

**Geographic Analysis of Poverty Status and Aquatic  
Resources Use - focusing especially on the Livelihoods of the  
Poor- in Cambodia**

Consultancy Report

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# **Geographic Analysis of Poverty Status and Aquatic Resources Use - focusing especially on the Livelihoods of the Poor- in Cambodia**

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(31 October 2000)*

## **1. Introduction**

Cambodia has a land area of 181,035 km<sup>2</sup>, about 20% of which is used for agriculture. The country's capital city is Phnom Penh. International borders are shared with Thailand, Lao and Vietnam. A central plain drained by the Great Lake and the Mekong and Bassac River systems. In comparison with its neighbors, Cambodia is a geographically compact country administratively divided in 24 provinces/municipalities, three of which have relatively short maritime boundaries. The Census of Population 1998 enumerated the total population of the country as 11.4 million inclusive of the institutional population. The population of the rural sector is about 82% of the total population.

In rural Cambodia, given the vagaries of agricultural production (47-50% of GDP: MAFF, 1998), wide fluctuations in income and the high incidents of shocks (illness, accidents, etc.) and the paucity of reserves i.e. savings and food stocks, especially for poor households, common property resources, especially aquatic resources are of pivotal importance in ensuring food security. Fish provides 70-80% of all animal protein intake (Thouk et al., 2000), foraging for fish, crabs, shrimps, snails, frogs and green vegetables from rice fields is carried out by 87% of households (UNICEF, 1994), every year a huge migration takes place within Cambodia to the Tonle Sap to trade rice for Trey Riel (*Henicorhynchus sp.* – a small cyprinid) and other small fish species to make PRAHOC (fish paste), a key component of seasonal food security for poor rice farmers. Fishing or fishing related activity is the primary occupation for 10.5% of households and a part-time activity for 34.1% of households (Ahmed et al., 1998) and most landless people catch and trade fish for rice.

Cambodian freshwater capture fisheries probably contribute more to national food security and the economy than such fisheries do in any other country in the world. The annual catch ranges between 290,000t – 430,000t (Deap et al., 1998; Ahmed et al. 1998; Thuok et al., 2000, Jensen, 2000), which is the fourth largest in the world. The monetary value of the total catch at the landing site ranges from US\$100-200 million, increasing in the market chain to US\$250-500 million, which the freshwater fisheries contribution is thus 9-18% of the total GDP of US\$ 2, 800 million (MEF, 1999). In Cambodia nearly 10 million people live in rural areas; 4.3 million live on less than US\$113 per year.

Through family fisheries and foraging in rice fields they catch between 160,000t – 250,000t<sup>1</sup> of aquatic resources.

An overriding theme in all development efforts in Cambodia is to provide support to alleviate poverty and support vulnerable groups of society. Poverty alleviation is one of the most urgent tasks facing Cambodia and aquatic resources are crucial to Cambodian people's livelihoods, especially the livelihoods of the poor. Aquatic resource production takes place in the wetland ecosystem that is driven by the annual flooding of the Mekong under the influence of the southwest monsoon (June-October) temporarily submerging many thousands of square kilometres beside the river its tributaries, the Tonle Sap Great Lake and Bassac river. 86% of the country lies within the catchment of the Mekong (Murshid, 1998). The large, central low-lying alluvial plain and the Tonle Sap Great Lake, which covers an area of 2,600-3,000 km<sup>2</sup> (in the dry season) and 10,000-13,000 km<sup>2</sup> (in the wet season), together with the Mekong river flowing from north to south, dominates Cambodia's terrain and the livelihoods of most of its population. The outlet of the Tonle Sap Great Lake (a river of the same name) flows into the Mekong during the dry season, whilst during the wet season the Mekong flood flows back into the lake inundating 10,400 km<sup>2</sup>.

Poverty is a serious problem in Cambodia. About 36 per cent of the Cambodian population lives below the poverty line (MoP/UNDP, 1999). Little is known about the regional distribution of poverty in Cambodia. The 1993-94 and the 1997 Cambodia Socio-economic Survey's are large enough only to support regional poverty comparisons at a highly aggregated level, i.e. poverty head count for Phnom Penh (11%); other urban areas (30%) and rural areas (40%). However, it is overwhelmingly clear that rural households with agriculture as their primary source of income account for 90% of Cambodia's poor.

The geographic distribution of poverty status and aquatic resources use, focusing especially on the livelihoods of the poor is the subjects of this report.

The main objective of this report, which is based on the current literature, is to assess the following:

- The current status of livelihoods of Cambodia's rural poor, geographic distribution (nationally, by regions: the Mekong floodplain, Tonle Sap Great Lake, Plateau and Mountainous, and coastal and by provinces within Cambodia), broken down to the lowest possible administrative level, i.e. the Human Development Indices by province;
- Socio-economic characteristics of the rural poor; and
- The aquatic resources (mainly fisheries and aquaculture), their use and importance in terms of rural food security, national economic development and key management tools and issues.

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<sup>1</sup> Although larger than previous figures this is probably an under-estimate.

## 2. Geographic Distribution of Poverty Status in Cambodia

### 2.1 Overview of Poverty in Cambodia

Freedom from poverty is an essential component of human development, because poverty prevents people from enjoying long, healthy and enriched life. It restricts people's choices and robs them of dignity and self-respect.

There are many different ways of measuring poverty, resulting from the fact that poverty in Cambodia has so many dimensions and equally large number of causes. Poverty is simultaneously caused by and manifested in low income, low consumption expenditures, lack of physical assets, landlessness, poor health and disability, high rates of mortality and mortality, low levels of education, and physical isolation, among other things. These can be used as poverty indicators to define poverty and to measure levels of poverty in Cambodia.

The absolute poverty is pervasive in Cambodia (UNDP, 1997; UNDP, 1998; MoP, 1998)<sup>2</sup>, With the incidence of poverty of 39.0 per cent (1993/94) of Cambodians (Table 2.1) living below the poverty line of about US\$ 145 per person per year; it is meant that most of them have incomes that are just below the poverty line. As would be expected, the *headcount* (incidence of poverty) is lowest in Phnom Penh (11.1%), followed by urban areas outside Phnom Penh (29.9%) and rural areas (40.1%) (Table 2.2). In addition, the *poverty gap* (depth of poverty), which measures the shortfall between the expenditures of the poor house holds and the poverty line, is relatively small in Cambodia (9.2% in 1993/94, declining till 8.7% in 1997) (Table 2.1 & 2.2). The *poverty severity index* (severity of poverty) is estimated at 3.1% in 1993/94 and 1997 for all of Cambodia, with large regional variation (Table 2.1 & 2.2). Indeed, if perfect targeting were possible, an annual income transfer of only about US\$ 18 per person per month- or US\$ 190 million for the country- would be required to alleviate poverty. This constitutes approx. 40% of the overseas development assistance that Cambodia received in 1995.

As one would expect, about 90 percent of the poor in Cambodia live in rural areas, where there are about 9.5 million population (82% of the total population of Cambodia) (NIS/MoP/UNDP/SIDA/World Bank, 2000; GPC, 1999). The incident poverty is greatest among farmers. On the other hand, poverty rates are relatively small for civil servants and public employees. Thus, any poverty alleviation strategy has to focus the agricultural sector.

The limited evidence surveyed suggests that consumption inequality in the rural areas may have increased between 1993-94 and 1996, the richest 20% individuals

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<sup>2</sup>The poverty line is defined as an expenditure of US\$ 0.48 per capita per day in Phnom Penh, US\$ 0.37 in other urban areas (district and provincial towns and cities of Sihanouk ville, Kep, and Pailin), and US\$ 0.32 in the rural areas.

experiencing an increase in their relative share of national consumption at the expense of the poorest 80%. This trend, which is typical of that found in most transitional economies, occurs because liberalization creates new income generation opportunities that the rich are better able to exploit.

Although there was an increase in consumption inequality in the rural areas between 1993-94 and 1996, the evidence suggests that Cambodia economic growth was strong enough to actually to improve the absolute consumption of the poor. The poorest 20% of the population reduced their share of food in total consumption, and significantly increased their ownership of such consumer durable as radio, television sets, bicycles and motorcycles. This experience supports the widely held view that economic growth is often the strongest determinant of poverty reduction. Furthermore, despite three strong years of economic growth<sup>3</sup>, the poverty rates for the country declined only modestly from 39 per cent in 1994 to 36.1 percent in 1997 (MoP, 1998a). The proportion of the population whose per capita consumption expenditure was below the poverty line fell significantly in the urban areas outside Phnom Penh, modestly in the rural areas, but not at all in Phnom Penh.

Table 2.1: Poverty Indices by Region, Cambodia, 1993/94 (percent)

Stratum	Population share	Headcount index	Poverty gap index	Poverty severity index
Phnom Penh	10.7	11.4	3.1	1.2
Other urban areas	11.0	36.6	9.6	3.6
Rural Areas	78.2	43.1	10.0	3.3
Total*	100	39.0	9.2	3.1

Source: NIS 1998 and Prescott and Prahan (1997).

\* "Total" refers to sampled regions only.

Table 2: Poverty Measures by Region, Cambodia, 1997

	Population (million)	Population Share (%)	Headcount index (%)	Poverty gap index (%)	Poverty severity index (%)
<b>Food poverty line</b>					
Phnom Penh	0.9	8.5	3.4	0.5	0.1
Other urban areas	1.1	10.5	15.4	3.3	1.1
Rural Areas	8.4	81.0	20.0	3.9	1.2
Total	10.4	100.00	17.9	3.5	1.1
<b>Poverty line</b>					
Phnom Penh	0.9	8.5	11.1	2.2	0.6
Other urban areas	1.1	10.5	29.9	7.5	2.7
Rural Areas	8.4	81.0	40.1	9.7	3.4
Total	10.4	100.00	36.1	8.7	3.1

Source: NIS 1998; MoP/UNDP/SIDA/World Bank 1999

## 2.2 Who are the Poor?

In Cambodia it is easy to target the poor by sector of employment and education. Highest incidence of poverty (poverty headcount) is found among individuals living in households headed by someone working in agriculture and fishing (46%), followed by those in construction and mining (37%) and transport (31%) (UNDP, 1997). Among government workers, the incidence of poverty is only 20%. Looking at the same data differently, one finds that nearly 75% of the poor are in agriculture and fishing. This is not surprising, given the large numbers of Cambodians working in this sector and the very low productivity in this sector. For example, Ahmed et al. (1998) found that 77% of households living around the Tonle Sap Great Lake, Mekong and Bassac provinces (Kandal, Kg. Cham, Kg. Chhnang, Siem Reap, Pursat, Battambang and Kg. Thom) reported active involvement in farming and 39% in fishing (Table 2.3). The rate of involvement in fishing by households varies between provinces. For instance, in Kampong Chhnang, 54% of the households are actively engaged in fishing compared to only 21% in Kampong Thom (Table 2.3). AIT-Aqua-Outreach (1998) (raw data), in the baseline survey of 50 households living at Chbar Morn and Somrong districts, Kampong Speu provinces, reported that 76% of the sampled households engaged in subsistence fishing in rice fields (100%), lakes (21%), canals (18%) and stream (3%).

Table 2.3: Percentage of households involved in fishing and agriculture activities, 1996

Province	Fishing activity	Agriculture activity
Phnom Penh	40.07	42.28
Kandal	31.40	76.90
Kampong Cham	38.20	77.6
Kampong Chhnang	54.26	69.79
Siem Reap	39.77	87.38
Pursat	48.36	82.71
Battambang	46.39	77.69
Kampong Thom	21.44	81.53
Kampong Speu	76.00*	100.00

\* Percentage of households involved in subsistence fishing only.

The incidence of poverty also varies greatly by the educational level of the household head. Not surprising while 47.1% of individuals living in households headed by someone with no schooling are poor, the corresponding rate is 30.1% for household heads with higher secondary education and 0% for those with a college/university degree. The Socio-economic assessment of freshwater capture fisheries in the 8 selected provinces around the Great Lake, Tonle Sap, Mekong and Bassac rivers (1998) the educational level of household head varied between provinces (Table 2.4). The educational rates are consequently lower in this population with 36% of household heads able to read and write in Khmer than in the population with 70% in target survey areas (Babteay Meanchey, Battambang, Kampong Chhnang, Kampong Speu, Otdor Mean Chey, Preah Vihear, and Siem Reap in which the Cambodia World Food Program conducted survey (WFP Cambodia, 1999). The latter rate compares to national rural

rate of 76%. But they are lower than that found in the UNICEF/WFP Baseline Survey (77%).

Table 2.4: Educational status of household heads in selected 8 freshwater fisheries provinces around the Tonle Sap Great Lake/ Mekong/Bassac, 1996

Education	Phnom Penh	Kanda 1	K. Cham	K. Chhnang	Siem Reap	Pursat	Battambang	K. Thom	Total
No education	23.2	12.0	22.3	20.2	26.4	20.8	20.1	26.8	20.3
Can read only	28.3	30.9	30.6	34.9	57.2	32.2	50.2	31.4	36.3
Primary	36.8	31.4	31.7	31.5	9.9	26.7	19.3	25.1	27.1
Secondary	9.6	22.2	11.8	12.3	5.5	14.0	8.3	14.4	13.4
Higher second.	1.8	3.2	3.4	1.1	1.0	6.3	2.1	2.1	2.8
Bachelor/above	0.4	0.4	0.3						0.2

Source: Ahmed et al. (1998).

The UNDP Cambodia Human Development (1997) cited from the CSES (1996) that the proportion of adults literate is 0.844, with the average number of schooling years of 6.13, compared to only 0.166, with 0.98 schooling years, in Mondulhiri (Table 2.5).

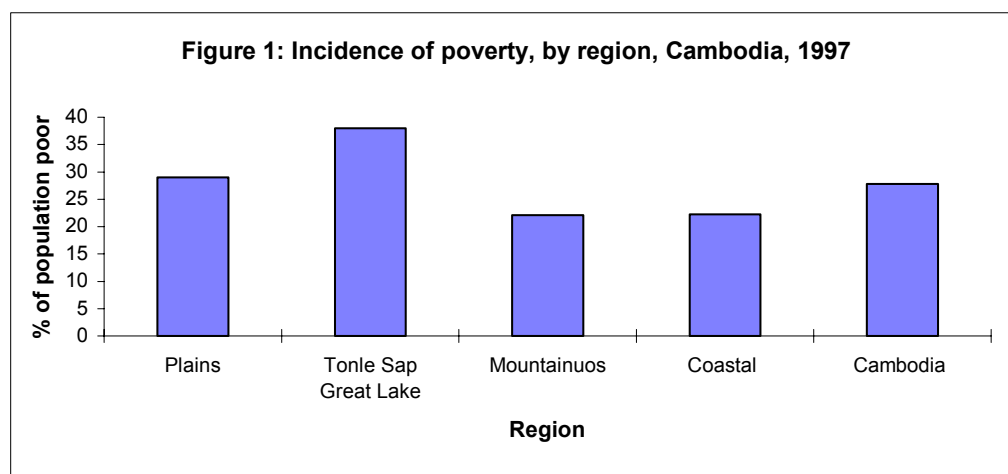
Table 2.5: Proportion of Adults Literate and Average Number of Schooling Years, By Provinces, Cambodia, 1996

Province	Proportion of adults (> 15 years) literate	Average no. of schooling years
Banteay Meanchey	0.629	3.30
Battambang	0.703	3.84
Kampong Cham	0.707	3.63
Kampong Chhnang	0.584	3.22
Kampong Speu	0.708	3.74
Kampong Thom	0.554	2.73
Kampot	0.687	3.39
Kandal	0.726	4.08
Koh Kong	0.653	3.16
Kratie	0.713	2.84
Mondulhiri	0.166	0.98
Phnom Penh	0.844	6.13
Prey Veng	0.619	3.49
Pursat	0.690	3.63
Ratanakiri	0.294	1.52
Siem Reap	0.453	2.05
Sihanouk Ville	0.669	3.90
Stung Treng	0.668	3.29
Svay Rieng	0.678	3.57
Takeo	0.650	3.56
Kep	0.506	2.37
<b>National</b>	<b>0.668</b>	<b>3.68</b>



### 2.3 Distribution of Poverty by Region

There are large regional disparities in the incidence of poverty, with the coastal and Mountainous regions having the lowest incidence of poverty (about 22 per cent) and the Tonle Sap Great Lake region having the highest incidence (38 percent) (Figure 2.1). The Plains region falls in between with 29 per cent of population below the poverty line (UNDP, 1999).



Source: CSES (1997) and UNDP, 1999.

### 2.4 Distribution of Per Capita Consumption, by Regional Provinces Within Cambodia

A true nationwide breakdown of the geographic distribution of per capita consumption between provinces is not available because 6 out of Cambodia's 21 provinces were excluded from the coverage by the SECS (Preah Vihea, Koh Kong, ModulKiri, Ratanakiri, Stung Treng and Kratie). The estimated mean values of per capita consumption expenditure in the 15 provinces, which were covered are shown in Table 2.6 Accordingly, the provincial means are shown together with the 95 per cent confidence interval. The main urban centers - Phnom Penh and Sihanouk Ville - are clearly the best off. The two provinces surveyed in the coastal region - Sinaouk Ville and Kompot - have significant higher per capita consumption levels than the other regions. Border provinces in the far West near Thailand, and in the East near Vietnam, have the lowest average consumption levels. Most of the Northern provinces along the border with Vietnam, Lao and Thailand were excluded from the survey. They are classified as upland region, composed of Preah Vihea, Ratanakiri, Modulkiri, Stung Treng and Kratie, which have lower numbers of population and lower consumption levels as compared to the Plains, Tonle Sap Great Lake and Coastal regions, and probably lower than the Mountainous region (per comm. H.E. Mr. Seng Soeurn Deputy Director General of NIS/MoP, 17 October 2000). The province of Koh Kong is of the three provinces situated in the Coastal region. It is estimated that the level of per capita

consumption is comparable to other two provinces of Kom Pot and Sihanouk Ville (per comm. Seng Soeurn, October 2000).

Table 2.6: Distribution of Per Capita Consumption by Regional Provinces, 1997  
(Riel per day; US\$ 1= Riel 2,500)

Province/Region	Population (million)	No. of house- holds in sample	Daily per capita Consumption			95% confidence interval of mean	
			Median	Mean	Standard error of mean	Lower band	Upper band
Phnom Penh	1.00 (8.7%)	1708	1219	4367	116	4140	4594
Kandal	1.07 (9.4%)	510	1381	1642	45	1553	1730
Kampong Cham	1.60 (14%)	664	1195	1426	36	1356	1496
Say Rieng	0.47 (4.2%)	270	1092	1194	35	1125	1262
Prey Veng	0.94 (8.3%)	594	1225	1465	32	1403	1527
Takeo	0.79 (6.9%)	413	1226	1521	100	1325	1718
<b>Plains region</b>	<b>5.87 (51.5%)</b>	<b>4159</b>	<b>1323</b>	1878	<b>36</b>	<b>1808</b>	<b>1949</b>
Kampong Thom	0.56 (5.0%)	97	1269	1779	143	1495	2064
Siem Reap	0.78 (6.1%)	175	1219	1549	114	1323	1775
Banteay Meanchey	0.57 (5.1%)	206	1137	1412	111	1194	1631
Battamabang	0.79 (6.9%)	293	1125	1392	54	1286	1497
Pursat	0.36 (3.2%)	207	1333	1697	89	1522	1872
Kampong Chhnang	0.42 (3.7%)	136	1271	1585	90	1408	1762
<b>Tonle Sap Great Lake region</b>	<b>3.48 (24.0%)</b>	<b>1114</b>	<b>1219</b>	<b>1529</b>	<b>39</b>	<b>1453</b>	<b>1605</b>
		70	4395	5162	378	4407	5917
Sihanouk Ville	0.15 (1.4%)	130	1147	2159	573	1025	3294
Kom Pot	0.52 (4.6%)	<b>200</b>	<b>1397</b>	<b>2803</b>	<b>431</b>	<b>1953</b>	<b>3652</b>
<b>Coastal region</b>	<b>0.67 (6.0%)</b>						
Kampong Speu	0.6 (5.2%)	105	1214	1296	54	1189	1403
<b>Mountainous region</b>	<b>0.6 (5.2%)</b>	<b>105</b>	<b>1214</b>	<b>1296</b>	<b>54</b>	<b>1186</b>	<b>1403</b>
<b>Cambodia</b>	<b>10.6 (87.0%)</b>	<b>5578</b>	<b>1300</b>	<b>1833</b>	<b>32</b>	<b>1770</b>	<b>1895</b>

## 2.5 Food Shares and Poverty

An indicator of poverty that is widely used in the absence of data on poverty line is the share of total consumption expenditure that is spent on food by households “food share”. Poor households spend much larger shares of total their expenditure on food than non poor households, as the Table 2.7 shows below. In 1996 the poorest quintile of the population had a food share of 66%, while the corresponding figure for the riches quintile was less than 50%. However, there was a marked decline in the share of total expenditure being spent on food by all households between 1993/94 and

1996. The food share of the poorest quintile declined from 72.6% to 65.6% - a decline of nearly 10%. These data suggests that the absolute (real) income of the poorest quintile of the population had improved during the period. The decline was approximately similar in the rural and urban areas, suggesting an equivalent decline in poverty in both strata.

Table 2.7: Share of food in total monthly expenditure, by total monthly expenditure quintile and rural/urban residence, Cambodia, 1993/94 and 1996.

Total exp. quintile	Rural		Urban		Total	
	1993-94	1996	1993-94	1996	1993-94	1996
1 - Poorest	72.74	65.48	70.86	64.22	72.55	65.60
2	71.91	66.87	67.95	63.56	71.74	66.76
3	71.54	65.53	62.28	59.03	71.12	64.04
4	69.57	56.75	56.34	55.18	67.20	56.03
5 - Richest	63.64	48.23	48.25	45.34	57.64	48.18
Total	69.88	60.57	61.15	57.47	68.05	60.12

Notes: Quintiles are constructed on the basis of total household consumption expenditure per month; aggregation of the quintile distribution is done over individual (as opposed to households) and is based on sample weights. Quintiles are stratum-specific; thus the poorest rural quintile refers to the lowest 20% of individuals in the rural consumption distribution.

## 2.6 Inequality and Poverty

Measured by several alternatives indicators, inequality is consistently higher in Phnom Penh (0.46), declines in other urban areas (0.44), and is the lowest in rural areas (0.33) (Table 2.8). The Gini coefficients (inequality) for neighboring countries are 0.30 in Laos, 0.35 in Vietnam and 0.32 in Indonesia. Given the heavy weight of rural areas in the population, Cambodia appears to exhibit a similarly low degree of overall inequality as some of its neighboring countries.

Table 2.8 Consumption inequality measures, June 1997

	<i>Gini coefficient</i>	<i>Population weighted theil measure</i>	<i>Per capita consumption theil measure</i>	<i>Variance of the logarithm of per capita consumption</i>	<i>Consumption share of the poorest 10% of the population (percent)</i>	<i>Consumption share of the richest 10% of the population (percent)</i>
Phnom Penh	0.46	0.78	0.38	0.41	2.6	40.3
Other urban areas	0.44	0.49	0.33	0.47	2.7	37.6
Rural areas	0.33	0.21	0.17	0.30	3.7	27.1
Total	0.42	0.48	0.29	0.41	3.0	35.3

Source: NIS 1999; 1998; 1995 (CSES: 1993-94), Perscott and Pradhan 1997.

## 2.7 Poverty Line in Cambodia

### Food poverty line

The benchmark adopted for setting the food poverty line is a 2,100 calorie minimum energy requirement per person per day. In principle, one could allow the calorie requirement to vary by age, weight, and the activity of the individual. Table 2.9 illustrates the calories requirements for different types of individuals. The heavily the daily activity, the more calories are need. Children need less calories than adults.

Table 2.9: Differential Energy Requirements

Type of Individual	Calorie requirement
Subsistence farmer	2,780
Male engaged in heavy work	3,490
Rural women	2,235
10-year old boy	2,080
10-year old girl	1,915

Source: WHO (1985).

A food poverty line of Riel 1,185 per day for Phnom Penh, Riel 955 per day for other urban areas and Riel 881 per day for rural areas represent the minimum required per person to reach a daily calorie consumption of 2,100. The food poverty lines and underlying breakdown by broad food categories are shown in Table 2.10. More than two-third (69%) of the calories are obtained from cereals, especially rice. Meat consumption is the largest expenditure category in all regions.

Table 2.10: Composition of Food Poverty Line by Food Group  
(in Riels per person per day; US\$ 1= Riel 2,500)

Food group	Phnom Penh	Other Urban	Rural	Calorie
	1184.9	995.3	881.4	2100
Beverage	51.3	37.1	31.2	122.3
Cereal	289.0	247.3	246.8	1440.2
Daily products	7.6	2.7	5.7	1.5
Eggs	20.6	20.8	20.7	7.8
Fruit	104.5	78.2	62.5	55.6
Meat	433.7	368.3	311.7	202.8
Oils and fat	13.1	12.8	12.5	50.3
Other food products	54.4	35.4	26.2	55.7
Sugar, salt, species and seasoning	92.3	84.2	81.0	121.5
Vegetable	118.3	108.5	83.1	42.2

## Non-food allowance

Regression analysis is used to identify the typical value of non-food expenditures of households capable of reaching the food poverty line. This method yields different shares of the non-food allowances in the poverty line for each region. This is necessary because price differences between regions of non-food items may be different from price differences of food items. The regression results are given in Table 2.11.

Table 2.11: Estimated Food Demand Equation

	Estimated coefficient	Standard error
Constant	0.729846	0.00196
Dummy Phnom Penh	-.0628002	0.0053
Dummy Other Urban	-.0019263	0.0049
Beta	-.1076779	0.0029

R squared 0.28

Using this approach, the estimated non-food allowance is Riel 393 per day in Phnom Penh, 296 in Other Urban areas and 236 in rural areas.

## Poverty Line

The poverty lines are obtained by adding the non-food allowance and the food power line for each region. The resulting overall poverty lines for Cambodia in 1993-94 are Riel 1,578 (US\$ 1= Riel 2,500) per person per day in Phnom Penh, Riel 1,264 for Other Urban areas and Riel 1,117 for the rural areas.

## 2.8 Socio-economic Characteristics of the Poor

While the *consumption-based measures* of poverty are a convenient yardstick for measuring the distribution of the living standards in the Cambodian population, they do not fully capture other social characteristics of the poor such as literacy, health, or access to clean water. This section gives a brief overview of the distribution of selected non-monetary or social indicators of household living standards, using data collected by the CSES (see Table 2.12)

**Household Composition.** Household composition, in terms of size of household and the characteristics of its members, is often quite different for the poor and non-poor households. Table 2.12 shows household size and the age of the family members by expenditure quintiles. The poor do tend to live in larger households, with an average family size of 6.6 persons in the poorest quintile compared to 4.9 in the riches quintile. The poor also tend to live in younger households - with twice as many children under the age of 15 per family (3.4) in the poorest quintile than in the richest quintile - and slightly fewer elderly people over age 60. Better-off household tend to have heads that are somewhat older, but the difference cross the quintiles is very small. One explanation

may be that the average age of women heading households (50.1 years) is greater than that of men heading households (42.3 year), and in Cambodia poverty rates decline with the average age of the household heads beyond 39. But even after adjusting for age differences, poverty is still significantly lower among households headed by women, who most do not live in female headed households (only 21 per cent) (NIS/MoP/SIDA/UNDP/World Bank, 1999).

**Literacy and Schooling.** Literacy and schooling are important indicators of the quality of life in its own right, as well as being the key determinant of the poor's ability to take advantage of income earning opportunities. Cambodia has achieved a (self-reported) basic literacy rate averaging 67 per cent of adults older than 15, implying a high degree of literacy among the poor. The literacy gap which remains is quite large, with literacy ranging just from over half of adults (58 percent) among the poorest 20% of the distribution of school attainment. Years of schooling among adults aged over 15 averaged only 3.1 years in the poorest 20% of the population, increasing to 5.3 years of schooling among the richest 20% (Table 2.12; also Table 2.5). Here there is a very large gender gap, with mean grade attainment among men of 5.1 years compared to 3.2 years among women.

The NIS (1999) reported that the poverty headcount index by reported literacy of the household heads shows poverty was lower among the literate (34%) than among the illiterate (42%). Although two-third of the poor still in households whose head is reported to be illiterate.

**Housing Conditions and Assets.** Housing conditions are another important element among different aspects of social well being. Water and sanitation are especially important influences on health and nutrition status. The CSES shows that the poor are extremely disadvantaged in access to safe sources of water supply and sanitation. Only 4 per cent of the poorest quintile have access to piped water, while more than 17% of the richest quintile do. Similar differences are apparent in access to sanitation. Few of the poor - 9% - have access to a toilet in the home, while around half of the riches 20% do. Another indicator of housing standards is access to electricity. Here again the access of the poor lags far behind. Access to electricity from a generator or line connection - the most convenient energy source - rises sharply with income, from a mere 1% among people in the poorest quintile to 37% of the Cambodians in the richest quintile. Table 2.12 also shows the five quintiles of population access to bicycles, motorized transport and ownership of durable (radio and TV).

## ***2.9 Human Development and Livelihoods in Cambodia***

Human development is about improving ordinary people's lives by enlarging their choices and helping them realize their full human potential. While per capita income is an important aspect of improving people's lives, it is by no means the only one. Health and education are no less important in judging people's welfare. The global *Human Development Report 2000* additionally includes freedom and human rights in its definition of human development.

Table 2.12: Decomposition of Differences in Poverty Estimates (Socio-economic poverty indicators)

	Total	Quintile/a					Region		
		Poorest	2	3	4	Richest	Phnom Penh	Other Urban	Rural
Household size	5.6	6.6	6.0	5.7	5.0	4.9	5.9	5.9	5.5
Children per family (age 0-14)	2.4	3.5	2.8	2.5	1.9	1.8	2.3	2.6	2.4
Elderly per family (age 60+)	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3
Dependency disabled/b	0.84	0.78	0.93	0.93	0.91	0.68			
Age head household	44.6	44.1	43.0	44.1	45.2	46.1	45.0	45.3	44.5
Female head household(%)	21.1	18.6	17.3	18.9	23.3	26.6	25.8	23.4	20.4
Literacy (% adult aged 15+)	66.6	57.7	64.3	66.2	67.9	77.1	81.8	72.5	67.3
Years of education (avg. adult aged 15+)	4.0	3.1	3.7	3.8	4.2	5.3	6.1	4.7	3.7
Years of education/c (avg. male aged 15+)	5.1	4.1	4.7	4.8	5.4	6.6	7.3	5.8	4.7
Year of education/c (avg. female aged 15+)	3.2	2.4	2.9	3.0	3.3	4.3	4.9	3.8	2.8
Access to piped water (%)	7.1	4.3	3.4	3.5	5.5	16.7	33.6	13.4	2.9
Toilet in house (%)									
Electricity from line or generator (%)	22.1	8.7	11.3	13.9	21.1	48.7	78.0	46.7	11.7
Radio (%)	12.4	1.3	2.1	5.5	10.4	36.8	67.4	30.2	3.0
TV (%)	27.7	23.0	25.1	25.8	29.9	33.0	38.7	31.4	25.9
Bicycle (%)	13.8	3.0	4.8	7.0	12.7	35.9	57.0	21.6	7.2
Car, jeep or motorized cycle (%)	60.9	57.7	65.3	63.6	61.6	56.8	41.1	60.9	63.5
	18.0	6.4	6.7	11.7	18.8	40.5	58.8	27.1	11.6

Source: CSES 1993-94 and 1997; Pescott and Pradhan 1997.

/a Quintile distribution based on real per capita expenditure using the implicit food poverty line price deflators;

/b Dependency defined as number of disabled in family divided number of family members time 1000;

/c Average over all individuals aged 15 and above. All other variables are averages across households.

There are several means (indicators, proposed by UNDP), of measuring the status of human development in a country, which are defined below.

- a. *Human Development Index (HDI)*. It is a composite measure of longevity/life span, educational attainment, and standard of living;
- b. *Gender-related Development Index (GDI)*. It is similar to the HDI but additionally takes into account the gender inequality in life expectancy, educational attainment, and standard of living;
- c. *Gender Empowerment Measure (GEM)*. It is a measure of the relative participation of women and men in political and economic spheres of activity; and

- d. *Human Poverty Index (HPI)*. It is a measure of deprivation in three essential elements of human life, longevity, knowledge and a decent living standard.

### **Human Development Indices in Cambodia (see also Table 2.13)**

The HDI score for Cambodia, using the most recent household survey data from the General Population Census of 1998 and the Cambodia Socio-economic Survey (CSES) 1999, is 0.517. This is one the lowest HDI in Asia, just higher than Laos (0.484) and Bangladesh (0.461). Cambodia's GDI score (viz. 0.514) is very similar to its HDI score. The Value of the GEM for Cambodia is 0.283. No GEM is reported in UNDP Human Development Report 2000. Finally, Cambodia's HPI score is 42.53, which reflects the high levels of mortality and child malnutrition and the poor availability of public services in the country.

Table 2.13 National Human Development Indices, Cambodia, 1998

	Human Development Indices			
	HDI	GDI	GEM/a	HPI/a
Cambodia	0.517	0.514	0.283	38

Source: UNDP Human Development Report 2000 and calculations from the CSES 1999.

/a Calculation from the CSES 1997.

### **National Distribution of Human Development in Cambodia**

As in the per capita GDP, an average HDI or GDI score for a country can mask significant disparities in human and gender-related development among economic and social groups within the country. This appears to be the case for Cambodia, as Table 2.14. The score for urban Cambodia is about 21% greater than that for the rural Cambodia. Likewise, there are large disparities in both HDI and GDI across economic groups. The richest 20% of Cambodia have an HDI score that is 40 greater than that of the poorest 20%.

As with the HDI and GDI, the HPI also differs significantly across socio-economic groups (Table 2.14). As would be expected, HPI is significantly greater among the poorest quintile than the richest<sup>4</sup>.

### **Regional and Provincial Distribution of Human Development Within Cambodia**

The UNDP (1997) cited from the CSES and reports that the provincial HDI scores are shown in Table 2.15. Not surprisingly, Phnom Penh (0.865) and Sihanouk Ville (0.750) have the highest HDI scores in the Country. Prey Veng (0.277), Kampong Speu (0.280) and Kep Ville (0.295) have the lowest HDI scores. The Mekong corridor (0.554) and

<sup>3</sup> The rich can also suffer from human's poverty as human poverty is defined not on the basis of income but on the basis of other indicators of living standards, such as mortality, illiteracy, child malnutrition and access to safe water and health services.



the Coastal region (0.527) have the highest HDI scores, while the Mountainous region has the lowest HDI scores. The Plains (0.480) and the Tonle Sap Great Lake (0.435) regions have the HDI scores in between the Mekong corridor and the Mountainous region.

Table 2.14: Human Development Index, Gender Development Index and Human Poverty Index, by nationwide, by rural and urban and by per capita expenditure quintile, Cambodia, 1999

	Human Development Indices		
	HDI	GDI	HPI
Cambodia	0.517	0.514	38
Rural	0.500	0.496	40.52
Urban	0.604	0.601	27.88
Poorest 20%	0.445	0.441	44.86
Second 20%	0.473	0.469	42.10
Third 20%	0.497	0.491	39.23
Fourth 20%	0.531	0.525	36.00
Richest 20%	0.623	0.620	29.05

The different regions and provinces of Cambodia differ in their GDI scores (Table 2.15). The highest GDI score is 0.602 for Mekong corridor and the lowest one is 0.448 for the Mountainous region.

### **Cambodia-specific Human Development Index (CHDI)**

The standard HDI includes four components: life expectancy, adult literacy, child schooling enrollment, and per capita consumption expenditure. However, there are many variables that have a strong influence on the quality of life in a community; these include child malnutrition and health outcomes and access to basic services (e.g., drinking water, sanitation, electricity), health services, housing, and entertainment and information. These variables are particularly important in the context of a poor country like Cambodia. A Cambodia-specific Human Development Index (CHDI) aggregates all the above different social and economic indicators.

Thus, the CHDI covers a much wider and richer range of social, human and economic measures than the standard HDI. Another significant advantage of CHDI over the HDI is that all of its components are more readily influenced by policy interventions in the short run. The HDI has been criticized on the grounds that its component (viz., adult literacy and life expectancy) is not amenable to policy intervention in the short run.

As such, the CHDI, like the HDI, can range from a low of 0 to a high of 1, with higher values reflecting higher standards of living.

Table 2.15: Human Development Indices and Gender-related Development Indices, by region and province, Cambodia, 1996

Province/region	HDI	GDI	Cambodia-specific
			HDI
Phnom Penh	0.865	0.914	0.936
Kandal	0.474	0.457	0.496
Kampong Cham	0.410	0.487	0.475
Say Rieng	0.407	0.467	0.429
Prey Veng	0.277	0.304	0.419
Takeo	0.448	0.453	0.432
<b>Plains region</b>	<b>0.480</b>	<b>0.513</b>	<b>0.531</b>
Kampong Thom	0.316	0.363	0.336
Siem Reap	0.349	0.403	0.325
Banteay Meanchey	0.495	0.535	0.409
Battambang	0.521	0.539	0.456
Pursat	0.428	0.471	0.401
Kampong Chhnang	0.502	0.507	0.453
<b>Tonle Sap Great Lake region</b>	<b>0.435</b>	<b>0.478</b>	<b>0.396</b>
Sihanouk Ville	0.750	0.674	0.659
Kom Pot	0.487	0.500	0.448
Koh Kong	0.578	0.493	0.374
Kep Ville	0.295	0.309	0.374
<b>Coastal region</b>	<b>0.527</b>	<b>0.494</b>	<b>0.463</b>
Kampong Speu	0.280	0.397	0.456
Mondulkiri	0.329	0.373	0.216
Ratanakiri	0.447	0.575	0.375
<b>Mountainous and Plateau region</b>	<b>0.352</b>	<b>0.448</b>	<b>0.349</b>
Stung Treng	0.440	0.509	0.371
Kratie	0.668	0.695	0.506
<b>Mekong corridor</b>	<b>0.554</b>	<b>0.602</b>	<b>0.438</b>
<b>Cambodia</b>	<b>0.517</b>	<b>0.514</b>	<b>0.435</b>

Since the data requirements for the CHDI are significantly more exacting than those for the HDI, it is not possible to calculate it for every country in the world. However, using the household survey from the CSES 1996, it is possible to calculate the CHDI for each and region and province. The results indicate that the ranking of the top three provinces does not change whether one uses the standard HDI or the CHDI. Phnom Penh,

Sihanouk Ville and Kratie rank as the provinces with the highest human development score irrespective of the index used. The three provinces with the lowest HDI score - Mondulkiri, Siem Reap and Kampong Thom - are not the same provinces with the lowest rank on the CDHI score (viz., Prey Veng, Kampong Speu and Kep Ville). Indeed, Kampong Speu experiences the biggest change in ranking with the use of the CHDI; it falls from a rank of six on the HDI to a rank of 20 on the CHDI.

### **3. Geographic Distribution of Aquatic Resources Use in Cambodia, focusing especially on the Livelihoods of the Poor**

#### **3.1 Geography and Aquatic Resources Base in Cambodia**

Cambodia's inland aquatic resources are primarily inland fisheries. The inland fisheries occupy two major ecosystems consisting of: (1) The Tonle Sap Great Lake region, and (2) the Mekong-Bassac inundated region. The Tonle Sap Great Lake fisheries account for 60% of current annual commercial fisheries production shown in government statistics. The provinces covered by the Tonle Sap Great Lake region are: Kampong Thom, Siem Reap, Banteay Meanchey, Battambang, Pursat, Kampong Chhnang and part of Kandal to the north of Phnom Penh. The Mekong-Bassac inundated region covers the provinces of Kandal to the south of Phnom Penh, Kampong Cham, Say Rieng, Prey Veng and Takeo. Of these Svay Rieng is the only province where all fisheries operations are open access and tax free. The three provinces of Siem Reap, Kampong Chhnang and Kandal account for 50% of the total inland commercial catch. A third ecosystem consisting of upper part of the Mekong and the rapids region of Cambodia covers provinces such as Kratie and Stung Treng, is considered less important for inland commercial fisheries, but serves as an important ecological link for most of the migratory species and provides subsistence fishing opportunities to the nearby residents. The Department of Fisheries (DoF) considers all above-mentioned provinces (including Phnom Penh) as important for commercial inland fisheries production and reports the annual catch of inland capture fisheries from these provinces (Table 3.1).

#### **3.2 The Important Role of Fisheries in National Economic Development**

Fisheries in Cambodia play an important role in strengthening the national economy (ECFA, 1992). If considering the data of DOF (1999) in Cambodia with a price estimated at Riels 1,950/kg (US\$ 1 = Riels 3,800), So Nam and Nao Thuok (1999) reported that the contribution of total fisheries to the GDP is therefore Riels 311.7 billion. With the current GDP of Riels 10,750 billion (Ministry of Economic and Finance, 1999), the total fisheries contribution is thus 5.4% of GDP (Table 3.2). While Zalinge and Nao Thuok (1999) and Ahmed et al. (1998) estimate that annual freshwater fish is 300,000-400,000 tons, the total fisheries contributes (at the landing site) 8.8%-10.3% of GDP. The price estimated by the Ministry of Planning (1995) in calculation of fisheries role in the economy at Riels 1.0 million/MT (US\$ 1 = Riels 2,500), the

contribution of fisheries to GDP is therefore 148.8 billion Riels. With national GDP (1995) of Riels 7,200 billion, the fisheries contribution is thus 2.1% of the GDP. In 1990 nominal GDP was Riels 1,396 billion (US\$ 1,965 million) (World Bank, 1992). FAO (1993) suggests that the fisheries in Cambodia contribute about 2.0% of the GDP in 1990. While the University of Michigan study (1976) found that commercial and subsistence fisheries of the whole country contributed 3.5% to 4.5% to the GDP.

Table 3.1: Distribution of inland capture fisheries production, by province, Cambodia.

Province	Fish production (t)				
	1980	1985	1990	1995	1999
<b><u>Plains region</u></b>					
<b><u>(Mekong-Bassac)</u></b>					
1. Phnom Penh	2000	5740	4600	5935	5106
2. Kandal	1500	10375	12500	13570	12344
3. Kampong Cham	3700	4280	5100	6850	4500
4. Prey Veng	1000	2138	2230	3105	2200
5. Takeo	600	1447	1900	1760	1500
<b><u>Tonle Sap Great Lake reion</u></b>					
6. Kampong Thom	2500	2470	4100	4100	6000
7. Siem Reap	2000	8450	9000	8000	7000
8. Banteay Meanchey	-	-	190	192	200
9. Battambang	1300	3700	4300	4712	5200
10. Pursat	2500	5410	7200	7848	7300
11. Kampong Chhnang	3700	10220	12000	14417	17900
<b><u>Upper Mekong region</u></b>					
12. Stung Treng	-	670	680	515	700
13. Kratie	300	1500	1300	1496	1050
<b>Total</b>	<b>18400</b>	<b>56400</b>	<b>65100</b>	<b>72500</b>	<b>71000</b>
<b>Total including marine</b>	<b>19600</b>	<b>67578</b>	<b>105000</b>	<b>103000</b>	<b>109000</b>

Source: DoF (2000): Department of Fisheries, Fisheries Data Collection and Statistics 1980-1999.

Taking freshwater fish capture into consideration, the production of this particular year in the statistical record is 75,700 MT (DOF, 1999). Together with the readjusted production from family fishing of 24,000 MT (JICA, 1997), the total freshwater fish catch is therefore 99,700 MT, valued about 194.4 billion Riels (US\$ 1 = 3,800 Riels). Hence freshwater fish capture alone contributes about 1.8% of the GDP. While Nao Thuok and Sina. (1997) estimated that the contribution from the Great Lake is thus from 1.5% to 1.8% of the GDP. However, Van Zalinge (1997) suggests that the rough estimates of overall freshwater fish production in Cambodia is likely to be some 300,000-450,000 tons annually with a value at the landing place of US\$ 100-225 million, increasing in the market chain to US\$ 250-500 million. With these values, the inland fisheries contribution is greater, varying from 3.2%-4.9% at the landing site, increasing to 8.8%-17.6% in the market chain, to the GDP (So Nam and Nao Thuok, 1999).

For the contribution of fisheries in the economy, the discussions will further confine to the roles in fish contribution to GDP, as protein diet or per capita consumption, and

employment. Table 3.2 shows that the rural poor of Cambodia involved in fishing and fishing related activities accounted for 24,080 persons in 1982, increasing to 130,221 persons in 1998. This indicates the importance of fisheries in the national economic development and in generating employment of the rural poor.

The following section will discuss the contribution of fisheries in Cambodia's food security as protein diet or per capita consumption.

### **3.3 The Significance of Fish and Fish Products and Rural Livelihoods of Cambodia**

Cambodia is a country of forests, rivers and rice fields. Rice farming, fishing and extracting forest products have been the major means of generating food, materials, energy and additional income for subsistence since immemorial.

Table 3.2 Cambodia's Commercial Fish Catch and Aquaculture Production (tons), 1982-1998

Year	Total*	Inland	Marine	Aquaculture	Value** (US\$ million)	% of GDP	People employed
1982	68,715	65,700	3,015	-	62.2	nd	24,080
1983	68,161	58,717	9,444	-	77.5	nd	25,319
1984	64,424	55,093	7,721	1,610	70.6	nd	26,078
1985	70,578	56,400	11,178	3,000	84.3	nd	33,069
1986	73,628	64,181	7,247	2,200	76.9	nd	31,764
1987	82,071	62,154	17,417	2,500	108.7	nd	42,582
1988	86,800	61,200	21,00	4,600	121.7	nd	42,499
1989	82,088	50,500	26,050	5,538	130.5	nd	43,496
1990	111,400	65,100	39,900	6,400	187.9	9.7	48,697
1991	117,800	74,700	36,400	6,700	165.2	9.2	50,070
1992	111,150	68,900	33,700	8,550	155.1	7.5	73,622
1993	108,900	67,900	33,100	7,900	151.9	7.9	89,120
1994	103,200	65,000	30,000	8,200	140.6	5.9	92,251
1995	112,510	72,500	30,500	9,510	147.6	5.1	104,571
1996	104,310	63,510	31,200	9,600	138.9	4.5	99,836
1997	114,600	73,000	29,800	11,800	140.8	4.6	92,817
1998	122,000	75,700	32,200	14,100	152.1	5.4	111,300
1999+	310,000	255,000	35,000	20,000	171.1	5.2	130,221
Estimation							
2000+	325,000	255,000	45,000	25,000	208.7	5.5	144,690
Projection							
Average							
1984-1990	81,570	59,223	18,645	3,693	111.5	9.7	35,287
Percent	100	72.6	22.9	4.5			
Average							
1991-1998	118,947	73,121	33,690	12,136	146.7	6.1	
Percent	100	61.4	28.3	10.2			

Source: Cambodian Department of Fisheries (1999): Fisheries Data Collection and Statistics 1982-1998; So Nam and Nao Thuok (1999); and Ministry of Economic and Finance (1999)

\* Total production, excluding rice-field fisheries and family fisheries

\*\* Price of fish derived from DOF (1999) and personal communication (1999)

+ Total production, including rice-field fisheries (50,000 tons per year) and inland family fisheries (120,000 tons per year) (Deap et al., 1998 and Ahmed et al., 1998)

The significance of fish and fish products in national economic development and in generating employment is well discussed documented above and by lots of authors. Beside this, fish and fish products play a very important role in food security as source of nutrition, family income generation and livelihood support to rural Cambodia.

Estimates of relative nutritional important of fish in the Cambodian diet varies. The RGC First Socio-economic Development Plan (1996-2000) notes that, on average, fish and fishery products are believed to account for 40-60% of the protein intake of the rural population (Gum, 1997). However, in some areas (e.g., in villages in close proximity to inland water bodies and along the coastline) the relative importance of fish as a source of protein is higher (approx. 70-75%)(Deegent et al., 2000; So Nam and Nao Thuok, 1999; Ahmed et al., 1998; Thuok and Sina, 1997; MoE, 1996; Shamr and Ahmed, 1996). For the bulk of the population the protein balance comes from the consumption of small animals, principally poultry and pigs, that most rural households keep both for food and when sold, as a source of additional income.

Fish consumption has traditionally been high in Cambodia, with the level of 20-25 kg per capita in 1970 (Lagler, 1976), but has drastically fallen to 13.3-16 kg per capita in 1990 (MS, 1992) according to various estimates probably due to environment degradation, increased population (annual growth rate: 2.5-3%)(World Bank, 1992). The Fisheries Sector Review (MS, 1992) estimates that supply falls short of demand for 77,000 MT annually. Freshwater capture fisheries is considered already close to its maximum yield, and increased in fish production will have to come from aquaculture or, to a limited extent, from marine fisheries.

So Nam and Nao Thuok (1999) and DoF (2000) reported that the national rate of per capita of fish consumption is 20-30 kg per annum. However, fish consumption per capita for Cambodian was estimated by many other experts (Table 3.3) as 25 kg (Tana, 1993) in the South-Eastern Cambodia, 13.5 kg (Csavas, 1994), 40 kg (CIAP unpublished) in the South and 38 kg (APHEDA, 1997) in the South-west Cambodian. FAO Participatory Natural Resource Management in the Tonle Sap Region estimate 71 kg/capita in the floating villages and 32 kg/capita in the up-land areas of Siem Reap province (Hy, 1995). While MRC/DOF/DANIDA Freshwater Capture Fisheries Management Project (1995) in fishing dependent communes where 83 communes were sampled (5,117 interviews) representing more than 2.4 million people in total, shows that the average fish consumption is 86.8 kg/capita. Based on the weekly consumption, per capita fish consumption in both fresh (43.5 kg/year) and processed form (27.5 kg/capita/year, excluding fish sauce) amounts to 71 kg per annum (Ahmed et al., 1998). If the fish sauce is included, per capita consumption of fish (fresh and fresh equivalent of processed fish) will reach as high as 75.6 kg. For the fishing households, per capita fish consumption is about 80 kg per annum compared about 67 kg for non-fishing households. Gregory et al. (1997) in an 8 months study in 3 villages in Svay Rieng, one of the province poor in fishery resources, reported that fish consumption of 21.5 kg/caput/year, 33.8 kg/caput/year and 39.5 kg/caput/year in Samakee, Thanal Keng and Thluk Pring village respectively. A lot of national and international organizational agencies have put their strong efforts and fund to get the reliable information of fish consumption in most regions of Cambodia. This indicates that the value of fish and

other aquatic products are primary source of animal protein and nutrition for Cambodia's rural people and its importance in national food security and economy is great.

Table 3.3: Distribution of Per Capita Fish Consumption, by region, Cambodia

Region	Per capita fish consumption (kg/capita/year)	Author
Cambodia	20-30	DoF, 2000; So Nam and Nao Thuok, 1999
Cambodia	23-31	So Nam and Nao Thuok, 1999
Great Lake (only Siem Reap)	32	Hy, 1995
Great Lake (6 provinces)	71	FAO/PNRM, 1995
Tonle Sap Great Lake (8 provinces)	86.8	DoF/FCFMC, 1995
Tonle Sap Great Lake(including Kandal and Phnom Penh)	71	Ahmed et al., 1998
Southeastern (Svay Rieng)	25	Tana, 1993
Southeastern (Svay Rieng)	21.5-39.5	Gregory, 1997
Southwestern (Kompot)	38	APHEDA, 1997
South (Kandal and Takeo)	40	CIAP, unpublished

However, approximately, with the current freshwater fish catch of 300,000-400,000 tons (MRC/DOF, 1998/1999) and population of 11.4 million the annual per capita consumption can be estimated about 23-31 kg (So Nam and Nao Thuok, 1999). This is not yet included the per capita consumption from aquaculture of about 1.2 kg. Comparing with consumption from other protein sources from beef (3.3 kg), pork (8.5 kg) and chicken (2.8 kg), the protein consumption from fish is much more significant than from others sources (FAO, 1993). Moreover, it is comparable with other Southeast Asian countries.

Ahmed et al. (1998) reported that rice occupy 90% of total cultivated land (1.844 million ha) and supplies 75% of the total calories. Rainfed rice occupies 77% of the total cultivated land and produces 67% of rice annually. Eighty-four per cent of the farmers operated 1-5 ha of land (Oversen et al., 1996). Rice and fish are twin nutritional staples for majority of Cambodians, particularly for the 80-85% rural poor (Oxfam GB 2000; Williams, 1999; Gutman, 1999; Degent and Thuok, 1998). A number of authors have commented that the role of aquatic resources (mainly fish), in supporting rural livelihood has been under estimated or over-looked (Gum, 2000). Gregory (1997), Gregory and Guttman 1999, and Gutman 1999 indicated that this is noted for the importance of rice field ecosystem, for utilization of off-farm common property such as fisheries and forests (Numa and Ahmed 1996) and for fisheries in general (Detgen et al., 2000; Phounsavan et al., 1999; Van Zalinge and Thuok, 1999). Oxfam 2000 reported that the main livelihood activities in the study area (4 villages in Battambang province) are rice and Charmkar cultivation and fishing (other aquatic resources collection). The aquatic resources therefore, not only provide a source of food but also importantly, a source of cash. Utilization of aquatic resources (mainly fish) is an important livelihood

activity for all families in the study area and for the landless, represents the main source of income.

Cambodia's rice fields and floodplains still produce a significant amount of aquatic products such as fish, shrimps, frogs, crabs and snails. These are vital importance for local food supply and a source of income and subsistence to peasant households. Gathering of uncultivated vegetable food items and catching of fish from floodplains and flooded ricefields are a necessary buffer to the yearly supply of food and income whenever crop production fails, which is a common phenomenon (Ahmed et al. 1998; Ovesen et al., 1996).

Another type of aquatic ecosystem is flooded forest, which also plays an important role in the household food production and income systems. Despite encroachment and destructive practices, Cambodia still has nearly 700,000 ha of its area under flooded forests. The common use of flooded forest are: charcoal, fire wood, encroaching agriculture, catching wildlife through setting fire in the forest, supply of brush shelter and other fishing devices, and construction materials. In addition, food medicine, honey, dye and glue are collected from flooded forests. The wildlife includes crocodiles, snakes, turtles, frogs and waterfowls. They are indiscriminately hunted for food, trade and other products.

### ***3.4 Geographic Distribution of Aquatic Resources Use in Cambodia, emphasizing use by the Poor***

The Sustainable use of aquatic resources (primarily fisheries) and their environment are necessary precondition for the continued supply of fish and livelihoods to rural people. Being a common national resource pool, human intervention is critical in maintaining the sustainability of Cambodia's capture fisheries.

Many authors provide an overview of the management of the freshwater capture fisheries of Cambodia (Degent et al., 2000; Gum, 2000; Ofam GB, 2000, Vuthy et al., 1999; Thuok and Sina, 1997). The Department of Fisheries (DoF), under the Ministry of Agriculture of Agriculture, Forestry and Fisheries (MAFF), has its mandate to manage fisheries and other aquatic resources within Cambodia. The Fisheries-Fiat Law on "Fisheries Management and Administration" was issued on 9<sup>th</sup> March 1987. This law classifies all permanent and temporary water bodies including flooded forests types, as the fisheries domain. Tana (1990) indicated that within the fisheries domain, all living aquatic animal and vegetation able to reproduce are considered to be property of the State.

By law, the fisheries domain is divided into areas assigned by group, and the protected fisheries domain. The designation of each category and the actual boundaries of these areas are the responsibilities of the MAFF (Tana 1990).

The areas assigned by group include:

- Areas defined as fishing lots (concession) for commercial exploitation;



- Areas defined as fish sanctuaries. These areas are reserved for fish reproduction in both wet and dry season, which they are deeper than other areas in the fisheries domain, and for scientific research. There are 13 fish sanctuaries, 8 situated in the Great Lake, throughout the country (DoF, 2000).
- Areas defined as inundated forest areas. These areas include those flooded seasonally by monsoon and are very important habitats for fish spawning and feeding (Fisheries-Fiat Law, 1987). It is estimated that 85% of the remaining freshwater inundated forests is found around the Great Lake (AWB, 1993; Gum, 1998). This includes inundated forest areas located inside fishing lots (Degen and Thuok, 1998)

The protected fisheries domain comprises fishing areas outside of the areas assigned by group. Fishing is regulated by classification of permitted fishing gears into family or small scale and middle scale. Both the middle and commercial scale (fishing lots/Dais) fishing gears are subjected to open fishing seasons, where family-scale fishing is permitted throughout the year (Tan 1971, Tana, 1996). The open seasons of fishing are as follows:

- From 1<sup>st</sup> October to 31<sup>st</sup> of May for areas to the North of the Quatre Bras parallel (Chaktomuk River)
- From 1<sup>st</sup> November to 30<sup>st</sup> of June for areas to the South of the Quatre Bras parallel (Chaktomuk River)

The fisheries management system is based on the categorization of fishing into family-scale, middle-scale and large/commercial-scale determined by Proclamation. The criteria for classification of each fishing gear is based on the size of the gear, the method of fishing and the catch capacity of the gear.

### 3.4.1 Large or commercial-scale

These areas are exclusive geographic areas (lots/dais) for large fishing. The size of fishing lot ranges from 20 km<sup>2</sup> to 350 km<sup>2</sup>, including lakes areas, river areas and inundated forests. Vuthy et al. (1999) indicated that traditionally, lots are awarded through competition, public bidding system for a period of 2 consecutive years, with auction fee of the first year payable as well, in the second year. In total there are 270 fishing lots and bag net fishing lots or Dais (Figure 3.1; Table 3.4), throughout the country, which are divided into: (1) lake-stream fishing lots (135); (2) sand-bank fishing lots (20); and (3) bag net fishing lots (Dais) (115), collecting small fish, white lody carp, prawn and *Pangasius* seed. Table 3.4 shows the distribution of fishing lots and Dais, by province. Twelve out of 24 municipalities/provinces comprises fishing lots and bag net fishing lots (Dais). There are 80 fishing lots and Dais in Kandal, compared to only 4 fishing lots in Banteay Meanchey. Bagnet fishing lots for prawn are only located in Prey Veng province (13 bag net). There are two provinces of Prey Veng (10) and Kandal (21) comprising of bag nets or Dais for collecting *Pangasius* seed.

The fishing lot system was first codified in 1908 and now covers approx. 8,529 km<sup>2</sup> of most of the productive fishing areas in the country (Gum, 2000). The largest fishing lots are found in Great Lake, which are composed of about 80% of the total areas of the Lake. The owner of each lot has the exclusive right to harvest fish from the lots following the specific guidelines “Burden Book” for each lot. These guidelines describe the open season, the payment schedule, permissible fishing gears, the boundaries, the main geographic features and the designated public fishing areas for each (Degen and Thuok, 1998).

Table 3.4: Distribution of fishing lots and Dais, by province, Cambodia, 1998

Province	Riverine -lake fishing lot	Bag net fishing lot	Bag net fishing lot for white lady carp <sup>1</sup>	Bag net fishing lot for prawn	Bag net fishing lot for <i>Pangasius</i> seed <sup>2</sup>	River- bank fishing lot	<b>Total</b>
<b>Plains region</b>							
<b>(Mekong-Bassac)</b>							
1. Phnom Penh	1	25					<b>26</b>
2. Kandal	19	38	1		21	1	<b>80</b>
3. Kampong Cham	12					12	<b>24</b>
4. Prey Veng	19		7	13	10		<b>49</b>
5. Takeo	20						<b>20</b>
<b>Tonle Sap Great</b>							
<b>Lake region</b>							
6. Kampong Thom	7						<b>7</b>
7. Siem Reap	7						<b>7</b>
8. Banteay Meanchey	4						<b>4</b>
9. Battamabang	12						<b>12</b>
10. Pursat	7						<b>7</b>
11. Kampong Chhnang	19						<b>19</b>
<b>Upper Mekong</b>							
<b>region</b>							
12. Kratie		8				7	<b>15</b>
<b>Total</b>	<b>135</b>	<b>63</b>	<b>8</b>	<b>13</b>	<b>31</b>	<b>20</b>	<b><u>270</u></b>

<sup>1</sup> Khmer name: Tey Linh (scientific name: *Thynichthys thynnoides*)<sup>2</sup>. In 1996, bag net fishing lots for collecting *Pangasius* seed were banned to operate.

Source: Department of Fisheries- Exploitation Office (2000).

The bag net lot system (Dai) is a fixed riverine position, where large nets were allowed to capture large quantities of migrating small “ white fish, mostly cyprinid carp, including Trey Riel/Linh”; these migrations are highly seasonal and related to the lunar cycle. During the peak of the fishing season, several hundred kilogram or even one ton of fish can be caught in just 5-10 minutes (Thuok and Sina, 1997). The bagnet fishery contributed 10-20% of the total catch of 72,500 tons from large scale fishery in 1995 (Deap, 1999). The total catch from bagnet fishery in Kandal and Phnom Penh is shown in Table 3.5. The Dai fishery is the main contributor to fish paste (Prohok), fish sauce

(Tuktrey) and fish feed and fish meal for aquaculture development. Every year a huge migration takes place within Cambodia to the Tonle Sap to trade rice for small fish (trash fish) to make fish paste (Prohok), a key component of seasonal food security for poor rice farmers.

Table 3.5: Bagnet (Dai) fishery catch in Phnom Penh and Kandal, Cambodia, 1999

Year	No. of dais	Fish catch, by month (ton)						Total (Ton)
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	
1995	63		128	386	5379	6979	1569	<b>14429</b>
1996	68	8	71	363	10104	15581	3361	<b>15488</b>
1997	68		92	989	11043	16602	945	<b>14671</b>
1998	63	12	19	4942	3803	199		<b>8894</b>

Source: Deap L. (1999).

Ngor Peng Bun (1999) reported that collected *Pangasius fry* (*Pangasius hypophthalmus*) by mosquito bag net is a profitable business and is a recent fishing practice since the 1980s which takes place in a relatively short periods, from June-July and sometimes till August. The activity was mostly operated by Vietnamese fishers, who are supported by military groups, and Cambodia fishers, with the support of civil and military high rank officials, in four major provinces, Kampong Cham, Kandal (Neak Loeung down to the Cambodian-Vietnames border in Leuk Dek district), Prey Veng and Phnom Penh. Millions of fry were shipped to many private nurseries in Dong thap province, Vietnam for further distribution to cage and pond culture enterprises in eight provinces of the Southern Vietnam, while small numbers of fry are kept for pond culture in Cambodia. In 1989, this was incorporated in the Fisheries Fiat Law, as bag net fishing lots, in order to manage its stock and improve its productivity for rural food security of Cambodia. The collection of a single target species of *P. hypophthalmus* fry (about 25%) have imposed negative impact on other many species, particularly small cyprinids of about 70-80% of the total catch (Tana, 1992). The collection of this fry has expanded in the main channel of the Mekong river from Kampong Cham-Kratie border down to Cambodian-Vietnam bother. It also takes place in the whole Tonle Toch river in Kampong Cham province and Prey Veng province and in the Tonle Sap river from Phnom Penh to Prek Kdam. Bun P.N (1999) also reported that the total catch reaches from 0.5 to 1.0 million fry per Dai per day in Muk Kampul district, Kandal province. The total numbers of Dais and total catch of *P. hypophthalmus* fry is summarized in Table 3.6. MRCS reported that each year at least 100 million are exported to Vietnam.

Table 3.6: Distribution of Dais and catch of *P. hypophthalmus* fry, by province, Cambodia, 1998 (million heads)

	Kandal/Phnom Penh	Kampong Cham	Prey Veng	Total
No. of Dais (unit)	652	161	136	949
<i>P. hypophthalmus</i> fry	703-1,862	173.9-386.4	1.4-4.7	878.3-2,253

Source: Calculation from Bun P.N. (1999).

Ahmed et al. (1998) reported that the involvement in large scale fishing by household living in fishing dependent communes is generally very limited. Fishing lots are leased rich people coming from outside fishing the communities. Very few fish workers are also often brought from other locations. Ahmed and Tana (1996) found that very few of people living in the adjustment or nearby fishing communities get employed or choose to work in the large scale fishing operation as fish workers. As shown in Table 3.7, only 23 household heads, of total 1985 households, represent 1.2% of the fishing households, and some 42 members from the fishing house holds are engaged in large scale fishing operation. Also none of the households from Kandal, Siem Reap and Pursat province have any involvement in large scale operations as leaser or sub-leaser, although many of the fining lots are located within these provinces (see also Table 3.4).

Table 3.7 Distribution of fishing households\* by category of fishing involvement in open season, Cambodia, 1996

Category of involvement	Household heads		All household	
	No. of households	%/b	No. of households	%/c
Family fishing	1599	87	1971	99
Middle-scale fishing	172	9	283	14
Large-scale fishing	19	1	23	1
Commercial fish workers	45	3	53	3
<b>Total/a</b>	<b>1835</b>	<b>100</b>	<b>2330</b>	<b>117</b>

Source: Ahmed et al. (1998).

\* Households living in Tonle Sap Great Lake region (6 provinces) and Plains region (2 provinces and Phnom Penh).

/a The total may exceed the number of households engaged in fishing as members in some households are involved in more than one category of fishing.

/b Expressed as % of households in which the heads of the households are fishing (n= 1835).

/c Expressed as % of total numbers of fishing households (n=1985)

The distribution of households engaged in large scale fishery by type of fishing ground or fishing lots in Phnom Penh, K. Cham, K. Chhnang and K. Thom is shown in Table 3.8. The average area of fishing lot is 24 182 m<sup>2</sup> for fishing lot leased or sub-leased by household heads (Ahmed et al., 1998). 16.7% of household, on average, have engaged in the large scale fishery in Tonle Sap Great Lake (5 province) and Mekong-Bassac Plains region (3 province). These household heads have operated in their fishing lots for an average of 2 to 10 years but they have been involved in such fishing activity for 9 to 30 years.

The total production of fish from large scale fisheries (fishing lots), province by province and nationally is shown in Table 3.1 and Table 3.2. The commercial fish production nationally varies from 18,400 tons in 1980 to 71,000 tons in 1999. Kampong Chhnang catches more fish (117,900 tons), followed by Kandal (12,344 tons) and Pursat (7,300 tons) and Siem Reap (7,000 tons) in 1999. Van Zalinge and Thuok (1999) indicated that the large scale fishery catch accounts for 45,000-80,000 tons (Table 3.9),

which is comparable to the figure of commercial fish catch (large scale and middle scale fisheries) informed by the DoF.

Table 3.8: Distribution of households (number) engaged in large scale fishing in various fishing grounds, Cambodia, 1999

Fishing ground	Phnom		K. Cham	K.	Siem	Pursat	Battam	K.	All
	Penh	Kandal		Chhnang	Reap		bang*	Thom	
Riverine/lake lot	2	0	5	4	0	0	-	2	13
Fish dai lot	1	0	0	0	0	0	-	0	1
River bank lot	0	0	4	0	0	0	-	0	4
Prawn dai lot	0	0	0	0	0	0	-	0	0
Others	0	0	0	1	0	0	-	0	1
<b>Total</b>	<b>3</b>	<b>0</b>	<b>9</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>23</b>
<b>% of households engaged in large scale fishing</b>	<b>7.7</b>	<b>0</b>	<b>37.5</b>	<b>26.3</b>	<b>0</b>	<b>0</b>	<b>33.3</b>	<b>28.5</b>	<b>16.7</b>

\* Information on the distribution of households by fishing grounds was not available for Battambang.

Source: Calculation from Ahmed et al. (1998) Table 3.47.

Table 3.9 Range of the annual inland water catch in the years from 1994-1998, Cambodia.

Cambodia. Range of the annual inland water	Catch in the years from 1994-1998 Annual catch range (tons)
• Large scale fisheries	
- Fishing lots <sup>1</sup>	30,000 - 60,000
- Dai (bagnets) <sup>2</sup>	15,000 - 20,000
• Middle scale fisheries <sup>3</sup>	85,000- 100,000
• Family fisheries <sup>3</sup>	115,00 - 140,000
• Rice field fisheries <sup>4</sup>	45,000 - 110,000
<b>• Total Inland Fish Catch</b>	<b>290,000- 430,000</b>

Source: Deap et al.(1998) and Ahmed et al. (1998).

<sup>1</sup>Range reflects uncertainty in actual catch levels.

<sup>2</sup>Range shows approx. minimum and maximum value in 1994-1998.

<sup>3</sup>Based on socio-economic survey data extrapolated to entire country.

<sup>4</sup>Approx. 1.8 million ha (rice fields) x likely range of fish yields: 25-62 kg/ha.

Rainboth (1996) found that the river and lake ecosystems of Cambodia support rich fish diversity. The species composition of fish in the household catch varies by fishing season, category of fishing and geographic area. In the socio-economic household survey that the DoF/MRC-FCFMC carried out in the fishing districts of 8 provinces (5,117 households), they found that there are 15 of the most important species in terms of quantity in the household catch (Table 3.10). The highest number of households in all fishing categories reported mud carp (Riel) as the most important species in terms of

quantity in their catch. This followed by climbing perch (Kranh Srai), snakehead (Raws) and moonlight gourami (Kawmpleanh). Van Zalinge and Thuok (2000) reported in the 12 provinces where they working now, in close cooperation with the DoF, and are composed of fishing lots (Table 3.4), the composition of species caught also differs from fishing categories, season and geographic area. In Table 3.11 shows the top ten species in terms of quantity and value, nationally. The first top species (Riel) is caught by the rural household, averaged of 36.5% compared to only 21% in the national level. Other three species of Raws, Pruol and Pra are caught by both rural households and nationally (all levels or quintiles of people).

More intensive gears are used in fishing lots, such as bamboo barrage traps to enclose large areas and seine nets to enclose shoals of fish. Most of the gears used in large scale fishing are jointly owned by share the shareholders.

Table 3.10 Percentage of households reporting the most important species (ranked as number one in items of catch quantity by category of fishing, 1996

Name of species*	Scientific name	Family fishing (n=1758)	Middle-scale fishing (n=207)	Large-scale fishing (n=22)	Total
Riel (mud carp)	<i>Henicorhynchus spp.</i>	33.2	44.4	31.8	36.5
Kranh Srai (climbing perch)	<i>Anabas testudinus</i>	10.5		4.5	
Raws (snakehead)	<i>Channa marulius</i>	8.6	4.3		
Kawmpleanh (moonlight gourami)	<i>Triochoaster microlepis</i>	6.0		4.5	
Kanchos (myastus catfish)	<i>Mystus spp.</i>	3.2			
Kampus (small shrimp)		3.1	2.4		
Changva (blue danio)	<i>Danio aeguipinnatus</i>	2.4	4.3	9.1	5.2
Kes (common sheat fish)	<i>Micronema spp.</i>	2.0		13.6	
Andaing (walking catfish)	<i>Clarias spp.</i>	2.3			
Chhlang (yellow Mystus)	<i>Mystus nemerus</i>	1.9			
Linh (white lady carp)	<i>Thynnichthys thynnoides</i>	1.5	1.9		
Ta aun (whiskered sheat fish)	<i>Ompok hypophthalmus</i>	1.6	4.8	9.1	5.1
Pruol (small scale mud carp)	<i>Cirrhinus micrlepis</i>		3.4		
Pra (tridescent shark-catfish)	<i>Pangasianodon hypophthalmus</i>		2.4		
Klang hey (twisted faw sheat fish)	<i>Belodontchthys dinema</i>		1.9		

Source: Ahmed et al. (1998).

Recently, the DoF has introduced a new management category referred to as “research lots”. The allocation of research lots began in 1997 with the designation of 7 lots. During the auction period of 1999-2000, the system of research lots expands to 69. A key feature of research lots is that they no longer are subjected to public auction and are instead allocated and managed by direct agreement between lot owners and the DoF/MAFF. In addition, these arrangements are valid for 4-6 years (Seilert and Lambert 2000). The intention appears to be to re-classify all riverine and lacustrine lots as research lots. The objective is to improve the management of lots through research into catches, fish biology, water quality and impacts, operation and socio-economic

conditions of local fishing communities. Vuthy et al. (1999) reported that the DoF has added new conditions to the management of these lots such as demarcation of boundaries, canal rehabilitation, re-planting of flooded forests etc.

Table 3.11: Cambodia. Ranked relative species composition (top-ten species only) and value of the 1995/96 catch by category of fishing (Deap et al., 1998). Family and rice field fisheries have not been included due to insufficient data

Species name	Lot (%)	Dai (%)	Middle (%)	Total catch (%)	Total value (%)
1. Riel ( <i>Henicorhynchus spp.</i> )	11	40	20	21	9
2. Chadaur ( <i>Channa micropeltes</i> )	16	-	8	9	19
3. Chakauk ( <i>Cyclocheilichthys enoplos</i> )	8	1	13	9	8
4. Khnong Veng ( <i>Dangila spp.</i> )	5	6	7	6	2
5. Kroum ( <i>Osteochilus spp.</i> )	2	10	2	4	2
6. Pruol ( <i>Cirrhinus microlepis</i> )	5	3	2	3	4
7. Pra ( <i>Pangasius spp.</i> )	8	0	1	3	3
8. Chhpin ( <i>Barbodes goninotus</i> )	3	0	4	3	2
9. Sluk russey ( <i>Paralabuca typus</i> )	1	11	0	3	1
10. Raws ( <i>Channa striata</i> )	5	0	1	2	6
Weight % of 10 species	64	70	59	63	56
Share in total catch	33	23	44	100	
Share of total value	41	15	44		
Number of species recorded	75	44	62		

### 3.4.2 Middle-scale fishery

The middle-scale fishery requires licenses by the DoF. These licensed gears with a fee payable based on the expected catch per season per gear type. It comprises gill nets no longer than 10 m, seine nets, fish traps associated with bamboo fence, hooked long line, lift net, fishing trap bigger than 30 cm in diameter etc. Middle-scale gears can be used through the fisheries domain but only during the open season and outside fishing lots and fish sanctuaries.

Most of middle-scale fishers operate Mekong upper (37%) and Tonle Sap (31%) (Ahmed et al., 1998). Those along the Great Lake and its adjoining small rivers/lakes comprise 18% of the total middle -scale fishers (Table 3.13). Those engaged in the middle-scale fishing are mostly license holders with one cosharer located in almost all provinces under the study except in Kandal and Battambang.

Middle-scale fishing is also operated Takeo, Prey Veng, Kratie, Stung Treng, Bantey Meanchey. Table 3.14 shows number of middle-scale fishing gears licensed in 1999.

Table 3.13 Number of households engaged in middle-scale fishing in various fishing ground in 8 provinces of Tonle Sap Great Lake, its tributaries/lakes and Mekong/Bassac

Fishing ground	Phnom Penh	Kandal	K. Cham	K. Chhnang	Siem Reap	Pursat	Battambang	K. Thom	All	%
Tonle Sap	31	6	0	32	0	0	1	17	87	30.7
Great Lake	0	0	0	2	5	0	14	0	21	7.4
Mekong upper	16	0	90	0	0	0	0	0	106	37.5
Mekong Lower	2	0	4	0	0	0	0	0	6	2.1
Bassac river	4	0	0	0	0	0	0	0	4	1.4
Small river/lake connected to Tonle Sap	1	0	0	5	0	0	0	11	17	5.7
Small river/lake connected to Great Lake	0	0	0	0	0	30	0	0	30	10.6
Small river/lake connected to Mekong/Bassac	4	1	7	0	0	0	0	0	12	4.2
Others										
<b>Total</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0.4</b>
<b>(%/a)</b>	<b>58</b>	<b>8</b>	<b>101</b>	<b>39</b>	<b>5</b>	<b>30</b>	<b>15</b>	<b>28</b>	<b>284</b>	<b>100</b>
	<b>21.32</b>	<b>0.70</b>	<b>8.68</b>	<b>8.30</b>	<b>0.96</b>	<b>6.56</b>	<b>2.41</b>	<b>5.94</b>	<b>5.55</b>	<b>100</b>

/a Percentage of number of households surveyed.

Table 3.14: Distribution of middle-scale fishing gears licensed, by province, Cambodia, 1999

Province	Morng (gill net)	Uorn (seine net)	Neam (deep bag net)	Chuorn (Vee)	Chayra (big cone shaped net)	Lop (drum trap)	Lop Nor Rarv (bamboo fence trap)	Hooked long line
	(meter)	(unit)	(unit)	(unit)	(unit)	(unit)	(unit)	(unit)
1. Phnom Penh	23000	3	50	5	16	10		1500
2. Kandal	36150	27	36	11	27			7050
3. Kampong Cham	32230	1250	1		22			
4. Prey Veng	1620	1	8		38			
5. Takeo	-	71						
6. Kampong Thom	3700	40						18000
7. Siem Reap	100000	25					11	65000
8. Banteay Meanchey	81500	53						
9. Battambang	68500	38		15			72	
10. Pursat	135040	42				900	10	72450
11. Kampong Chhnang	144500	35	92	50	45	2800		
12. Kratie	10000	60		1	1			
13. Stung Treng	55000	12						
<b>Total</b>	<b>724540</b>	<b>1657</b>	<b>187</b>	<b>85</b>	<b>500</b>	<b>3796</b>	<b>200</b>	<b>164000</b>

Source: DoF (2000). Fisheries Data and Statistics.

The total production of middle-scale fishery varies from 85,000 to 100,000 tons according to season and uncertainty in actual catch levels (Table 3.9). This catch



contributes about 23% to the total freshwater fisheries catch, which includes family and rice field fish catches, and 44% while excludes the last two category of fishing (Table 3.11). According to the socio-economic households survey (5,117 households) in selected 8 provinces around Tonle Sap Great Lake and Mekong/Bassac, only 5.5% of the total number of households engaged in middle-scale fishing, with the average catch 3.4 tons per household per annum. It is meant that very few of the rural poor can access to the middle-scale fishery. The estimated catch of 84,826 tons per annum is reported from just 8 provinces (total households = 452714), comparable to total fish catch of middle-scale fishery in Cambodia (Table 3.15). The top ten fish species caught and value of the middle-scale catch are shown in Table 3.11. Ahemd et al. (1998) also reported the 15 important fish species caught by 207 households engaged in middle-scale fishery (Table 3.10).

Table 3.15: Estimated average annual catch for fish from middle-scale and family -scale fishing, the study provinces, Cambodia, 1996

Province	Total no. of households/a	% of household engaged in/b		No. of household engaged in		Average. annual catch per household (kg)		Total catch per annum (ton)		
		Middle - scale	Small-scale	Middle-scale	Small-scale	Middle - scale	Small -scale	Middle-scale	Small-scale	Total
Phnom Penh	27224	21.32	34.93	5805	9508	3896	1111	22617	10565	33178
Kandal	134220	0.70	29.90	944	40136	2610	905	2465	36319	38771
K.. Cham	96712	8.68	38.40	8392	37139	1334	263	11194	9767	20966
K. Chhang	42335	8.30	54.68	3513	23149	1981	1137	6959	26320	20966
Siem Reap	35937	0.96	38.81	344	13949	8750	462	3006	6444	33281
Pursat	34766	6.56	52.08	2282	18106	5248	354	11977	6410	9462
Battambang	47724	2.41	46.07	1149	21985	3929	704	4515	15475	18378
K. Thom	33796	5.94	22.08	2009	7462	6802	836	13666	6238	19994
<b>All</b>	<b>452714</b>	<b>5.55</b>	<b>38.52</b>	<b>25126</b>	<b>174379</b>	<b>3376</b>	<b>658</b>	<b>84826</b>	<b>114686</b>	<b>199204</b>

Source: Ahmed et al. (1998). Table 3.48; 3.49;3.54; and Table 3.55.

/a Based on total families in the 8 provinces.

/b Based on percentage of household engaged in middle-scale (5.5%) and small-scale (38.5%).

### 3.4.3 Family-scale or subsistence Fishing

The family-scale fishing is not licensed and these family gears can be used throughout the year and throughout the fisheries domain, except in fish sanctuaries. These family gears can be used inside fishing lots in areas designated as “set aside” for people during open season and throughout the lots during the closed season (Cambodia- Fisheries-Fiat Law, 1987).

The law makes provision for access to fishing grounds for “family scale” fishing, which is distinct from commercial fishing activity. The definition of subsistence level fishing is based on fishing effort and monitored by gear size. However the definition of subsistence is not based on the level of fishing effort required to derive a subsistence living. Therefore in order for poor people to derive a livelihood from fishing they must operate a level of fishing effort disallowed by law. This is recognised by many local authorities that do not routinely pursue subsistence fishers. However, the privatisation

of most of the national inland fishery has brought subsistence fishers into conflict (sometimes violently) with lot operators.

The law currently provides no basis for people to escape from poverty through incremental increases in fishing effort.

Many authors have discussed aquatic resources (primarily fisheries) and livelihoods and access and conflicts in specific province, particularly the provinces around the Tonle Sap Great Lake (Azimi et al., 2000; Gum, 2000; Oxfam, 2000, Degen et al., 2000, Cambodia Daily Newspaper, 2000; Sothirith, 2000; Kato, 1999, Thuok and Song, 1999; Swift, 1999; Van Avker, 1999; and Ahmed et al., 1998), and few studies have done at provinces situated on the Mekong upper and its major tributaries such as Stung Treng (EGW, 2000) and Ratanakiri (Phiak, 2000; FPO, 2000). The above mentioned authors conclude that the fishers or the rural poor's livelihoods are dependent on aquatic resources (mainly fisheries) for subsistence food and family generating income and they have limited access to fisheries resources, particularly productive fishing grounds or fishing lots.

Ahmed et al. (1998) reported the regional distribution of households engaged in family - scale fishing. They found that subsistence fishers concentrate only in the small rivers and lakes (39%), followed by inundated forests (17%) and Tonle Sap (15%) (Table 3.16; Table 3.17). The total percentage of households engaged in family-scale fishing in the study provinces is 39%, equally 174,379 households out of 452,714 households living in the fishing districts of eight provinces around the Tonle Sap Great Lake and Mekong/Bassac regions (Table 3.15). Note that family fishers have limited access to good fishing grounds thus prompting them to violate fish reserves and go beyond lot boundaries in or to obtain a bigger catch for their fishing efforts (Ahmed et al., 1998 and 1996).

Table 3.16: Number of households engaged in family fishing during the open season in various fishing grounds by province in Cambodia, 1996

Fishing ground	Phnom Penh (n=95)	Kandal (n=340)	K. Cham (n=447)	K. Chhnang (n=257)	Siem Reap (n=203)	Pursat (n=238)	Battam bang (n=287)	K. Thom (n=104)	Total (n=1971)
Great Lake	0	0	0	4	33	2	0	6	45
Tonle Sap	13	5	37	150	12	0	0	0	217
Flooded Ricefield	21	76	71	58	96	16	141	39	518
Mekong River	0	11	131	1	1	0	0	0	144
Bassac River	0	30	12	2	5	2	0	1	52
Small river/lake	27	268	169	122	147	157	245	70	1205
Inundated Forest	16	64	33	67	81	30	197	29	517
Ohters	0	0	0	0	0	0	1	0	1
<b>Total/a</b>	77	454	453	404	375	207	584	145	2699

/a Indicate number of households engaged in fishing, This may exceed the total number of households engaged in family fishing in some of the provinces since some households fish in more than one fishing grounds.

Source: Ahmed et al. (1998).

Table 3.17: Number of households engaged in family fishing during the closed season in various fishing grounds by province in Cambodia, 1996

Fishing ground	Phnom Penh (n=95)	Kandal (n=340)	K. Cham (n=447)	K. Chhnang (n=257)	Siem Reap (n=203)	Pursat (n=238)	Battam bang (n=287)	K. Thom (n=104)	Total (n=1971)
Great Lake	0	0	0	4	35	4	0	0	43
Tonle Sap	28	3	27	136	6	0	0	6	206
Flooded Ricefield	43	60	117	76	107	204	111	45	763
Mekong River	8	11	133	0	1	0	0	0	153
Bassac River	4	24	16	2	4	2	0	1	53
Small river/lake	36	264	215	124	93	125	217	72	1146
Inundated Forest	27	56	50	77	80	33	148	31	502
Ohters	1	0	0	0	0	0	0	0	1
<b>Total/a</b>	147	418	558	419	326	368	476	155	2867

/a Indicate number of households engaged in fishing, This may exceed the total number of households engaged in family fishing in some of the provinces since some households fish in more than one fishing grounds.

Source: Ahmed et al. (1998).

The family-scale fish catch varies from 115,000 to 140,000 tons per annum, which contributes to 32.5% of the total freshwater fish production, including rice field fishery (Table 3.9). The last 15 years the family-scale catch did not appear in the government statistic table as they paid less attention to the livelihoods of the poor who are dependent on fisheries resources for their food security and income generation. Recently, this has been fully recognized and the government (DoF/MAFF) adopted the family-scale fish catch from the DoF/MRC-FCFMC in 1998 since they have not enough budgets for conducting research and collecting data and information. The DoF are encouraging all 24 municipalities/provinces fisheries divisions to pay more attention to collect such data, and it is focusing on the provinces where are situated far from Tonle Sap Great Lake, Mekong and Bassac rivers, such as Kompong Speu, Ratanakiri, Mondulkiri, Preah Vihea and Ortdar Meanchey, which are not rich in fisheries resources.

Table 3.15 show the percentage and number of households engaged in family-scale fishing in selected 8 provinces around Tonle Sap Great Lake and Mekong Bassac region, the average catch per household and the total family-scale fish catch in those provinces. The 15 important fish species is shown in Table 3.10.

The types of fishing gears/equipment depend on the environment conditions and the species to be caught. There are restrictions on the types of fishing gears that can be used in fishing (Tan 1971). Family fishers use smaller gears than middle-scale and large-scale fishers. An estimated 102,603 households (65% of the total fishing households involved in family-scale fishing) from eight provinces use gillnet during closed season. Bamboo and rattan traps are used by 44,342 households (28%). Harpooned gear, castnet, scooping net, small handle dragnet and single hooked line are also used by subsistence fishers in both closed and open seasons (Ahmed et al., 1998).

Ahmed et al. (1998) also reported that beside direct participation in fishing a large number of households were also involved in various fishing related activities such as fish processing, bamboo fence trap/net making or repairing, wholesale/retail fish buying and selling and fish oil extraction. Processing of fish was the single activity in the fishing dependent communes. A total of 35% of the households reported involvement in

fish processing as an important livelihood activity. Fish selling and net making were undertaken by 15% and 11% of the households, respectively.

Hence fishing and fishing related activities are crucial for daily livelihoods of the subsistence fishers. In the following aspect, the livelihoods of subsistence fishers and aquatic resources, in particular fisheries will be discussed.

### **☛ Livelihoods of Subsistence Fishers and Aquatic Resources**

A lot of authors reported the aquatic resources (mainly fisheries) are significantly play a very important role in food security of the poor. The three were studies conducted in three different areas; communities actively engaged in fishing in Tonle Sap Great Lake and Mekong/Bassac regions (Ahmed et al., 1998), protracted emergency target communities which are largely upland displaced persons (Helmert and Kenefick, 1999) and lowland rice farming communities with little access to recognized productive grounds (Gregory, 1999). The common theme of these studies is that the rural households sampled, fish is a major food items that is either bought or caught, the percentage contribution from either source dependent on the households' access to areas to fish.

Gum (2000) reported that access to fishing areas is a dominant theme through the literature reviewed. Access has two main components, the availability areas to fish and the availability of rights to fish these areas. The availability of areas to fish such as lake, stream, canal, rice field, inundated forest etc, appears to be not a major problem. Almost the entire land areas of Cambodia lies within the Mekong floodplains and the DoF considers 13 provinces, out of Cambodia's 24 provinces and municipalities, as commercial produces of freshwater fish. These provinces contain the vast majority of population and it can therefore be assumed that there are sufficient areas available for most of the population to catch fish. The major issue therefore revolves around the rights to fishing areas.

Ahmed et al. (1998), in a households survey of 5,117 households in eight provinces found that 92% of the families reported that they have access to Common Property Resources (CPRs), such as inundated forest, rivers, lakes, flooded ricefields, irrigation canal and dikes, located within or outside of their communes. Major uses of there areas include food collection, grazing of livestock, cultivation of crops or utilization of water. There will be a significant negative effects on the livelihood opportunities available, especially for subsistence households whose alternatives are extremely limited if restrictions are imposed on access to and exploitation from these common proper areas.

Degen et al (2000), Vanzalinge and Thuok (1999), Thuok and Sina (1997), and Shamr and Ahmed ( 1996) reported that the family-scale or subsistence fishing component of this catch, is considered to be as important as the commercial component, in terms of production and distribution.

Oxfam (2000), in the mini case study in four villages of Battambang province, found that access to fisheries resources not only provides a source of food but also importantly, provides a source of cash. A total of 77-90% of all families interviewed

(three categories: 1. landless, 2. have land and draft animals and have land and without draft animals) were indicated to be active in fishing and 20-42% active in collecting aquatic plants. Some of the interviewed households have stop using the rice land (flooding, many rats and high risks of crop failures) and reported that fishing allows family to buy food.

Dege et al. (2000), however, despite the importance of the subsistence fishery, it is largely excluded from the fisheries management policies. In addition they observed that the typical rural subsistence livelihood strategy incorporating elements of private and CPRs utilization provide equitable access without major capital requirements. Furthermore fisheries are largely CPRs, and there is therefore, a need to define access user right and, with it, distribution entitlements.

The real threat to rural livelihoods is the combination of increasing land pressure and decreasing access to CPRs (Van Acker 1999). Furthermore, decreasing access to CPRs will affect the livelihoods of the more vulnerable households compared to those with better assets or livelihood means. Similarly, Kato (1999), in her study of landless in Takeo province notes that, as access to CPRs becomes more restricted, diminished, and priced out of reach, the poverty and vulnerability of Cambodia's rural poor will intensify.

A study on livelihood strategies in Pursat province found that the majority of population of the Northwest Cambodia is dependent on a subsistence, farming and foraging system. The typical rural livelihood strategy is thus, a balance between access to agriculture land (private property) and fisheries and forests (common property). However, in the rural Cambodia context, rational use of CPRs in combination with agriculture production may be a more sustainable strategy for food security rather than relying on agriculture production alone.

Azimi et al. (2000) note that 15% of the population of Cambodia are said to depend on the Great Lake's fisheries for their livelihoods and Thuok and Sina (1997) estimate that 88% of the population of 170 villages located in and around the inundated forest fringing the Great Lake, rely on fishing or fishing related activities. Gum (1998) has documented the almost total reliance on local fisheries and forest resources of 12 villages (13,000 people) situated within the inundated forest zone. Thuok and Song (1999) note that 67% of the population of Kompong Khleang Commune in Siem Reap province, an area situated within the inundated forest zone, have little land and rely on fishing.

EWG (2000), Cheav. (2000), Phiak (2000) and PFO (2000) reported that 90% of people (from nine different ethnic groups) living along the four rivers of Mekong and its major tributaries of Sekong, Sesan, and Srepok in Stung Treng province, northeaster Cambodia, depend on fishing for their daily food and livelihoods. These people rely heavily on fishing and also collecting riverine vegetables for food and medicine as well as collection of eggs of birds and reptiles that nest on the riverbed.

### 3.4.4 Rice Field Fishery

The rice field fishery is not defined in the previous Fisheries-Fiat Law (1987) and the new revised law (1999).

As known, rice field fishery ecosystem is rich in aquatic resources derived from animals such as fish, small shrimps (Danio), crabs, snails, beetles and from aquatic vegetable such as morning glory, lotus and water lily. These aquatic resources have been being utilized by the rural poor as food source and livelihoods.

Gum (2000) noted that these resources represent an important sources of food and income, which is traditionally, widely accessible to the rural population and requires little capital investment to exploit. However, the importance of these resources are also generally not appreciated by the government and development organizations and as a consequence, are threaten by projects that promote the conversion of wetlands into agriculture land, the use of pesticides and alter the flooding regime of rice fields.

Tana (1990) noted that while the rice field fishery is an important source of livelihood support, this fishery is generally not formally managed by any government agencies although they fall within the mandate of the DoF.

For 12 million people in Cambodia rice and fish are the key components of their diet and culture and the livelihoods of most Cambodians centre on the production/acquisition of these commodities. The natural resource base for most comprises rain fed rice land and access to aquatic resources and forest products<sup>4</sup>. Traditional community access to forests and fisheries has been eroded through privatization of these resources to commercial interests. Forests cover has declined from 73% in 1950's to 58% at present (NGO CG, 1999). Most of the forest loss has occurred in the last 20 years. During the last 5 years 62% of the remaining commercial forest resources have been allocated to foreign companies for exclusive exploitation rights (Ministry of Commerce, 1998 in NGO CG, 1999). Most of Cambodia's most productive inland fisheries have been allocated as 164 lake riverine and river beach lots concessions to business interests (Degan and Nao Thuok, 1998 in NGO CG, 1999) covering 852,900 ha (Zalinge et al. 1998 in NGO CG, 1999).

Four agro-ecosystems can be distinguished, inundated plains around the Tonle Sap lake and in the delta, the alluvial plain, the river bank and levees along the Mekong and Bassac and marsh land and lakes behind the levees. In Cambodia around 20% of the land area is cultivated and 85-90% of the cultivated area is under rice production, commonly a monoculture. Table 3. 18 show the rice cultivation system in Cambodia.

Table 3.18: Rice cultivation systems in Cambodia

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<sup>4</sup> 80% of people in rural areas depend on rainfed rice and fish and fish products constitute 75% of animal protein intake, whilst the capture/collection of aquatic resources during the "hungry months" generates income buy rice. As well as fish these include, crabs, shrimps, snails, frogs, beetles and aquatic vegetation including morning glory, lotus and water lily.

System	Planting period	Harvest	% of total area	Productivity
Lowland rain fed	Jun-Oct (transplanted)	Oct-Dec.	85	1-1.5 t/ha
Floating rice	May-Jun (broadcast)	Dec.-Jan.	6	
Flood recession	Nov-Mar (transplanted)	Feb.-May	8	3 t/ha
Lowland irrigated	Nov-Mar (transplanted)	Feb-May	<1	3 t/ha
Upland	Apr-Jun (broadcast)	Dec.	<1	

Oversen et al, 1996.

Flooding and drought affect the harvest frequently. Soils are general poor, especially in Kompong Speu, Kompong Chhnang and Takeo. Apart from the dominant rice monoculture some farm family livelihoods are based on the “rice and sugarpalm complex”. Poor sandy soils of Takeo are quite suitable for sugar palm trees. The value of cash income from 20 sugar palms equates to that from 1 ha of rice (Oversen, 1996).

The lean period is from mid-July to mid-October corresponding to the rice harvest and the pre-harvest period. Many resort to credit during this period. Aquatic resources are collected July and August. Every day foraging in and around rice fields provides uncultivated vegetables such as lotus stems as well as fish, frogs and reptiles. Studies of income shares by source in 3 provinces indicate that hunting/gathering represents 18-19% of incomes (a similar share to that from male labour) (Murshid, 1998). Women and children often undertake this.

There is not much studies on rice field fishery within Cambodia, only few by Gregory (1997), Gregory and Guttman (1999) on Overview of rice field fishery in Svay Rieng province (Southeastern Cambodia), and by Gum (1997) in Battambang province, Shams and Ahmed (1996) in Pursat province, Shams and Hong in Kompong Thom province and Ahmed et al. (1998) in 8 provinces around Tonle Sap Great Lake in the Northwestern Cambodia.

The total rice field fish catch varies from 45,000 to 110,000 tons per annum according to geographic area and season, which contributes 16-26% to the total freshwater capture fisheries (Table 3.9). Ahmed et al. (1998) reported that yields of fish caught from rice field varies from 25 kg to 62 kg per ha of rice field, with approx. 1.8 ha within Cambodia, compared to 50 kg/ha, on average, in Svay Rieng (Gregory and Guttman, 1999; Guttman, 1999), 18% of which consisted of aquatic animals other than fish such as shrimp, frogs, snails and crabs. They valued the rice field catch at approx. US\$ 100/household/year, which was up to 42% of the total average value of the rice production for the families studied.

Subsistence fishers do not only concentrate mainly in small rives and lakes, but also in flooded ricefields (26% in open season and 39% in closed season) in the selected 8 provinces around Tonle Sap Great Lake and Mekong-Bassac rivers in order to collect aquatic animals and plants for their daily food and family income (see Table 3.16; 3.17).

### 3.4.5 Aquaculture and Livelihoods in Cambodia

In the previous Fisheries-Fiat Law (1987), being a relatively new fields of development, specific laws for aquaculture in relation to the environment, research, development and management and rural food security were not available. Therefore, there is no legal definition of aquaculture in Cambodia. However, all aquaculture farm in pond or pen seized more than 0.5 ha or cage seized more 15 sq. meters, crocodile farming of more than 5 head, turtle farming of more than 50 head, boa or non-poisonous snakes farming of more than 20 head, establishment shop or store and middle scale processing of fisheries products of more than 1 ton per year or fisheries processing industry, can be taken place on the contingency that permission is available (Art. 19, Chapter 2; Art. 30, Chapter 3, March 9, 1987; Article 2, Proclamation, January 10, 1989). The issuance of licenses or permissions is done by the Department of Fisheries and provincial fisheries division.

The total aquaculture production, value, production as % of GDP and people employed are shown in Table 3.19 below.

Cage and pen culture, which is reported to have originated in Cambodia, is the major system of inland aquaculture production and its history is going back to the 10<sup>th</sup> century. Due to special hydrological cycle of the Mekong and its natural buffer reservoir, the Great Lake, the inland fish catch was always highly seasonal in Cambodia, especially in the case of the large-sized carnivores (*Channa and Pangasius* species), most sought-after by the well-to-do segment of the population. Fishermen in the Great Lake have stored first the surplus of their catch in bamboo pens or floating cages and kept them alive by some feeding, later started to stock smaller individuals to their cages in order to “fatten” and sell them in the off-season. Capturing juveniles especially for cage and pen culture and feeding them regularly over a whole growing season seems to be the end of a long evolutionary process. Cage and pen culture was thus developed and practiced by fishing communities closely interrelated with their capture fisheries activities, as it is still the case, especially in the Great Lake.

Pond culture is of recent origin. Some time around the 1960s, pond culture of Chinese carps and tilapia was attempted around Phnom Penh, the capital city and in some plantation and garden ponds. It did not, however, catch on probably because of the fact that supply of fish from capture fisheries was sufficient to meet demand and also because of the subsequent unrest lasting almost two decades.

#### **Cage and Pen Culture**

Cage culture system seems to have originated in the Great Lake, presently 77% of the cages are located in the Tonle Sap, Mekong and Bassac Rivers, only 23 % in the lakes itself (Table 3.20). Cage culture system was reportedly introduced a century ago through ethnic Chinese and later became very popular among ethnic Vietnamese. The extent of freshwater cage culture production by species and systems in Cambodia is



shown in Table 3.19. Cage culture of fish still dominates Cambodian aquaculture since ranging

Table 3.19: Aquaculture Production (ton) in Cambodia (1994-1998)

Province/municipal	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Bantey Meanchey	-	-	-	-	-	-	2	2	10	7	5	5	7	2	20
Battambang	152	6313	350	252	450	800	850	750	1,300	1,000	500	273	470	2,285	1,200
kampot*	-	100	-	1	25	-	21	-	31	30	15	83	43	50	80
Kandal	638	495	600	570	1,020	965	899	937	1,813	750	1,136	1,045	1,245	1,450	2,300
Krung Keb*	-	-	-	-	-	-	-	-	-	-	-	-	2	3	4
Koh Kong*	-	-	-	-	60	60	10	-	70	500	560	740	15	266	1,493
Kompong Cham	28	36	35	80	100	200	336	400	326	357	250	480	420	410	450
Kompong Chhnang	20	180	150	130	450	540	1,212	500	800	605	1,218	1,600	1,710	1,826	1,800
Kompong Speu	-	37	-	5	10	10	-	-	7	10	20	54	29	10	15
Kompong Thom	-	70	28	50	150	238	260	380	980	1,200	1,050	1,010	940	1,550	1,800
Kratie	96	115	125	130	240	130	93	108	107	101	70	124	150	100	105
Phnom Penh	419	740	629	782	1,110	1,050	1,007	1,050	1,193	1,000	1,150	1,103	1,210	1,050	1,285
Prey Veng	134	28	53	40	60	69	50	102	136	98	110	362	385	400	450
Pursat	-	92	80	80	275	300	460	736	550	650	856	1,380	1,450	1,226	1,600
Siem Reap	9	472	150	374	580	1,008	913	1,410	1,143	1,372	1,070	1,050	750	900	1,200
Sihanouk Ville*	28	-	-	-	15	50	57	30	13	15	35	22	35	26	23
Stung Treng	-	-	-	-	-	8	10	-	6	5	5	27	19	15	15
Svay Rieng	14	4	-	5	10	10	-	-	5	50	60	61	90	100	110
Takeo	-	-	-	-	45	100	215	295	60	150	90	81	30	80	100
Total (tons)	1,610	3,000	2,200	2,500	4,600	5,538	6,400	6,700	8,550	7,900	8,200	9,510	9,600	11,709	14,100
Value (US\$ million)	1.0	1.8	1.3	1.5	2.8	3.3	3.8	4.8	6.0	11.4	12.1	14.6	13.8	13.6	17.2
Production as % of GDP	nd	nd	nd	nd	nd	nd	0.2	0.3	0.3	0.6	0.5	0.5	0.4	0.5	0.6
Export earning (US\$)															
People employed	1,293	3,015	2,633	2,807	2,842	3,156	3,979	4,613	8,544	6,667	10,149	11,203	9,600	10,628	12,024

Source: Cambodian Department of Fisheries Data (1999); Nandeesh et al.(1997); So Nam et al. (1996); Ministry of Economy and Finance (1999).

from 90%-80% during 1984-1991 to 80%-70% of aquaculture production during 1992-1998 came from these systems, while the rest was from pond culture (Tana, 1995; Savanary, 1997, DOF, 1999). The major cultured species from cage and pen systems are *Pangasius hypophthalmus* (73%) followed by *Channa micropeltes* (21%). Other species produced include *Puntius sp.*, *Clarias batrachus*, *Oxyeleotris marmorata*, *Cirrhinus sp.*, *Puntius altus* and *Leptobarbus hoevenii* which fishermen used to stock for a couple of months for fattening during abundant catches and then sell when fish were scarce.

Pen culture is a technique practiced in some parts of the Great lake (surrounded by Siem Reap, Battambang, Pursat, Kompong Thom and Kompong Chhnang province) and in the rivers and lakes around the capital. Young fish (primarily *Pangasius* catfish species) are stocked into bamboo pen at low water level (1-3 m in depth) and are usually marketed as fingerlings/juveniles or transferred to floating cages when water starts to rise. The size of the pens may vary from 500-5,000 m<sup>2</sup> (FAO, 1993); they are smaller in the rivers and bigger in lakes.

Table 3.20: Number of fish cages and ponds, by province, Cambodia, 1999.

Province	Pond				Cage			
	Available		Used		Available		Used	
	No.	m <sup>2</sup>	No.	m <sup>2</sup>	No.	m <sup>2</sup>	No.	m <sup>2</sup>
1. Phnom Penh	112	516000	112	516000	308	14916	308	14916
2. Kandal	758	483100	590	409460	1050	8595	960	7620
3. Prey Veng	1450	1350000	1450	1350000	94	3300	94	3300
4. Takeo	28790	4606400	787	157400	20	240	20	240
5. Svay Rieng	2100	42000	2100	4200				
6. Kampong Speu	3986	1741500	210	22200				
7. Kampong Cham	787	29300	240	9740	675	9400	585	8352
8. Kratie	103	20000	25	5000	120	1200	200	2000
9. Stung Treng	17	21000	5	7000	30	315	30	315
10. Kampong Thom	900	90000	600	60000	450	15000	380	12700
11. Kampong Chhnang	51	4850	22	2090	410	6300	520	4680
12. Pursat	419	740438	219	410000	53	4900	53	4900
13. Battambang	170	54129	170	54129	41	57897	41	57897
14. Banteay Meanchey	600	58292	600	58292				
15. Siem Reap	595	103810	489	88320	325	25590	325	25590
<b>Total</b>	<b>40838</b>	<b>9860819</b>	<b>7619</b>	<b>3153831</b>	<b>3576</b>	<b>147653</b>	<b>3561</b>	<b>142510</b>

Source: DoF (2000).

### Pond Culture

Pond culture of fish is the least developed technique in Cambodia. Its contribution to the total is estimated slightly below 1000 tons/year, or some 10% of the total aquaculture production (1984-1992) (DOF, 1993; FAO, 1993) and some 15-20% of total cultured fish volume in 1993-1998 (DOF, 1999). There are two fish pond culture systems in Cambodia. Intensive fish culture, mainly *Pangasius* catfish, which contributed less 10% of the total aquaculture production. This was found around Phnom Penh and Kandal province. There are a number of farmers who have undertaken these activities in smaller ponds ranging from 300-1,500 m<sup>2</sup>. Seeds collected from the wild are stocked at 4-10 fish/m<sup>2</sup> and grown to more than 1 kg over

a period of one year. Fish are fed with cooked rice bran during most part of the year, though during glut fishing season, they are fed with trash fish. Depending on the management strategies adopted, the production is as high as 30-100 tons/ha/year (Nandeesh, 1994; Nandeesh et al., 1997).

Another system is low input pond, rice/fish and other integrated fish/animals/vegetable culture techniques, so called extensive/semi-intensive system, of tilapia (*O. niloticus*), silver barb (*P. gonionotus*), pangasius catfish (*P. hypophthalmus*), silver carp (*H. nilotrix*), common carp (*C. carpio*), grass carp (*C. idallus*), big head carp (*Aristichthys nobilis*), catla (*Catla catla*), rohu (*L. rohita*), mrigal (*C. mrigala*), small scale mud carp (*C. micropeltes*), giant barb, (*Catlocarpio siamensis*), walking catfish (*Clarias macrocephalus and batrachus*) and other minor specie. This small scale aquaculture system is promoted by various national organizational agencies: Department of Fisheries, Aquaculture research and development centers/stations, provincial Fisheries Office and various NGOs/IOs, which have the same objective and policy of enhancement food security and livelihoods and poverty alleviation (Table 3.21). It contributed about 10% of the total aquaculture production in 1984-1992 and about 15-20% in 1993-1998. With the stocking densities ranging from 2-6 fish/m<sup>2</sup>, a production of 2-5 tons/ha/8 months has been obtained.

Table 3.21: On-going Freshwater Aquaculture Research Activities/Projects

Description	Target Site	On-Station/ Farm	Term	Donor	Budget (US\$)
<b>1. AIT-AARM Project</b>					
1.1 Small scale aquaculture technologies (exotic fish seed nursing and grow-out)	Svay Rieng/ Takeo/Kg Speu	On-farm	1994 till 2000 and Phase 3- 2001-2003	SIDA/DA NIDA  Phase 3 (2001- 2003)	900,000
1.2 Rice fish culture	Svay Rieng	On-farm	1996-1998 1996-2000		
1.3 Rice field fishery (rice field, trap pond, and wild fish marketing)	Svay Rieng/Take o/Kg Speu	On-farm	1998-2000 + Phase 3		
1.4 Fisheries Community Management (Fish refuge, fish conservation, reservoir)	Svay Rieng/Take o/Kg Speu	On-farm	1998-2000 + Phase 3		
<b>2. MRC/READ Project</b>					
2.1 Socio-economic	Prey	On-farm	1997-1999	DANIDA	1,947,350 (Cambodia and Vietnam)

research 2.2 Extension strategy and methodology	Veng/Kandal/TaKeo Prey Veng/Kandal/TaKeo	On-farm	1998-2000		
<b><u>3.SAO/SCALE Project</u></b>  3.1 Small-scale aquaculture technologies (Exotic fish nursing and grow-out)  3.2 Small-scale aquaculture extension strategy  3.3 Exotic fish breeding, nursing and grow-out  3.4 Indigenous fish breeding and nursing	Kandal  Kandal  Kandal  Kandal	On-farm  On-farm/station  On-station/farm  On-station	1994-2001  1994-2001  1994-2001  2000-2002	EU/DFID TFUK/ New Zealand	
<b><u>4. Fisheries Research Station, DoF</u></b> 4.1 Exotic fish breeding, nursing and grow-out  4.2 Indigenous fish breeding, nursing and grow-out	Phnom Penh  Phnom Penh	On-station  On-station/farm	1982- till date  2001-2005	Govt.  Govt. + DANIDA	
<b><u>5. Bati Fish Seed Research Center</u></b> 5.1 Exotic fish breeding, nursing and grow-out  5.2 Extension strategy  5.3 Pangasius hypophthalmus	Prey Veng  Prey Veng/Svay Rieng/ Kg Speu/ Siem Reap  Prey Veng	On-station  On-farm/station  On-station	1992-2000  1994-2000  1996-2000	Govt. + PADEK/ Oxfam  PADEK/ Oxfam Belgium/ Novib  PADEK/ Oxfam	

breeding and nursing					
5.4 Indigenous fish breeding, nursing and grow-out	Prey Veng	On-station/farm	2001-2005	MRC/DANIDA	
<b>6. Padek Project</b>					
6.1 Exotic fish breeding, nursing and grow-out	Prey Veng/Svay Rieng/ Kg Speu/ Siem Reap	On-farm/station	1992-2000	Oxfam Belgium/ Novib	
6.2 Extension strategy	Prey Veng/Svay Rieng/ Kg Speu/ Siem Reap	On-farm/station	1993-2000		
<b>7. APIP-Fisheries Component</b>					
7.1 Hatchery rehabilitation and Breeding of Indigenous Fish Species	Phnom Penh	On-station	1999-2004	World Bank loan	1,000,000
<b>8. DoF/MRC-AIMFS</b>					
	Phnom Penh and Prey Veng	On-station/farm	2001-2005	DANIDA	2,630,000 (Cambodia, Lao, Thailand and Vietnam)
8.1 5-8 Indigenous Mekong Fish Species breeding, nursing and grow-out technologies	Two national aquaculture research centers (Chraing Chamrers and Bati)	On-station	2001-2003		
8.2 Extension system and materials	Being identified	On-farm	2004-2005		
<b>9. FAO</b>					
Small scale aquaculture	Siem Reap, Battambang, Takeo and Kampot				
<b>10. ADRA</b>					
Small scale aquaculture	Kampong Thom				New Zealand Government
<b>11. Organization</b>	Rural				

<u>having not aquaculture specialist</u> APHEDA, CRS, CCFC, CWS, WFP, CONCERN WORLD-WIDE, CCC, CIDSE, GRET, IWDA, LWS, MCC, OXFARM GB, VSC, JICA, GTZ, SAMAKEE, AMERICA QUAKER, and EU/PRASAC	development, including small scale aquaculture				
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Source: So Nam (2000b).

### Fish Seed Production

So Nam et al. (2000) reported that field data collection was implemented from 15 February 2000 to 15 April 2000 throughout Cambodia. The overview is based on visits to 39 hatchery stations consisting of 11 Government hatchery stations, 7 private hatchery stations and 21 small-scale farmer hatchery stations.

The dominant hatchery technology throughout the country is the Chinese system circular spawning and incubation tanks with water supply from large rectangular reservoir used in every hatchery stations. Typically spawning tanks were larger than hatching tanks to allow high water flows and natural spawning after injection of exogenous hormones.

At least six species namely, *Silver carp*, *Common carp*, *Tilapia*, *Mrigal*, *Silver barb* and *Clarias* Hybrid catfish (*C. macrocephalus* x *C. gareipines*) with using exogenous hormones (HGG and LHRH analogues, Pituitary gland and Ovaprim) for injection to stimulate to induce spawning.

Most hatcheries nurse some of larvae till fry or/and fingerling stages but the majority of larvae and fry are sold to specialized nursery operators.

Tilapia is one of the most important species produced (36% of the total seed production) (Table 3.22) in Cambodia due to fish are produced seed naturally in pond throughout the year, it is popular species and well known by people, fast growing and favorite by consumers and followed by Common carp (28%) and Silver carp (17%), and another 9% is *Clarias* hybrid catfish that is produced by all private hatchery stations. A total number of fingerling produced in Phnom Penh is about 2.6 million in three hatcheries, followed Prey Veng (1.2 million) and Kandal (1.1 million) (Table 3.23).

Table 3.22: Percentage of fish species produced in Cambodia, 1999.

Description	Percentage
Tilapia	36.33
Silver carp	5.56
Silver barb	17.12
Common carp	27.74
Mrigal	4.12
Hybrid catfish	8.51
Other	1
<b>Total</b>	<b>100.00</b>

**Table 3.23: Distribution of Hatcheries, by province, Cambodia, 1999**

Province	Annual Fingerling Production	Number of Stations	Name of Stations
Banteay MeanChey	250,000	1	Wath Svay
Battambang	200,000	1	Battambang
Kandal	1,067,784	3	Toul KraSang; Pov vutha; Ku Piseth
Kompong Speu	54,570	2	Khat Sokny, Lao Thoun
Kompong Thom	13,501	2	Khun Vuthy, So Then
Kompot	33,552	2	Kompot (Chouk), Mang Nhoun
Phnom Penh	2,643,390	3	Chk Angre, Poug Ping, Chrang Chamres
Prey Veng	1,266,750	8	Bati, Sok Saron, Sam Peach, Mot Then, Put Ven, Chk Sambath, Heng Thon, Ean Sak
Pursat	73,000	1	Pursat
Siem Reap	113,370	1	Tek Vil
Svay Rieng	217,375	2	Prasot, Sam Vesna
Takeo	650,346	3	Kseng, Ven Choun, Khiev Sam
<b>Total</b>	<b>7,042,638</b>	<b>29</b>	

So Nam et al. 2000.

The total production of fish seed (7.1 million fingerling) in Table 3.23 (result of this study) is lower than in DoF statistic data (9.2 million fingerling in 1999). We do not know clearly, why these are different. We think the DoF over estimate the total number of fingerling or they count the same fish seed, which have already been counted before they had been transported from other provinces to that province. Or maybe the total number of fingerling is under estimated in this study, as we did not reach the farmers who have Tilapia spawning naturally in their cultured ponds.



#### 4. Conclusions

It is beyond the scope of this report to make concrete policy recommendations for poverty alleviation, human development and aquatic resources management in Cambodia. Rather the intention of this report has geographically been to describe and analyze the poverty, human development and aquatic resources situation in the country, highlighting differences across economic groups, rural and urban areas, provinces, and men and women. However, it may be useful in this chapter to simply point out some salient aspects of poverty, human development and aquatic resources use in Cambodia that might be of interests to policy makers.

The estimates in this report indicate that the incidence of poverty declined modestly in Cambodia from 39% in 1993-94 to 36% in 1997-98. On regional basis, the report finds that during this period the incidence of poverty declined significantly in Other Urban areas (from 37% to 30%), modestly in Rural areas (from 43% to 40%), and imperceptibly in Phnom Penh (remaining at 11%).

For targeting purposes, the poverty estimates indicate that rural households - and particularly those with fishing and agriculture as primary sources of income - continue to account for almost 90% of the Cambodia's poor. Poverty needs to be targeted mainly to the rural population and should focus on fishing and agriculture.

The report presents the set of socio-economic indicators in relation to levels of per capita consumption, it finds that:

- Poorer households still tend to be larger, younger, and to have proportionally more children in them as compared to richer households, and they are more likely to be headed by a male;
- Average households size declined significantly during the periods of 1993-94 to 1997, led by a decline the average number of children per household, and this decline occurred across all per capita expenditure quintiles and in all regions;
- The poorer are still more likely to live in households in which the head of household is illiterate and has significantly fewer years of schooling. In the case of years of schooling, this tendency has become more marked over time, providing further evidence that the benefits of recent development have been received disproportionately by the better educated and contributing to the observed worsening in the distribution of per capita consumption during this period;
- Access to piped water has increased dramatically. Although there are fairly sharp differentials in such access by per capita consumption quintile, such differentials are confined in Phnom Penh;
- Differentials across per capita consumption quintile in two indicators (whether a toilet is located in the dwelling, whether the households has access to electricity from line or generator) are also marked, and the indicators sufficiently easy to verify, that they may be useful as indicators of poverty for targeting purposes in both rural and urban Cambodia; and
- Ownership of many consumers' durables (most notably radios, but also TVs and motor vehicles) has increase in all quintiles, a finding also consistent with the observed declined in poverty.

There is no doubt that the level of human development in Cambodia is very low. Even with recent revised HDI score, Cambodia still ranks among the lowest 20% of the countries in terms of its HDI ranking. However, Cambodia is also a very poor country - among the poorest 20 countries in the world. Indeed, the analysis of this report indicates that Cambodia's level of human development is consistent with its low per capita income. Since many components of human development, such as literacy, school enrollment, longevity, nutrition and lack of poverty, are strongly related to per capita GDP, it is likely that robust, broad-based economic growth will, on its own, improve the human development situation in the country.

It may be useful to keep in mind three findings that have emerged consistently from the analysis undertaken in this report. First there are large differences in social and human outcomes across economic groups. Whether it is literacy or school enrollments, access to basic services or health outcomes, the poorest 20% of the population has the worst possible indicators. Second, there are large provincial differences in socio and human indicators. The province of the Northeast, such as Ratnakiri and Mondulakiri, as well as the provinces of Kampong Cham, Siem Reap and Prey Veng are very low on the human development score. Third, there marked gender differences in social outcomes. While primary enrollment rates for boys and girls are similar. In the report, it finds that there is large gap, with mean of grade attainment among men compared to among women.

As reported that aquatic resources (in particular fisheries) significantly play a very important role in food security, sustainable livelihoods and income generation of the rural poor. Freshwater capture fisheries are by far the largest source of supply of fish. Hence, the sustainable management of freshwater fisheries is of overriding importance to the food security and sustainable rural livelihoods in Cambodia.

Although, the majority of villages still grow rice, fish in various farms is a staple diet. Cambodia's rural households make their living on fishing and fishing related activities in communities that have access to the country's vast inland waters. Although 39% of the households living in fishing dependent communes acknowledged fishing as their main livelihood activity, many more households take part in fishing from time to time and are engaged in related input supply, marketing and processing activities. Moreover, both fishing and non-fishing households have a higher per capita consumption of fish. Overall, per capita of fish consumption is 20-30 kg per annum. Thus, within the context of Cambodia's rural economy, aquatic resources (mainly fisheries) are important not only for those who catfish directly, but for those who engaged in fishing related activities and those who benefit from the steady supply of animal protein from local production.

Although most households consider themselves as rice farmers, it would be a great mistake to think of Cambodia's food security in terms of rice alone. For many generations, fish and other aquatic resources (plant and animal) have supplied a sizeable proportion of protein and nutrition to Cambodians, particularly the poor. The degree of dependence on fishing and fishing related activities and farming varies according to the topographic situation and endowment of land and water resources within each locality. Historically, Cambodia's rice farmers have barely made a living from meager size of land that produced only one crop a year. Hunting and gathering of food and materials provide the needed foods and income security to peasant farmers and fishers. Thus, development policy must consider the role of natural

resources such as fisheries and other aquatic resources in ensuring a sustainable livelihood and food security to Cambodia's growing population.

The Department of Fisheries' statistics show an annual catch of 65,000-75,000 t in thirteen provinces where commercial (large scale and middle scale) takes place. But Zalinge and Thuok (1999) and Deap et al. (1998) estimate that the actual commercial catch is 130,000-180,000 t per annum (middle scale catch = 85,000-100,000). The present study showed that the subsistence or small scale or family and rice field catches amounts to 115,000-140,000 t and 45,000-110,000 t per annum, respectively. The current dualistic approach that allows large scale intensive harvesting to generate revenue along with subsistence fishing apparently leads to many conflicts. Commercial fishers, particularly the fishing lots operators, harvest as much as they can, primarily to maximize profits without discrimination about size and species. Since most of the costs are fixed costs, the operators have tendency to harvest and market as much as they can. Compliance with and support toward the existing regulations that are aimed to protect the public resources from overfishing and destructive fishing practices have been very poor. A sizeable proportion of the households surveyed stated their lack of awareness of some of the important fisheries regulations. The government must strengthen the awareness campaign and, perhaps, consider a community based approach to manage the fisheries and other aquatic resources for sustainable food security. This will require a change in the current dualistic policies on management that gives little incentives for self-regulation and responsible fishing.

Management policies in the future need to be directed towards ensuring a sustainable livelihoods for people who depend on fisheries and other aquatic resources. They include fishers, farmers and consumers. To ensure community participation, the nature and distribution of access rights must be very well considered. Mysliwiec (1987) pointed out those policies and initiatives that create local self-reliance and build local human and fisheries and other aquatic resources will serve Cambodia's interest best.

The traditional fish culture center around Tonle Sap Great Lake and Mekong and Bassac and rivers. These practices are commercially oriented and focus on the raising of juvenile indigenous fish caught from wild stocks. Small scale, low input, pond and rice field fish culture however focuses on the breeding and raising of exotic fish species primarily for livelihood support using normal on-farm resources. The intensive pond culture of juvenile indigenous fish from wild stocks and focus on commercial orientation are also practiced in Cambodia. The important issues are the sustainability of the pen and cage culture systems in the Tonle Sap Great Lake and Mekong and Bassac rivers and intensive pond culture given the harvesting of recruits to the existing commercial fisheries and indiscriminate use of small fish as feed (trash fish). For the small scale pond and rice field fish culture systems, the main issue are long-term effect of introduced exotic fish species and their market acceptance. However, the common issue to the above systems of aquaculture, is the relationship between fish culture and existing capture fisheries. Evidently, sustainable and equitable management of existing fisheries in many circumstances will reduce the need for the introduction or promotion of aquaculture of exotic fish species or will influence greatly, the culture system employed.

The use of exotic fish species may only be abolished if they can be replaced with indigenous ones, but suitable culture technologies are only available for a few of these. A national

program of aquaculture systems of freshwater indigenous fish species must be set up in order to achieve an immediate objective of:

*"Economically feasible and attractive aquaculture systems developed using freshwater indigenous fish species, which may complement or replace the use of exotic species for culture purposes in Cambodia"*

## 5. References

- Ahmed M., Hap Navy, Ly Vuthy and Marites Tiongco. 1998.** Socio-economic Assessment of Freshwater capture Fisheries of Cambodia. Report on a Household Survey. 185 pages. MRC/DOF/DANIDA.
- AIT-AARM (1998).** Kampong Speu Database, Phnom Penh.  
Aquatic Resources
- Azimi et al. (2000).** Environment in Transition Cambodia, Lao, Thailand and Vietnam. Asia Development Bank.
- Csavas I., Doulman D., Peter T., Padro J., and Debas L. 1994.** Cambodia Rehabilitation and Development Needs for the Fisheries Sector. FAO fisheries Circular No. 873, FAO, Rome.
- CSES (1996).** Cambodia's Socio-economic Survey. Phnom Penh.
- CSES (1997).** Cambodia's Socio-economic Survey (1997). Phnom Penh.
- Deap L. 1999.** Bagnet (Dai) fishery in Tonle Sap, DoF, Phnom Penh.
- Deap. 1998.** Catch Statistic of Cambodian Freshwater Fisheries. DOF/MRC/DANIDA- Capture Fisheries Management project.
- Deap. L 1998.** Catch Statistic of Cambodian Freshwater Fisheries. DOF/MRC/DANIDA- Capture Fisheries Management project.
- Degent et al. 2000.** Taken for granted conflicts over Cambodia's Freshwater fish resources, paper written for the 8<sup>th</sup> IASCP Conference, Bloomington, Indiana 31<sup>st</sup> May to 4<sup>th</sup> June 2000.
- Degent P. and Nao Thuok, 1998.** Inland Fisheries management in Cambodia: Is the fishing lots system the basis for improved management or should be abolished?
- DoF (1980-2000).** Department of Fisheries, Fisheries Data Collection and Statistics from 1980 to 2000. Phnom Penh, 2000.
- DoF (2000).** The Department of Fisheries Data Collection and Statistics 1980-1999, Phnom Penh Cambodia.
- FAO. 1993.** Cambodia fisheries program mission: rehabilitation and development needs. Technical cooperation program. FAO, Rome.
- General Population Census of Cambodia (1998).** Phnom Penh.
- Gregory R 1997.** Rice Field Fisheries Handbook, Cambodia IRRI Australia Project, Cambodia.
- Gregory R and Guttman H. 1999.** A Diverse Monoculture, Aquatic Animal Production from Rice Fields in South East Asia, Cat and Culture Mekong Fisheries Network Newsletter, Vol. No 1 September 1999.
- Gum W (1998).** Natural Resources Management in the Tonle Sap Biosphere Reserve in Battanbang Province, Consultant report of European Commission support program to the Environment sector in Cambodia, August 1998.
- Gum W. 2000.** Draft consultation report on Inland aquatic resources and Livelihoods in Cambodia. Oxfam GB, Phnom Penh, Cambodia.

**Gum W., 1997.** Consultancy report on Fisheries development in Northwestern Cambodia, May 1996 to February 1999, CARERE/UNDPRGC.

**Guttman H. 1999.** Rice Field Fisheries- A resource for Cambodia, Naga, The ICLARM quarterly, Vol. 22, No. 2, April-June 1999.

**Hy H. 1995.** Fish Production and Consumption in Siem Reap province. Participatory Natural Resources in the Tonle Sap Region, Siem Reap, Cambodia.

**JICA. 1997.** The Agricultural Development Study of the Mekong Flooded Area in Cambodia. Draft Final Report. Sanyu Consultants Inc.

**Lagler K.F. 1976.** Fisheries and Integrated Mekong River Basin Development. Terminal report of the Mekong Basinwide fisheries studies, University of Michigan. Ann Arbor. Appendix 1. 367p.

**Land and Vulnerability in Cambodia 2000.** Notes prepared for World Bank Country Assistance Strategy Annex C. (World Bank, 2000). Livelihoods & Nutrition in Cambodian Communes affected by Civil Conflict Since 1989.

**MAFF. 1998.** Agricultural Development Plan (1999-2010), Long, Medium and Short Term, Phnom Penh, Cambodia.

**MEF- Ministry of Economic and Finance. 1999.** Cambodia Economics and Finance, Phnom Penh, Cambodia.

**Mekong Secretariat 1992** (Committee for Coordination of Investigation of the Lower Mekong Basin). Fisheries in the Lower Mekong basin (Review of Fisheries Sector in the Lower Mekong Basin. Bangkok. 92 p. plus annex.

**Ministry of Economic and Finance. 1999.** Cambodia Economics and Finance, Phnom Penh, Cambodia.

**Ministry of Planning. 1995.** Cambodian Economic Development Plan, Phnom Penh, Cambodia.

**MoE (1996).** National Environment Action Plan, Management of Tonle Sap Ecosystem, Draft Working Paper No. 3, Ministry Of Environment, July 1996.

**MoP- Ministry of Planning 1998a.** “ An updated Poverty Profile for Cambodia 1997” Kingdom of Cambodia, Phnom Penh.

**MoP/UNDP/SIDA/World Bank, 1998.** Ministry of Planning A poverty profile of Cambodia- 1997.

**MoP/UNDP/SIDA/World Bank, 1999.** Ministry of Planning Cambodia Poverty Assessment (1999).

**MoE 1996.** National Environment Action Plan, Management of the Tonle Sap Ecosystem, Draft Working Paper No. 3, Ministry of Environment, July 1996.

**Ngor P.B. 1999.** Catfish fry collection in the Mekong River, Kandal/Phnom Penh. DoF, Phnom Penh.

**NIS/MoF/UNDP/SIDA/World Bank, 1995.** Cambodia Socio-economic Survey 1993-94. Phnom Penh

**NIS/MoP/UNDP/SIDA/World Bank, 1996.** Consumer Price Index. Phnom Penh.

**NIS/MoP/UNDP/SIDA/World Bank, 1997.** Consumer Price Index. Phnom Penh.

**NIS/MoP/UNDP/SIDA/World Bank, 1998.** Cambodia Socio-economic Survey 1997. Phnom Penh

**NIS/MoP/UNDP/SIDA/World Bank, 2000.** Cambodia Socio-economic Survey 1999. Phnom Penh.

**Numa Shams and Ahmed M. 1996.** Common and Private property linkages to sustain livelihood in low-land forest-fisheries-farming systems of Northwest Cambodia. Paper presented at Voices of the common 6<sup>th</sup> annual conference of international association for the study of common property, Clark Compus University of California at Berkeley June 5-6 1996.

**Ovesen J, I-B Trankell and J. Ojendal 1996.** When every household is an island: Social organization and power structures in rural Cambodia.

**OXFAM GB (2000)** All our livelihoods are Dead. Landless and Aquatic Resources in Battambang Province, Cambodia.

**Phounsovanth et al., 1999.** Are state-user relation conducive to fisheries co-management in the lower Mekong Basin? MRC/FIU Technical symposium, Phnom Penh, 13-14 December 1999.

**Prescott N. and Pradhan M., 1997.** A poverty profile of Cambodia. World Bank Discussion Paper No. 373, Washington, USA.

**RCG (1995).** Royal Government of Cambodia, First Socio-economic Development Plan., Phnom Penh.

**Shamr N. and M. Ahmed (1996).** Common and Private Property Linkages for Sustainable Livelihoods in Low Land Forest-Fisheries-Farming System of Cambodia. Paper presented at Voices of the Common 6<sup>th</sup> Annual Conference of International Association for the Study of Common Property, University of California June 5-8 1996 USA.

**So Nam and Nao Thuok 1999.** Aquaculture Sector Review (1984-1999) and Aquaculture Development Plan (2000-2020). Phnom Penh, Cambodia.

**UN WFP, 1998.** Socio-economic Assessment of Freshwater Capture Fisheries of Cambodia - Report on a household Survey Mekong River Commission, Phnom Penh; World Food Programme Protracted Emergency Target Zones in Cambodia

**Tana (1996).** Status of Biodiversity of the Great Lake (Boeung Tonle Sap), an approach for better conservation and future sustainable development. Tnle Sap Technical Workshop, MoE, Phnom Penh, 1996.

**Tana T.S (1990).** Compiled Theme of Fisheries Law, Translated by Touch Seng Tana, Department of Fisheries Phnom Penh.

**Tana T.S. 1993.** Fish Supply and Demand in Rural Svay Rieng Province, Cambodia. Asian Institute of technology, Bangkok, Thailand.

Thuok N et al. (2000).

**Thuok N. and Sina, L. 1997.** Review of the fisheries and aquaculture sector in Cambodia. CMB/95/003: Natural resource base development for the Tonle Sap Area.

**UNDP- Cambodia Human Development Report 1997.**

**UNDP- Cambodia Human Development Report 1998.**

**UNDP- Cambodia Human Development Report 1999.**

**UNDP- Cambodia Human Development Report 2000.**

**UNICEF (1994)** Nutritional status and food practices in rural areas: Food and Nutrition survey in 12 villages of 4 provinces in 1993-94, Phnom Penh, 1994

**UNICEF/WFP Cambodia: Kenfick E., 1998.** Baseline Survey of CASD Project and WFP Target Areas. WFP/UNICEF, Phnom Penh.

**Vazalinge N. and Nao Thuok, 2000.** Present status of Cambodia's freshwater capture fisheries and management. DoF, Phnom Penh.

**VanZalinge and Nao Thuok. 1999.** The present status of Cambodia's fisheries and management implications. In project for management of the freshwater capture fisheries of Cambodia.

**VanZaling, N.P. F 1997.** Fisheries Research needs in the Lower Mekong Basin from a perspective. Contribution to national Fisheries workshop, Vientiane, Lao PDR, 19-21 March 1997.

**WFP Cambodia: Kent Helmers and Erix Kenefick, 1999.** Survey of Household

**Williams S. 1999.** Where has all land gone? Land Right and Access in Cambodia, Volume 1, Review of land issues and property law, Oxfam GB. Phnom Penh.

**World Bank, 1997**, Cambodia: Progress in Recovery and Reform, East Asia and Pacific Region, Washington D.C., June.

**World Bank. 1992.** Cambodia Agenda For Rehabilitation And Reconstruction. Washington D.C. 219 p. plus appendices.

**World Health Organization (1985).** Energy and Protein Requirement, Technical Report Series No. 724, Geneva.