24.49	18.31	25.17	27.07	22.17	25.17	23.95	23.55
6-10 years	14.03	8.24	14.32	10.51	24.10	12.24	17.50	10.34
Above 10 years	1.02	0.46	3.70	2.24	1.93	1.36	2.26	1.36
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

4.5. Ethnic Origin of Household Members

The sample households all belong to one of four ethnic groups (Khmer, Chinese, Vietnamese and Cham), but the majority (99%) of households are of Khmer origin (Table 4.5). A minority of fishing village households are of Vietnamese or Cham origin.

Generally, Khmer (Cambodian) fishing communities are involved in family or small-scale fishing (meaning that they fish mainly for household consumption), while other ethnic groups are more likely to be engaged in middle-scale and commercial fishing. The earlier socioeconomic survey conducted during 1994-1995 by staff of the Management of Freshwater Capture Fisheries of Cambodia Project (Hap 1999) showed that middle-scale fishing for commercial purposes was most commonly conducted by fishers of Cham ethnic origin.

Table 4.5. Ethnicity of household heads by village type (%).

Ethnicity	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All Villages (n=410)
Khmer	97.14	99.26	100.00	98.78
Chinese	0.00	0.74	0.00	0.24
Vietnamese	2.14	0.00	0.00	0.73
Cham	0.71	0.00	0.00	0.24
Total	100.00	100.00	100.00	100.00

4.6. Occupation of Household Head

Of the total sample, the major primary occupation for the household head was fishing (54%), followed by farming (39%). The primary occupation for a minority of household heads was small business or fish trade/processing (Table 4.6). The primary occupation of most household heads in fishing villages was fishing (87%). Similarly, in fishing cum farming villages, the majority of household heads considered fishing their primary occupation (65%), while farming was the major occupation for a minority (26%). This was reversed in farming villages, where farming was the primary occupation for 85%, although fishing was also the primary occupation for a minority (10%). This shows that fishing and farming really are the primary occupations for the vast majority of the households in fishing, fishing cum farming and farming villages, and that they really are very dependent on natural resources.

In fishing villages, the secondary occupation of the household head was generally fish culture, fish processing, farming, fishing or laboring (85%). In fishing and farming villages, however, the secondary occupation for the head of household was generally farming (30%), fishing (21%) or fish processing (15%). In farming villages, the most common secondary occupation was fishing (51%) or small business (14%). This implies that for the majority of sample households, both primary and secondary occupations consist of fishing, farming, fish culture or fish processing (Table 4.6).

Table 4.6. Primary and secondary occupations of the household head by village type (%).

Type of Occupation	Fishing (n=140)		Fishing cum Farming (n=135)		Farming (n=135)		All Villages (n=410)	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Fishing	87.14	10.32	65.19	20.66	9.63	51.20	54.39	27.42
Fish processing	0.00	19.84	2.22	14.88	0.00	0.00	0.73	11.56
Fish trading	1.43	3.17	0.74	0.83	0.00	0.80	0.73	1.61
Fish culture	5.00	32.54	0.00	9.92	0.00	0.80	1.71	14.52
Net/ gearmaking	-	0.00	-	2.48	-	0.00	-	0.81
Farming	3.57	12.70	28.15	29.75	85.19	9.60	38.54	17.20
Labor	0.00	8.73	0.74	8.26	0.00	9.60	0.24	8.87
Small business	0.71	4.76	0.74	7.44	2.22	14.40	1.22	8.87
Money lending	-	0.79	-	0.00	-	0.80	-	0.54
Motor taxi/ car/engine boat driving	0.71	1.59	0.00	0.83	0.00	0.80	0.24	1.08
Government/ NGO official	1.43	1.59	0.74	2.48	1.48	0.80	1.22	1.61
Housekeeping	0.00	0.00	0.74	0.83	0.00	2.40	0.24	1.08
Others	0.00	0.79	0.74	1.65	1.48	8.80	0.73	3.76
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Overall, the primary occupations of all household members were farming (27%) and fishing (23%); the other major occupation, being a student, for 26%. In fishing villages, this rises to 40% of all household members being engaged in fishing as their primary occupation. In fishing cum farming villages, fishing and farming formed the primary occupation for 50% of all household members, while in farming villages 47% of household members conduct farming activities as their primary occupation. The detailed information is presented in Table 4.7. Overall, only 8% of all household members mentioned "daily labor or housekeeping" as their primary occupation. This suggests that the vast majority of household members are engaged in income-generating and/or livelihood-sustaining occupations. For the secondary occupation of the household member, majority (44%) were farming, fishing and fish culture and the rest were fish processing, daily labor and shop/small business (Appendix A, Table 3).

Table 4.7. Primary occupation of household members by village type (%).

Type of Occupation	Fishing Village (%)	Fishing cum Farming Village (%)	Farming Village (%)	All Villages (%)
Fishing	39.56	25.17	8.80	23.75
Fish processing	2.85	5.30	0.41	2.87
Fish trading	1.58	1.19	0.41	1.03
Fish culture	7.12	2.52	0.95	3.34
Net/gearmaking	1.42	0.66	0.00	0.66
Bamboo and cane works	0.16	0.26	0.00	0.14
Farming	7.28	25.30	47.36	27.61
Daily labor	2.69	3.18	3.11	3.01
Housekeeping	5.38	2.78	5.28	4.42
Shop/small business	2.37	4.24	4.33	3.72
Government/private job	2.85	2.25	0.81	1.93
Motor taxi/engine boat driving	1.27	0.40	0.27	0.61
Money lending	0.16	0.00	0.14	0.09
Fuel wood collection	1.74	0.40	0.54	0.85
Livestock raising	0.00	0.00	0.00	0.00
Student	23.42	26.36	27.20	25.78
Others	0.16	0.00	0.41	0.19
Total	100.00 (n=632)	100.00 (n=755)	100.00 (n=739)	100.00 (n=2126)

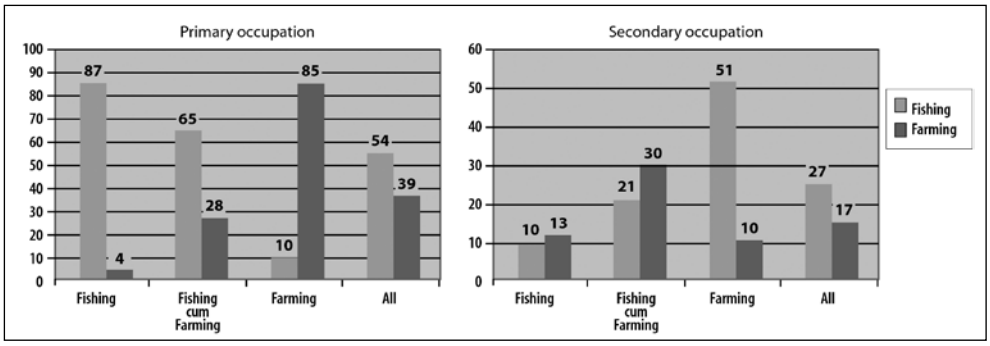

Figure 4.7. Fishing and farming as primary and secondary occupations of household head by village type.

Table 4.8 shows the important relationship between primary occupation and level of education of the household head. Among household heads who have had no education, the only occupations are fishing and farming. Other occupations, such as fish culture, fish processing or work as a government/ NGO official, are conducted by household heads who have had some level of education. This implies that higher levels of education provide better access to alternative or additional occupations for household income generation.

Table 4.8. Relationship between level of education and primary occupation of household head.

Type of Occupation	No Education (n=54)	Below 3 Years (n=284)	4-5 Years (n=36)	6-10 Years (n=35)
Fishing	70.37	53.52	47.22	45.71
Fish processing	0.00	1.06	0.00	0.00
Fish trading	0.00	0.70	2.78	0.00
Fish culture	0.00	1.41	5.56	2.86
Farming	27.78	38.73	41.67	48.57
Laborer	0.00	0.35	0.00	0.00
Motor taxi/car/engine boat driving	0.00	0.35	0.00	0.00
Government/NGO job	0.00	1.06	2.78	2.86
Teaching	0.00	0.35	0.00	0.00
Others	1.85	0.70	0.00	0.00
Total	100.00	100.00	100.00	100.00

Note: Only one household head had more than 10 years of education. He is excluded from this table.

4.7. Housing and Basic Facilities

A house is the most important asset and a basic need for any household. Generally in Cambodia, dwellings are built on land, or on boats, fish culture cages (floating houses) or stilts over water. Houses built on boats, cages or stilts over water are commonly part of a fishing village or community, known as a floating village or commune. Of the households sampled in this study, about 74% live in houses built on land and 16% live in floating houses (Appendix A, Table 4).

As Table 4.9 shows, the average value of house owned increases with annual household income in all village types. However, on average, households in farming villages own higher value houses than households in equivalent income groups in fishing and fishing cum farming villages (excluding households with an income above US$ 400 in fishing cum farming village).

Table 4.9. Average value (US$) of houses by village type and income groups.

Income Groups (US$ per Annum)	Average House Value (US$)			
	Fishing	Fishing cum Farming	Farming	All
<100	108.33	-	143.75	128.59
100-200	834.38	198.07	1,027.47	638.90
200-300	594.23	500.00	1,460.00	900.64
300-400	1,212.32	956.82	1,630.00	1,335.50
400+	1,854.05	3,080.62	2,050.35	2,330.94

Land is also a very basic need and a necessary asset for rural households. Table 4.10 shows the average amount of different types of land owned by households in each village type. It should be noted, however, that land ownership varies significantly between households in different income groups. Additionally, fishing village households own less land compared to households in other village types, especially homestead and agricultural land. In general, the majority of households in fishing cum farming and farming villages each own at least 1 ha of agricultural land.

Table 4.10. Average household ownership of land (m^2) by type of land and village type.

Land Type	Fishing	Fishing cum Farming	Farming	All
Homestead	197.60	443.30	409.54	347.77
Agricultural	3,661.42	16,530.67	12,754.10	10,870.61
Pond/cage	34.75	39.61	137.75	70.01
Orchard	113.55	24.99	1,402.15	505.54
Fallow	38.67	408.59	627.61	352.96

Note: All the sample households.

As another indicator of household wealth, Table 4.11 shows the energy sources used for lighting in different village types. The majority of households use kerosene (84%) and batteries (57%) for lighting. The proportion using kerosene was higher in farming villages (96%), than the other village types, reflecting the fact that it is cheap and more convenient to use and readily available in rural areas than batteries or candles. Only 8% of the households surveyed had electricity at home, although this is as low as 2% in farming villages. The highest number of households with electricity (12%) was in fishing villages, usually supplied by a household-owned generator (Appendix A, Table 5).

Table 4.11. Sources of energy for lighting by village type.

Source for Lighting	Fishing	Fishing cum Farming	Farming	All Villages
Kerosene	79.29	77.78	96.30	84.39
Candle	15.00	17.78	21.48	18.05
Battery	78.57	77.04	13.33	56.59
Others	-	-	0.74	0.24
Total	(n=140)	(n=135)	(n=135)	(n=410)

Note: Percentages are greater than 100, due to multiple responses.

In terms of sources of energy for cooking, forest wood was very commonly used by households living in rural areas. The vast majority of households sampled in this study used forest wood as the source of energy for cooking. This was highest in fishing cum farming (100%) and fishing villages (98%), and slightly lower in farming villages (96%). The remainder used biogas burners and charcoal (Appendix A, Table 6).

The living conditions of sample households appear to be poor, with limited access to basic facilities, such as sources of water for drinking, cooking and bathing or latrines, in common with many rural areas of Cambodia. Most fishing village households depend on the river or lake as a supply of water for drinking (94%), cooking and bathing (97%), while a minority rely on bottled or tube well water. However, in farming villages, the major sources of water were tube wells and ponds for drinking (74%) and cooking (70%). Overall, 58% of households purify or boil water before drinking, although this was slightly lower in fishing cum farming villages (50% of households). There were different sources of drinking, cooking and bathing water by province and income group (Appendix A, Tables 7 and 8). Most households in fishing and fishing cum farming villages have open latrines over water or land (97% and 79% respectively). In farming villages, although a fairly high proportion of households have sanitation latrines (41%), a significant minority (27%) have no latrine. Finally, more than 50% of the sample households had access to a public or private medical clinic, and the average distance to a clinic was 1,855 m (Table 4.12).

4.8. Ownership of Assets and Equipment

Ownership of household assets and professional equipment is very important for daily life and the livelihood system of the household. Table 4.13 presents the average values of assets, such as the house, electronic appliances, transport, furniture and fixtures, cell phone, livestock and farm equipment owned by sampled households. On average, the value of the house and farm equipment owned by fishing village households was low compared to the other types of village, but fishing households owned a greater value of assets, such as electronic and transport equipment, furniture and fixtures, cell phone and generators. Fishing households are more likely to own transport equipment (i.e., a boat) as it will be used for fishing. Likewise, generator and cell phone are used for fish processing and trade. In contrast, the value of livestock and farm equipment owned is highest in farming village households. Overall, the average value of all assets owned by households

was higher in fishing villages and in Kandal province compared to the other types of village and province (Appendix A, Table 9).

Table 4.12. Percentage of households by type of amenities and by village type.

Basic Facilities	Fishing Village	Fishing cum Farming Village	Farming Village	All Villages
Drinking water source				
River/lake	93.6	61.5	18.5	58.3
Bottled	3.6	0.7	-	1.5
Tube well	2.9	31.1	47.4	26.8
Pond	-	3.0	26.7	9.8
Rain	-	3.7	7.4	3.7
Cooking water source				
River/lake	97.1	68.9	26.7	64.6
Pond	0.0	1.5	35.6	12.2
Tube well	2.1	26.7	34.1	20.7
Rain	0.7	3.0	3.7	2.4
Bathing water source				
River/lake	97.1	79.3	31.1	69.5
Pond	1.4	-	28.1	9.8
Tube well	1.4	20.7	40.7	20.7
Rain	-	-	-	-
Purify/boil drinking water				
Yes	61.4	50.4	60.7	57.6
No	20.0	29.6	25.2	24.9
Yes and no	18.6	20.0	14.1	17.6
Have electricity at home				
Yes	12.1	10.4	2.2	8.3
No	87.9	89.6	97.8	91.7
Latrine type				
Open latrine	97.1	79.3	31.9	69.8
Sanitation latrine	1.4	20.7	40.7	20.7
No latrine	1.4	-	27.4	9.5
Source of medical care				
Village quack	2.9	1.5	1.5	2.0
Medical clinic (public)	60.0	75.6	45.2	60.2
Medical clinic (private)	62.9	34.1	57.8	51.7
Traditional herbs	2.9	1.5	1.5	2.0
Others	-	12.6	6.7	6.3
Average distance (m) to hospital	2,442.4	886.7	2,217.1	1,855.1

Table 4.13. Average values (US$) of household assets by village type.

Asset Type	Fishing (n=141)	Fishing cum Farming (n=135)	Farming (n=134)	All (n=410)
House	1706.16	2,519.91	1,912.24	2,041.45
	(2,135.57)	(5,874.58)	(1,527.94)	(3,707.46)
Electronic appliances	109.05	59.82	49.60	73.41
	(215.46)	(113.03)	(59.20)	(147.99)
Transport equipment	2,419.75	561.85	296.40	1,114.03
	(18,908.50)	(1,021.47)	(861.21)	(11,129.82)
Furniture and fixtures	56.85	22.36	22.31	34.21
	(208.12)	(65.98)	(66.17)	(133.96)
Cell phone	73.50	15.35	1.12	30.74
	(674.95)	(44.72)	(10.67)	(397.50)
Generator	75.86	13.81	6.31	32.70
	(457.76)	(67.43)	(42.46)	(273.48)
Tube wells	2.27	4.22	9.62	5.31
	(15.51)	(18.55)	(47.12)	(30.44)
Livestock	15.83	80.19	270.20	120.16
	(56.48)	(269.97)	(443.90)	(317.34)
Poultry	0.59	4.90	4.96	3.43
	(2.55)	(19.73)	(13.87)	(14.02)
Modern farm equipment	5.67	164.26	153.65	106.25
	(29.48)	(451.15)	(953.37)	(606.53)
Traditional farm equipment	2.88	20.57	57.54	26.57
	(13.77)	(48.82)	(130.30)	(82.98)
All assets, excluding house	2,805.62	972.16	891.86	1,576.45
	(18,939.94)	(1,289.95)	(1,626.31)	(11,179.88)
All assets	4,511.78	3,492.07	2,804.07	3,617.90
	(19,073.60)	(6,458.96)	(2,643.71)	(11,872.97)

Note: Numbers in parentheses are standard deviation. Average values are based on all households.

An inventory of ownership of professional equipment showed that the households owned a range of equipment for farming, fishing and fishing-related activities, although not all sample households owned all of the listed equipment (Table 4.14). Ownership of farm equipment (which includes traditional and modern ones) and livestock was highest in farming villages, compared to fishing and fishing cum farming villages. On average, farming village households own a greater value of traditional equipment than households in other village types, reflecting these households' dependence

on farming. Households in fishing cum farming villages owned on average the greatest value of modern farming equipment, which may reflect the slightly higher wealth of many households, due to their dual livelihood strategies.

Table 4.14. Number of households owning farming and fish processing equipment and average value (US$), by village type.

Type of Equipment	Average Value (US$)				Number of Households			
	Fishing	Fishing cum Farming	Farming	All	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Farm equipment/livestock								
Traditional	14.51 (27.36)	38.25 (60.78)	64.80 (135.73)	49.36 (107.25)	31	74	121	226
Modern	133.33 (62.58)	636.41 (701.91)	588.26 (1,814.47)	574.52 (1,316.65)	6	35	35	76
Cow/buffalo	92.98 (109.23)	350.20 (477.29)	520.85 (500.47)	388.14 (471.20)	24	31	72	127
Poultry	9.28 (4.80)	24.88 (38.63)	14.99 (20.89)	17.68 (27.58)	9	27	44	80
Processing equipment								
Barrel	55.00 (63.64)	6.00 (-)	0.00 (-)	38.67 (53.15)	2	1	-	3
Cube	6.57 (8.39)	56.41 (62.45)	0.88 (-)	34.23 (52.25)	2	4	1	22
Smoke griller	17.92 (7.77)	15.33 (11.83)	0.00 (-)	15.72 (11.27)	6	34	-	7
Jar	7.54 (11.93)	5.67 (9.62)	2.04 (1.57)	5.63 (9.84)	78	66	42	186
Basket	4.30 (4.64)	3.75 (-)	0.54 (0.54)	3.76 (4.38)	18	1	3	13
Large bowl	4.13 (4.83)	2.58 (1.26)	0.00 (-)	3.77 (4.26)	10	3	-	3
Others	6.56 (7.69)	0.30 (-)	0.00 (-)	4.48 (6.53)	2	1	-	40

Note: The average value is based on the households who owned specific equipment. Numbers in parentheses are standard deviations.

A greater number of households in fishing and fishing cum farming villages owned processing equipment compared to households in farming villages, which reflects the higher occurrence of fish processing. The common equipment used consisted of a barrel, cube, smoke griller and jar. A number of households in farming villages also owned some processing equipment, such as jar, basket and cube. It should be noted that most farming households will process some fish to produce fish paste *(prahoc)* and fermented fish

during peak fishing periods, for household consumption during the rest of the year.

Almost all households in the sample owned some fishing equipment. Even farming households owned some family scale gear, such as bamboo fence, trap, castnet, gillnet, liftnet and shrimp blast bunch (Table 4.15). Farming households commonly fish outside of the farming season or during free time from ricefields, for household consumption. Primary gear used was gillnet (60%), whereas secondary gear used was hook longline (9%) and bamboo fence trap. The tertiary gear used was folded woven trap (2%) (Appendix A, Table 10).

4.9. Annual Income

Household income can be considered as the value of food and services derived from fishing and farming activities, plus other sources of income, such as labor, business, government/NGO jobs, livestock raising and remittances/gifts from relatives. As Table 4.16 shows, average total annual income was higher in fishing and fishing cum farming village households, compared to farming village households.

Overall, the highest average annual incomes were generated in fishing cum farming (US$1,507 per annum) and fishing households (US$1,462 per annum), compared to farming village households (US$703). Overall, fish culture generates the most income per household (US$1,024 per annum), and was conducted by 22% of households in the total sample. However, almost half (44%) of all fishing households were involved in fish culture, compared to 19% in fishing cum farming villages and 2% in farming villages. Fishing generated an average annual household income of US$609 overall, and was conducted by 85% of all households. However, in farming villages, only 66% of households generated income from fishing, and the average income from the activity was only US$285 per annum in these villages. Overall, farming generated an average annual income of US$438 for 55% of households involved, although this was significantly higher in fishing cum farming villages (US$744 per annum). Fish processing generated an average annual income of US$203 for 16% of households involved, while government or private employment generated an average annual income of US$351 for 10% of households. Generally, households with multiple occupations or sources of income have higher incomes, which result in greater ownership of assets and better living conditions.

Table 4.15. Number of households owning fishing equipment and average value (US$), by village type.

Type of Fishing Equipment	Average Value (US$)				Number of Households			
	Fishing	Fishing cum Farming	Farming	All	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Bamboo fence eel trap	56.09 (27.78)	112.50 (-)	0.00	59.41 (30.18)	16	1	-	17
Bamboo fence	461.63 (532.32)	273.89 (447.13)	79.21 (55.20)	319.36 (467.56)	23	35	7	65
Bamboo trap	171.62 (197.72)	65.40 (52.82)	90.19 (86.13)	104.09 (129.02)	17	25	13	55
Big vertical slit trap	57.50 (-)	20.00 (-)	0.00 (-)	38.75 (26.52)	1	1	-	2
Castnet	218.75 (558.21)	23.75 (13.62)	17.00 (22.18)	95.14 (345.20)	8	4	9	21
Folded woven trap	71.10 (41.89)	47.04 (20.38)	62.50 (-)	67.70 (39.90)	38	6	1	45
Funnel trap	3.50 (-)	56.25 (23.94)	18.75 (18.16)	35.59 (29.19)	1	4	3	8
Gillnet	110.54 (125.97)	54.18 (51.11)	31.41 (30.47)	70.61 (92.85)	116	91	80	287
Harpoon	7.14 (7.08)	7.11 (5.30)	4.80 (1.78)	6.74 (6.03)	18	7	5	30
Hook longline	26.03 (20.17)	15.67 (13.47)	9.71 (8.36)	18.25 (16.97)	29	18	21	30
Liftnet	13.44 (4.49)	2.81 (1.42)	15.00 (-)	8.89 (6.47)	4	4	1	9
Seine net 1	1,396.65 (2,724.50)	861.11 (1,580.35)	0.00 (-)	1,211.27 (2,370.10)	17	10	-	26
Small vertical slip trap	131.56 (131.56)	0.00 (-)	50.25 (30.21)	96.71 (181.78)	8	-	6	14
Mosquito net	0.00	52.75 (45.52)	27.81 (17.15)	45.63 (40.49)	-	9	4	14
Shrimp blast bunch	0.00	172.58 (250.72)	30.00 (-)	159.61 (241.71)	-	10	1	11
Single hooked line	0.00	0.00	0.25 (-)	0.25 (-)	-	-	1	1
Handled pick out-cone shaped hard trap	0.00	0.00	4.63 (2.30)	4.63 (2.30)	-	-	2	2

Note: The average value is based on the households who owned specific equipment. Numbers in parentheses are standard deviations.

Table 4.16. Average annual household income from different sources by village type.

Sources of Income	Average Income (US$) of Households Involved in Activity				Number of Households Involved			
	Fishing	Fishing cum Farming	Farming	All	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Fishing	661.93 (1,264.81)	791.44 (4,679.31)	284.57 (378.12)	608.79 (2,877.14)	134	119	89	342
Fish culture	1,194.27 (2,076.25)	692.89 (846.89)	309.58 (386.85)	1,023.61 (1,790.76)	61	25	3	89
Fish processing	299.26 (833.61)	141.66 (125.29)	23 (34.25)	203.13 (551.74)	28	35	3	66
Fish trading	560.11 (1,082.49)	466.67 (337.89)	376.67 (434.75)	504.56 (819.44)	11	6	3	20
Farming	111.48 (78.31)	743.53 (1,208.80)	292.21 (493.71)	438.21 (850.35)	28	84	113	225
Crocodile culture	-	1,500.00	-	1,500.00	-	1	-	1
Daily labor	129.51 (175.22)	113.67 (223.79)	145.19 (259.70)	129.82 (221.00)	28	28	30	86
Bamboo and cane works	15.00 (10.61)	12.5 (-)	4.00 (-)	11.63 (8.05)	2	1	1	4
Fuel wood collection	38.31 (18.07)	38.72 (22.59)	31.36 (18.72)	35.69 (19.89)	53	47	65	165
Government/ NGO job	533.71 (451.03)	248.06 (174.25)	260.6 (142.37)	351.18 (320.30)	14	16	10	40
Housekeeping	-	25.00 (-)	195.00 (21.21)	138.33 (99.29)	-	1	2	3
Livestock raising	151.63 (344.84)	157.71 (193.51)	124.37 (137.14)	140.36 (222.76)	28	27	49	104
Money lending	245.00 (7.07)	250.00 (-)	150.00 (67.70)	191.43 (70.52)	2	1	4	7
Motor taxi boat driving	352.32 (213.60)	182.5 (138.95)	750.00 (-)	328.85 (233.27)	7	4	1	12
Net/ gearmaking	35.00 (21.21)	20.44 (14.45)	-	24.08 (16.09)	2	6	-	8
Shop/small business	265.4 (373.90)	238.34 (193.73)	246.46 (307.42)	249.26 (297.82)	23	24	39	86
Others (remittances/ gifts from relatives)	142.50 (99.91)	46.25 (5.30)	560.29 (1,239.87)	433.54 (1,063.58)	3	2	13	18
Average total annual income per household	1,462.22 (2,136.98)	1,506.67 (4,484.89)	703.05 (728.12)	1,228.74 (2,908.67)	424	427	425	1276

Notes: The average annual income from each source is based on the households involved.
The total annual income is based on all households.
Numbers in parentheses are standard deviations.

Table 4.17 shows the overall average income generated from different activities. Overall, fishing and related activities generate 61% of household income, while farming generates 19%. However, it should be noted that most households rely heavily on farming to produce rice and crops for household consumption for all or at least part of the year.

Table 4.17. Overall average annual household income from different sources and percentage of total.

Sources of Income	Overall Average Annual Income	% of Total Average Income
Fishing	495.57	40.3
Fish culture	207.09	16.9
Fish processing	19.74	1.6
Fish trading	24.61	2.0
Farming	230.55	18.8
Wage income	25.11	2.0
Government/NGO job	32.86	2.7
Small trading	51.34	4.2
Others	141.87	11.5
Average total annual income per household	1,228.74	100.0

Note: The average income from each source and total annual income is based on all households.

4.10. Sources and Utilization of Credit

In Cambodia, borrowing and lending of money between households is common practice in rural areas and 49% of households in the sample borrowed money, mainly from friends or relatives. However, this appears to be highest in fishing villages, where 69% of households borrowed money to support fishing operations. This contrast with farming villages, where only 33% of households borrowed money (Table 4.18). It was reported that friends and relatives, the major sources of borrowing funds, may or may not charge interest. Local money lenders usually charged a high interest rate, about 5-10% per month.

Table 4.18. Percentage of households borrowing money and sources by village type.

Borrowing and Sources	Fishing	Fishing cum Farming	Farming	All
Borrowed money	(n=140)	(n=135)	(n=135)	(n=410)
Yes	68.57	43.70	33.33	48.78
No	31.43	56.30	66.67	51.22
Sources of borrowing	(n=120)	(n=91)	(n=43)	(n=254)
Friends and relatives	89.17	87.91	97.67	90.16
Financial institution	10.00	10.99	2.33	9.06
Money lender	0.83	1.10	0.00	0.79

4.11. Household Food Consumption

Rice and fish are staple food for Cambodian people, and this is represented in consumption patterns (Table 4.19). Protein intake is composed of meat, fresh fish and processed fish. On average, households consumed 35 kg of meat and fish per week, although this was significantly higher in farming households (49 kg) compared to fishing and fishing cum farming households (28 kg). Additionally, meat was found to form a greater proportion of the total meat/fish consumed in farming households (55%), compared to fishing (40%) and fishing cum farming (47%) households.

Table 4.20 shows the average amount spent per week on consumables, either bought at the market or produced at home. The amount and average cost of each food item consumed by households during a one-week period is shown in Table 31 in the appendix. Overall, households spent an average of US$20.4 per week on consumable food products (including household production and products bought at market). This was highest in fishing households (US$21.5) and lowest in farming households (US$17.7). The average per capita expenditure per week was US$ 3.2, and was similarly highest in fishing and lowest in farming households. On average, 40% of consumables were produced by the households and 60% were bought at the market, although in fishing households, 71% of consumables were bought.

Table 4.19. Average household consumption of fish and meat per week by village type and closed season in 2003.

Fish and Meat Items	Fishing (n=141)	Fishing cum Farming (n=135)	Farming (n=133)	All (n=409)
Meat (kg)	11.34 (28.32)	13.26 (12.84)	26.88 (19.89)	17.32 (22.31)
Meat as % of all meat/fish	40%	47%	55%	49%
Total fish	***9.01 (28.24)***	***8.36 (7.30)***	***11.55 (7.74)***	***9.66 (17.26)***
Fresh fish (kg)	6.60 (3.79)	6.58 (3.62)	5.16 (2.55)	6.12 (3.43)
Fishball (kg)	1.71 (0.76)	3.00 (-)	0.50 (-)	1.72 (0.91)
Fish egg (kg)	2.00 (-)	1.00 (-)	0.60 (0.57)	1.04 (0.64)
Fresh fish as % of all meat/fish	32%	30%	24%	27%
Total processed fish	***7.96 (28.23)***	***6.48 (6.03)***	***10.18 (5.97)***	***8.23 (16.86)***
Fermented (kg)	0.85 (1.34)	0.48 (0.35)	0.61 (0.27)	0.66 (0.87)
Prahoc (kg)	3.85 (31.57)	0.46 (0.24)	0.52 (0.54)	1.85 (20.10)
Salted dry fish (kg)	1.81 (1.18)	2.21 (1.19)	1.37 (0.84)	1.71 (1.09)
Processed fish as % of all meat/fish	28%	23%	21%	23%

Note: Numbers in parentheses are standard deviations.

Table 4.20. Average household expenditure on self-produced and market-bought consumables (US$) during the week before the interview (in closed season).

Items	Fishing	Fishing cum Farming	Farming	All
Expenditure for self-produced consumables (US$)	6.2	8.6	8.0	8.1
Market expenditure on consumables (US$)	15.3	11.6	9.7	12.3
Total expenditure on consumables (US$)	21.5	20.1	17.7	20.4
Average household size	6.0	6.6	6.5	6.4
Per capita expenditure per week (US$)	3.6	3.0	2.7	3.2
% of consumables which are self-produced	28.6	42.6	45.1	39.9
% bought at market	71.4	57.4	54.9	60.1

5 Economic Fishing Activities

5.1. Purpose and Period of Fishing

Overall, 62% of households fished all year round; 14%, only in closed season; and 8%, only in open season. The remainder (16%) fished only occasionally or not at all. The majority (86%) of fishing households were engaged in fishing in both open and closed seasons. In contrast, one-third of farming households (33%) fished only during the closed season, and only 29% of farming households fish all year round (Table 5.1). This reflects the fact that in farming villages, fishing is generally an additional, rather than main, livelihood occupation. Also, the open season is generally the busiest farming season and household members may not have time to conduct fishing, whereas during the closed (flooded) season, there are fewer farming activities.

Fishing was conducted for household consumption only, for sale only, or for both sale and consumption. As Table 5.1 shows, almost all fishing households (95%) and over half (75%) of fishing cum farming households fished for sale only or for sale and household consumption. In farming villages, however, only 40% of households fished for sale, although a further 27% of farming village households also fished, for household consumption only.

Table 5.1. Percentage of households who fish during each season, number of households who fished last week and purpose of fishing during closed season (August 2003).

Household Data	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All Villages (n=410)
% of households who fish in different fishing seasons				
- Closed (June-September)	5.00	3.70	32.59	13.66
- Open (October-May)	5.00	13.33	6.67	8.29
- All seasons (whole year)	85.71	71.85	28.89	62.44
- Occasional	0.00	0.00	0.74	0.24
NA	4.29	11.11	31.11	15.37
Number of households who fished last week (closed season, 2003)				
Yes	84.29	67.41	53.33	68.54
No	17.14	32.59	46.67	31.46
Purpose of fishing (closed season, 2003); % of households				
Consumption only	0.00	29.63	27.41	19.01
Sale only	40.00	45.93	33.33	39.76
Sale and consumption	55.00	11.11	6.67	24.88
NA	5.00	13.33	31.85	16.35

5.2. Members of Household Involved in Fishing

Overall, fishing was conducted for an average of 3.54 person-hours in the closed season and 1.15 person-hours per household in the open season (Table 5.2). Overall, fishing households spent the longest time fishing, followed by fishing cum farming and farming households. The same pattern was seen in open and closed seasons. All households spent longer time fishing in the closed season than in the open season. This reflects the fact that many households in all village types have dual livelihood strategies and spend some time farming as well as fishing. The open season is the busiest time of year for rice farming and therefore household members have less time to fish. Additionally, during the open season many households fish using bamboo traps placed near the riverbank. These are simply set and checked a few times a day, and so do not take up much time for household members.

On average, the number of household members who went fishing during the closed season was 2.3 per household in fishing villages, 2.05 in fishing cum farming villages and 1.46 in farming villages (Table 5.2). In the open season the average number of people per household fishing was less; 2.5 in fishing villages, 1.1 in fishing cum farming and 0.43 in farming villages. Farming households tended to use small-scale fishing gear, which requires only one person to operate, whereas fishing households used larger-scale gear. This

Table 5.2. Number of household members who fished and average number of hours spent fishing last week, by season (August 2003 and February 2004) and village type.

Number per Household	Closed Season				Open Season			
	Fishing	Fishing cum Farming	Farming	All	Fishing	Fishing cum Farming	Farming	All
Number of males	1.59	1.63	1.29	1.53	1.25	0.87	0.40	0.84
Number of females	0.70	0.43	0.17	0.48	0.23	0.23	0.03	0.16
Total number of people	2.30	2.05	1.46	2.00	1.48	1.10	0.43	1.00
Days per week	6.14	5.80	6.40	6.10	5.26	3.58	2.26	3.71
Hours per person per week	11.38	7.68	7.46	9.18	7.68	4.49	3.87	5.36
Hours per person per day	1.98	1.78	1.42	1.77	1.66	1.26	0.53	1.15
Total person-hours per household per day	4.55	3.65	2.07	3.54	2.46	1.39	0.23	1.15

implies that households living in fishing villages are more actively involved in fishing, which is to be expected as fishing is generally the main and/or only livelihood occupation.

5.3. Fishing Grounds

There are many different types of fishing grounds making up inland fisheries of Cambodia, including lakes, rivers, reservoirs, stream/canals, flooded forests and ricefields. Use of different fishing areas varies with the season. As shown in Table 5.3, in closed season, fishing and fishing cum farming village households fish mainly in the Great Lake, flooded forests and rivers, whereas farming village households fished mainly in ricefields in the periphery of the Lake. During the open season (October to May), fishers operated mainly in the Great Lake and rivers, as flooded forest areas dry out at this time.

Table 5.3. Percentage distribution of fishing grounds used in open and closed seasons, by village type.

Type of Fishing Ground	Closed Season (% of Households)				Open Season (% of Households)			
	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)	Fishing (n=137)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=407)
Ricefield	3.57	2.22	40.00	15.16	0.73	0.74	13.33	6.51
Great Lake	39.29	31.11	19.26	30.07	45.99	32.59	19.26	43.32
River	32.86	25.93	10.37	23.23	26.28	25.19	8.15	26.38
Canal	4.29	5.93	2.22	4.16	0.00	8.89	11.85	9.12
Flooded forest	34.29	24.44	15.56	24.94	21.90	5.93	8.15	15.96
Fishing lot	0.71	6.67	0.00	2.44	0.52	1.48	4.44	3.26

5.4. Main Types of Gear Used

At present, there are three levels of fishing operation and gear types in inland fisheries of Cambodia, composed of family/small-scale (subsistence) fishing, middle-scale (artisanal) fishing, and large-scale (industrial/commercial) fishing. Family-scale fishing can be conducted year round, while middle-scale and large-scale gears are only permitted during the open season (October-May). The type of gear used varies according to the type of fishing operation, fishing ground and fish species. Gear restrictions are composed of the number, length and mesh size of nets.

Types of gear used by the sample households by village type are shown in Table 5.4. Overall, the gears used most commonly in the closed season were gillnet (62%), bamboo fenced trap (15%), hook longline (10%) and folded woven trap (10%). Gillnets are the most commonly used gear type for households in all village types, in open and closed seasons, and represent a low-cost gear, suitable for catching many different fish species.

Table 5.4. Percentage distribution of fishing gears used by sample households by village type.

% of Households	Closed Season				Open Season			
Type of Gear	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)	Fishing (n=136)	Fishing cum Farming (n=135)	Farming (n=136)	All (n=407)
Gillnet	68.57	59.26	57.04	61.71	60.29	46.67	33.82	46.93
Castnet	0.71	1.48	2.96	1.71	1.47	-	5.88	2.46
Bamboo fenced trap	12.14	25.19	8.89	15.37	11.73	13.33	3.68	9.58
Big cylindrical drum trap	-	-	-	-	0.74	0.74	-	0.49
Big vertical slip trap	-	-	-	-	1.47	-	-	0.49
Seine net	2.14	2.96	-	1.71	5.15	5.93	0.74	3.93
Hook longline	11.43	7.41	12.59	10.49	2.21	2.22	10.29	4.91
Bagnet	-	0.74	-	0.24	-	0.74	-	0.25
Mosquito net	0.71	5.19	2.22	2.68	0.74	1.48	-	0.74
Folded woven trap	22.86	5.93	1.48	10.24	11.03	1.48	0.74	4.42
Bamboo pieced-eel trap	11.43	0.74	-	4.15	4.41	-	-	1.47
Single hook line	-	-	0.74	0.24	-	-	-	-
Small vertical slit trap	2.86	-	2.22	1.71	-	-	-	-

Note: The data in Table 5.4 are for sample households in all seasons.

5.5. Fish Production and Consumption

Inland fisheries in Cambodia occupy two major ecosystems: first, the Great Lake and Tonle Sap River zone and second, the Mekong-Bassac inundated forests zone. There are 13 provinces, including Phnom Penh, with access to inland fisheries of Cambodia. Of those provinces, the selected ones in this study, namely, Kampong Chhnang, Siem Reap and Kandal, account for 50% of the total inland commercial fisheries production. In this study area, two provinces (Kampong Chhnang and Siem Reap) are in the Great Lake and Tonle Sap River zone and one province (Kandal) is in the Mekong-Bassac River zone.

As Table 5.5 shows, the average annual catch per household is higher in fishing villages compared to other village types. Of these three provinces, the highest average annual household catch was in Siem Reap province (15,424 kg), followed by Kampong Chhnang province, (8,197 kg). This implies that Siem Reap province may have better fishing areas compared to other provinces, and may also be due to the fact that there are greater areas of flooded forest. However, both provinces in the Great Lake and Tonle Sap River zone had higher fish catches than villages in the Mekong-Bassac zone. In terms of fish utilization, overall 75% of total fish catch was sold, and only 6% was used for household consumption. The remainder was processed (8%) and used for fish feed (11%), as Table 5.5 details.

Table 5.5. Average catch and utilization (kg) of fish per household by village type in each province during the fishing year (2002-2003).

Village Type	Average Annual Amount per Household (kg)				
	Total Catch	Consumption	Sold	Processed	Fish Feed
Fishing	8,197	136	7,402	67	592
Fishing cum farming	2,258	172	1,166	30	889
Farming	557	150	347	16	44
Total - Kampong Chhnang	*3,638*	*153*	*2,940*	*38*	*508*
Fishing	2,539	302	1,002	479	757
Fishing cum farming	1,299	178	680	395	45
Farming	290	79	188	10	12
Total - Kandal	*1,444*	*193*	*646*	*306*	*299*
Fishing	15,424	723	11,369	1,884	1,449
Fishing cum farming	5,023	240	4,597	113	73
Farming	255	128	121	4	1
Total - Siem Reap	*6,901*	*364*	*5,362*	*667*	*508*
Overall average	*3,990*	*236 (6%)*	*2,982 (75%)*	*333 (8%)*	*439 (11%)*

The relationship among average household catch, utilization and value of gear owned for the fishing season 2002-2003 (open and closed seasons) is presented in Tables 5.6 and 5.7 below. Households were divided into five groups, according to the value of gear owned: (1) less than US$15; (2) US$15-100; (3) US$100-200; (4) US$200-300; and (5) over US$300. The results show a positive relationship between average catch and value of gear owned, that is, households owning a high value of gear tended to have high annual catches (Table 5.6), in both open and closed seasons (Table 5.7). Specifically for fishing lots, there was very high fish production compared to family-scale fishing and the vast majority of the catch was sold. As Table 5.7

Table 5.6. Average catch and utilization of fish (kg) by gear value during fishing year (2002-2003).

Value of Gear Owned (US$)	Average quantity (kg)				
	Catch	Consumption	Sold	Processed	Fish feed
Above 300	14,755	644	11,044	1,471	1,596
200 – 300	2,683	266	1,770	196	451
100 – 200	1,331	180	750	201	201
15 – 100	623	156	293	90	84
0 – 15	36	9	18	6	3
Fishing lot	300,000	50	289,750	200	10,000
All	3,990	236	2,982	333	439

Note: The average per household is based on all households owning gear in each category.

Table 5.7. Average catch and utilization (kg) of fish by value (US$) of gear owned for open and closed fishing seasons in 2002-2003.

Value of Gear (US$)	Average Annual Quantity (kg) Open Season (2002)					Average Annual Quantity (kg) Closed Season (2003)				
	Catch	Consumption	Sold	Processed	Fish Feed	Catch	Consumption	Sold	Processed	Fish Feed
Above 300	13,214	543	9,708	1,470	1,493	1,541	101	1,336	0	103
200 – 300	2,091	199	1,376	188	328	592	67	394	8	123
100 – 200	1,045	117	570	190	168	287	63	180	11	33
15 – 100	395	71	179	90	55	227	85	113	0	29
0 – 15	15	5	5	5	0	22	5	13	1	3
Fishing lot	300,000	50	289,750	200	10,000	-	-	-	-	-
All	3,501	174	2,621	327	379	489	62	361	6	60

shows, 97% of the catch from fishing lots was sold, the remainder generally being used for fish feed. A negligible quantity of catch from fishing lots was consumed by fishing households or was processed.

As shown in Table 5.8, average household catches were higher in the open season (3,501 kg) than in the closed season (508 kg) and a greater amount was consequently consumed, processed, used for fish feed and sold fresh. The average household catch was highest in fishing villages, followed by fishing cum farming and farming villages, for open and closed seasons. In particular, the high catch amounts for fishing and fishing cum farming households in the open season reflect the lot fisheries, which are only

operational during the open season. Utilization of catch also varied among different village types. Farming households consumed a greater portion of the catch at home (29-39%) compared to fishing households (11-25%), in both closed and open seasons. This probably reflects the fact that both fishing and farming households reserved a similar amount of the catch for household consumption and sold and/or processed the remainder.

Table 5.8. Average catch and utilization of fish (kg) per season by village type and by fishing season.

Catch/ Utilization for Season	Open Season (2002)				Closed Season (2003)			
	Fishing	Fishing cum Farming	Farming	All	Fishing	Fishing cum Farming	Farming	All
Total catch	7,612	2,441	244	3,501	885	433	128	488
Consumption	304	141	70	174	78	56	50	61
Sold	5,717	1,836	155	2,621	681	319	66	361
Processed	787	163	9	327	6	11	1	6
Fish feed	804	301	9	379	120	47	11	60

Similarly, weekly catch rates during the open season were high in the fishing and the fishing cum farming village households (17 and 15 kg, respectively), but fairly low in farming households (3 kg). With regard to sale of catch, the average price in farming villages is slightly higher than other village types (Table 5.9). Figure 5.1 shows the use of weekly fish catch in closed season for all sample households.

Table 5.9. Average weekly fish catch, utilization and price per household (closed season, 2003).

Catch/Utilization (kg)	Fishing Village	Fishing cum Farming Village	Farming Village	All Villages
Catch	16.88	15.10	3.03	12.60
Sold	12.91	10.61	1.72	9.15
Consumption	1.69	1.70	1.11	1.54
Processed	0.07	0.26	0.01	0.12
Fish feed	2.21	2.54	0.19	1.78
Average price (US$/kg)	0.38	0.37	0.46	0.39

Note: Weekly amounts based on the week before interview in August 2003.

5.6. Major Species Caught

In Cambodia, the lake, river and inundated forests ecosystems support a rich fish diversity (Rainboth 1996; Ahmed et al. 1998). The species composition of fish catches of the surveyed households varied according to type of

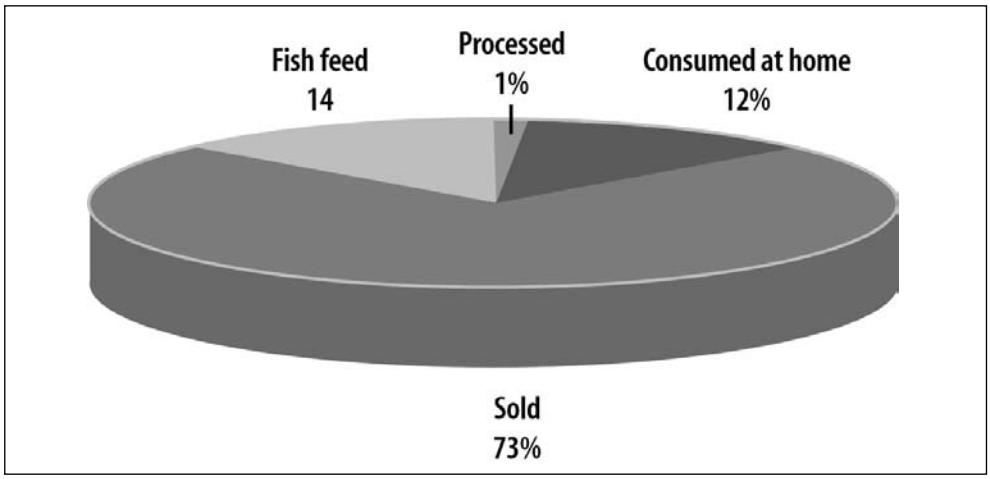

Figure 5.1. Use of weekly fish catch during closed season, all households (August 2003).

fishing gear used, fishing grounds and fishing season. Table 5.10 shows the top 20 fish species by volume caught during one week in each of the closed season (August 2003) and open season (February 2004).

Overall, the most commonly caught species during the closed season was *kampleanh sre* (12%), followed by *real* (7%), *kampleanh pluk* (6%), *kampeus* (6%), *chkok* (5%) and *chpin* (5%). In the open season, the species caught in highest quantity were *kampleanh sre* (16%), *real* (16%), *kampleanh pluk* (10%), *kross* (7%), *khnong veng* (6%) and *slat* (5%). The top 20 species make up 78% of the total catch in the closed season and 85% of the total catch in the open season. In terms of price, all species were sold for a higher price in the closed season compared to the open season. During the closed season, the most valuable species was *andeng tunle* (US$1.3 per kg), followed by *andat chker* (US$1.0), *tunle* (US$1.25 per kg) and *antung* (US$1.10 per kg). Overall, small *proma* represented the least valuable of the top 20 species, being sold for US$0.5 during the closed season (Table 5.11). Appendix A, Tables 11-13, show the top 20 fish species of volume caught and average price by province during closed season.

Table 5.10. Top 20 species by total quantity caught in all provinces during the week before the date of interview in closed season (August 2003) and open season (February 2004).

Top 20 by Volume (Closed Season)			Top 20 by Volume (Open Season)		
Species	**Sum of Catch (kg)**	**Unit Price (US$/kg)**	**Species**	**Sum of Catch (kg)**	**Unit Price (US$/kg)**
Kampleanh sre	2,445	0.15	*Kampleanh sre*	6,918	0.07
Real	1,426	0.30	*Real*	6,553	0.17
Kampleanh pluk	1,311	0.14	*Kampleanh pluk*	4,041	0.07
Kampeus	1,110	0.39	*Kross*	2,853	0.09
Chkok	991	0.43	*Khnong veng*	2,464	0.25
Chpin	960	0.39	*Slat*	1,968	0.17
Kantrop	876	0.21	*Krum*	1,227	0.55
Chlang	761	0.49	*Linh*	1,106	0.06
Kranh sre	727	0.21	*Kachanh chrass**	1,032	0.02
Kross	715	0.16	*Real angkam*	977	0.07
*Chrakeng**	670	0.38	*Chpin*	953	0.34
*Chrakeng**	475	0.40	*Chkok*	901	0.38
Kanh choss krobey	456	0.17	*Ross*	706	0.48
Kanh choss chnot	451	0.21	*Kachanh chrass**	700	0.03
Kanh choss	450	0.20	*Proul*	669	0.56
Chlang	448	0.75	*Chrakeng*	626	0.21
Sroka kdam	396	0.09	*Khlang hai*	619	0.84
Slat	378	0.37	*Sroka kdam*	498	0.04
Angkot prak	320	0.13	*Kranh sre*	437	0.13
Ross	307	0.43	*Po*	382	0.37
Top 20 species[1]	15,672	0.30	Top 20 species	35,628	0.24
Other species[2]	4,299	0.30	Other species	6,431	0.20
All species[3]	19,971	0.29	All species	42,059	0.20

Notes:
* - has the same name in Khmer but has a different scientific name.
[1] Top 20 species: Total caught by top 20 species and average price.
[2] Other species: Total caught of other species excluding top 20 species and average price.
[3] All species: Total caught of all species and average price.

Table 5.11. Top 20 species by average prices (US$/kg) in all provinces during the week before the date of interview (closed season, August 2003 and open season, February 2004).

Top 20 by Price (Closed Season)			Top 20 by Price (Open Season)		
Species	**Sum of Catch (kg)**	**Unit Price (US$/kg)**	**Species**	**Sum of Catch (kg)**	**Unit Price (US$/kg)**
Andeng tunle	3	1.25	*Damrey*	107	0.96
Andat chker	14	1.00	*Antung*	80	0.92
*Chlang**	21	0.83	*Khlang hai*	619	0.84
C chdor	14	0.81	*Antung*	32	0.75
*Chlang**	448	0.75	*Krai*	1	0.75
Andat chker	5	0.63	*Andeng tun*	1	0.75
Kanh chruk loeung	3	0.63	*Chdor*	53	0.70
Kromorm	64	0.60	*Kampeus*	335	0.60
Trasok	104	0.58	*Proul*	669	0.56
Pra	3	0.58	*Krum*	1,228	0.55
Kambot chromoss	4	0.56	*Chlang*	103	0.53
Antung	73	0.54	*Slat*	101	0.52
Proul	141	0.54	*Promar*	22	0.50
Kapaut	165	0.52	*Ross (big)*	706	0.48
Chrakeng	22	0.50	*Ross/phtuk* (small)	24	0.48
Krai	2	0.50	*Chrakeng*	285	0.45
Ross	2	0.50	*Prolung*	2	0.43
Kanh chorn chey	1	0.50	*Sandai* (small)	48	0.42
Chlang	761	0.49	*Kanhchorn chey*	31	0.41
Promar (small)	71	0.48	*Chkok*	901	0.38
Top 20 species[1]	1,921	0.64	Top 20 species	5,344	0.60
Other species[2]	18,050	0.22	Other species	36,715	0.11
All species[3]	19,971	0.29	All species	42,059	0.20

Notes:
* - has the same name in Khmer but has a different scientific name.
[1] Top 20 species: Total caught by top 20 species and average price.
[2] Other species: Total caught of other species, excluding top 20 species and average price.
[3] All species: Total caught in all species and average price.

5.7. Fish Processing

Fish from freshwater capture fisheries are processed using both traditional and modern technologies. The traditional processing of fish can be classified as small-scale, middle-scale and large-scale (commercial). Normally, traditionally processed fish products are for domestic consumption, whereas the modern processing industries supply both domestic and export markets.

Traditional Processing

Small-scale (family-scale) processing is common practice for Cambodian people, who are very fond of processed fisheries products like fish paste, fish sauce, dried salted fish, smoked fish, etc. These traditional ways of processing fish are well adapted to the irregularity of the seasonal fish catch. In the very short peak period for inland fish catches it is necessary to process fish quickly and in a basic way, i.e., by hand within the household. For example, in the production of fish paste and fish sauce, salt is added immediately to conserve fish, and it can be kept in this form for the whole year. The salted fish is further processed by the addition of water and other ingredients and left to ferment to make fish sauce. Though the final product is of low value, it is a way of handling the amount of fish during peak period. In general, small-scale fish processing is an activity of households who process for family consumption only. These are generally people living near the river, fishing lots and lakes, and in upland areas.

Middle-scale fish processing operations are usually family-run, relying on the family's labor, help of relatives and some additional hired labor during peak periods. Middle-scale processing operations are usually located near fishing lots, fishing villages or landing sites. Generally, they involve processing fish to produce dried salted fish, smoked fish, fermented fish *(pha-ork), marm*, etc. The market for sun-dried fish for animal feed has expanded markedly in the last few years, particularly for export to Vietnam.

Large-scale processing is generally operated by fisheries enterprises and fish sauce factories. They usually employ about 40-60 workers, most of whom (80%) are female, who are involved in the activities of transforming fish into dried salted fish products, ordinary fish pastes, boneless fish pastes (with high value), fermented fish and smoked fish (Tana and Seang 2002). Large-scale operations are normally run by private individuals, often fishers or their relatives, and are usually located in fishing villages near fishing lots, especially in the Great Lake and the Tonle Sap River.

Modern or Industrial Fish Processing

In general, the fisheries products obtained from industrial fish processing are mainly destined for export to international market. These enterprises are owned by private companies and foreigners, and are located in Phnom Penh and Sihanoukville. They are operated under supervision of the government, and represented by the fisheries company KAMFIMEX. There are four freezing processing plants in Cambodia, which all hold export permits. One plant is located in Phnom Penh and the other three are based in the port city of Sihanoukville. Two of the facilities are owned by one Cambodian firm, Lian Heng Trading Company. There are also some small freezing facilities which undertake contract processing mainly for traders, including KAMFIMEX, the state-owned trading company.

5.7.1. Fish Processing Activities

Of the total sample of 410 households in this study, 63% were involved in family-scale and/or middle-scale processing. Majority of fish processing took place at home rather than at the river site (Appendix A, Table 14). As Table 5.12 shows, this was much higher in fishing villages (79%), where processing constitutes one of the main income-generating activities for the household, compared to farming villages (38%). Fish is processed for both sale and household consumption. As shown in Table 5.12, virtually all households who process fish (99%) do so for household consumption. Additionally, 36% of processing households sell processed fish. However, this was higher in fishing households who processed fish (44%) and much lower in farming households who processed fish (6%).

Generally, fish processing takes place in the house, or less often at riverbank. Labor is most often provided by household members, but hired labor may also be used during peak fishing periods. During the peak period, the average number of people involved in processing was 2 household members and 6 hired laborers, while during the nonpeak period, fewer hired laborers were used (3 persons). The average daily wage rate was highest (US$1.75/day) in fishing villages during the peak period, but only US$0.56/day in fishing cum farming villages (Table 5.12).

Table 5.12. Percentage of households engaged in processing, purpose of processing and processing place by village type.

Description	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Processing households	***% of all households***			
Yes	78.7	75.6	37.7	64.6
No	21.3	24.4	62.3	33.3
Purpose of fish processing	***% of processing households***			
For sale	44.1	42.1	5.8	35.8
For consumption	99.1	98.1	100	98.5
Place for processing	***% of processing households***			
In the house	82.0	83.0	100	86.4
At riverbank	14.4	21.2	1.9	14.7
Place near the house	-	1.0	-	0.5
Labor utilization for processing				
Peak period				
Self labor	1.60	1.76	1.52	1.65
Hired labor	5.50	3.89	4.18	5.50
Average daily wage rate (US$/day)	1.75	0.56	-	0.88
Nonpeak period				
Self labor	1.32	2.05	1.00	1.69
Hired labor	-	2.50	-	2.50
Average daily wage rate (US$)	-	0.75	-	0.75

As Table 5.13 shows, a variety of different types of processed fish were produced in the study areas, including sun-dried fish, fermented fish, fishballs, fish fillets, fish sauce, fish paste *(prahoc),* salted, dried fish, semi-final fish paste (semi-final *prahoc*) and smoked fish. Some products were only produced for household consumption, while others were processed for sale and consumption. On average, in fishing villages most (91%) of the total processed product was sold, while in farming villages very little (5%) of the total produced was sold.

Various raw materials were used by households for fish processing. The vast majority (95-100%) of households use salt in addition to fish as main raw materials. Additionally, many households use firewood (60%) and sugar (50%) in fish processing (Table 5.14).

Table 5.13. Average annual quantity processed, sold and consumed (kg) per household and price by product type and village type during 2002-2003.

Village Type/ Utilization	Sun-dried Fish	Fermented Fish	Fish-ball	Fish Fillet	Fish Sauce	Fish Paste *(Prahoc)*	Salted Dried Fish	Semi-final Fish Paste	Smoked Fish	All Products
Fishing village *(n=140)*										
Produced	20.00 (10.41)	15.87 (16.07)	22.50 (10.61)	35.00 (21.21)	36.27 (25.27)	343.56 (2,466.98)	230.56 (589.35)	2584.17 (2,524.11)	193.33 (141.80)	305.48 (1,795.74)
Sold	0.00	1.96 (9.38)	0.00	22.50 (31.82)	0.00	314.89 (2,449.60)	208.78 (595.11)	2570.83 (2,534.14)	180.00 (136.38)	277.70 (,1787.13)
Consumed	20.00 (10.41)	13.91 (14.38)	22.50 (10.61)	12.50 (10.61)	36.27 (-)	28.57 (29.62)	21.89 (30.75)	13.33 (24.25)	13.33 (8.16)	27.74 (26.80)
Fishing cum farming *(n=135)*										
Produced	7.50 (3.54)	14.41 (11.35)	15.00 (-)	-	3.00 (-)	37.04 (77.30)	55.38 (83.43)	80.00 (112.69)	410.29 (691.03)	92.90 (309.10)
Sold	0.00	2.18 (8.97)	0.00	-	0.36 (3.04)	15.07 (67.42)	0.00	70.00 (121.24)	381.92 (678.83)	67.48 (302.80)
Consumed	7.50 (3.54)	12.24 (7.66)	15.00 (-)		29.88 (23.45)	21.97 (23.86)	55.38 (83.43)	10.00 (10.10)	28.37 (48.95)	25.42 (32.17)
Farming village *(n=135)*										
Produced	-	19.50 (26.05)	30.00 (-)	-	18.29 (9.25)	19.60 (16.85)	10.00 (-)	-	14.50 (14.85)	18.93 (14.77)
Sold	-	8.33 (20.41)	0.00	-	0.00	0.60 (4.06)	0.00	-	10.00 (14.14)	0.99 (6.00)
Consumed	-	11.17 (9.24)	30.00 (-)	-	18.29 (9.25)	19.00 (16.70)	10.00 (-)	-	4.50 (0.71)	17.94 (13.80)
All villages *(n=410)*										
Produced	17.22 (10.64)	15.80 (15.81)	22.50 (8.66)	35.00 (21.21)	19.50 (23.33)	157.35 (1,573.11)	140.44 (418.36)	2083.33 (2,466.31)	364.78 (637.17)	166.96 (1171.77)
Sold	0.00	2.87 (11.07)	0.00	22.50 (31.82)	0.14 (1.91)	133.30 (1,561.58)	104.39 (422.14)	2070.67 (2,473.86)	339.41 (625.06)	141.90 (1165.40)
Consumed	17.22 (10.64)	12.93 (11.51)	22.50 (8.66)	12.50 (10.61)	30.05 (23.02)	24.04 (25.36)	36.11 (60.28)	12.67 (21.87)	25.37 (44.98)	25.06 (27.66)

Note: Numbers in parentheses are standard deviations.

Table 5.14. Percentage of fish processing households using different raw materials by village type.

Raw Materials	Fishing	Fishing cum Farming	Farming	All
Fish	100.00	100.00	100.00	100.00
Salt	100.00	87.96	98.15	95.26
Sugar	53.57	37.96	64.81	49.64
Firewood	50.89	65.74	68.52	60.22
Charcoal	0.00	0.00	1.85	0.36
Sun-dried materials	4.46	0.93	0.00	2.19
Total	(n=112)	(n=108)	(n=54)	(n=274)

In terms of price of processed products in the study areas, on average, fermented and smoked fish sold for a higher price than other products, at US$0.70/kg and US$0.62/kg, respectively. The lowest priced product was fish sauce (US$0.25/kg). In farming villages, the average prices for all products were high compared to other villages (Table 5.15), due to low levels of fishing and processing, and therefore availability.

Table 5.15. Average price (US$) by product type and village type during 2002-2003.

Type of Products	Fishing (n=72)	Fishing cum Farming (n=13)	Farming (n=50)	All Villages (n=135)
Fermented fish	0.56 (027)	0.43 (-)	1.25 (-)	0.70 (0.40)
Fish fillet	0.25 (-)	0.00	0.00	0.25 (-)
Fish sauce	0.28 (0.08)	0.20 (0.06)	0.00	0.25 (-)
Fish paste *(prahoc)*	0.31 (0.22)	0.50 (0.28)	0.19 (0.24)	0.36 (0.25)
Salted dried fish	0.43 (0.18)	0.00	0.00	0.43 (0.18)
Semi-final fish paste *(prahoc)*	0.37 (0.16)	0.15 (-)	0.00	0.35 (0.16)
Smoked fish	0.41 (0.13)	0.66 (0.24)	0.75 (-)	0.62 (0.24)
Total	0.34 (0.19)	0.55 (0.28)	0.46 (0.49)	0.46 (0.27)

Notes: The average price here is based on reported households only (n=135). Numbers in parentheses are standard deviations.

Prices for processed fish products also varied between provinces, with slightly lower average prices in Kampong Chhnang province, and slightly higher prices in Siem Reap (Table 5.16).

5.7.2. Fish Cage and Pond Aquaculture

In Cambodia, there are two types of aquaculture in inland fisheries: cage and pen culture and pond culture. In the Great Lake, Tonle Sap and Mekong Rivers, cage and pen culture are the major systems. Normally, *chdor* (giant snakehead*), pra* (*Pangasius), po (Pangasius larnaudiei)* and *ross (Channa striata)* fish species and crocodiles are raised in the cages. Fishing households in the Great Lake and Tonle Sap and Mekong Rivers may retain some of the catch as live fish (e.g., species that are surplus to demand of the market during peak periods and small fish) in bamboo pens or in cages under their floating house (*dai* fishing). These fish are then raised

Table 5.16. Average price (US$) by product type and province during 2002-2003.

Type of Products	Kampong Chhnang (n=72)	Kandal (n=13)	Siem Reap (n=50)	All Provinces (n=135)
Fermented fish	-	0.81 (0.62)	0.59 (0.23)	0.70 (0.40)
Fish fillet	-	0.25 (-)	-	0.25 (-)
Fish sauce	0.25 (-)	0.25 (-)	0.24 (0.12)	0.25 (0.08)
Fish paste *(prahoc)*	0.28 (0.10)	0.35 (0.17)	0.55 (0.37)	0.36 (0.25)
Salted dried fish	-	-	0.43 (0.18)	0.43 (0.18)
Semi-final fish paste *(prahoc)*	0.25 (-)	-	0.36 (0.17)	0.35 (0.16)
Smoked fish	0.60 (0.17)	-	0.76 (0.46)	0.62 (0.24)
Total	0.42 (0.21)	0.40 (0.30)	0.48 (0.33)	0.44 (0.27)

Notes: The average price here is based on reported households only (n=135). Numbers in parentheses are standard deviations.

and fattened, and then sold in off-season (when demand is high). Cage and pen culture are common practices and have been developed by fishing communities as a secondary occupation. Pond culture has also been long developed and practiced in Cambodia, especially in areas that are located far from water bodies and fishing grounds.

In the study areas, both cage and pond culture were practiced. In total, there were 123 cages/ponds in the study villages. Overall, the average area was 18 m^2 for cages and 297 m^2 for ponds, while the average present value is US$351 for a cage and US$414 for a pond. However, it was found that in fishing villages, the average values were high compared to the other village (Table 5.17). The average value was dependent on size of cage or pond and cage construction materials. There were five fish species for fish culture in the study area: *chdor, pra, po, ross* and *andeng tunle,* and also crocodile cage culture. The average number, size and price of each species by village type are presented in Table 5.18.

Table 5.17. Percentage of households practicing fish culture and number of fish culture ponds and cages owned per household and area (m^2) by village type.

Village Type	Cages	Ponds	Total
Fishing – 48% of household culture			
Total number of cages/ponds	72	2	74
Average area of cage/pond (m^2)	17.54	103.75	20.12
Average present value of cage/pond (US$)	406.18	3,475.00	497.78
Fishing cum farming – 27% of household culture			
Total number of cages/ponds	19	21	40
Average area of cage/pond (m^2)	18.30	393.00	220.84
Average present value of cage/pond (US$)	142.06	212.31	180.03
Farming – 7% of household culture			
Total number of cages/ponds	-	9	9
Average area of cage/pond (m^2)	-	127.44	127.44
Average present value of cage/pond (US$)	-	180.72	180.72
All villages – 28% of household culture			
Total number of cages/ponds	91	32	123
Average area of cage/pond (m^2)	17.70	297.24	94.39
Average present value of cage/pond (US$)	351.42	413.64	368.49

Table 5.18. Species, number of fingerlings, size and average price per fingerling in cage or pond culture.

Species	Description	Unit	Fishing	Fishing cum Farming	Farming	All
Chdor (giant snakehead)	Average number	head	2,496	1,400		2,369
	Average size	cm	15.32	8.20		14.49
	Average price	US$	0.16	0.06		0.15
Pra (pangasius)	Average number	head	2,115	2,675	1,333	2,206
	Average size	cm	17.79	18.58	6.33	17.27
	Average price	US$	0.11	0.03	0.04	0.09
Po (Pangasius larnaudiei)	Average number	head	720			720
	Average size	cm	8.75			8.75
	Average price	US$	0.06			0.06
Ross (Channa striata)	Average number	head	6,000	3,753	2,917	3,646
	Average size	cm	8.00	7.79	5.17	7.19
	Average price	US$	0.10	0.03	0.01	0.03
Andeng tunle (Cnidoglanis nudiceps)	Average number	head	3,000			3,000
	Average size	cm	8.00			8.00
	Average price	US$	0.02			0.02
Kropeu (crocodile)	Average number	head		10		10
	Average size	cm		30.00		30.00
	Average price	US$	0.00	0.09		0.09

Note: Scientific names are enclosed in brackets.

5.7.3. Aquaculture Production

Aquaculture makes up only a small proportion of total fisheries production, about 5% in 1999 (DOF 1999). This may be due to the fact that the supply of fish from capture fisheries is still sufficient. Overall, average aquaculture production was found to be highest in fishing villages, compared to other village types. As shown in Table 5.19, different fish species were farmed in different village types. Species such as *chdor, pra, po* and *ross* are commonly raised in cage culture in and along the Great Lake and Tonle Sap and Mekong Rivers. Prices varied for different species, but were found to be broadly consistent among different village types, although the average price of *ross* species was relatively low in farming villages, possibly due to fish being of smaller size. Most (97%) of fish culture production was for sale, while the rest (3%) was for household consumption.

Table 5.19. Average annual production, amount consumed and sold (kg), and price (US$/kg) by species and village type for each cage/pond.

Village Type/Species	Production (kg)	Consumed (kg)	Sold	Price (US$/kg)
Fishing				
Chdor	1,670.38 (2,394.48)	8.00 (17.44)	1,659.44 (2,389.54)	1.01 (0.14)
Pra	1,612.32 (1,846.56)	11.65 (19.95)	1,562.61 (1,865.71)	0.50 (0.12)
Po	466.67 (450.92)	0.00	466.67 (450.92)	0.42 (0.38)
Ross	4,000.00 (-)	5.00 (-)	395.00 (-)	1.15 (-)
Subtotal	1,625.72 (2,106.18)	9.25 (18.18)	1,545.75 (2,095.26)	0.76 (0.30)
Fishing cum farming				
Chdor	1,282.00 (827.27)	23.00 (24.90)	1,259.00 (815.72)	1.02 (0.06)
Pra	1,425.56 (2,127.73)	3.50 (3.51)	1,422.44 (2,127.34)	0.45 (0.08)
Ross	754.06 (871.79)	36.11 (77.98)	956.28 (1,132.15)	1.00 (0.35)
Subtotal	995.85 (1,321.62)	24.78 (60.24)	1,101.82 (1,405.26)	1.46 (20.75)
Farming				
Kranh sre	25.00 (-)	5.00 (-)	20.00 (-)	0.45 (0.45)
Pra	283.00 (-)	3.00 (-)	280.00 (-)	0.55 (-)

Ross	416.67 (362.26)	11.67 (16.07)	405.00 (352.24)	0.85 (0.30)
Andeng tun	20.00 (-)	5.00 (-)	15.00 (-)	0.55 (-)
Subtotal	263.00 (299.80)	8.00 (10.95)	255.00 (292.95)	0.68 (0.27)
Grand total	1,357.56 (1,870.72)	13.82 (36.48)	1,338.40 (1,869.59)	1.88 (299.80)

Note: Numbers in parentheses are standard deviations.

Table 5.20 shows that the average rearing period for fish culture was 13 months, although this ranged from 1 to 24 months (the one-month rearing period is for a household who had just started to raise fish).

Table 5.20. Average rearing period, minimum and maximum, of fish aquaculture by village type.

Description	Fishing	Fishing cum Farming	Farming	All
Average of rearing	13.65	13.97	7.11	13.22
Minimum of rearing	8.00	2.00	1.00	1.00
Maximum of rearing	24.00	24.00	12.00	24.00

6 Fish Marketing and Distribution System

6.1. Marketing of Fresh Fish

Table 6.1 shows the marketing channels for fish sold by sample households in the previous week. Overall, 73% of households sold fresh fish and 35% (41% in fishing villages to 21% in farming villages) s directly to a fish collector at the fishing ground and 31% to a middleperson or trader at the landing site (31%). Fresh fish was also sold to cage farmers (5%), particularly in fishing villages (13% of households). The pattern of fish marketing and distribution in open and closed seasons is shown in Table 6.2. While both collectors and traders/middlepersons were important in closed season, during open season the majority of households who sold fish did so to traders and middlepersons at a landing site. During closed season, fishers may go to a distant fishing site and stay there for a few days. Catches would then be collected by a fish collector at fishing ground. In contrast, during open season, fishers tend to fish close to the village, and then take catches to middlepersons and traders at landing sites. Additionally, fishers who have borrowed money from a fish trader or middleperson (e.g., to buy fishing gear) are obligated to sell their catch through this trader until the debt is repaid.

Table 6.1. Percentage of households involved in fresh fish marketing by village type, during 2002-2003.

Type of Fish Buyer	% of All Sample Households			
	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Fish collector at fishing ground	40.7	43.0	20.7	34.9
Middleperson/trader at landing site	35.0	34.8	23.0	31.0
Fish processor	0.0	0.7	0.0	0.2
Cage farmer	13.6	2.2	0.0	5.4
Crocodile farmer/animal	0.7	0.0	0.0	0.2
Others	0.7	3.0	0.7	1.5
Total	90.7	83.7	44.4	73.2
Did not sell fish	9.3	16.3	55.6	26.8

Table 6.2. Marketing of fresh fish caught during one week in each season, 2003-2004.

Type of Buyer	% of All Sample Households			
	Fishing	Fishing cum Farming	Farming	All
Closed season (August 2003)	(n=140)	(n=135)	(n=135)	(n=410)
Households who sold fish last week	80.7	63.7	35.6	60.2
Fish collector at fishing ground	33.6	31.1	16.3	27.1
Middleperson/trader at landing site	30.7	27.4	19.3	25.9
Fish processor	0.00	0.7	0.0	0.2
Cage farmers	16.4	3.0	0.0	6.6.
Fishers (shrimp trap)	0.00	1.5	0.0	0.5
Open season (February 2004)	(n=136)	(n=135)	(n=135)	(n=406)
Households who sold fish last week	88.9	50.4	26.7	55.2
Fish collector at fishing ground	14.1	11.1	1.5	8.9
Middleperson/trader at landing site	54.8	34.8	23.7	37.7
Fish processor	1.5	1.5	0.7	1.2
Cage farmers	17.8	3.0	0.7	7.1
Fishers (shrimp trap)/crocodile farmer	0.7	0.0	0.0	0.3

6.2. Marketing of Processed Fish

Overall, 39% of households sold processed fish (see Section 5.8). Almost half of these households (46%) sold their product direct to consumers, while 29% to middlepersons or traders in the nearest city, and 25% to collectors on site (Table 6.3). However, in farming villages almost all (89%) households selling processed fish sold directly to consumers.

Table 6.3. Marketing of processed fish during 2002-2003.

Type of Buyer	% of Households who Sold Processed Fish			
	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Collected on site	17.7	49.1	5.7	24.7
Middleperson/trader in nearest city	35.3	35.9	5.7	29.2
Direct to consumer	47.1	15.1	88.6	46.1

6.3. Fish Cage Culture Product Marketing

Overall, 28% of households cultured farmed fish (see Section 5.9), and nearly all (26% of all households) sold the products. The majority of sample households who sold farmed fish (cage or pond culture) did so to fish collectors on site (48%) or middlepersons and traders at landing sites (48%), as Table 6.4 shows. The remaining households sold farmed fish to other cage farmers or used the production to pay money lenders. In general, there did not seem to be any constraints for marketing and distribution of domestic fish culture products.

Table 6.4. Distribution of household marketing of fish products from cage/pond culture by village type.

	Fishing		Fishing cum Farming		Farming		All	
	Number of Households	(%)	Number of Households	(%)	Number of Households	(%)	Number of Households	(%)
Fish collector on site	36	25.7	12	8.9	3	2.2	51	12.4
Middle person/ trader at landing site	30	21.4	18	13.3	3	2.2	51	12.4
Money lender	1	0.7	1	0.7	0	0.0	2	0.5
Crocodile farmer	0	0.0	2	1.5	0	0.0	2	0.5
Total	67	47.9	33	24.4	6	4.4	106	25.9

7 Farming Activities

7.1. Agricultural Production

Land is the most important asset in the portfolio of farming and rural households. In the study areas, land was classified into five types; homestead, agricultural, pond, orchard and fallow land. In general, farming households owned more land than households in other village types (Table 7.1).

On average, the area of homestead land owned by sample households was 349 m^2 per household. Households in fishing villages owned the least area of homestead land, at 200 m^2 only. One of the reasons why fishing households own less homestead land is that, in general, fishing households have cage culture under their floating house or near their house on the lake, whereas farming households have ponds in their homestead land areas. The average size of pond owned by the sample households was 84 m^2. This was found to be higher for households in farming villages (142 m^2) and reflects the fact that there is more land in farming villages. Overall, the average area of agricultural land owned was 10,897 m^2 per household, but was greatest in fishing cum farming villages at 16,531 m^2 (1.6 ha).

Table 7.1. Average land area (m^2) owned per household by village type.

Type of Land/ Average Area Owned (m^2)	Fishing (n=140)	Fishing cum Farming (n=135)	Farming (n=135)	All (n=410)
Homestead	200.45	443.30	409.54	349.48
Agricultural	3,687.57	16,530.67	12,754.10	10,897.19
Pond	37.82	74.42	142.06	84.17
Orchard	113.55	24.99	1,402.15	505.54
Fallow land	40.39	411.64	632.33	359.98

Table 7.2 shows the average land allocation of surveyed households by type of crop or vegetable, type of land and irrigation status in the study areas. Generally, most land used for rice and crop cultivation was nonirrigated. However, some land used to grow vegetables, such as cucumber, eggplant and lotus, was irrigated. Generally, most agricultural land in Cambodia is not irrigated.

As shown in Table 7.3, there is a variety of crops and vegetables in the study areas including corn/maize, mung bean, soybean, yard-long bean, lotus, cucumber, chili, sesame, watermelon, eggplant, pumpkin, wax gourd and sweet potato. Most of the sample households were engaged in rice crop

(50%), mung bean (12%), chili (10%) and corn/maize (9%) (Appendix A, Table 15). The average annual production of rice and mung bean (crops grown in highest quantities overall) for sample households was 3,110 kg and 3,123 kg, respectively. This was followed by watermelon (1,396 kg), chili (1,287 kg), eggplant (1,035 kg) and sesame (1005 kg). In terms of total value, mung bean represented the most valuable crop grown, and the average annual production was valued at US$959 per household (for households growing the crop). This was followed by sesame (US$361) and rice (US$298). In terms of value per kilogram, sesame and yard-long bean represented the most valuable crops, being worth US$0.36 per kg.

The results indicated that fishing cum farming villages had higher rice production compared to farming village, which is unlikely. This may be due to the fact that these village types have bigger ricefields compared to farming only village.

The sample households in general use family laborers that include both men and women (Appendix A, Table 16). On the average, there is no significant difference in wage rates between men and women (Appendix A, Table 17).

Table 7.2. Allocation of land for various crops during 2003/2004.

Crop/Vegetables	Average Land Area (m^2)			Percentage* (%)	
	Irrigated	Nonirrigated	All	Irrigated	Nonirrigated
Rice (wet and dry)	2,932	40,134	43,066	6.94	93.06
Corn/maize	278	3,245	3,523	7.90	92.10
Mung bean	2,609	29,200	31,809	8.20	91.80
Soya bean	-	4,778	4,778	0.00	100.00
Yard-long bean	-	45	45	0.00	100.00
Lotus	2,688	8,938	11,625	23.12	76.88
Cucumber	333	711	1,044	31.91	68.09
Chili	2	6,020	6,022	0.03	99.97
Sesame	1,000	26,633	27,633	3.62	96.38
Watermelon	1,084	1,631	2,715	39.92	60.08
Eggplant	-	823	823	0.00	100.00
Pamlein	-	6,100	6,100	0.00	100.00
Wax gourd	-	1,202	1,202	0.00	100.00
Tobacco	-	150	150	0.00	100.00
Sweet potato	-	440	440	0.00	100.00
Cabbage	-	80	80	0.00	100.00

Notes: These data are based on households who reported only.
* Percentage of total land area used for each type of crop/vegetable.

Table 7.3. Average production and values of crops/vegetables by village type in 2003.

Crop and Vegetable	Fishing Village		Fishing cum Farming		Farming		All Villages	
	Products (kg)	Values (US$)	Products (kg)	Values (US$)	Products (kg)	Values (US$)	Products (kg)	Values (US$)
Rice	1,449	118	4,488	349	2,944	314	3,110	298
Corn/maize	104	20	730	105	35	7	335	50
Mung bean	70	14	3,747	1,141	1,474	483	3,123	959
Soybean	-	0	680	211	125	37	284	87
Yard-long bean	-	0	25	9	-	0	25	9
Lotus	-	0	733	199	210	60	406	112
Cucumber	271	44	123	20	20	2	210	34
Chili	1,350	104	1,048	71	1,387	89	1,287	85
Sesame	5	1	1,096	394	-	0	1,005	361
Watermelon	-	0	100	25	1,504	58	1,396	56
Eggplant	-	0	70	9	2,000	25	1,035	17
Pamlein	750	161	850	22	-	0	821	61
Wax gourd	187	7	1,000	25	2,000	75	515	18
Sweet potato	800	56	500	38	-	0	650	47
Cabbage	-	0	-	0	50	13	50	13

7.2. Use of Common Pool Resources

Households depend on a vast number of common pool resources, including firewood, aquatic plants, wild animals, fruits and animal grazing areas. The number of households using each of a range of resources is shown in Table 7.4. It shows that sample households overwhelmingly relied on forest resources of the Great Lake and Bassac River area. Every household collected firewood for household cooking, fish processing and other related activities. More than 50% of the sample households collected self-grown vegetations, such as morning glory, *trouy rang*, water lily, etc., from the Lake, 20-25% households collected lotus/lotus roots and *sundance* leaves. Almost 42% of the sample households derived benefits of water transport either as a passenger or as a provider of transportation services. On the average, more than 30% of the sample households collected nonfish aquatic animals, such as rats, mollusks and snails/crabs, and 22% of the households collected swamp eels any time of the year. In addition, the Lake resources provided animal grazing and duck raising benefits to fewer households. Few households also reported to have recreation benefits from the Lake resources.

The relative importance of each of the common pool resources used by households is shown in Figure 7.1. Households were asked to rate each resource as most important, important, somewhat important or not at all important. Generally, the resources considered most important were those used by the greatest number of households. Overall, firewood, river transportation, morning glory, water lily and *trouy rang* plants and animal grazing land were considered the most important resources.

Table 7.4. Number of households using common pool resources from the Tonle Sap Lake and surrounding area in 2003.

Resources	Number of Households Collected				Percentage of Households Collected			
	Kandal	Kampong Chhnang	Siem Reap	All	Kandal	Kampong Chhnang	Siem Reap	All
Firewood	140	135	134	409	100.00	100.00	99.26	99.76
Morning glory	111	125	112	348	79.29	92.59	82.96	84.88
Trouy rang	93	113	83	289	66.43	83.70	61.48	70.49
Water lily	91	83	93	267	65.00	61.48	68.89	65.12
Phkasnor	94	95	71	260	67.14	70.37	52.59	63.41
Sundance (fruit)	57	61	53	171	40.71	45.19	39.26	41.71
Transportation	58	57	56	171	41.43	42.22	41.48	41.71
Rat	45	45	59	149	32.14	33.33	43.70	36.34
Mollusk	40	45	49	134	28.57	33.33	36.30	32.68
Snails/crabs	41	45	48	134	29.29	33.33	35.56	32.68
Lotus/lotus roots	20	49	40	109	14.29	36.30	29.63	26.59
Swamp eel	46	26	19	91	32.86	19.26	14.07	22.20
Mat-making materials	8	44	30	82	5.71	32.59	22.22	20.00
Sundance (leaves)	17	37	28	82	12.14	27.41	20.74	20.00
Snakes	40	24	8	72	28.57	17.78	5.93	17.56
Kanchhet	9	31	30	70	6.43	22.96	22.22	17.07
Traditional medicine	27	24	16	67	19.29	17.78	11.85	16.34
Animal grazing	1	8	42	51	0.71	5.93	31.11	12.44
Recreation	18	31	2	51	12.86	22.96	1.48	12.44
Toads	19	12	18	49	13.57	8.89	13.33	11.95
Bamboo/canes	14	8	6	28	10	5.93	4.44	6.83
Saomaoprey	7	10	6	23	5	7.41	4.44	5.61
Wild animals/ birds	5	17		22	3.57	12.59	0	5.37
Duck grazing	1	2	11	14	0.71	1.48	8.15	3.41
Turtles	3	3	1	7	2.14	2.22	0.74	1.71

Table 7.5 provides information on average quantity and value of each open access resources derived by the sample households year round. Product values were estimated based on the respondents' assigned price against each resource. It is clear from the table that, on the average, each household collected 1,943 kg of firewood, which had value worth US$29. Among the three types of villages, households of the fishing cum farming villages collected the highest amount of firewood (2,256 kg) followed by households of farming only villages. Although households in fishing only villages collected the least firewood (1,913 kg), the average total value was the highest (US$34) in these villages. This may be due to higher collection cost as they live in distant places from the flooded forests. Our observation during field visits and data collection revealed the alarming fact that not only the households living within the Lake area collected forest resources for subsistence use. Tons of forest resources were extracted by either the residents or nonresidents of the Lake area for commercial purpose that put enormous pressure to forest resources within the Lake area, which contributed to the destruction of fish habitat and environment. In terms of quantity, among other products, mat-making materials (98 kg), morning glory (44 kg), water lily (17 kg), snails/crabs (16 kg) and bamboo/canes (14

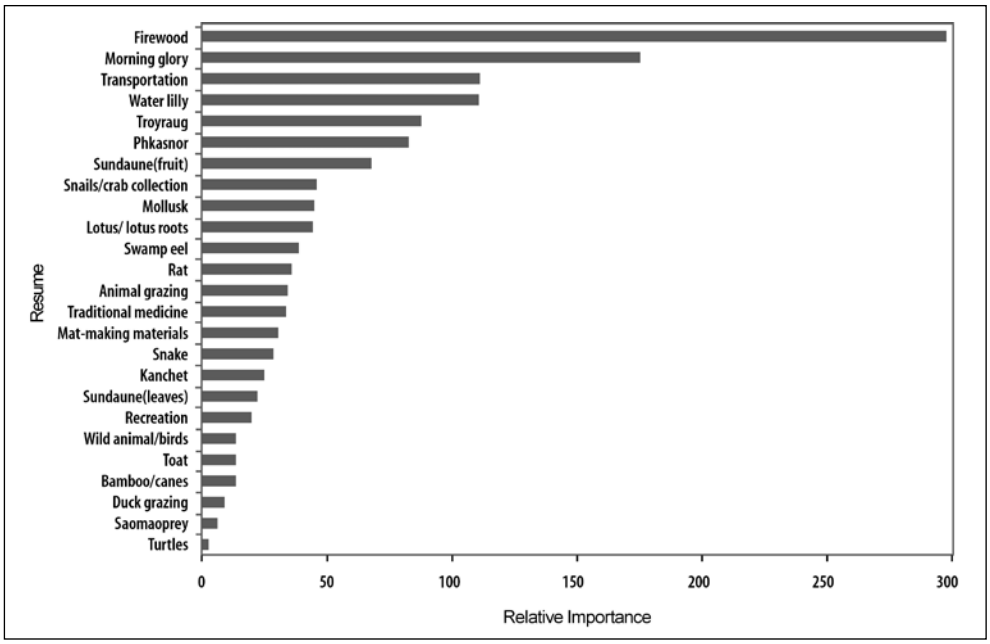

Figure 7.1. Relative importance of open access resources to sample households.

Note: Importance scores were estimated based on the following scale: Most important = 3, important = 2, somewhat important = 1, not important =0.

kg) were important. In total, sample households, on the average, collected 2,355 kg of different products and services that naturally grew in the Lake area that had a total average value of US$132.

Table 7.5. Average collection (kg) and value of open access resources by sample households.

Resources	Fishing Village		Fishing cum Farming Village		Farming Village		All	
	Quantity (kg)	Value (US$)	Quantity (kg)	Value (US$)	Quantity (kg)	Value (US$)	Quantity (kg)	Value (US$)
Animal grazing	10.00	5.00	204.38	33.27	102.62	17.52	116.76	19.74
Bamboo/canes	14.93	10.73	18.13	10.94	10.33	6.50	14.86	9.88
Duck grazing	2.00	3.50	21.22	3.25	18.16	2.65	17.44	2.79
Firewood	1,913.15	33.94	2,256.04	30.07	1,659.99	22.90	1943.31	29.06
Kanchet	5.00	0.67	6.03	0.60	3.03	0.42	4.61	0.53
Lotus/lotus roots	7.55	0.95	8.53	1.38	9.25	1.35	8.61	1.29
Mat-making materials	60.50	7.63	46.61	4.64	183.33	10.56	97.99	7.10
Mollusk	27.19	4.51	10.33	2.37	10.98	1.69	15.60	2.76
Morning glory	53.33	4.02	44.16	4.95	33.50	4.84	43.66	4.61
Phkasnor	5.32	1.13	6.28	1.27	3.97	0.95	5.31	1.13
Rat	11.20	3.47	6.53	2.73	6.00	3.10	7.73	3.10
Recreation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Saomaoprey	4.14	0.30	2.70	0.39	1.58	0.19	2.85	0.31
Snails/crab collection	25.72	3.06	15.38	2.19	8.50	1.06	16.08	2.05
Snake	8.30	5.48	3.71	1.57	3.75	2.19	6.26	3.81
Sundance (fruit)	10.90	2.36	9.00	1.44	5.55	1.05	8.56	1.63
Sundance (leaves)	5.59	0.33	2.74	0.35	2.11	0.26	3.12	0.32
Swamp eel	6.55	51.41	4.88	11.73	3.16	3.43	5.37	30.05
Toad	5.63	3.40	3.00	1.56	3.22	1.32	4.10	2.19
Traditional medicine	4.80	1.15	6.06	2.30	5.19	1.41	5.34	1.62
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trouy rang	4.03	0.72	4.49	0.71	3.57	0.44	4.08	0.64
Turtles	7.33	5.00	3.00	2.83	2.00	5.00	4.71	4.07
Water lily	21.87	1.89	13.34	1.40	14.97	4.01	16.81	2.47
Wild animal/birds	7.00	0.90	0.59	0.44			2.05	0.55
Total	2,222.0	151.6	2,697.1	122.4	2,094.8	92.8	2,355.2	131.7

8 Summary of Results

8.1. Socioeconomic Characteristics of Households

The average household size for the sample villages was 6.4, ranging from 2 to 15 in the overall sample. The average age of the household head was 45 years, ranging from 20 to 77 years. Overall, 76% of household members were over 10 years of age, and therefore able to participate in household and/or income-generating activities. The vast majority (99%) of the sample households were of Khmer origin. Although most households were headed by men, a significant minority (15%) were headed by females.

Overall, the majority of household heads received 1-3 years education (69%), although 13% received no formal schooling. The proportion receiving no education was highest in fishing villages, where 19% of household heads were never been to school. This suggests that there may be fewer educational opportunities in fishing communities compared to farming villages. Of all household members, 35% received 1-3 years education; 24%, 4-5 years; and 16%, 6 years or more. Overall, 25% of all household members received no education (29% of female household members).

The primary occupation of the household head was generally fishing (54% overall, 87% in fishing villages) or farming (39% overall, 85% in farming villages). Secondary occupations consisted of fishing (27%), farming (17%), fish culture (12%), fish processing (12%), laboring (9%) or small business (9%). Similarly, the main primary occupations of all household members were farming (27%), fishing (23%) and studying (26%). Only 8% of household members mentioned housekeeping or daily labor as their primary occupation, suggesting that nearly all members of the household were engaged in income-generating or livelihood activities for most of their time. The occupation of the household head was linked to educational level. Although fishing and farming represented the main occupations for most household heads, all those involved in value-adding (fish culture or processing) and/or business-generating activities received some level of education.

8.2. Housing and Assets

Overall, the value of houses owned in each village type was directly related to the total household income; households with the greatest annual income also owned the most valuable houses in the village. The average house

value was US$2,041, although this varied significantly from US$129 for the poorest households (with annual income less than US$100) to US$2,330 for households with an annual income over US$400. Generally, farming households owned houses of greater value, and a greater amount of land than fishing or fishing cum farming households.

On average, each household owned assets (excluding the house) worth a total of US$1,570, although fishing households owned a higher value of assets than farming households (US$2,806 compared to US$892). This reflects more widespread ownership of motorized boats, generators and cell phones in fishing villages. In contrast, farming and fishing cum farming households owned a greater value of farm equipment and livestock. Almost all households owned some fishing, farming and fish processing equipment.

Ownership of assets is linked directly to household income. Households accumulate assets such as fishing gear, farming equipment, electrical equipment, animals, house and land as investment to increase fishing or farming production, to improve standard of living and food security. Therefore, the value of fishing gear owned is positively related to size of catch, and the value of processing and farming equipment owned is linked to production and income from these occupations.

8.3. Annual Household Income

Overall, the average household income was highest in fishing cum farming villages (US$1,507), followed by fishing villages (US$1,462) and farming villages (US$703). Fishing and related activities (processing, trade, fish culture) were the most important income-generating activities, making up 61% of household income. Overall, farming generated 19% of household income and other activities generated 20%.

Fish farming represented the highest single income-generating activity; an average annual income of US$1,024 for households was involved. The other important sources of household income included fishing (which generated an average annual income of US$609 for households involved), farming (US$438), fish processing (US$203) and government or private employment (US$351). Generally, multiple occupations resulted in the highest overall annual household incomes. Almost half of all households (49%) borrowed money, mainly from friends or relatives. This was highest in fishing villages (69%), where households often borrowed money to purchase new fishing gear.

8.4. Food Consumption

The overall average expenditure on food and consumables (including household production) was US$20.4 per household per week, or US$3.2 per capita. This was highest in fishing households (US$3.6) and least in farming households (US$2.7). Overall, 60% of consumables were bought from the market and 40% were produced by the household. On average, households consumed 35 kg/week of meat, fish and processed fish. This ranged from 49 kg/week in farming households to 28 kg/week in fishing and fishing cum farming villages. Additionally, meat formed a greater portion of this intake in farming households (55%) compared to fishing households (40%).

8.5. Fishing Activities

Overall, 84% of households in the sample villages fished regularly. The majority (62%) fished year round, 14% fished only in the closed season and 8% only in the open season. However, in farming villages, only 29% of households fished year round and 32% fished only occasionally or not at all.

In fishing villages, the vast majority of the sample households (95%) fished for both sale and household consumption. This contrasted with farming villages, where only 40% of households fished for both sale and household consumption and 27% fished for household consumption only. In fishing cum farming villages, 56% of households fished for sale and consumption and 30% fished only for consumption at home.

Overall, 1.15 person-hours per household per day were spent fishing in open season, and 3.54 person-hours per household per day in closed season. This was greatest in fishing households (4.55 in open season and 2.46 in closed season) and least in farming households (2.02 in closed season and 0.23 in open season). In fishing and fishing cum farming households, two people per household were generally involved in fishing, while in farming households this was usually just one person. This reflects the larger gear typically used by fishing households, which requires two people to operate.

During open season, fishing takes place mainly on the Great Lake and its linked rivers. During closed season, a greater number of different fishing grounds within the extended Lake area are used, including flooded forests and ricefields in addition to rivers, streams and the Lake itself. Farming

households tended to fish mainly in ricefields during closed season (as fishing can be conducted while planting or harvesting rice). The main fishing gears used were gillnets, bamboo traps (which are used mainly in closed season when the river is not flooded) and hooked longlines. There was a positive relationship between the value of fishing gear owned and catch amount, reflecting the greater capacity of larger scale gear and investment of full-time fishing households.

8.6. Fish Production and Consumption

Overall, the total annual catch per household was 3,990 kg, the majority of which (3,500 kg) was caught in open season. This ranged from 8,197 kg in fishing villages to 557 kg in farming villages and reflects catches from lot fisheries during open season. The vast majority of the catch (75%) was sold, while the remainder was either used for fish cage/pond culture feed (11%), processed (8%) or consumed at home (6%). A similar amount of fish was consumed at home by households in all village types, although fishing households sold a greater proportion of their overall catches. Overall, 73% of all households sold fresh fish; 35% of all households sold directly to a collector at the fishing site; and 31% sold to a middleperson or trader at a landing site.

A wide variety of fish species were caught in all village types. However, the top 20 species represented 85% of the total catch by volume in closed season, and 72% in open season. Furthermore, the top six species make up 41% of the total catch amount during closed season *(kampleanh sre, real, kampleanh pluk, kampeus, chkok and chpin)* and 50% of the catch during open season *(kampleanh sre, real, kampleanh pluk, kross and khnong veng)*. The average price for fresh fish during closed season in 2003 was US$0.39/kg, although this was highest in farming villages (US$0.46). However, there was significant variation among the prices of different species sold in open and closed seasons. Overall, prices varied from US$0.38kg for *chkok* sold in open season to US$1.25/kg for *andeng tunle* sold during closed season.

8.7. Fish Processing

Overall, 63% of households processed fish, although this ranged from 79% in fishing villages to 38% in farming villages. Typically, fish processing involved 5-8 people, including 3-6 hired laborers, with higher numbers

employed during the peak fishing season. On average, households produced 167 kg/year of processed fish products, ranging from 305 kg/year in fishing villages to 28 kg/year on farming villages. Overall, 85% of processed fish production was sold, and 15% was consumed at home. Overall, 23% of all households (39% of those who processed fish) sold processed fish products. Of those households who sold processed fish, 46% sold direct to consumers, 29% sold to middlepersons or traders in the nearest town and 25% sold to collectors. However, in farming villages (where only 2% of households sold processed fish) nearly all sales (89%) were direct to the consumer. The average price for processed fish was US$0.46/kg, although this varied from US$1.25/kg for fermented fish sold in farming villages to US$0.15/kg for *prahoc* sold in fishing cum farming villages.

8.8. Pond and Cage Aquaculture

Overall, 28% of the sample households farmed fish in cages or ponds, and nearly all (26% of all households) sold some or all of the products. Fish culture practice was highest in fishing villages (48% of households) and lowest in farming villages (7% of households). The average aquaculture production in sample villages was 1,358 kg/year per household, with highest production in fishing villages and lowest in fishing cum farming villages. There were two main marketing channels for domestic aquaculture production; half of all households who sold farmed fish sold to fish collectors and half sold to traders and middlepersons at landing sites.

8.9. Agriculture

On average, households owned 349 m^2 of homestead land (although fishing village households owned only 200 m^2 on average) and 10,897 m^2 of agricultural land (3,688 m^2 in fishing villages). Almost all agricultural land was nonirrigated. A variety of crops were grown including rice, beans, sesame and chili. In terms of quantity, rice and mung bean represented the highest crop volumes (3,110 and 3,123 kg/year, respectively), and mung bean cultivation represented the highest average income generation (US$959/year). However, sesame and yard-long bean represented the most valuable crops grown, both generating US$0.36/kg.

8.10. Use of Other Common Pool Resources

The common pool resources collected and used most commonly by householders were firewood, morning glory, *trouy rang*, water lily and *phkasnor* (aquatic plants) and *Sundance* fruit. These were also considered to be the most important of all resources available to householders, along with use of the river for transportation. On the average, the sample households collected 2,355 kg of common pool resources that had a value of US$132. In terms of value and weight, firewood is a dominant resource to households irrespective of village type.

9 Conclusions

The results of this study show that households in the Tonle Sap area were highly dependent on aquatic and other natural resources for livelihoods and income. Almost all households had diversified livelihood strategies, incorporating fishing, fish processing, farming and other occupations. Aquatic resources in the Tonle Sap area provided a wide range of use values for dependent users. Fish catches were sold for income generation, consumed fresh by the household, processed and preserved for later household consumption (thereby providing food security), and used as input or feed for aquaculture. Likewise, rice and crop farming, as well as collection of common pool resources, such as aquatic plants, animals and firewood, provided income and food for household consumption.

Overall, fishing and related activities generated 61% of household income, and fishing (or fish culture) represented the single most lucrative income-generating activity in all village types. Although this study interviewed a relatively small sample in different village types (fishing, fishing cum farming and farming), certain differences in livelihood strategies, asset ownership and income were noted among the three village types included in the survey. Fishing and fishing cum farming households spent more time and effort, and relied more heavily on fishing and related activities. This was seen to correspond with higher overall incomes and asset ownership than farming households. Education levels for household heads were fairly low in all village types. However, fishing households generally had lower levels of education compared to farming households, and therefore had fewer employment opportunities open to them. This made these households particularly at risk to threats and changes to fishery resources.

Aquaculture was practiced by around a third of sampled households but would seem to present a viable livelihood strategy for the majority of fishing and farming households, as it can be land or river-based. The production can be used for household consumption and/or income generation. Demand for fish was consistently high, and likely to increase rather than decrease in the future. Aquaculture could perhaps help meet this demand. Current aquaculture practice is capture-fisheries dependent, relying on wild fish fry and could not replace fishing as a livelihood option. Aquaculture could serve as a useful source of additional income and may relieve some pressure from inland capture fisheries. However, widespread uptake of aquaculture is limited by capital to buy cages, land for ponds and equipment.

As a caveat, it is again stressed that the economic values of aquatic resources generated by this current study were in gross terms. The limited time and resources at hand when this study was conducted necessitated the current estimation. The gross values therefore should be compared with production costs to get a fuller picture of the net contribution of resources to rural livelihoods. Along this line, future efforts can be geared towards the gathering of input quantity and input price data for purposes of estimating the costs associated to each livelihood activity. The data gathering can be done through another survey or through less expensive methods, such as key informant interviews or other forms of participatory rural appraisal techniques.

10 Bibliography

Ahmed, M., N. Hap, V. Ly and M. Tiongco 1998. Socioeconomic assessment of freshwater capture fisheries of Cambodia. Report on household survey. Mekong River Commission, Phnom Penh, Cambodia. 185 p.

Bann, C. 1997a. An economic analysis of tropical forest land use options, Ratanakiri Province, Cambodia. Res. Rep. Economy and Environment Program for Southeast Asia, Singapore. 73 p.

Bann, C. 1997b. An economic analysis of alternative mangrove management strategies in Koh Kong Province, Cambodia. Res. Rep. Economy and Environment Program for Southeast Asia, Singapore. 58 p.

Barbier, B., M. Acreman and D. Knowler. 1996. Economic valuation of wetlands: A guide to policy makers and planners. Ramsar Convention Bureau, Gland, Switzerland.

CEMARE (Center for the Economics and Management of Aquatic Resources) and SIFAR (Support Unit for International Fisheries and Aquatic Research). 2002. Design of a research programme for the social and economic valuation of the aquatic resources of the lower Mekong Basin. Report prepared for the United Kingdom Department for International Development. 89 p.

De Lopez, T.T., K. Vibol, S. Proeung, P. Dareth, S. Thea, C. Sarena, S. Song, V. Chantha, N. Vandy, L. Bunly and C. Sinoeun. 2001. Policy options for Cambodia's Ream National Park: A stakeholder and economic analysis. Res. Rep. No. 2001-RR5. Economy and Environment Program for Southeast Asia, Singapore. 74 p.

DOF (Department of Fisheries). 1999. Statistics of the Department of Fisheries of the Ministry of Agriculture, Forestry and Fisheries, Cambodia (unpublished).

Hap, N. 1999. Production technology and technical efficiency of freshwater capture fisheries in Phnom Penh, Kampong Cham and Battambang Province, Cambodia. M.S. thesis. 97 p. University of the Philippines at Los Baños, Laguna, Philippines.

Hap, N., S. Thay and V. Hav. 2001. Valuation of flooded forests in Kandal Province. Economy and Environment Program for Southeast Asia, Singapore. 31 p.

IIED (International Institute for Environment and Development). 1997. Valuing the hidden forest: methodological approaches for local-level economic analysis of wild resources. Res. Ser. 3(4). Sustainable Agriculture Programme, IIED, London, UK. 71 p.

McKenney, B. and P. Tola. 2002. Natural resources and rural livelihoods in Cambodia: A baseline assessment. Work. Pap. 23, 116 p. Cambodia Development Resource Institute.

Rainboth, W.J. 1996. Fishes of Cambodian Mekong. FAO species identification field guide for fisheries purposes. Food and Agriculture Organization, Rome, Italy.

Roudy, G. 2002. Natural resource use and livelihood trends in the Tonle Sap floodplain, Cambodia. M.S. thesis in Environmental Technology. Imperial College of Science, Technology and Medicine, University of London, London, UK. 88 p.

Tana, H.E. and T. Seang. 2002. The inland and marine fisheries trade of Cambodia. Oxfam America, Phnom Penh, Cambodia. 145 p.

Torrell, M. and A.M. Salamanca. 2003. Wetlands management in Vietnam's Mekong Delta: An overview of pressures and responses, p. 1-19. *In* M. Torrell, A.M. Salamanca and B.D. Ratner (eds.) Wetlands management in Vietnam: Issues and perspectives. WorldFish Center, Penang, Malaysia.

Appendix A
(Tables)

Table 1. Education of household heads by ethnicity (%).

Education Level	Khmer (n=405)	Chinese (n=1)	Vietnamese (n=3)	Cham (n=1)	All (n=410)
No education	12.84	0.00	33.33	100.00	13.17
Less than 3 years	69.38	100.00	66.67	0.00	69.27
4–5 years	8.89	0.00	0.00	0.00	8.78
6–10 years	8.64	0.00	0.00	0.00	8.54
Above 10 years	0.25	0.00	0.00	0.00	0.24
All	100.00	100.00	100.00	100.00	100.00

Table 2. Education of household heads by income (US$) group.

Education	Number of Households	Percentage Compared to Number of Households by Level of Education				
		<100	100-200	200-300	300-400	400-500
No education	54	3.70	9.26	22.22	14.81	50.00
Below 3 years	284	1.76	8.10	8.10	11.97	70.07
4-5 years	36	0.00	5.56	5.56	8.33	80.56
6-10 years	35	0.00	11.43	5.71	0.00	82.86
Above 10 years	1	0.00	0.00	0.00	0.00	100.00
Total	410	1.71	8.29	9.51	14.81	69.51

Table 3. Secondary occupation of eligible members of sample households by village type.

Type of Occupation	Fishing (n=406)	Fishing and Farming (n=452)	Farming and Fishing (n= 562)	All Villages (n= 1,420)
Fishing	10.10	11.95	18.15	13.87
Fish processing	11.58	14.16	1.25	8.31
Fish trading	3.69	0.66	0.53	1.48
Fish culture	28.57	10.62	1.60	12.18
Net/gearmaking	1.48	2.88	0.18	1.41
Bamboo and cane works	0.99	0.88	0.00	0.56
Farming	10.84	18.58	23.13	18.17
Daily labor	4.19	5.09	9.79	6.69
Housekeeping	2.96	2.88	2.31	2.68
Shop/small business	4.93	4.65	8.54	6.27
Government/private job	0.00	0.88	0.53	0.49
Motor taxi/engine boat driving	0.00	0.00	0.18	0.07
Money lending	0.00	0.00	0.53	0.21
Fuel wood collection	18.23	25.22	26.51	23.73

Livestock raising	0.00	0.88	3.91	1.83
Student	1.23	0.22	1.78	1.13
Others	1.23	0.44	1.07	0.92
Total	100.00	100.00	100.00	100.00

Table 4. Distribution of housing type of sample households.

Type of House	Percent of Households
Small floating house of wood and tin/tile roof	3.46
Medium floating house made of wood and tin/tile roof	6.42
Big floating house made of wood and tin/tile roof	3.46
Small floating house made of can/bamboo and palm leaves	8.89
Medium floating house made of can/bamboo and palm leaves	3.21
Big floating house made of can/bamboo and palm leaves	0.74
Small house made of wood and tin/tile roof	5.43
Medium house made of wood and tin/tile roof	20.99
Big house made of wood and tin/tile roof	23.70
Small house made of can/bamboo and palm leaves	12.59
Medium house made of can/bamboo and palm leaves	8.89
Big house made of can/bamboo and palm leaves	2.22
Total (n=410)	100.00

Table 5. Percentage distribution source of electricity of sample households by income and village type.

Income Groups	Fishing Village			Fishing and Farming Village	
	Own Generator (n=13)	Connected with Electricity (n=15)	Connected with Generator on Rent (n=2)	Own Generator (n=3)	Other's Generator (n=11)
<100	0.00	0.00	0.00	0.00	0.00
100-200	7.69	0.00	0.00	0.00	0.00
200-300	0.00	0.00	0.00	0.00	0.00
300-400	7.69	20.00	0.00	0.00	9.09
400+	84.62	80.00	100.00	100.00	90.91
All	100.00	100.00	100.00	100.00	100.00

Table 6. Sources of energy for cooking by village type.

Source of Energy	Village Type					
	Fishing (n=140)		Fishing and Farming (n=135)		Farming and Fishing (n=135)	
	No. of hh	(%)	No. of hh	(%)	No. of hh	(%)
Forest wood	138	97.87	135	100.00	129	96.27
Biogas burner	3	2.13	2	1.48	1	0.75
Charcoal	1	0.71	0	0.00	2	1.49
Others	1	0.71	0	0.00	0	0.00
Total cases	143	102.14	137	101.48	132	97.77

hh – household.

Table 7. Sources of drinking, cooking and bathing water of sample households by province.

Village Type	Source of Water (%)				
	River and Lake	Bottled Water	Tube Well	Pond	Rain
Drinking	*(n=238)*	*(n=6)*	*(n=108)*	*(n=40)*	*(n=15)*
Kampong Chhnang	46.64	0.00	22.22	0.00	0.00
Kandal	23.95	16.67	54.63	50.00	20.00
Siem Reap	29.41	83.33	23.15	50.00	80.00
Total (n=410)	100.00	100.00	100.00	100.00	100.00
Cooking	*(n=265)*	*(n=0)*	*(n=85)*	*(n=49)*	*(n=10)*
Kampong Chhnang	43.77	0.00	22.35	0.00	0.00
Kandal	25.28	0.00	60.00	34.69	50.00
Siem Reap	30.94	0.00	17.65	65.31	50.00
Total (n=410)	100.00	0.00	100.00	100.00	100.00
Bathing	*(n=285)*	*(n=0)*	*(n=85)*	*(n=39)*	*(n=0)*
Kampong Chhnang	41.40	0.00	20.00	0.00	0.00
Kandal	27.72	0.00	64.71	15.38	0.00
Siem Reap	30.88	0.00	15.29	84.62	0.00
Total (n=410)	100.00	0	100.00	100.00	0.00

Table 8. Percentage of households having access to drinking water by type of water and income group.

Income Group	River/Lake	Bottled Water	Tube Well	Pond	Rain	All
<100 (n=25)	68.00	0.00	12.00	8.00	12.00	100.00
100-200 (n=50)	34.00	2.00	36.00	12.00	16.00	100.00
200-300 (n=55)	45.45	3.64	25.45	5.45	20.00	100.00
300-400 (n=59)	38.98	0.00	27.12	11.86	22.03	100.00
400+ (n=385)	40.78	1.56	22.86	11.95	22.86	100.00

Table 9. Average value of household assets and house by province in US$.

Asset Type	Kampong Chhnang	Kandal	Siem Reap	All Provinces
House	1,371.67	1,917.95	2,433.14	1,907.71
Electronic appliances	60.34	44.67	116.29	73.41
Transport equipment	444.25	1,983.47	882.17	1,114.03
Furniture and fixtures	29.20	51.99	20.77	34.21
Generator	14.26	11.89	72.71	32.70
Tube wells	4.81	10.66	0.28	5.31
Livestock	42.40	196.27	118.98	120.16
Cell phone	7.72	10.61	74.47	30.74
Poultry	2.98	5.09	2.19	3.43
Modern farm equipment	56.14	53.86	210.70	106.25
Traditional farm equipment	15.61	24.34	39.84	26.57
All assets without house	677.71	2,392.85	1,538.40	1,546.81
All assets	2,049.38	4,310.80	3,971.54	3,454.52

Table 10. Primary, secondary and tertiary gear used by households (%) during last week, closed season, from the date of survey, by village type (August 2003).

Gear Type	Fishing Village (n=140)	Fishing cum Farming Village (n=135)	Farming Village (n=135)	All Villages (n=410)
Primary gear				
Gillnet	63.57	58.52	56.30	59.51
Castnet	0.00	0.00	2.22	0.73
Bamboo fence trap	5.00	14.07	4.44	7.80
Seine net	0.71	0.00	0.00	0.24
Hook longline	4.29	2.96	2.22	3.17
Bagnet	0.00	0.74	0.00	0.24
Bamboo fence trap	0.71	1.48	1.48	1.22
Net	0.71	0.74	0.00	0.49
Folded woven trap	11.43	2.96	0.74	5.12
Bamboo pieced eel trap	7.14	0.74	0.00	2.68
Single hooked line	0.00	0.00	0.74	0.24
Secondary gear				
Gillnet	5.00	0.74	0.74	2.20
Castnet	0.71	1.48	1.48	1.22
Bamboo fence trap	5.71	7.41	2.22	5.12
Seine net	1.43	2.96	0.00	1.46
Hook longline	6.43	3.70	10.37	6.83
Bamboo fence trap	0.71	1.48	0.74	0.98
Net	0.00	3.70	1.48	1.71

Folded woven trap	7.14	1.48	0.74	3.17
Bamboo pieced eel trap	2.14	0.00	0.00	0.73
Small vertical slit trap	2.86	0.00	2.22	1.71
Tertiary gear				
Bamboo fence trap	0.00	0.74	0.00	0.24
Hook longline	0.71	0.74	0.00	0.49
Net	0.00	0.74	0.74	0.49
Folded woven trap	5.00	1.48	0.00	2.20
Bamboo pieced eel trap	1.43	0.00	0.00	0.49

Table 11. Top 20 species by sum of volume and average price in Kampong Chnang province during the week before the date of interview (August 2003).

Top 20 by Volume			Top 20 by price		
Species	**Sum of Caught (kg)**	**Price (US$)**	**Species**	**Sum of Caught (kg)**	**Price (US$)**
Chlang	558	0.423	*Kropoat*	154	0.813
Kampleanh pluck	512	0.084	*Chpin*	14	0.813
Real	481	0.081	*Prolung*	19	0.656
Chrakeng	447	0.382	*Kambot chromoss*	1	0.625
Kanh choss	371	0.119	*Kromorm*	64	0.600
Kross	307	0.080	*Kray*	2	0.500
Kampeus	245	0.430	*Bey kamnath, khlar*	4	0.450
Chkauk	232	0.407	*Kampleav*	3	0.438
Kropoat	154	0.813	*Krum*	115	0.437
Krum	115	0.437	*Kampeus*	245	0.430
Chpin	113	0.347	*Chlang*	558	0.423
Kranh sre	92	0.149	*Chkauk*	232	0.407
Kantrop	90	0.122	*Slat*	35	0.396
Linh	89	0.046	*Ross, phatouk*	33	0.388
Chkok tituy	79	0.344	*Chakeng*	447	0.382
Kampleanh sre	77	0.079	*Pream*	7	0.375
Sroka kdam	74	0.075	*626*	2	0.375
Kromorm	64	0.600	*Kess*	1	0.375
Kanh choss chnot	55	0.175	*Kamport*	18	0.350
Damrey	46	0.328	*Chpin*	113	0.347
Top 20 species[1]	4,201	0.276	Top 20 species[1]	2,067	0.479
Other species[2]	513	0.217	Other species[2]	2,647	0.118
All species[3]	4,714	0.216	All species[3]	4,714	0.216

Notes:
[1] Top 20 species: This raw is total caught by top 20 species and average price.
[2] Other species: Total caught of other species excluding top 20 species and average price.
[3] All species: Total caught in all species and average price.

Table 12. Top 20 species by sum of volume and average price in Kandal province during the week before the date of interview (August 2003).

Top 20 by Volumes			Top 20 by Price		
Species	**Sum of Caught (kg)**	**Price (US$)**	**Species**	**Sum of Caught (kg)**	**Price (US$)**
Kampleanh sre	2,240	0.202	*Antung*	448	1.105
Kantrop	767	0.278	*Khacheung*	30	0.625
Chpin	613	0.410	*Damrey*	4	0.608
Krai	532	0.226	*Trasok*	104	0.575
Real	494	0.164	*Antung*	73	0.542
Kampleanh pluck	486	0.214	*Kanchorn chey*	1	0.500
Chakeng	454	0.415	*Chlang*	61	0.500
Antung	448	1.105	*Kropoat*	6	0.433
Kanhchoss krabey	433	0.178	*Ross, phatouk*	257	0.428
Kanh choss chnot	395	0.212	*Chakeng*	454	0.415
Slat	343	0.362	*Chpin*	613	0.410
Kross	329	0.290	*Kampeus*	155	0.394
Sroka kdam	290	0.113	*Kanhchoss*	34	0.379
Angkot prak	288	0.125	*Slat*	343	0.362
Andeng tun	270	0.138	*Chakeng*	100	0.354
Ross, phatouk	257	0.428	*Kanhchoss thmor*	25	0.322
Kanthor	234	0.307	*Kross*	23	0.313
Andeng reung	200	0.100	*Kanthor*	234	0.307
Khayong beung	185	0.092	*Kross*	329	0.290
Kaek	172	0.278	*Kantrop*	767	0.278
Top 20 species[1]	9,430	0.282	Top 20 species[1]	4,061	0.457
Other species[2]	1,331	0.230	Other species[2]	6,700	0.144
All species[3]	10,761	0.316	All species[3]	10,761	0.316

Notes:
[1] Top 20: This raw is total caught by top 20 species and average price.
[2] Other species: Total caught of other species excluding top 20 species and average price.
[3] All species: Total caught in all species and average price.

Table 13. Top 20 species by sum of volume and average price in Siem Reap province during the week before the date of interview (August 2003).

Top 20 by Volume			Top 20 by price		
Species	**Sum of Caught (kg)**	**Price (US$)**	**Species**	**Sum of Caught (kg)**	**Price (US$)**
Pous prolit	1,750	0.075	*Chlang*	21	4.058
Chkauk	977	0.460	*Andeng tunle*	3	1.250
Kampleanh sre	827	0.056	*Real, real top*	14	1.000
Kampeus	710	0.368	*Ross*	1	1.000
Andeng tun	536	0.365	*Promar*	34	0.831
Real	450	0.586	*Kanh choss thmor*	4	0.750
Angkot prak	428	0.153	*Chlang*	142	0.700
Ta oan	412	0.292	*Proul*	119	0.693
Kampleanh pluck	313	0.171	*Krolang*	60	0.625
Chpin	234	0.413	*Andat chker*	5	0.625
Kanh choss kdaung	222	0.420	*Kanh chruk loeurng*	3	0.625
Changvar prolung	210	0.463	*Real*	450	0.586
Kross	173	0.240	*Pra*	3	0.575
Kantrong preng	159	0.470	*Ross, phtouk*	17	0.535
Chlang	142	0.700	*Chpin, chpin prak*	22	0.500
Chakeng	123	0.468	*Linh*	6	0.500
Proul	119	0.693	*Kamboth chromoss*	3	0.500
Kranh sre	103	0.329	*Kanh choss chnot*	1	0.500
Krolang	60	0.625	*Kantrong preng*	159	0.470
Andat chker	59	0.454	*Chakeng*	123	0.468
Top 20 species[1]	8,007	0.390	Top 20 species[1]	1,190	0.840
Other species[2]	549	0.462	Other species[2]	7,366	0.237
All species[3]	8,556	0.404	All species[3]	8,556	0.404

Notes:
[1] Top 20: This raw is total caught by top 20 species and average price.
[2] Others: Total caught of other species excluding top 20 species and average price.
[3] All species: Total caught in all species and average price.

Table 14. Percentage distribution of sample households for fish processing place.

Province		At Home		At River Site		Others	
	Total	Number	(%)	Number	(%)	Number	(%)
Kampong Chnang (n=135)	87	65	74.71	28	37.48	1	2.67
Kandal (n=140)	112	110	98.21	2	2.04	-	0.00
Siem Reap (n=135)	70	63	90.00	9	10.00	-	0.00
Total (n=410)	269	238	88.48	39	44.08	1	2.27

Table 15. Number of households involved in farming activities by type of crops and village type.

Crops/Vegetables	Fishing	Fishing cum Farming	Farming	All
Rice	23	43	127	193
Corn/maize	7	14	13	34
Mung bean	1	34	11	46
Soya bean		4	10	14
Yard-long bean		1		1
Lotus		3	5	8
Cucumber	6	2	1	9
Chili	2	11	25	38
Sesame	1	11		12
Watermelon		1	12	13
Eggplant		1	1	2
Pamlein	2	5		7
Wax gourd	6	1	1	8
Sweet potato	1	1		2

Table 16. Type of labor utilization by crop and by gender.

Crop/Vegetable	Male			Female		
	Self	Exchange	Hired	Self	Exchange	Hired
Rice (wet and dry)	2	0	4	2	0	51
Corn/maize	2	0	0	2	0	0
Mung bean	2	0	2	2	0	6
Soya bean	2	0	0	2	0	1
Lotus	2	0	0	2	0	13
Cucumber	1	0	0	2	0	0
Chili	2	0	0	2	0	1
Sesame	2	0	6	1	0	13
Watermelon	2	2	0	2	0	0
Eggplant	2	0	0	2	0	0
Pamlein	1	0	0	1	0	0
Wax gourd	1	0	0	2	0	0
Tobacco	1	0	0	3	0	0
Sweet potato	1	0	0	2	0	0

Table 17. Average daily wage of labor by type of crop/vegetable and sex.

Crop/Vegetable	Wage Rate (US$)	
	Male	Female
Rice	0.75	0.74
Corn/maize	0.67	0.67
Mung bean	0.82	0.76
Soya bean	0.63	0.65
Lotus	0.75	1.00
Chili	0.69	0.64
Sesame	0.85	0.80
Pamlein	0.75	0.69
Grand total	0.76	0.74

Appendix B1:
Guide Questions for the Village General Information

Questionnaire for the Village General Information
Socioeconomic Component of ADB IFReDI/TA
Project of The WorldFish Center

1 - General Information

Chief of village: .....
Village name: ..... Commune: .....
District name: ..... Province: .....

2 - Situation of Village

- Total households: .....
- Total population: ..... Male: ..... Female: .....
- Poor families: .....
- Medium families : .....
- Rich families: .....
- Total female-headed household .....
- Principal occupation .....
- Landless: .....

3 - Infrastructure

- Number of school/s:
  + Primary school : .....
  + Secondary school : .....
- Number of market/s : .....
- Number of hospital/s : .....
- Number of pagoda/s : .....
- Road condition : .....
- Means of transportation : .....

- Number of well water : Well water ..... Tube well water .....
  How far (km) from village to district? .....
  How far (km) from village to province? .....

Appendix B2:
Questionnaire for First Round Data Collection

Economic Valuation of Aquatic Resources of Tonle Sap Basin

ADB-IFReDI TA, Implemented by the WorldFish Center

(August 2003)

I Location and Address:

Name of the household head: .....

Village: ..... Commune: .....

District:.....

Province (Kampong Chhnang 1, Siem Reap 2, Kandal 3): ..... ☐

Village type (fishing 1, fishing and farming 2, farming and fishing 3): ..... ☐

II Profile of the head of the household:

1 Age: ..... ☐

2 Sex (male 1, female 2): ..... ☐

3 Ethnicity (Khmer 1, Chinese 2, Vietnamese 3, Cham 4, others 5): ..... ☐

4 Education (0, below 3 years, 4-5 years, 6-10 years, above 10 years): ..... ☐

5 Religion (Buddhist 1, Muslim 2, Christian 3, others 4): ..... ☐

6 Principal occupation: ..... ☐

7 Secondary occupation: ..... ☐

Code: fishing 1, fish processing 2, fish trading 3, fish culture 4, net/gear making 5, farming 6, laborer 7, small business 8, money lending 9, fuel wood collection 10, motor taxi/car/engine boat driving 11, government/ngo job 12, housekeeping 13, teaching 14, others 15

8 Household income (Riel) from the sources below during September 2002 to August 2003

Fishing: .....

Fish processing: .....

Fish trading: .....

Fish culture: .....
Net/gear making: .....
Bamboo and cane works: .....
Farming: .....
Daily labor: .....
Housekeeping: .....
Shop/small business:.....
Government/private job: .....
Motor taxi/engine boat driving: .....
Money lending: .....
Fuel wood collection: .....
Livestock raising: .....
Crocodile culture: .....
Others (specify): .....

Note: For fishing-related information, collect information by closed and open season and then add up.

III Profile of the members of the household including household head

9 Total number of members in the household: Male: ☐ Female: ☐

10 Age distribution of the members (years):

Below 5	Male: ☐ Female: ☐
6 to 10	Male: ☐ Female: ☐
11 to 15	Male: ☐ Female: ☐
16 to 30	Male: ☐ Female: ☐
31 to 45	Male: ☐ Female: ☐
46 to 60	Male: ☐ Female: ☐
Above 60	Male: ☐ Female: ☐

11 Level of education of the eligible members of the households in years:

0	Male: ☐ Female: ☐
1 to 3	Male: ☐ Female: ☐
4 to 5	Male: ☐ Female: ☐
6 to 10	Male: ☐ Female: ☐
Above 10	Male: ☐ Female: ☐

12 Number of members in the household eligible to work:
Male: ☐ Female: ☐

13 Occupation of the eligible(from 10 years) members of the household:

	P S		P S
Fishing	Male: ☐☐	Female:	☐☐
Fish processing	Male: ☐☐	Female:	☐☐
Fish trading	Male: ☐☐	Female:	☐☐
Fish culture	Male: ☐☐	Female:	☐☐
Net/gear making	Male: ☐☐	Female:	☐☐
Bamboo and cane works	Male: ☐☐	Female:	☐☐
Farming	Male: ☐☐	Female:	☐☐
Daily labor	Male: ☐☐	Female:	☐☐
Housekeeping	Male: ☐☐	Female:	☐☐
Shop/small business	Male: ☐☐	Female:	☐☐
Government/private job	Male: ☐☐	Female:	☐☐
Motor taxi/engine boat driving	Male: ☐☐	Female:	☐☐
Money lending	Male: ☐☐	Female:	☐☐
Fuel wood collection	Male: ☐☐	Female:	☐☐
Student	Male: ☐☐	Female:	☐☐

IV Environment, Sanitation and Energy Sources ☐

14 Type or status of latrine/toilet

Open latrine above water/land 1
No latrine/toilet 2
Sanitary latrine 3
Others (specify) 4

15 Sources and nature of drinking water ☐

River/lake water 1
Bottled water 2
Tubewell water 3
Pond water 4
Others (specify) 5

16 If river/lake/pond, do you purify or boil the water (yes 1, no 2) ☐

17 Sources of cooking and washing water ☐

River/lake water 1
Pond water 2
Tubewell water 3
Others (specify) 4

18 Sources of bathing and cleaning water ☐
River/lake water 1
Pond water 2
Tubewell water 3
Others (specify) 4

19 Sources of medical care: ☐
Village quack 1
Medical clinic (public) 2
Medical clinic (private) 3
Traditional herbs 4
Others 5

20 How far (km) is the nearest hospital from your house? (km) _____

21 Is your village connected with electricity grid? (yes 1, no 2) ☐

22 Do you have electricity in your home? (yes 1, no 2) ☐

23 If yes, sources of electricity:_____ ☐
Own generator 1
Connected with electricity grid 2
Connected with private generator 3

24 If no, what are the sources of household energy needs?_____
For lighting:
Kerosene lamp 1
Candle 2
Battery 3
Others (specify) 4
For cooking and fish processing: ☐
Forest wood 1
Biogas burner 2
Charcoal 4
Others (specify) 5

25 If firewood, from where do you collect firewood and how much (kg)?
Flooded forest:_____ ☐
Mountain forest:_____ ☐
Homestead forest:_____ ☐
Others (specify):_____ ☐

V Household asset and land ownership

26 Land ownership status

Land Type	Area in m^2
Homestead	
Agricultural land	
Pond land	
Orchard land	
Fallow land	

27 Housing type. ☐
Floating:
Small floating house made of wood and tin/tile roof 1
Medium floating house made of wood and tin/tile roof 2
Big floating house made of wood and tin/tile roof 3
Small floating house made of cane/bamboo and palm leaves 4
Medium floating house made of cane/bamboo and palm leaves. 5
Big floating house made of cane/bamboo and palm leaves 6
On land:
Small house made of wood and tin/tile roof 7
Medium house made of wood and tin/tile roof 8
Big house made of wood and tin/tile roof 9
Small house made of cane/bamboo and palm leaves 10
Medium house made of cane/bamboo and palm leaves 11
Big house made of cane/bamboo and palm leaves 12

28 Present value of the house (in riel):_____

29 Present value of household assets:
Electronic appliances:_____
Transport equipment (boat, bicycle, motorbike, motor boat):_____
Furniture/fixtures:_____
Electricity generator:_____
Battery:_____
Tubewell:_____
Hand phone/radio transmission:_____

30 Fisheries and fishing-related assets and present value (Riel)

Fishing Equipment	Number	Present Value (Riel)
Harpoon		
Bamboo trap		
Castnet		
Liftnet		
Gillnet		
Seine net		
Hook longline		
Bamboo fence		
Bagnet (nonmotorized)		
Funnel trap		
Others (specify)		

31 Present value of assets related to fish processing

Processing Equipment	Number	Present Value (Riel)
Barrel		
Cube		
Smoke griller		
Jar		
Others (specify)		

32 a. Present value of farm equipment
Traditional:_____
Modern:_____

b. Value of livestock and poultry

VI Fishing and related activities

33 How many people in your household do fishing?
Male: ☐ Female: ☐

34 What time of the year do you fish? ☐
(closed season 1, open season 2, all season 3, occassional 4)

35 Why do you fish? (for sale 1, consumption only 2) ☐

36 Did you fish last week?(yes 1, no 2) ☐

37 If yes, how many days?_____

38 How many hours per day?_____

39 How many persons?_____

40 How much fish (in kg) did you catch, consume and sell during last week? (Use Species Code List.)

Species	Quantity (kg)					Price/ kg	Buyer*
	Caught	Sold	Consumed	Processed	Fish feed**		

*Buyer: fish collector on site 1, middleperson/trader at the landing site 2, fish processor 3, cage farmer 4, animal/crocodile farmer 5

**Include animal feed also

41 Where did you catch fish? ☐
(ricefield 1, Great Lake 2, river 3, canal 4, flooded forest 5, fishing lot 6, pond 7)

42 What type of fishing gear did you use for fishing?:_____ ☐
(gillnet 1, castnet 2, bamboo fenced trap 3, seine net 4, longline 5, scoopnet 6, bagnet 7, bamboo fenced trap 8, net 9)

43 What type of boat did you use for fishing and at what cost?

Type of Boat	Number of Boats	Owned	Renting Cost	Fuel Cost (Riel)
Motorized				
Non-motorized				
Others (specify)				

44 How much fish (in kg) could you catch, consume and sell during open season in 2002?
Caught (kg):_____
Consumed (kg):_____
Sold (kg):_____
Processed (kg):_____
Used as fish feed (kg):_____

45 How much fish (in kg) could you catch, consume and sell during closed season in 2003?
Caught (kg):_____
Consumed (kg):_____
Sold (kg):_____
Processed (kg):_____
Used as fish feed (kg):_____

46 Where did you sell fish during the last open and closed seasons? ☐
To fish collector on site 1
To middleperson/trader at the landing site 2
To fish processor 3
To cage farmer 4
To animal/crocodile farmer 5
Others (specify) 6

47 What species did you catch? (Use Species Code List)

Open Season 2002		Close Season 2003	
Species	**Rank by Quantity Caught**	**Species**	**Rank by Quantity Caught**

48 How do you market your fish? (yes 1, no 2)
Carry to the market to sell directly to the consumers ☐
Carry to the landing site and sell to wholesaler ☐
Middlepersons collect from fishing ground ☐
Wholesale buyer from whom you borrowed money ☐
Others (specify) ☐

49 Did you borrow money during this year? (yes 1, no 2) ☐

50 If the answer is "yes", from whom did you borrow money? (yes 1, no 2)
Friends and relatives……………………………..……………..1
Financial institutions…………………………………………..2
Local money lender……………………………………………3
Fish trader/wholesaler…..……………………….....…………..4
Others (specify) ……….......…………………………………...… 5

51 Are you obliged to sell fish to your trader/money lender? (yes 1, no 2) ☐

52 If yes, do you get market price for your fish? (yes 1, no 2) ☐

53 If no, how much less per kg?_____ ☐

VII Fish Processing Activities

54 Do you process fish? (yes 1, no 2) ☐

55 If yes, purpose of processing: (yes 1, no 2)
Self-consumption ☐
For sale ☐

56 What fish products did you process during September 2002 - August 2003?

Products	Quantity (kg)	Sold (kg)	Consumption (kg)	Price/ kg
Salted dried fish				
Dried fish				
Smoked fish				
Fermented fish				
Fish fillet				
Prahoc				
Semi-final *prahoc*				
Fisah sauce				
Fish ball				
Others (specify)				

57 Where do you process fish? ☐
Within house……...……..1
River bank……...2
Other (specify)……...……...3

58 What kind of raw materials did you use for processing?

Raw Materials	Quantity (kg)	Price/kg
Fish		
Salt		
Sugar		
Firewood		
Charcoal		
Fuel		
Sun-dried materials (m^2)		
Others (specify)		

59 Labor Utilization

Sex	Peak Season		Wage Rate	Nonpeak Season		Wage Rate
	Self	Hired		Self	Hired	
Male						
Female						

60 How much processed fish did you sell during September 2002 - August, 2003

Type of Processed Fish	Amount Sold (kg)	Price/kg	Buyer**	Amount Consumed
Salted dry				
Dried fish				
Smoked				
Fermented				
Prahoc				
Fish sauce				
Others				

*Buyer: collector on site 1, middleperson/trader in the nearest city 2, sell directly to the consumer 3 animal/crocodile farmer 4

VIII Fish Cage/Pond Culture

61 Do you culture fish in cage or pond? (yes 1, no 2) ☐

62 If yes, in how many cages/ponds:_____ ☐

63 Total area of cages/ponds (m^2):_____ ☐

64 Present value of the cage/pond (riel):_____ ☐

65 Type of species and number of fingerlings:

Species	Number	Size (cm)	Source	Cost per Fingerling (Riel)
Giant snakehead				
Pangusius				

66 Operating cost per day:
Labor (hours):
-maintenance:_____
-fish collection:_____
Fish bought (kg):_____
Fish caught (kg):_____
Other costs:_____

67 Rearing period (months):_____

68 Total production (kg) and selling price:

Species	Consumption	Production	Sold	Price/kg	Buyer*
Giant snakehead					
Pangusius					

*Buyer: fish collector on site 1, middleperson/trader at the landing site 2, fish processor 3, money lender/collector 4, animal/crocodile farmer 5

IX Farming Activities

69 Farm production during September 2003 - August 2003

Crops and Vegetables	Production (in kg)	Total Value (Riel)

70 Labor utilization in farming activities during 2002 -2003

Crops / Vegetables	Male			Female			Wage Rate	
	Self	Exchange	Hired	Self	Exchange	Hired	Male	Female

71 Input cost (Riel) of farming activities during 2002 - 2003.

Crops/ Vegetables	Inputs Cost				
	Irrigation	Chemical Fertilizers	Cow Dung	Seeds	

72 How much land (in m^2) did you cultivate during 2002-2003?

Crops /Vegetables	Land Cultivated	
	Irrigated	Nonirrigated

X Dependence of Households on Resources within Lake and Flooded Forest

73 What resources do you collect from the Lake and flooded forest and how do you value them in your daily life?

Resources	Yes/ No	Quantity (kg)		Value	How Important*
		Sold	Consumed		
Firewood					
Bamboo/canes					
Mat-making materials					
Wild animals/birds					
Transportation					
Animal grazing					
Duck grazing					
Fruits collection					
Sundance (fruit)					
Sundance (leaves)					
Phkasnor					
Water lily					
Lotus/lotus roots					
Trouy rang					
Kanchet					
Saomaoprey					
Morning glory					
Snails/crab collection					
Mollusk					
Rat					
Toad					
Turtles					
Tortoises					
Swamp eel					
Snake					
Traditional medicine					
Recreation					

* Very important 4, important 3, somewhat important 2, not important 1

XI Household Consumption during Last 7 Days

74 How much of the following items did your household consume during last week?

Consumable Items	Quantity (kg)		Price/kg
	Self	Market	
Rice			
Corn			
Noodles			
Vegetables			
Fish			
Chicken			
Meat			
Bread			
Salted dried fish			
Prahoc			
Fermented			
Smoked fish			
Fish egg			
Fish sauce			
Fish ball			

Interviewed by:_____ Verified by:_____
Date:_____ Date:_____

Appendix B3:
Questionnaire for Second Round Data Collection

Economic Valuation of Aquatic Resources of Tonle Sap Basin
ADB-IFReDI TA, Implemented by the WorldFish Center
(January 2004)

I Location and Address:

Name of household head: .....

Village: ..... Commune: .....

District:.....

Province (Kampong Chhnang 1, Siem Reap 2, Kandal 3): .....

Village type (fishing 1, fishing and farming 2, farming and fishing 3): .....

II Fishing and related activities

1 How many people in your household do fishing this week?
Male:☐Female:☐

2 Did you fish last week?(yes 1, no 2)

3 If yes, how many days?_____

4 How many hours per day?_____

5 How many persons?_____

6 How much fish (in kg) did you catch, consume and sell during last week? (Use Species Code List.)

Species	Quantity (kg)					Price/ kg	Buyer*
	Caught	Sold	Consumed	Processed	Fish Feed**		

*Buyer: fish collector on site 1, middleperson/trader at the landing site 2, fish processor 3, cage farmers 4, animal/crocodile farmer 5

**include animal feed also

7 Where did you catch fish?
(rice field 1, Great Lake 2, river 3, canal 4, flooded forest 5, fishing lot 6, pond 7)

8 What type of fishing gear did you use for fishing?:_____
(Gillnet 1, castnet 2, bamboo fenced trap 3, seine net 4, longline 5, scoop net 6 , bagnet 7, bamboo fenced trap 8, seine net 9, folded woven trap 10, bamboo piced-eel trap 11, big vertical slip trap 13, big cylindrical drum trap 14)

9 What type of boat did you use for fishing at what cost?

Type of Boat	Number of Boats	Owned	Renting Cost	Fuel Cost (Riel)
Motorized				
Non-motorized				
Others (specify)				

10 How do you sell fish during this season?

To fish collector on site……..... = 1 ☐
To middleperson/trader at the landing site..…… …….. = 2 ☐
To fish processor.…...…….. = 3 ☐
To cage farmer..…….. = 4 ☐
To animal/crocodile farmer....……..... = 5 ☐
Others (specify)..…… …….. = 6 ☐

11 What species do you catch most this season? (Use Species Code List)

Species	Rank by Quantity Caught	Species	Rank by Quantity Caught

12 Did you catch as many fish as you could during last year (open season)? yes 1, no 2

13 If yes, how much less per week, in kg, as compared to last year (open season):_____

III Household Consumption during Last 7 Days

14 How much of the following items did your household consume last week?

Consumable Items	Quantity (kg)		Price per Unit (Riels/kg)
	Self	Market	
Rice			
Corn			
Noodles			
Vegetables			
Fish			
Chicken			
Meat			
Bread			
Salted dried fish			
Prahoc			
Fermented			
Smoked fish			
Fish egg			
Fish sauce (l)			
Fish ball			
Egg (no.)			

IV Ask the Following Questions to Households who have Cage Culture

15 Labor used per week (hours):

Maintenance (hours/week):……..
Catch fish feed (hours/week):……..……

16 Operating expenses:

Fish feed catch (kg/week):…….....……
Fish feed bought (kg/week):…….....
Price of fish feed (Riels/kg):…….....…..
Other expenses (Riels/week):…….....

Interviewed by:_____ Verified by:_____
Date:_____ Date:_____