

Baseline Survey Report

Kampong Speu, Kampot, Prey Veng and Takeo Provinces

For

JICA- Freshwater Aquaculture Improvement and
Extension Project (FAIEX)

By

Dr. SO Nam

**Research Scientist, Inland Fisheries Research and Development
Institute**

E-mail: sonammekong2001@yahoo.com

Phnom Penh, November 2005

TABLE OF CONTENTS

EXECUTIVE SUMMARY	iv
ACKNOWLEDGEMENTS	vi
LIST OF ABBREVIATIONS	vii
CHAPTER 1: OVERVIEW	1
1.1 BACKGROUND	1
1.2 NATURAL ENVIRONMENT IN CAMBODIA.....	2
1.3. SOCIO-ECONOMIC CHARACTERISTICS IN CAMBODIA.....	3
1.3.1 <i>Demography, education and employment</i>	3
1.3.2 <i>GDP and economic growth</i>	5
1.3.3 <i>Poverty profile</i>	6
1.4. CURRENT STATUS OF INLAND FISHERIES IN CAMBODIA.....	6
1.4.1 <i>The importance of inland fish to the Cambodian people</i>	6
1.4.2 <i>Freshwater aquaculture development in Cambodia</i>	9
1.4.3 <i>Natural stock enhancement using community ponds</i>	10
1.4.4 <i>Institutional framework of fisheries sector</i>	11
1.4.5 <i>National development plan and strategy</i>	14
1.4.6 <i>Past and present aquaculture project/assistance</i>	15
1.5 METHODOLOGY FOR TARGET AREAS IDENTIFICATION	15
1.6 FAIEX PROVINCES AND TARGET AREAS	17
1.6.1 <i>Kampong Speu</i>	17
1.6.2 <i>Kampot</i>	22
1.6.3 <i>Prey Veng</i> .	23
1.6.4 <i>Takeo</i>	25
1.7 COMPREHENSIVE HOUSEHOLD BASELINE SURVEY	27
1.7.1 <i>Survey</i>	27
1.7.2 <i>Survey target areas and target households and key informants</i>	28
1.7.3 <i>Data collection</i>	29
1.7.4 <i>Data analysis</i>	29
CHAPTER 2 HOUSEHOLD AND FARM CHARACTERISTICS.....	30
2.1 DEMOGRAPHIC PROFILE OF HOUSEHOLDS.....	30
2.2 EDUCATION	31
2.3 HOUSEHOLD OCCUPATION.....	33
2.4 HOUSEHOLD INCOME.....	33
2.5 TYPE OF HOUSE.....	34

2.6 SOURCE OF LIGHTING	35
2.7 SOURCE OF DRINKING WATER.....	36
2.8 FUEL USED FOR COOKING	37
2.9 TOILET FACILITY WITHIN PREMISE.....	37
2.10 HOUSEHOLD DURABLES AND ASSETS.....	38
2.11 LAND HOLDING AND OWNERSHIP.....	39
2.12 LIVESTOCK.....	41
2.13 MONEY SAVING AND DEBT	43
2.14 RICE CONSUMPTION AND PRODUCTION.....	43
2.14.1 Rice consumption.....	43
2.14.2 Rice production	44
2.14.3 Pesticide application for rice production.....	46
2.14.4 Main purpose of rice production.....	46
2.15 HOUSEHOLD EXPENDITURE FOR BUYING RICE	47
2.16 HOUSEHOLD FISH AND ANIMAL CONSUMPTION.....	48
2.16.1 Distribution of fish and other animal protein intake.....	48
2.16.2 Fish consumption	49
2.17 CAPTURE FISHING.....	50
2.17.1 Number of fishers and fishing days.....	50
2.17.2 Main fishing grounds	51
2.17.3 Fish capture from trap ponds.....	51
2.17.4 Fish capture from other fishing grounds	52
2.17.5 Household expenditure for buying fish	54
2.18 CURRENT SITUATION OF FISH REFUGE PONDS	57
2.19 CURRENT STATUS OF HOUSEHOLD PONDS.....	57
2.20 SUMMARY	59

CHAPTER 3 CURRENT STATUS OF SMALL-SCALE AQUACULTURE IN FAIEX PROJECT AREAS

3.1 BIO-PHYSICAL POND CHARACTERISTICS	62
3.1.1 Pond characteristics	62
3.2 FARMER'S EXPERIENCE IN AQUACULTURE.....	67
3.2.1 Years of experience	67
3.2.2 Major purpose of fish culture.....	68
3.2.3 Major source of information	68
3.2.4 Fish farmer's record	71
3.2.5 Fish species cultured.....	72

3.2.6 Pond preparation and fertilization.....	.74
3.2.7 Rearing duration.....	.75
3.2.8 Feed 75
3.2.9 Harvesting	77
3.2.10 Household member's participation in fish culture.....	..79
3.3 CONSTRAINTS TO FISH CULTURE.....	81
3.4 FARMER'S ASSESSMENT AND ATTITUDE TO FISH CULTURE	82
3.4.1 Fish culture farmer	82
3.4.2 Non-fish culture farmer.....	.83
3.5 SUMMARY 84
REFERENCES.....	86
APPENDICES.....	88
APPENDIX 1 TERMS OF REFERENCE.....	88
APPENDIX 2 BASELINE SURVEY TEAM MEMBERS.....	90
APPENDIX 3 LIST OF FARMERS FOR INDIVIDUAL INTERVIEW	92
APPENDIX 4 LIST OF KEY INFORMANTS FOR GROUP INTERVIEW/DISCUSSION.....	97
APPENDIX 5 QUESTIONNAIRE SURVEY FORMAT FOR INDIVIDUAL FARMER'S INTERVIEW	100
APPENDIX 6 QUESTIONNAIRE SURVEY FORMAT FOR KEY INFORMANT GROUP DISCUSSION	131

EXECUTIVE SUMMARY

Socio-economic characteristics of surveyed households in FAIEX project areas

Rice and fish are the mainstays of food security for all inhabitants of Cambodia. Fish is the single most important and affordable food source accounting for over 70% of total animal protein intakes. While wild fish from capture fisheries are abundant in areas close to major water bodies like Tonle Sap, there are many fish scarce areas. The Freshwater Aquaculture Improvement and Extension (FAIEX) Project of JICA identified four target provinces including Kampong Speu, Kampot, Prey Veng and Takeo, which were fish scarce areas with potential for small-scale aquaculture development. A baseline socio-economic survey of 327 households (i.e. 84 from Kampong Speu, 80 from Kampot, 80 from Prey Veng and 83 from Takeo) was conducted between August and November 2005.

Socio-economic conditions of surveyed households in the target areas were similar and higher than the average for rural households in Kampong Speu, Kampot, Prey Veng and Takeo provinces. The percentage of economically productive household members was high, indicating that the availability of productive labour force in surveyed households to construct new ponds and to search for natural fish feed is sufficient. Sampled households had more family members and higher literacy levels than the national average for the rural sector of Cambodia, suggesting that they have higher ability to take advantage of this new fish culture technology introduction. Though still classed as poor and marginal, surveyed households were not the poorest community members. Surveyed household heads were predominately male, suggesting that access to male labour for pond construction may be a constraint to the participation of women in aquaculture.

Rice cultivation was the most important activity in the surveyed areas and the predominant occupation of household heads, and provided highest household income. The overall average land area owned by surveyed households was 1.50 ha, which less than the average area for three of the four provinces. Having slightly smaller land holdings and more household members indicates that households need to intensify their production systems to achieve the same standard of living. The construction of a fish pond allows households to intensify and diversify their production activities and since all sampled farm lands are owned by individuals, land tenure is not a problem of

digging fish ponds. The majority of surveyed households produced only one crop of rice, with an overall maximal rice production of 2.87 tons per household per year in good years (sufficient rainfall) and minimal rice production of 1.91 tons per household per year in bad year (drought). All surveyed households for the four provinces consumed averagely 1.64 tons of rice per household per year. Therefore there is a high surplus of rice in good years and rice production and consumption is nearly equal in bad years.

Most surveyed households owned two or three cows, one or two pigs and 15 or 20 chickens. Around half of sampled households owned a small number of ducks (i.e. 9-15 ducks per household). Livestock were mainly free range and there was only limited scope for integration, because penning livestock requires feed that many target households cannot afford. Only manure from large ruminants was collected and this was primarily used for rice fields. The use of improved stocks and vaccines is increasing slowly only.

The majority of sampled households owned television sets, indicating that extension materials relating to farming technologies (including fish culture) should be available on TV's program. Radios and cassette players were the second common durables in the surveyed areas. Bicycles were by far the most important means of transportation in the four survey province, followed by motorcycles, which are the second most important means of transportation.

Wild fisheries play an important role in the livelihood strategies in the surveyed areas. Most households captured wild fish 3 to 5 days a week from various fishing grounds including rivers/streams, lakes, rice fields, community ponds, trap ponds and roadside ponds. Capture fisheries provided each family member with 13.2 kg in Kampong Speu, 13.8 kg in Kampot, 18.7 kg in Prey Veng and 11.6 kg in Takeo. All of these households reported that wild fish catches were not enough for household consumption. Most of these households spent about Riel 26,642 (US\$ 1 = Riel 4,000) to buy 6.21 kg of fish per month in wet and dry seasons. As for households who did not capture wild fish spent more money (Riel 37,302) to buy more fish (8.19 kg) per month in both seasons. These should be objectively verifiable indicators for monitoring and evaluation of FAIEX activities.

All surveyed households consumed more fish in wet season than in dry season. Fish contributed around 65% of the total animal protein intakes, which is closed to the national average for the whole country. Average annual per capita fish consumption was

18.15, 20.86, 18.29 and 18.95 kg per person for Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively. The survey results confirm that the Kampong Speu, Kampot, Prey Veng and Takeo provinces are fish scarce areas, where fish consumption is well below the national average.

Analysis of current patterns of resource use and availability show that surveyed households have sufficient resources to undertake fish culture as a new activity. Moreover current fish consumption levels of surveyed households are relatively low, demand and preference for fish is high and around 95% of surveyed households owning ponds were interested in trying fish culture. Therefore, these surveyed households will require only minimal encouragement to grow fish.

Current situation of small-scale aquaculture development in FAIEX project areas

The survey results showed that there was no tradition of fish culture practice in the four provinces and that the majority of farmers started culturing fish in the last five years. While a large number of fish farmers had learnt fish culture knowledge from several sources including training courses, extension materials, television and radio organized and produced by the government (i.e. DoF/PFDs) and various NGOs/IOs, they had little basic knowledge on the subject.

Most ponds were closed and a small number open or connected to rice fields. All rain-fed ponds were several years old and between 263-364 m² in area and between 2.0-3.0 m deep. The pond area and depth was usable for profitable fish culture in the surveyed areas. Nearly all ponds were constructed within the homestead, which would deter theft and would allow all household members to participate in fish culture. Water retention of the majority of fish ponds was reported to be good or fair and between 7-9 months per year. Moreover water condition of most ponds, which were fertilized with organic animal and green manure, supplemented by a small amount of inorganic fertilizers before stocking were fertile. With supplementary feeds such as rice bran, vegetables, kitchen waste, duckweed and termites, sampled fish farmers could produce between 45 and 106 kg fish per household or 25-41 kg fish per 100 m² in the closed pond culture system and between 20-57 kg fish per household or 32-41 kg fish per 100 m² in the open pond or pond connected to rice field culture system. Fish yield in the open pond culture system was slightly higher than yield in closed pond culture system. This finding is concordant with the results reported by PADEK- Fisheries program and AIT Outreach project in Svay Rieng Province that while ponds connected to rice fields

were more productive than closed ponds because fish have access to additional food sources in the rice fields, there were increased problems with predatory fish species.

Farmers identified major effects of fish culture such as (1) increase fish availability thereby its contribution to household food security, (2) reduction in expense for buying fish from market leading some household saving, (3) additional household income from selling fish and better use of unused on-farm resources.

Fish farmers were facing a number of technical problems including (1) lack of fish culture knowledge, (2) lack of water source during dry season, (3) high fish mortality, (4) inadequate availability of good quality seed, (5) lack of local fish seed suppliers, i.e. fish seed have to be obtained from distance places, (6) polluted pond water, (7) poaching and (8) small size of fish seed. Other problems such as lack of capital, credit availability and the high interest rate remain as major issues constraints farmers to fish culture.

Although fish culture farmers facing several problems as mentioned above, all were willing to continue the activity and the majority of them wanted to expand their fish culture activities for both household fish consumption and sale. Interestingly, 97% of sampled non-fish culture farmers who never engaged in fish culture previously were interested in starting fish culture and expected meeting part of household fish consumption as wild fish catch is far below household requirement and this was an important factor in household motivation and interest in trying fish culture as a new activity.

Most households were poor and marginal with little cash income therefore fish culture recommendations must be low cost and low risk. This requires relying primarily on on-farm resources like organic animal and green manures and supplementary feeds such as rice bran, vegetables, kitchen waste, duckweed and termites.

ACKNOWLEDGEMENTS

This baseline study was funded by JICA- Freshwater Aquaculture Improvement and Extension Project (FAIEX).

I would like to thank H.E. Mr. Nao Thuok (Director - General of Department of Fisheries), Mr. Hav Viesth (Chief of Aquaculture Division), Mr. Haing Leap (Deputy-Chief of Aquaculture Division), Mr. Chin Da (Deputy-Chief of Aquaculture Division) and all Chiefs and Deputy Chiefs of Fisheries Divisions in Kampong Speu, Kampot, Prey Veng and Takeo provinces for their firm support.

I would like to acknowledge commune leaders, village leaders, commune council members, local fish seed producers, as well as to villagers from Kampong Speu, Kampot, Prey Veng and Takeo provinces who gave their time and support to the field survey.

I am indebted to all FAIEX project extension staff: Mr. Phon Pech, Mrs. Chhoum Chantha, Mr. You Sam On and Mr. Kheav Sambok in Kampong Speu province; Mr. King Sophany, Mr. Sar Sarin, Mr. Pheun Phalla and Mr. Ly Seyha in Kampot province; Mr. Chan Samnang, Mr. Seng Sam Oeun, Mr. Ngin Sok and Mr. Khan Bonvarun in Prey Veng province; and Mr. Ouk Hak, Ms. Hun Sotheary, Mr. Mear Sareth and Mr. Sao Kosal in Takeo province for their field guidance and tireless efforts.

In particularly I would like to express my sincere gratitude to my baseline survey team members including Mr. Thao Lo, Mr. Eng Tong, Mr. Soeun Norng, Mr. Meas Vichit, Mr. Seng Leang, Ms. Hing Sopheavy, Mr. Ngo Sarakmony, Miss Hy Tang Horn, Miss Tan Phalla and Mr. Sen Rotha for their valuable contribution and great efforts which allowed the successful completion of the survey and the production of this baseline survey report.

Last but not least, my sincere thanks to Miss Aya Yamaguchi (Rural Development Specialist of JICA- FAIEX project) and Mr. Satoshi Chikami (Chief/Advisor of JICA-FAIEX project) for providing useful comments to improve this report, and Miss Mineko Sato for help with administrative and accounting aspects.

LIST OF ABBREVIATIONS

AARM	Aquaculture and Aquatic Resources Management
AD	Aquaculture Division
ADB	Asian Development Bank
ADRA	Adventist Development and Relief Agency
AFFD	Agriculture, Forestry and Fisheries Division
AIMS	Aquaculture of Indigenous Mekong Fish Species
AIT	Asian Institute of Technology
APHEDA	Australian People for Health and Development Abroad
APIP	Agriculture Productivity Improvement
BFSPRS	Bati Fish Seed Production and Research Station
CARERE	Cambodia Rehabilitation and Reconstruction Programme
CASD	Community Action for Social Development
CCFRS	Chrang Chamres Fisheries Research Station
CEDAC	Centre d'Etude et de Development Agricole Cambodgiene
CIDSE	Cooperation Internationale pour le Development
CIPS	Cambodia Inter-Censal Population Survey
CRS	Catholic Relief Services
DAFF	Department of Agriculture, Forestry and Fisheries
DANIDA	Danish International Development Agency
DFID	Department for International Development
DoF	Department of Fisheries
EU	European Union
FAIEX	Freshwater Aquaculture Improvement and Extension Project
FAO	Food and Agriculture Organization
FDAP	Fisheries Development Action Plan
FFP	Family Food Production
FHI	Family Health International
FLDO	Farmer Livelihood Development Organization
GDP	Gross Domestic product
GTZ	German Technical Cooperation
HDI	Human Development Index
IFReDI	Inland Fisheries Research and Development Institute
IFSP	Integrated Farming System Program
IOs	International Organizations
JICA	Japan International Cooperation Agency
M&E	Monitoring and Evaluation
MAFF	Ministry of Agriculture, Forestry and Fisheries
MCC	Mennonite Central Committee
MEF	Ministry of Finance
MRC	Mekong River Commission
NGOs	Non Government Organizations
NIS	National Institute of Statistics
NPRS	National Poverty Reduction Strategy
PADEK	Partnership for Development of Cambodia

PFD	Provincial Fisheries Division
PRASAC	Pole Regional de Recherche Appliquee au Development des Savanes d'Agriculture Centrale: Support Programme for the Agriculture Sector in Cambodia
READ	Rural Extension for Aquaculture Development Project
RMGs	Ready Made Garments
SAO	Southeast Asia Outreach
SCALE	SAO Cambodia Aquaculture Low Expenditure
SEDPII	Second Socio-Economic Development Plan
SIDA	Swedish International Development Agency
UNDP	United Nations for Development Programme
UNICEF	United Nations Children's Fund
WB	World Bank
WFP	World Food Programme of the United Nations

CHAPTER 1: OVERVIEW

1.1 Background

The Freshwater Aquaculture Improvement and Extension Project (FAIEX) began its activities in Cambodia in February 2005. This five year project is funded by the Governments of Japan and Cambodia and operates through the Department of Fisheries (DoF) in Cambodia, under the auspices of the Japan International Cooperation Agency (JICA). The Purpose of the Project FAIEX is expressed as "Small-scale aquaculture technologies are extended largely in target areas". The Overall Goal of this Project is expressed as "Aquaculture production in target areas is increased".

Beginning with a desk study review of natural environment/resources (including fisheries) and socio-economic characteristics, followed by a review of NGO aquaculture experiences and a comprehensive household survey conducted between August and November 2005, FAIEX produced a framework to assess the potential for and constraints to small-scale aquaculture development at the household level. Key determinants of areas with aquaculture potential were identified and applied to selected pilot areas in Kampong Speu, Kampot, Prey Veng and Takeo provinces where FAIEX is active (Fig. 1.1). The outputs of the baseline survey are presented in this report.

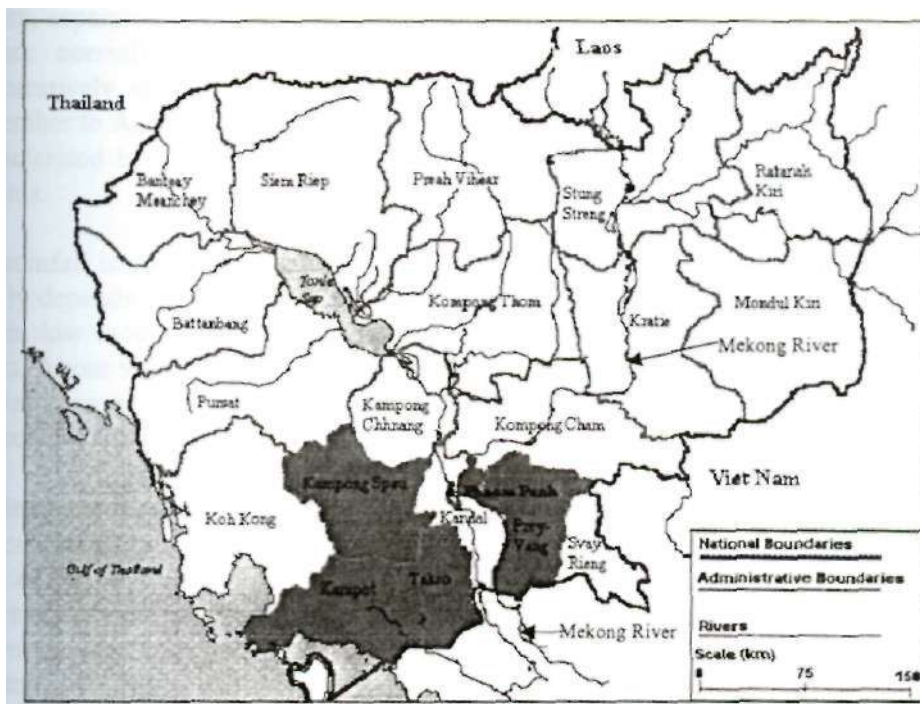


Fig. 1.1 Location map of the four target provinces (i.e. Kampong Speu, Kampot, Prey Veng and Takeo).

Chapter 1 gives an overview of natural environment in Cambodia, information on some basic socio-economic indicators in Cambodia, a current status of Cambodia's inland fisheries and aquaculture development, methods for target area identification, the four provinces, where FAIEX works, the communes surveyed and the survey methodology. Chapter 2 details findings on household characteristics and household economic activities, including income, resource profiles, farming system practices and fish capture; while Chapter 3 covers biological and physical pond characteristics, fish culture systems and farmers' experience in, constraints and attitude to fish culture.

1.2 Natural environment in Cambodia

Cambodia is located in the Indochina Peninsula, sharing its international borders with Laos, Viet Nam and Thailand (Fig. 1). Cambodia covers a total area of 181,035 km² and is surrounded by low maintains and lowlands where Mekong River runs across from the north-eastern border with Laos to the southern border with Viet Nam. Around 86 percent of the country lies within the Mekong catchment area. The Tonle Sap Great Lake, which is situated in the central western part of the country and the largest and the most productive lake in Southeast Asia, serves as a natural reservoir of the Mekong River system, expending from 2,500-4,000 km² in dry season and to 10,000-15,000 km² in wet season and has 4,800 km² of flood forest coverage (So Nam & Buoy Roitana, 2005).

The climate has two distinct seasons or tropical monsoons, the south-western and north-eastern, separated by a short transition period. The south-western monsoon, or the wet season, normally May to October, dominates when atmospheric pressures are comparatively low over Asia, while the north-eastern monsoon, or dry season, from November to April, dominates when atmospheric pressure high. The transitional period, characterized by variable winds, occurs in the intervals between these two dominant patterns.

The rainfall is generally plentiful, but it is so unevenly and seasonally distributed and largely depends on geographic orientation. Annual average precipitation is 2,000-3,000 mm in low mountains of north-eastern region and 1,400-1,600 mm in south-western coasts. About 90% of the annual precipitation falls between May and October (i.e. wet or rainy season). The average number of wet days varies from less than one day a month in December and January to more than twelve days a month in August and September.

The temperatures are remarkably and uniformly warm throughout the year and subject to small variation due to elevation, season and maritime influences. Temperatures are high except during the early part of the north-eastern monsoon when occasional outbreaks of cool air from central Asia sweep over the land. Cool spells occur during December and January; while from the end of February to the break of the monsoon is hot and dry. These condition last until the southwest monsoon commences in May. Mean minimum temperature is 22 °C in Cambodia. Daily highs at Phnom Penh average 32°C, and lows average 23°C.

The relative humidity of the atmosphere is highest at slightly more than 80% and lowest in March at just over 60%.

Due to such topographical and meteorological conditions, the water level of the Mekong River fluctuates more or less 10 m between the two seasons. Hence, most of the lowlands including rice fields get annually inundated and flooded in wet season but turn to be very arid in dry season. It is generally observed that the lowlands of Cambodia prone to natural calamities: floods in the wet season and drought in the dry season.

1.3. Socio-economic characteristics in Cambodia

1.3.1 Demography, education and employment

The population of Cambodia in 2004 is estimated to be 13.091 million according to the Cambodia Inter-Censal Population Survey (CIPS) 2004 (NIS, 2004). The annual population growth rate is estimated to be 1.85% (1998-2004). The estimated rural population in Cambodia is 85%. The percentage of female population is about 52% and female-headed households 29%. Average Cambodia's household size is assumed to be around 5. The percentage of infants and children aged from 0 to 14 years is estimated as 39%, which is much higher than that of elders (4%) aged over 65 years. Thus, 57% is in the economically active age groups between 15 and 64 years (Table 1.1).

The estimated density of population in Cambodia is 74 per km². Regarding the ethnical distribution, Khmer consists of about 90% and the minorities such as Cham, Chinese, Vietnamese and Khmer-Loeu account for the rest.

Approximately 74% of the population aged 15 years and above is literate (Table 1.2). Adult literacy rates for males are considerably higher than those for female both in rural and urban areas. Nationally, around 24% of the population aged 10 and over have not attended school (Table 1.1). Percentage of rural population with no formal schooling was higher than that of urban population. Similarly, the percentage of female population with no formal schooling is higher than that of male population. Overall, 54% of population aged 25 and over have not completed primary school.

The employment rate is defined as the percentage of employed persons to the total number of persons in the labour force, which consists of employed and unemployed. The employment rate amounted to approximately 99% nationally, which is considered as an unusually high employment rate (NIS, 2004). The main reason for this that employment is given precedence and any person who work in any week was treated as employed during that week in enumerating the number of weeks to derive his/her employment status during the long reference period of one year. By sector, 74.2% of the employed Cambodia's population had worked in the agriculture (i.e. crops, livestock and poultry), fisheries and forestry sector, 7% in industry sector (i.e. mining, manufacture, electricity, gas and water supply and construction), and 18.8% in services (i.e. tax, hotel/restaurant, transport/communication, finance, public administration, real estate/business and other services) (Table 1.1).

Table 11 Basic socio-economic indicators of Cambodia

Estimated population size in 2004 (million)	1. Total	13.091
	2. Total Male	6.284
	3. Total Female	6.807
	4. Urban	1.964
	5. Urban Male	0.943
	6. Urban Female	1.021
	7. Rural	11.127
	8. Rural Male	5.341
	9. Rural Female	5.786
Annual population growth rate (1998-2004) (%)		1.81
Percentage of population by age group (2004)	0-14 years old	39
	15-64 years old	57
	65+	4
Percentage of female-headed households (2004)		29
Density of population per km ² (2004)		74
Average household size (2004)	1. Total	5.1
	2. Urban	5.4
	3. Rural	5.0
Percentage distribution of employed population by sector (2004)	1. Agriculture*	74.2
	2. Industry	7.0
	3. Services	18.8
Per capita GDP in US\$ at 2004 current prices		357
Percentage contribution to GDP by sector in 2004	1. Agriculture*	31.1
	2. Industry	27.5
	3. Services	35.8
Growth rates of GDP at 2004 current prices (% per annum)	1993-1994	4
	1994-1995	19
	1995-1996	9
	1996-1997	10
	1997-1998	16
	1998-1999	14
	1999-2000	5
	2000-2001	5
	2001-2002	8
	2002-2003	8
	2003-2004	13
Human development index (HDI) value in 2003		0.571
Percentage of population 10 years and over with no formal schooling in 2003	1. Total	24.4
	2. Total Male	16.2
	3. Total Female	31.6
	2. Urban	16.4
	3. Rural	25.8
Average monthly household income (x1000 Riel) in 1999	1. Total	403.3
	2. Phnom Penh	1,139.6
	3. Other urban	515.0
	4. Rural	314.2
Average monthly household expenditure (x1000 Riel) in 1999	1. Total	361.7
	2. Phnom Penh	1,007.0
	3. Other urban	453.3
	4. Rural	284.4
Percentage of total household expenditure on food items (1999)	1. Total	61.2
	2. Phnom Penh	39.6
	3. Other urban	58.5
	4. Rural	69.5

* including fisheries and forestry

Source:

1. Cambodia's Inter-Censal Population Survey 2004 (CIPS) General Report (NIS, 2004)

2. National Accounts of Cambodia 1993-2004 (NIS, 2005)

3. Cambodia Socio-economic survey 1999 (NIS, 1999)

Population figures relate to the 1998 Population Census of Cambodia

Table 1.2 Literacy and education in Cambodia

Literacy/Education	Both sexes	Male	Female
1. Adult literacy rate (%)*			
Total	73.6	84.7	64.1
Urban	83.8	91.8	76.9
Rural	71.7	83.3	61.6
2. Education attainment (%)**			
Pre school	0.1	0.1	0.2
None	4.3	4.3	4.3
Primary not completed	54.0	45.9	63.6
Primary	23.7	27.3	19.5
Lower secondary	11.3	13.6	8.6
Secondary/diploma	4.5	6.0	2.6
Vocational training	0.8	1.0	0.6
Beyond secondary	1.1	1.6	0.5
Ohters	0.2	0.2	0.1

* Percentage of literate persons aged 15 and over to total persons aged 15 and over

** Educational level completed by literate population aged 25 years and over

Source: CIPS 2004 (NIS, 2004)

1.3.2 GDP and economic growth

Per capita Gross Domestic Product (GDP) of Cambodia is US\$ 357 in 2004, which is low, the lowest in Southeast Asia. GDP growth rate is highly unstable in the last ten years, so that in recent years GDP growth has ranged from 4% in 1993-1994 to 19% in 1994-1995 (Table 1.1). Cambodia's GDP has grown remarkably in the last ten years, for example the average annual growth rate was recorded to be approximately 10% in for the years 1993 and 2004. The high economic growth has sprung from the industry and services, which expanded at 18% and 9% respectively over the same period (NIS, 2005). Agricultural growth remained significantly lower, at 7% over the same period. Over half GDP growth during 1999-2001 was attributable to ready-made garments (RMGs) (FAO/UNDP, 2003). The growth of RMGs has been impressive. The sector contributed to US\$ 13 billion in export earnings in 2002 (96.5 percent of total export earnings). It employs an estimated 210,000 people, of whom more than 90 percent are women, earning an average of US\$ 60 per month. Such heavy reliance on a single industry is normally undesirable, but in this case it is particularly so, because the future of this industry is in doubt.

The contribution of industry to GDP increased from 12.7% in 1993 to 27.5% in 2004, services decreased from 39.5% in 1993 to 35.8% in 2004, and agriculture, forestry and fisheries decreased from 45.1% in 1993 to 31.1% in 2004 (Table 1.1; NIS, 2005). In recent years, prolonged drought and late floods have hindered growth of agriculture sector. The low productivity of the agricultural sector is indicated in Table 1.1, which shows that although this sector employs three quarters of the population, it produces only a third of GDP. This in turn is mirrored in the relatively disadvantaged status of the rural areas, as indicated by the rural-urban gap in the figures on income, expenditure and proportion of expenditure devoted to food purchases. Proportion of expenditure on food is directly correlated to poverty and the fact that the average rural household in

Cambodia spends more than 60% of its total outlays on food purchases indicates a very poor population indeed. The rural areas are also disadvantaged in terms of education, and although the position of women in Cambodian society compares favourably with that in many other countries, the fact that the level of female involvement in formal schooling is only half that of males indicates a significant degree of gender bias.

Percent distribution of the fisheries sub-sector in GDP kept stable ranging from 9.8% to 10.8% for the years 2000-2004 (NIS, 2005).

1.3.3. Poverty profile

In 2003 Cambodia's Human Development Index (HDI) was 0.571, ranking it 130th out of 175 countries worldwide. This is the third lowest index among the 10 countries of Southeast Asia, with only the Myanmar and Laos ranked lower. Of Cambodia's other two neighbours, Thailand has an index of 0.768 (ranking it 74th globally) and Vietnam has an index of 0.688 (109th globally) (FAO/UNDP, 2003; Human Development Report 2005).

The above mentioned Cambodia's per capita GDP (US\$357) and HDI (0.571) reflect high poverty and food insecurity. Around 85% of population is rural and approximately 75% work in agriculture, which accounts for only 31.1% of GDP. The Head Count Index (HCI), one of the poverty measure indices, of Cambodia indicates 35.9% in 1999 (Table 3), meaning that 35.9% of the total population are living below the poverty line. The HCI is high in rural areas as 40.1% and relatively low in Phnom Penh (9.7%) and other urban areas (25.2%) in 1999. Virtually all indicators show poverty is primarily a rural phenomenon. Recent economic growth has benefited those living in the cities far more than those living in the countryside. Within the rural areas there is huge variation among different provinces, with between 8% and more than 50% of population below the HCI in 1997 (Table 1.3). Ten of the 24 provinces have poverty rates higher than the national average. Of these, four (Krong Kep, Prey Veng, Siem Reap and Krong Pailin) have poverty rates close to or above 50% more than the national average, but Krong Pailin has an exceptionally high rate of more than 97%. Moreover, of the five most populous provinces (Kompong Cham, Kandal, Prey Veng, Phnom Penh and Takeo) which together accounted for 44% of the total population, four have relatively low poverty rates of less than 20% (the exception is Prey Veng). Such provincial variations are attributable to factors such as resource endowment, socio-economic opportunities and development of infrastructure and other services.

1.4. Current status of inland fisheries in Cambodia

1.4.1 The importance of inland fish to the Cambodian people

The annual inland fish catch ranges between 300,000 t and 400,000 t (So Nam & Buoy Roitana, 2005 after Deap et al, 1998; Ahmed et al. 1998; Thuok et al., 2000, Jensen, 2000; DoF, 2005) which is the fourth largest country in the world after China, India and Bangladesh (FAO, 1999). Of the total inland fisheries production, approximately 17% is from commercial fisheries, 25% from middle-scale fisheries, 36% small-scale (family) fisheries and 22% from rice field fisheries. Inland fisheries production contributes over

75% to total fisheries production (i.e. inland and marine fisheries and aquaculture production) for the last five years (So Nam & Buoy Roitana, 2005).

Table 13 Poverty estimates in Cambodia

Province+Urban/Rural/Total	Head count index (%)	Poverty gap index (%)	Squared poverty gap indext (%)
Banteay Mean Chey	40.88	12.79	5.63
Battambang	26.41	7.34	2.93
Kompong Cham	12.07	3.06	1.14
Kompong Chhnang	44.60	12.54	4.97
Kompong Speu*	18.18	4.26	1.52
Kaompong Thorn	29.07	7.89	3.11
Kompot*	18.67	4.68	1.72
Kandal	18.4	4.62	1.72
Koh Kong	8.16	2.52	1.14
Kratie	38.59	11.68	4.94
Mondul Kiri	19.87	5.6	2.29
Preah Vihear	29.06	7.34	2.72
Prey Veng*	53.14	15.85	6.51
Pursat	40.74	11.75	4.79
Rotana Kiri	8.81	2.86	1.41
Siem Reap	53.73	19.13	0.05
Sihanouk Ville	34.12	10.67	4.81
Stung Treng	16.37	3.85	1.42
Svay Rieng	43.49	11.81	4.62
Takeo*	15.22	4.29	1.92
Otdar Mean Chey	39.05	13.55	6.26
Krong Kep	48.97	17.67	8.79
Krong Pailin	97.24	61.89	42.43
Total	36.1/35.9	8.7/6.5	3.1/2.0
Phnom Penh	11.1/9.7	2.2/2.0	0.6/0.6
Other urban areas	29.9/25.2	7.5/6.8	2.7/2.6
Rural areas	40.1/40.1	9.7/6.9	3.4/2.1

* Four target provinces of Freshwater Aquaculture Improvement and Extension Project (FAIEP).
+ Poverty estimates at provincial level, 1997.
* Poverty etsimates in Phnom Penh, other urban areas, rural areas and in Cambodia, 1997 and 1999.
Source: Cambodia socio-economic survey 1999 (NIS, 1999); Estimation of poverty rates at commune level in Cambodia (MoP/WFP, 2002)

Cambodian inland capture fisheries' contribution to national food security and the economy is higher than in any other country in the world. Fish is providing some 75% of the total animal protein intake for the population (Ahmed et al., 1998; So Nam, 2000; So Nam et al.; 2005), while rice constitutes around 75% of the total energy consumption (Murshid, 1998). So Nam and Nao Thuok (1999) estimated, based on fisheries statistics of the DoF and MRC, that the national rate of per capita offish consumption is 23-31 kg per annum. However, many other authors have estimated rates of fish consumption per capita in different provinces or regions in the late 1990's (Table 1.4). Recently, Hortle et al. (2004) suggested that the mean inland fish and other aquatic organism consumption is 65.5 kg/person/year (compared to a national average of 151 kg of rice per annum,

FACT/EJF, 2002). This rate is in the mid-upper level of world ranges of 15-90 kg/person/year (Hortle et al., 2004).

Approximately four million people (or 30%) derive employment from the sector (and related activities) in Cambodia (Nao Thuok, pers. comm., October 2005). Declining access to common property resources (forest and fisheries) is one of the major causes of food insecurity and malnutrition (So Nam, 2000). The Tonle Sap Great Lake and floodplain alone are home to an estimated 2.9 million people, of whom about 25% live in floating villages or raised houses with little or no access to farmland (ADB, 2004). The annual population growth of 2.2% means that each year an estimated 300,000 jobs need to be created, posing a new challenge to inland fisheries management. Although it is not possible to distinguish between farmers and fishers (most are engaged in both activities to some degree), there are lower barriers for fisheries making it an attractive

Table 1.4: Distribution of per capita fish consumption by province and region in Cambodia

Region	Per capita fish consumption (kg/capita/year)	Author
Cambodia (Average)	23-31	So Nam & Nao Thuok, 1999
Cambodia (Average)	60-66	Hotle et al., 2004
Tonle Sap (up land Siem Reap)	32	Hong Hy, 1995
Tonel Sap (floating village)	71	FAO/PNRM, 1995
Tonle Sap and plains (8 provinces)	87	DoF/FCFMC, 1995
Tonle Sap (including Kandal and Phnom Penh)	67-80	Ahmed et al., 1998
Fishing household	80	Ahmed et al., 1998
Non-fishing household	67	Ahmed et al., 1998
Fishing dependent commune	71-76	Ahmed et al., 1998
Southeastern (Svay Rieng)	22-40	Tana, 1993; Gregory, 1997
Southwestern (Kampot)	38	APHEDA, 1997
South (Kandal and Takeo)	40	CIAP, unpublished

Source: So Nam, 2000; So Nam et al., 2005; So Nam & Buoy Roitana, 2005.

activity to those seeking a livelihood. This in turn is creating new challenges for fisheries management.

The monetary value of the total inland catches at the landing site ranges from US\$ 150-200 million, increasing in the market chain to US\$ 250-500 million (e.g. Jensen, 2000), which the inland fisheries contribution ranges from 5-7% to 9-18% (So Nam, 2000) of the total national GDP of US\$ 2,800 million (MEF, 1999). Its gross value added to total fisheries values is less than 70%.

The importance of the inland fisheries is still under evaluated. The statistics are usually underestimated because secondary and tertiary occupations in fisheries or fisheries related activities are not revealed. However, with the increasing population pressure and owing to various causes inland fisheries production has been showing a decline, resulting in the reduced availability offish for consumption in most parts of the country.

1.4.2. Freshwater aquaculture development in Cambodia

Since the year 2000 when Cambodia adopted reform of fisheries sector, inland fisheries took off rapidly, while freshwater aquaculture production continued to show growth over the past two decades and increased from 1,610 in 1984 to 20,760 in 2004 (Fig. 1.2), representing a 11.9-time increase or a growth of 16.3% per year, ahead of annual growth rate (10%) of world aquaculture production (Olin, 2000). It represented 8.3 percent of total inland fisheries production in 2004 (So Nam et al., 2005). Therefore, Cambodian aquaculture has expanded, diversified and intensified, its contribution to aquatic food production has increased gradually and potentially. It is highly diverse and consists of a broad spectrum of systems, practices and operations, ranging from simple backyard small, household pond systems to large -scale, highly intensive, commercially oriented practices (So & Thuok, 1999; So Nam et al., 2005).

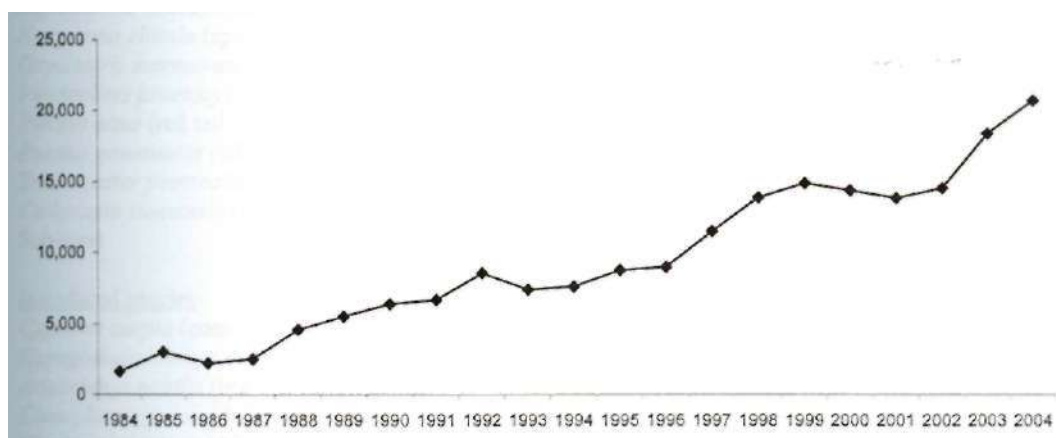


Fig. 1.2 Trends of freshwater aquaculture production in Cambodia. Source: DoF Fisheries Statistics (2005).

The current situation of cage and pond freshwater aquaculture in Cambodia is summarized in the study of So Nam et al. (2005). The number of fish cages has kept more or less stable for the last 10 years and reached 4,492 in 2004, operated in the Mekong basin, including the Tonle Sap Great Lake (42%), Tonle Sap River (17%), upper stretch of the Mekong River (19%), lower stretch of the Mekong River (14%) and Bassac River (7%). It is entirely dependent on wild fish both as seed and feed. The most popular cultured fish species is the giant snakehead *Channa micropeltes* followed by pangasiid catfishes and cyprinids. So Nam & Nao Thuok (1999) estimated that 72% of freshwater aquaculture production came from cage/pen culture and the remaining 28% from pond culture (Table 1.5).

Although Cambodia has no tradition to culture fish in earthen ponds in rural areas due to the difficulty of keeping water in fish ponds in dry season, the number of ponds used rapidly increased from 3,455 in 1997 to 11,509 in 2004 representing a 43% increase (So Nam et al., 2005). The major fish species produced are indigenous species including river catfish, hybrid catfish, silver barb and exotic species such as silver carp, common

Table 1.5 Freshwater aquaculture production and value by major species and system in 1998.

Species	Cage/Pen (ton)	Pond (ton)	Total (ton)	Value (000 US\$)
Indigenous species				
<i>Pangasius hypophthalmus</i> (striped catfish)*	5,332	987	6,319	5,055
<i>Pangasius larnaudi</i> (black ear catfish)*	144	423	567	709
<i>Pangasius conchophilus</i> *	108		108	162
<i>Pangasius pangasius</i> *	100		100	100
<i>Pangasius micronemus</i> *	72		72	65
<i>Channa micropeltes</i> (giant snakehead)*	1,969		1,969	3,938
<i>Channa striatus</i> (striped snakehead)*	104		104	156
<i>Cirrhinus auatus</i> (small scale mud carp)*	174		174	261
<i>Clarias batrachus</i> (walking catfish)	nd	52.5	52.5	79
<i>Clarias macrocephalus</i> (gunther walking catfish)		32	32	48
<i>Leptobarbus hoeveni</i> (hoeven's slender carp)*	nd			
<i>Notopterus chitala</i> (spotted featherback)*	nd			
<i>Oxyeleotris marmorata</i> (sand goby)*	nd	21	21	168
<i>Puntioplites proetozyron</i> (smith barb*)	nd			
<i>Puntius altus</i> (red tail tinfoil barb)	nd			
<i>Puntius gonionotus</i> (silver barb)		423	423	432
<i>Trichogaster pectoralis</i> (snakeskin gourami)*		32	32	32
<i>Catlocapio siamensis</i> (giant barb)*		11	11	16.5
Sub-total	8,003	1,982	9,985	11,222
Introduced species				
<i>Cyprinus carpio</i> (common carp)		212	212	212
<i>Hypophthalmichthys molitrix</i> (silver carp)		225	225	225
<i>Aristichthys nobilis</i> (big head carp)		42	42	42
<i>Ctenopharyngodon idella</i> (grass carp)		2.5	2.5	2.5
<i>Clarias gariepinus</i> (African catfish)		nd		
<i>Labeo rohita</i> (rohu)		nd		
<i>Catla catla</i> (catla)		nd		
<i>Catla mrigala</i> (mrigal)		nd		
<i>Oreochromis niloticus</i> (Nile tilapia)		635	635	635
<i>Oreochromis mosambicus</i> (Java tilapia)		22	22	22
Sub-total	0	1,139	1,139	1,139
Total	8,003	3,120	11,123	12,360

Source: So Nam & Nao Thuok (1999); Cited by APIP Fisheries Component (2001).

* Seed supply from the wild.

nd: no data.

carp, tilapia and mrigal (Table 1.5). In recent years, small-scale pond aquaculture has been introduced by the government (i.e. MAFF- DoF) and a number of NGOs and donors for the purpose of generating alternative livelihoods and securing the animal protein source (see section 1.4.6). As a result, small-scale fish culture in ponds has gradually been developed in certain areas, where project interventions seem successful.

1.4.3 Natural stock enhancement using community ponds

Beside the small-scale aquaculture development, a culture-based fisheries management or community-based management of communal fish refuge pond has also been implemented by the Aquaculture and Aquatic Resource Management (AARM) project

of the Asian Institute of Technology (AIT) aiming at natural stock enhancement for the rice-field fishery. Their activities include the release of broodstock of indigenous fish species into community ponds, categorized as public property, and the protection to ensure the spawning and sustainable use. The hatchling and juvenile as well as broodstock migrate from the community ponds to inundated rice-field through connecting canals. Local people particularly the rural poor who have no lands for farming can enjoy the capture offish after fish grow in inundated rice-field and canals.

1.4.4 Institutional framework of fisheries sector

Government organizations: The agency of the Royal Government of Cambodia currently responsible for the management of fisheries resources is the Department of Fisheries (DoF), under the Ministry of Agriculture, Forestry and Fisheries (MAFF). Currently, administrative reform of the DoF has been examined based on the new Fisheries Law (draft) (DoF, 2004a), which had been approved by the Council Ministers and now on the process of approval by the Assembly. The fisheries administration has a uniform linear organizational structure, indicating that the DoF will be responsible directly for the fisheries administration at provincial and district levels (Chapter 2, Article 6 of the new Fisheries Law).

The new organizational chart of the DoF after official launching of the new Fisheries Law is planned as shown in Fig. 1.3. The planned organization chart shall be defined/approved by the proclamation of the MAFF after the approval of the new Fisheries Law by the National Assembly. The responsibility for technical, management and administration work of the DoF rests with the Director, who is assisted by four Deputy Directors (Fig. 1.3) responsible for respective central divisions and units, and the Inland Fisheries Research and Development Institute (IFReDI) is also under the responsibility of the Director, who is assisted by a Director of IFReDI responsible for socio-economic and biological research. Although All the Provincial Fisheries Divisions (PFDs) are now attached to the Provincial Department of Agriculture, Forestry and Fisheries under the MAFF, the PFDs will be placed directly under the Director of DoF based on the new draft Fisheries Law. This will lead to a rigid institutional setup for fisheries extension services and more effective extension services can be made possible nationwide.

Regarding aquaculture research and development in Cambodia, Aquaculture Division of the DoF plays a major role in planning, developing policy, providing extension services and cooperation with aquaculture/fisheries centers. The Chrang Chamres Fisheries Research Station (CCFRS) in Phnom Penh has been the only one central level center, so far. However, the DoF has decided to move this center to another location due to difficulty in water intake and urbanization of its surrounding areas, and to substitute the function of national research center/institute for freshwater aquaculture with the Bati Fish Seed Production and Research Center (BFSPRC) located in Prey Veng Province. There are, in total, 11 provincial level fisheries stations with hatchery function including BFSPRC at present.

Human resources: The provision of certificate, diploma, undergraduate and post-graduate education represents a substantial investment in human resources (Table 1.6).

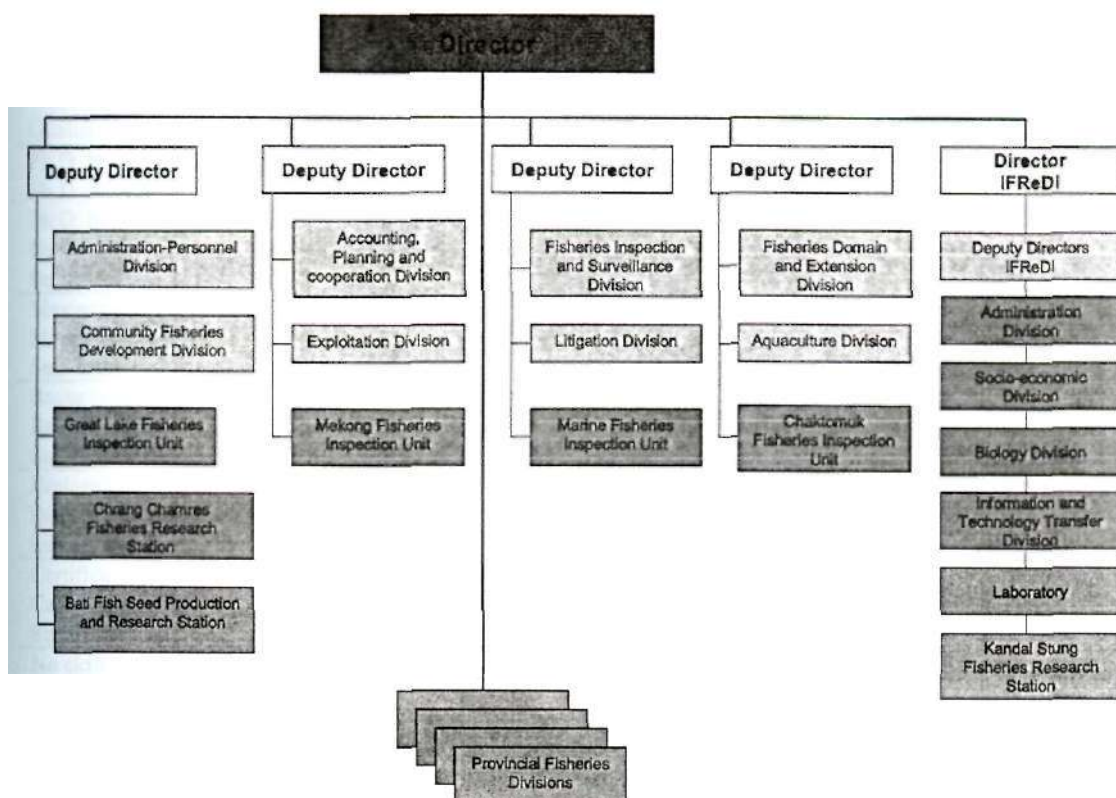


Fig. 13 Planned new organizational chart of the DoF.

It is therefore critical to ensure that education program are tailored to national (public and private) fisheries/aquaculture needs and that over-investment in total, or in particular areas, does not occur. Human resource requirement for the fisheries/aquaculture sector therefore need to be regularly assessed and reviewed, and matched against the output of the education system.

According to the DoF statistical data, the DoF has sufficient numbers of staff to work for the fisheries sector in Cambodia (Table 1.6). Many of them who have obtained master degrees in aquaculture, fisheries biology, fisheries management, rural development, agricultural economics and other social sciences from abroad (including Australia, Belgium, Denmark, Japan, Malaysia, Philippines, Singapore, Thailand and U.K.). There are also six staff members holding Ph.D. degrees from abroad (i.e. one from Belgium, three from Japan, one from the Philippines and one from Vietnam). These staff are highly qualified and have the appropriate skills to contribute to the development of the sector. Unfortunately, most of them (including one Ph.D.) have left the DoF due to a very low salary provided by the government and they are now working for NGOs or IOs. Many staff of AIT/A ARM project under the Aquaculture Division have been sent by the project to further the master course on "Aquaculture and Aquatic Resource Management" and other natural resources development and management

Table 1.6 Qualification and skills of the staff of the Department of Fisheries (DoF), Aquaculture Division (AD), Provincial Fisheries Divisions (PFDs) and four target PFDs of the FAIEX project, September 2005.

Qualification	DoF	AD	Four target PFDs**				
			PFDs	KS	KP	PV	TK
Ph.D. in Biology	3	0	0	0	0	0	0
Ph.D. in Economics	1	0	0	0	0	0	0
Ph.D. in Dev. Communication	1	0	0	0	0	0	0
Ph.D. in Environ, toxicology	1	0	0	0	0	0	0
Sub-total	6	0	0	0	0	0	0
Master in Aquaculture	12	6	0	0	0	0	1
Master in other fields	47	5	2	0	0	1	0
Sub-total	59	11*	2	0	0	1	1
Bachelor in Fisheries	138	21	82	1	4	3	3
Bachelor in other fields	33	0	15	0	2	0	0
Sub-total	171	19	97	1	6	3	3
Diploma in Fisheries	77	5	135	5	4	5	8
Diploma in other fields	20	1	16	0	2	3	1
Sub-total	97	6	151	5	6	8	9
Certificate in Fisheries	44	0	88	0	7	2	0
Certificate in other fields	9	0	57	0	10	0	5
Sub-total	53	0	145	0	17	2	5
No skill (i.e. unqualified staff)	114	2	400	7	5	41	15
Total	500	40	795	13	34	56	33

Source: Administration-Personnel Divisions of the DoF and PFDs, answer to questionnaires (2005).

Note: * Presently, the AD has only one staff member holding a master degree in aquaculture working for aquaculture sub-sector. Another staff member of the AD also holding a master degree in aquaculture is now the assistant of Director of the DoF. ** KS, Kampong Speu, KP, Kampot, PV, Prey Veng and TK, Takeo province.

courses at AIT for the last ten years during its project implementation period. Surprisingly, most of them have left the DoF for IO or NGO work (Table 1.6). Most people who do remain depend on salary supplements from projects for survival. What is the future of fisheries sector in Cambodia?

Qualifications and skills of Provincial Fisheries Division (PFD) Staff (including the four target provinces of FAIEX) are very low comparing to those of the DoF staff (Table 1.6). Most of the PFD staff have never followed any vocational or technical school. As a result, the staff do not have enough knowledge and technical skills to carry out and sometimes to understand extension works. This leads to extension services are not satisfactorily delivered.

Law and regulation: The Chapter 10 of the new Fisheries Law (draft) describes aquaculture management comprehensively. The following inland aquaculture operations require permission of the Fisheries Administration, namely the DoF at present:

1. A pond or a combination of ponds with a total area larger than 5,000 m²
2. A pen or a combination of pens with a total area larger than 2,000 m²
3. A cage or a combination of cages with a total area larger than 15 m²

Therefore, aquaculture carried out in small-scale ponds is not required permission but operators shall register into the Aquaculture Statistic Book by officers of the Fisheries Administration.

As for environmental aspect, the new Law (draft) indicates that all aquaculture operations shall maintain the quality of land, water, aquatic biodiversity and environment, and permission of Fisheries Administration is required for importing fish seeds for aquaculture after quality control by the laboratories.

As for stock enhancement activities for inundated rice fields, the new Law allows family-scale fishing at anytime in the open access area without permission (Chapter 7 of the new Law). This is indifferent from the current regulation (FIAT-LAW on Fishery Management and Administration, 1987).

1.4.5 National development plan and strategy

The long-term vision of the Government of Cambodia is to create a cohesive and advanced country, free from the grip of poverty and illiteracy. The long-term strategy to achieve this vision is the Government's Triangle and Rectangular Strategy. The Government's poverty reduction goals are envisioned in the Triangle/Rectangular Strategy, the medium-term Second Five-Year Socioeconomic Development Plan 2001-2005 (SEDPII): National Economic Growth and Poverty Reduction Strategy and the National Poverty Reduction Strategy 2003-2005 (NPRS).

SEDPII and NPRS focus on three national development objectives in the context of broader governance reform and poverty reduction strategies:

- Economic growth that is broad enough to include sectors from which the poor derive a livelihood;
- Social and cultural development;
- Sustainable use of natural resources and sound environmental management.

The fisheries sector plays an important role in the food security and the national economy of the country and therefore contributes significantly to the national development objectives.

The vision of the fisheries sector as described in the Fisheries Development Action Plan 2005 - 2008 (FDAP, November 18, 2004) (DoF, 2004b) is that "Ensuring the supply of fish and fishery products will keep pace with increasing demands to safeguard the nutritional standards, and the social and economic well-being of communities depending on fisheries for their livelihoods".

The goal of the fisheries sector as described in the FDAP is to maximize the contribution of fisheries to the achievement of national development objectives, especially those related to improving rural livelihoods of the poor, enhancing food security and the sustainable development and equitable use of the fisheries resource base.

The Department of Fisheries recognizes both the constraints and the potential of the sector, and is committed to ensuring that its contribution to the national development objectives is maximized. The overall goal of the FDAP takes into account the wider policy framework defined by SEDPII, NPRS, and the Triangle/Rectangular Strategy.

Improving Livelihood of Rural Poor People through Rural Aquaculture Development is of the six high priority areas defined in order to achieve the goal of the DoF' s FDAP. The overall objectives are to improve food security and nutrition and farm income through small-scale aquaculture development in Cambodia. To achieve the overall objectives, the specific objective is to introduce and identify the appropriate aquaculture technologies for different farming systems.

This FDAP is a continuing process from the current Second Five-Year Fisheries Sector Development Plan (2001-2005). The plan is divided in two parts, which are described as follows.

1. Short-term actions (one year, 2005)
 - Continuing the introduction of appropriate small-scale aquaculture technologies for different farming systems such as:
 - o Fish pond culture integrated with livestock.
 - o Fish culture integrated with rice (i.e. rice-cum-fish culture).
 - Continuing the implementation of fish farmer meets" and exchange activities.
2. Medium-term actions (2 to 3 years, 2006-2008)
 - Developing local fish hatcheries in collaboration with farmers.
 - Developing aquaculture training methods and extension materials.

1.4.6 Past and present aquaculture project/assistance

Recognizing the potential role of aquaculture in subsistence farming, many NGO's and donor's funded development projects began promoting freshwater small-scale aquaculture in rural Cambodia in the late 1980s (Table 1.7). The activities of these projects include (1) transferring aquaculture technologies (knowledge) to farmers through training and demonstration, (2) supporting the establishment of provincial level fish seed production stations and also supporting these stations to carry out extension services, (3) promoting private hatcheries (i.e. small-scale village fish hatchery), (4) building capacity of governmental fisheries staff, and (5) in some cases supporting on-farm and on-station research activities. However, most of these development projects took pin-point approach in which cooperation is focused on specific subject and the covering areas are specified to limited number of villages. Furthermore, many major projects have terminated the activities in recent years or could not expand the activities (Table 1.7).

1.5 Methodology for target areas identification

The abundance of wild fish, which influences the economics of fish culture development, varies with season and geographic location. A methodology to identify areas with high potential for fish culture development was targeted by FIAEP in Kampong Speu, Kampot, Prey Veng and Takeo provinces. The methodology based on fish abundance, and bio-physical and socio-economic criteria is described below.

A desk review of natural resources was the first activity conducted to identify target areas with higher potential for aquaculture development based on maps of rice ecosystems, water bodies, land-use, and other information. The small-scale aquaculture

Table 1.7 Summary of past and on-going NGO's and donor's funded development projects on small-scale aquaculture in rural Cambodia (September 2005).

Implementing organization	Funding organization	Name of the project	Major activity	Project period/budget	Site for research and development	Project area										Collaboration	
						Kandal	Kompong Cham	Kompong Speu	Kompong Som	Prey Veng	Sam Reap	Sray Rieng	Takeo	Other province			
On-going projects																	
MRC	DANIDA	AIMS	Aquaculture extension of indigenous fish species in Cambodia, Laos, Thailand and Vietnam. In Cambodia, research and development.	US\$ 2.6 million for 5 years from 2000 to 2005 (Phase I), Phase II: 2006-2007	CCFRS and BFSPRS		x			x				x		DoF, MRC, AIT/AARM	
SAO	ODA/DFID, EU, Oxfam US, NZ Gov.	SCALE/FLDO	Technical development and formulation of community fish seed production network	Since 1991 (continue)	Tuol Krasang Fisheries Station	x		x								DoF	
FAO	UN		Small-scale aquaculture development as a part of natural resource management program. Support for establishment of farmer's association	Phase I (1994-97), Phase II (1998-2000), Phase III (2002-2005)			x		x		x		x	Battambang		DoF	
CRS			Small-scale aquaculture development	Continue									x			DoF, AIT/AARM	
APHEDA	AusAID		Fish seed production at Chhouk Fisheries Station	Since 2000 till date					x							DoF/DAFF	
GTZ		IFSP	Small-scale aquaculture development	since 2002 till date					x						Kompong Thom	DoF, DAFF	
FHI			Small-scale aquaculture development	Since 2003 till date					x							DAFF	
Fishnished projects																	
AIT	DoF, SIDA, DANIDA	AARM	Extension of small-scale aquaculture, supporting core farmers to be fish seed producers, supporting natural fish stock enhancement using community fish refuge ponds and building small-scale hatcheries at PLAS and RUA. It has formulated a new phase (2005-2008) and already submitted to SIDA for granting.	Since 1993 and Phase III from 2001-2004: US\$ 0.4 million				x						x	x	Phnom Penh, Preah Vihear	SEAFDEC, SEILA MRC/AMS, PRASAC
World Bank			Support for research facilities and equipments and research of indigenous fish species	Since 2001 for 3 years, approx. US\$ 1 million	BFSPRS					x						DoF	
PADEK	OXFAM Belgium, NOBIS FOS		Small-scale aquaculture as a food security measure of remote area. Support for aquaculture extension, on-station and on-farm research, and build capacity of fisheries staff and supervise students' theses. It is planning to formulate a new phase from 2005 - 2008, although details are not determined	Since 1991 till 2004, terminating supporting BFSPRS in 2002 and aquaculture extension in 2004	BFSPRS			x		x	x	x				DoF	
MRC	DANIDA	READ	Examination of aquaculture potential using GIS in Cambodia and Vietnam. Establishment of small-scale hatcheries and on-farm research	1998-2001, US\$ 1.95 mil.		x				x				x		MRC/AMS	
PRASAC	EU	PRASAC	Small-scale aquaculture development as a measure of rural development and building Prasaut Fishery Station	1995-2003			x	x	x	x			x			AIT/AARM, PADEK	
APHEDA	AusAID		Construction of Chhouk Fisheries Station and extension activities in 5 districts of Kompot	1993-2004			x		x					Battambang, Preah Vihear		DoF, DAFF	
MCC			Provision of credit with 2% interest. Assist digging of fish ponds, building village hatcheries and providing extension services.	1993-2003						x						PADEK, WFP	
UNICEF	UN	CASD	Nutritional improvement of rural community through small-scale aquaculture	since 1986													
CARERE	UNDP		Small-scale aquaculture as a part of rural development Construction of Fisheries Stations in Northern provinces	Mid 1990s till 1999						x	x			Pursat, Battambang, Banteay-Meanchey		DoF, PADEK	
ADRA	NZ Gov.		Small-scale aquaculture development								x			Kompong Thom		DoF, PADEK	
SEILA			Small-scale aquaculture as a part of rural development													AIT/AARM, PADEK DoF, DAFF	
CIDSE			Small-scale aquaculture as a part of rural development								x			Kompong Thom		DoF, AIT/AARM	
JICE			Constructing Kompong Speu and Ksoeng Fisheries Stations					x					x			DoF, JICE, PADEK, AIT/AARM	

Source: So Nam & Nao Thuok (1999); Nao Thuok & Hav Viseth (2004); Consultations with AD and PFD staff (2005)

experiences, in Cambodia, of development projects funded by various NGOs and donors were reviewed (See section 1.4.6, Table 1.7).

A series of key informant interviews were conducted in each province, with the District Head, District Agriculture Head, Commune Head, and Village Head. Other criteria including level of inundation, availability of wild fish, accessibility, population density and other necessary socio-economic information were also considered.

Based on the above reviewed primary and secondary information, some districts without NGO's interventions were identified as target areas for aquaculture development, in each province. The provincial fisheries extension staff, in cooperation with the DoF aquaculture extension staff, have identified target communes to pilot FAIEX activities. The criteria for selecting target communes, in each province, include:

- Less abundance of wild fish,
- Many poor farmers,
- Interest of farmers in fish culture as an alternative livelihood,
- Rainfed lowland areas
- Accessibility (i.e. transportation/roads)
- Availability of household ponds for introducing fish culture,
- Availability of on-farm inputs for small-scale fish pond culture,
- Potential for selecting candidates of fish seed producing farmers,
- Availability of village refuge ponds for introducing community-based management of natural fish stocks,
- Rural development appreciated by local authority, and
- Security

Based on the above set criteria, 16 target communes for introducing small-scale aquaculture and four target villages for introducing community-based management of communal fish refuge ponds were selected and listed in Table 1.8. The commune and village profiles were detailed in a separate report.

1.6 FAIEX provinces and target areas

1.6.1 Kampong Speu

Kampong Speu province is adjacent to the western boundary of Phnom Penh, the capital city of Cambodia (Fig. 1.1 and Fig. 1.4). While there is some industrial development (particularly garment manufacture) in areas near to Phnom Penh, much of Kampong Speu remains rural. Administratively, the province is split into 8 districts, 89 communes and 1,319 villages. The province has a population of 0.688 million (0.327 million men and 0.361 million women) in 2004 (Table 1.9). The average household size is 5.3. Approximately 25% of the total households are headed by female. The child population (0-14 years) is approximately 40%, while elderly population (65+ years) is approximately 4%. The population density is 98 people per km , which is higher than the national average of 72 people per km .

Table 1.8 Selected target areas for FAIEX activities in the four project provinces.

Province	District selected	Commune selected*	Village selected**
Kampong Speu	Basedth	Kat Pkluk	
		Pheari Mean Chey	Pheari
		Phong	
	Kong Pisei	Veal	
Kampot	Chhuk	Krang Sbov	
		Krang Snay	Damnak Trop-
	Dang Tong	Ankor Meas	Khang Cheung
		Damnak Srokram	
Prey Veng	Ba Phnum	Boeung Preah	
	Kampong Trabaek	Chrey	Samrong
	Preah Sdach	Lvea	
	Prey Veng	Chea Khlang	
Takeo	Angkor Borei	Ponley	
	Kiri Vong	Angk Prasath	
	Tram Kak	Trapeang Thum-	
		Khang Cheung	
		Trapeang Thum-	
		Khang Tbound	
		Trapeang Kranhung	Prey Kduach

Note: * 16 target communes where FAIEX is going to provide intensive small-scale aquaculture extension services; ** 4 target villages where FAIEX is going to implement activities on community-based fish refuge pond management.

According to the CIPS 2004 Report # 2 (NIS, 2005a), adult literacy rate is 71% (Male, 84% and female, 60%); 93.5% of population in the age group of 10-14 years have attended school, 66% have not completed primary school, 73% of employed population (Male, 84% and female 63%) is literate people and 55% are unpaid family workers (Male, 39% and female 69%) (Table 1.9). Approximately 89% have been employed in agriculture sector (including fisheries and forestry), 6% in industry and 5% in services. The poverty rate in Kampong Speu province is 18.18%, which is lower than the national average of 36.1% in 1997 (Table 1.3).

Kampong Speu province has an area of 702,040 ha, of which 101,395.5 ha is rice paddy land, comprising 92,878.0 ha and 6,685.4 ha, and 1,205.0 ha and 627.0 ha of wet season rainfed and supplemental irrigated rice land, and full-irrigated and recession dry season land, respectively (Table 1.9). The total production of wet and dry season rice is 45,291.1 tons (Average yield, 0.5 t/ha) and 1,032.6 tons (Average yield, 0.6 t/ha), respectively.

According to the DoF Fisheries Statistics 2005, freshwater fish catch in Kampong Speu province is 1,400 tons, mainly from rice field and small water bodies (Table 1.10). Aquaculture production has increased from 7 tons in 1992 to 40 tons in 2004. This production, mainly from small-scale fish pond aquaculture, contributes approximately 3% to the total freshwater fish production. The number of ponds used for fish culture is 745 with a total area of 74,500 m². Six private (farmer's) hatcheries and one public

Table 1.9 Some basic socio-economic indicators in Kampong Speu, Kampot, Prey Veng and Takeo provinces (2004).

Indicator	Kompong Speu			Kampot			Prey Veng			Takeo		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1. Estimated population size (million)	0.688	0.327	0.361	0.575	0.278	0.297	1.025	0.489	0.536	0.890	0.430	0.460
2. Annual growth rate (1998-2004) (%)	2.0	-	-	2.56	-	-	1.04	-	-	1.68	-	-
3. Percentage of population by age group												
0- 14 (children)	40.4	-	-	40.9	-	-	39.1	-	-	39.5	-	-
15-64 (economically age group)	55.9	-	-	55.4	-	-	56.8	-	-	55.7	-	-
65+ (the elderly population)	3.7	-	-	3.7	-	-	4.1	-	-	4.8	-	-
18+ (the voting age group)	51.9	-	-	51.6	-	-	54.0	-	-	53.7	-	-
4. Percentage of female-headed households	25.1	-	-	31.2	-	-	35.0	-	-	41.3	-	-
5. Density of population per km ²	98	-	-	127	-	-	210	-	-	250	-	-
6. Average household size	5.3	-	-	5.1	-	-	4.6	-	-	5.0	-	-
7. Adult literacy rate	70.8	83.7	60	73.6	86.2	63.3	73.5	87.6	61.7	75	89.2	63.1
8. Education attainment (%)												
None	1	-	-	2	-	-	3	-	-	2	-	-
Not completed primary school	66	-	-	63	-	-	66	-	-	56	-	-
Primary	24	-	-	24	-	-	23	-	-	28	-	-
Lower secondary	7	-	-	9	-	-	6	-	-	11	-	-
Secodnary/diploma	2	-	-	2	-	-	2	-	-	3	-	-
Beyond secondary	0	-	-	0	-	-	0	-	-	0	-	-
9. School attendance (%)												
7 - 9 years old	77.7	77.8	77.6	83.2	81.4	85.1	88.2	88.9	87.5	86.7	86.6	86.8
10-14 years old	93.5	93.5	93.6	89.2	90.8	87.5	93.1	94.8	91.5	95.1	96.1	94.0
15-19 years old	48.7	59.2	37.7	48.2	59.9	37.2	47.6	58.5	35.7	61.8	69.9	52.9
20 - 24 years old	5.6	8.5	3.0	8.1	11.5	5.2	4.9	6.8	2.9	11.9	17.6	6.7
Total	59.0	62.8	55.2	60.0	65.3	54.7	62.5	66.3	58.5	66.6	71.3	61.7
10. Percentage of employed population in each age group												
7 - 9 years old	2.1	3.3	0.9	0.8	0.9	0.6	3.7	3.6	3.8	0.0	0.0	0.0
10 - 14 years old	21.3	22.7	20.0	15.4	16.2	14.6	14.9	14.5	15.2	1.8	0.9	2.8
15-24 years old	83.1	79.4	86.9	75.8	72.2	79.0	77.5	71.4	83.9	59.1	51.7	66.4
25 - 34 years old	98.6	99.7	97.6	99.2	99.3	99.1	97.7	97.8	97.7	97.5	97.8	97.3
35 - 44 years old	99.0	99.3	98.8	98.1	99.2	97.2	97.9	99.3	96.8	98.0	99.1	97.1
45 - 54 years old	97.5	96.2	98.3	98.2	98.6	97.9	98.1	99.3	97.3	97.2	98.1	96.6
55 - 64 years old	90.3	98.9	85.1	89.1	95.7	84.5	87.0	97.3	79.0	86.3	95.4	80.7
65+ years old	48.0	70.4	32.9	51.6	65.4	42.8	43.0	57.7	32.2	50.8	68.4	37.6
Total 7+ years old	68.1	67.3	68.8	64.8	62.9	66.5	65.7	63.5	67.7	58.2	55.2	60.8

Table 1.9 Continue.

Indicator	Kompong Speu			Kompot			Prey Vang			Takeo		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
11. Percentage of employed population by literacy												
Literate	73.0	84.0	63.0	74.0	86.0	65.0	75.0	87.0	65.0	75.0	88.0	64.0
Illiterate	27.0	16.0	37.0	26.0	14.0	35.0	25.0	13.0	35.0	25.0	12.0	36.0
Primary or lower	87.0	82.0	93.0	84.0	81.0	87.0	89.0	86.0	93.0	81.0	75.0	88.0
12. Percentage of employed population by sector												
Agriculture, Fisheries and Forestry	88.7	-	-	85.8	-	-	89.1	-	-	83.8	-	-
Industry	5.7	-	-	2.8	-	-	2.3	-	-	3.9	-	-
Services	5.6	-	-	11.5	-	-	8.6	-	-	12.3	-	-
13. Percentage distribution of employed population by main employment status												
Employer	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.2	0.2
Paid employee	8.3	8.9	7.9	5.1	8.1	2.6	5.3	8.1	3.0	5.8	9.9	2.5
Own account worker	36.2	52.1	22.8	41.7	56.8	29.2	42.2	57.4	29.5	45.5	55.2	37.6
Unpaid family worker	55.3	38.7	69.0	53.0	35.0	67.9	52.3	34.3	67.2	48.3	34.5	59.5
Other	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.1
14. Wet season rice land (ha)												
Rain-fed rice land	92,878.0	-	-	102,471.1	-	-	181,519.4	-	-	144,157.1	-	-
Supplemental irrigated rice land	6,685.4	-	-	10,254.9	-	-	16,260.0	-	-	19,553.1	-	-
15. Wet season rice production												
Total (mt)	45,291.1	-	-	135,768.8	-	-	187,087.8	-	-	197,377.5	-	-
Yield (mt/ha)	0.5	-	-	1.2	-	-	1.0	-	-	1.2	-	-
16. Dry season rice land (ha)												
Full-irrigated dry season rice land	1,205.0	-	-	7,140.0	-	-	63,509.3	-	-	59,945.5	-	-
Recession dry season rice land	627.0	-	-	3,332.0	-	-	2,785.5	-	-	17,158.0	-	-
17. Dry season rice production												
Total (mt)	1,032.6	-	-	7,827.7	-	-	150,588.1	-	-	174,351.2	-	-
Yield (mt/ha)	0.6	-	-	0.8	-	-	2.3	-	-	2.3	-	-

Source:

Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 05- Kompong Speu Province (NIS, 2005a).

Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 07- Kompot Province and 23- Kep Province (NIS, 2005b).

Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 14- Prey Veng Province (NIS, 2005c).

Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 21- Takeo Province (NIS, 2005d).

Saila Commune Database (CDC, 2005), website: www.saila.org

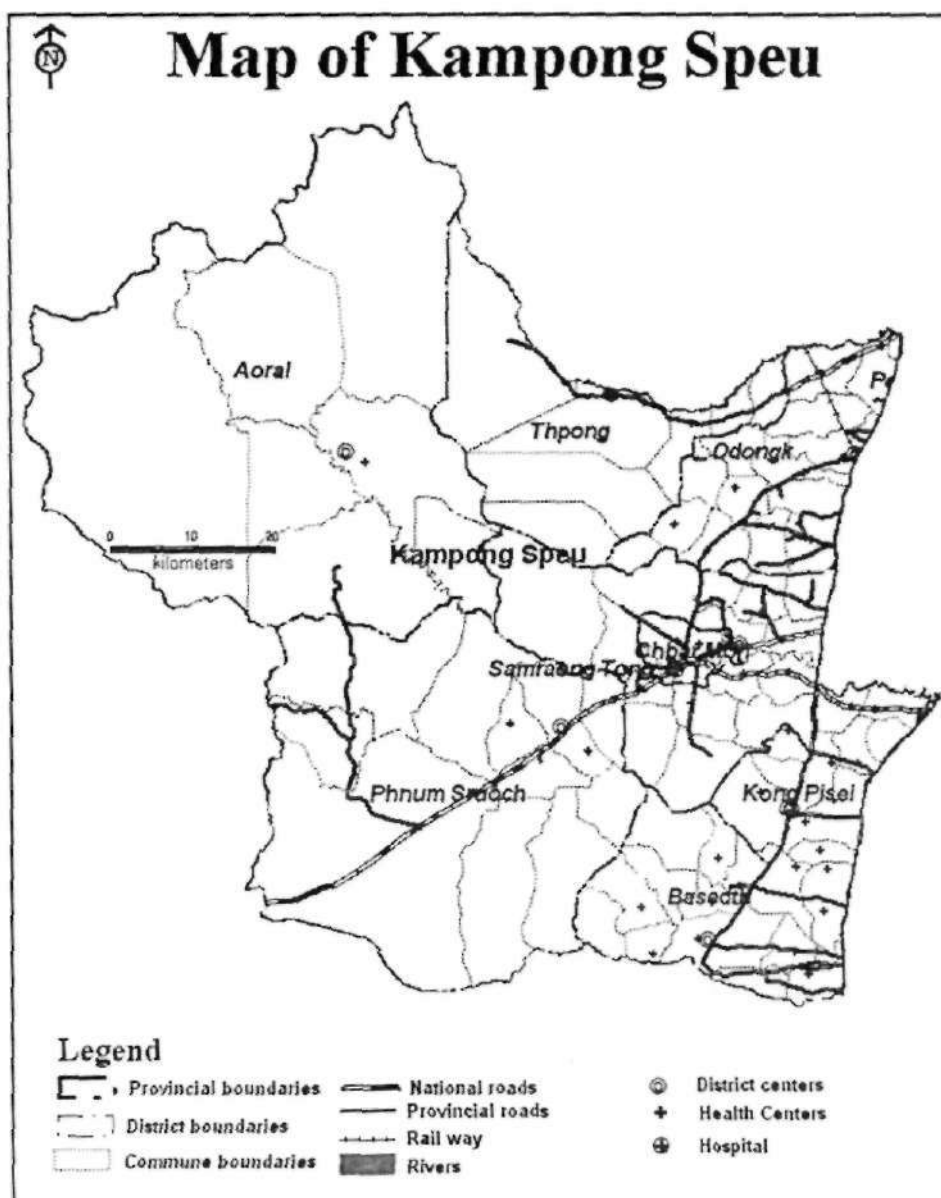


Fig. 14 Map of Kampong Speu province.

(government's) hatchery, namely Kampong Speu Fisheries Station, constructed by JICE produced 820,000 fish fry in 2004. In recent years PADEK, AIT and PRASAC have terminated the small-scale aquaculture activities in Kampong Speu and only SAO still continues such activities there (Table 1.7).

Table 1.10 Fisheries and aquaculture production in four FAIEX provinces

Province	Capture fisheries		Freshwater fish pond aquaculture			Total fry produced	No. hatchery		Freshwater fish cage aquaculture			Total fish production
	Freshwater (ton)	Marine (ton)	No. pond (No.)	Pond area (m ²)	Production (ton)		Private (Farmer)	Public (Government)	No. cage (No.)	cage area (m ²)	Production (ton)	
Kompong Speu	1,400	na	745	74,500	40	820,000	6	1	0	0	0	1,440
Kompot	5,500	5,980	1,257	180,000	210*	700,000	1	1	0	0	0	11,690
Prey Veng	12,000	na	1,880	282,000	380	1,938,000	8	1	284	2,352	130	12,510
Takeo	10,800	na	2,230	372,600	795	2,003,000	8	1	23	280	20	11,615

Source: DoF Fisheries Statistics 2005, Phnom Penh, Cambodia.

Note: * Not including 20 tons of shrimp pond and 20 tons of other marine fish cage aquaculture production in Kompot province.

1.6.2 Kampot

Kampot province is located 148 km southwest of Phnom Penh. It borders Kampong Speu in the north, Gulf of Thailand in south, Takeo in the east and Koh Kong in the west (Fig. 1.1; Fig. 1.5). Administratively, the province is split into 8 districts, 92 communes and 477 villages. The province has a population of 0.575 million (0.278 million men and 0.297 million women) in 2004 (Table 1.9). The average household size is 5.1. Approximately 31% of the total households are headed by female. The child population (0-14 years) is approximately 41%, while elderly population (65+ years) is approximately 4%. The population density is 127 people per km², which is higher than the national average of 72 people per km².

According to the CIPS 2004 Report # 2 (NIS, 2005a), adult literacy rate is 74% (Male, 86% and female, 63%); 89.2% of population in the age group of 10-14 years have attended school, 63% have not completed primary school, 74% of employed population (Male, 86% and female 65%) is literate people and 53% are unpaid family workers (Male, 35% and female 68%) (Table 1.9). Approximately 86% have been employed in agriculture sector (including fisheries and forestry), 3% in industry and 11% in services. The poverty rate in Kampot province is 18.67%, which is lower than the national average of 36.1% in 1997 (Table 1.3).

Kampot province has an area of 487,300 ha, of which 123,200 ha is rice paddy land, comprising 102,471 ha and 10,255 ha, and 7,140 ha and 3,332 ha of wet season rainfed and supplemental irrigated rice land, and full-irrigated and recession dry season land, respectively (Table 1.9). The total production of wet and dry season rice is 135,769 tons (Average yield, 1.2 t/ha) and 7,828 tons (Average yield, 0.8 t/ha), respectively.

According to the DoF Fisheries Statistics 2005, freshwater fish catch in Kampot province is 5,500 tons, mainly from rice field and small water bodies, and marine fish catch 5,980 tons (Table 1.10). Aquaculture production has increased rapidly from 31 tons in 1992 to 210 tons in 2004. This production, mainly from small-scale fish pond aquaculture, contributes approximately 2% to the total freshwater fish production. The number of ponds used for fish culture is 1,257 with a total area of 180,000 m². One private (farmer's) hatchery and one public (government's) hatchery, namely Chhuk Fisheries Station, constructed by APHEDA produced 700,000 fish fry. In recent years PRASAC and APHEDA (extension) have terminated the small-scale aquaculture activities in Kampot. However, APHEDA continues providing support for fish seed production at Chhuk Fisheries Station. Other on-going development projects of small-scale aquaculture are funded by GTZ and FHI (Table 1.7).

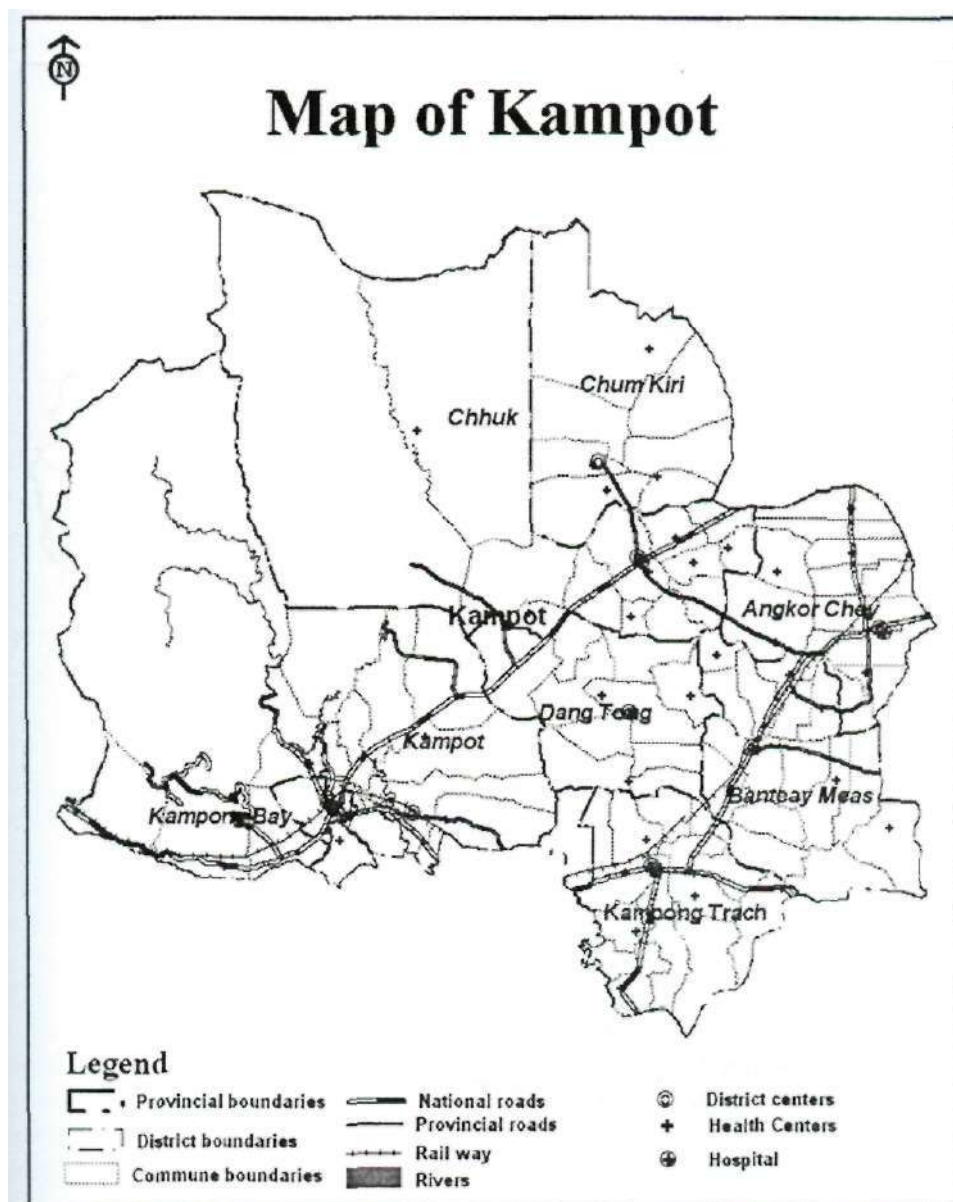


Fig. 15 Map of Kampot province.

1.6.3 Prey Veng

Prey Veng province in southern Cambodia is located 91 km east of Phnom Penh. It borders Kampong Cham in the north, Viet Nam in the south, Svay Rieng in the east and Kandal in the west (Fig. 1.1; Fig. 1.6). Administratively, the province is split into 12 districts, 116 communes and 1,136 villages. The province has a population of 1.025 million (0.489 million men and 0.536 million women) in 2004 (Table 1.9). The average household size is 4.6. Approximately 35% of the total households are headed by female. The child population (0-14 years) is approximately 39%, while elderly population (65+



Fig. 16 Map of Prey Veng province.

years) is approximately 4%. The population density is 210 people per km², which is significantly higher than the national average of 72 people per km².

According to the CIPS 2004 Report # 2 (NIS, 2005a), adult literacy rate is 74% (Male, 88% and female, 62%); 93.1% of population in the age group of 10-14 years have attended school, 66% have not completed primary school, 75% of employed population (Male, 87% and female 65%) is literate people and 52% are unpaid family workers (Male, 34% and female 67%) (Table 1.9). Approximately 89% have been employed in agriculture sector (including fisheries and forestry), 2% in industry and 9% in services. The poverty rate in Prey Veng is 53.14%, which is higher than the national average of 36.1% in 1997 (Table 1.3).

Prey Veng has an area of 470,930 ha, of which 264,074 ha is rice paddy land, comprising 181,519 ha and 16,260 ha, and 63,509 ha and 2,786 ha of wet season rainfed and supplemental irrigated rice land, and full-irrigated and recession dry season land, respectively (Table 1.9). The total production of wet and dry season rice is 187,088 tons (Average yield, 1.0 t/ha) and 150,588 tons (Average yield, 2.3 t/ha), respectively.

According to the DoF Fisheries Statistics 2005, freshwater fish catch in Prey Veng is, in total, 12,000 tons, comprising 2,500 tons from large-scale, commercial fishery (i.e. fishing lots), 3,500 tons from family and middle-scale fisheries and 6,000 tons from rice field fishery (Table 1.10). Aquaculture production has increased rapidly from 136 tons in 1992 to 510 tons in 2004. This production is mainly from fish pond aquaculture (75%), and another 25% comes from fish cage aquaculture. It contributes approximately 4% to the total freshwater fish production. The number of ponds used for fish culture is 1880 with a total area of 282,000 m². Eight private (farmer's) hatcheries and one public (government's) hatchery, namely Bati Fish Seed Production and Research Station (BFSPRS), constructed by PADEK and World Bank/APIP produced 1,938,000 fish fry to supply fish pond aquaculture. The fish seed species produced include two major indigenous species such as silver barb and sutchi catfish, and four major exotic species such as common carp, silver carp, tilapia and mrigal. In recent years PADEK, PRASAC, MCC and MRC/READ have terminated the small-scale aquaculture activities in Prey Veng (Table 1.7). World Bank/APIP ended its rehabilitation of the BFSPRS project in 2004, while PADEK terminated supporting BFSPRS in 2002. However, MRC/AIMS project continues supporting research activities, relating to broodstock management, inducing spawning, hatching and nursing of indigenous fish species, till the end of 2007.

1.6.4 Takeo

Takeo province is located about 78 km southwest of Phnom Penh. It borders Kandal in the northeast, Viet Nam in the south and Kampot and Kampong Speu in the west (Fig. 1.1; Fig. 1.7). Administratively, the province is split into 10 districts, 100 communes and 1,116 villages. The province has a population of 0.890 million (0.430 million men and 0.460 million women) in 2004 (Table 1.9). The average household size is 5.0. Approximately 41% of the total households are headed by female. The child population (0-14 years) is approximately 40%, while elderly population (65+ years) is approximately 5%. The population density is 250 people per km², which is significantly higher than the national average of 72 people per km².

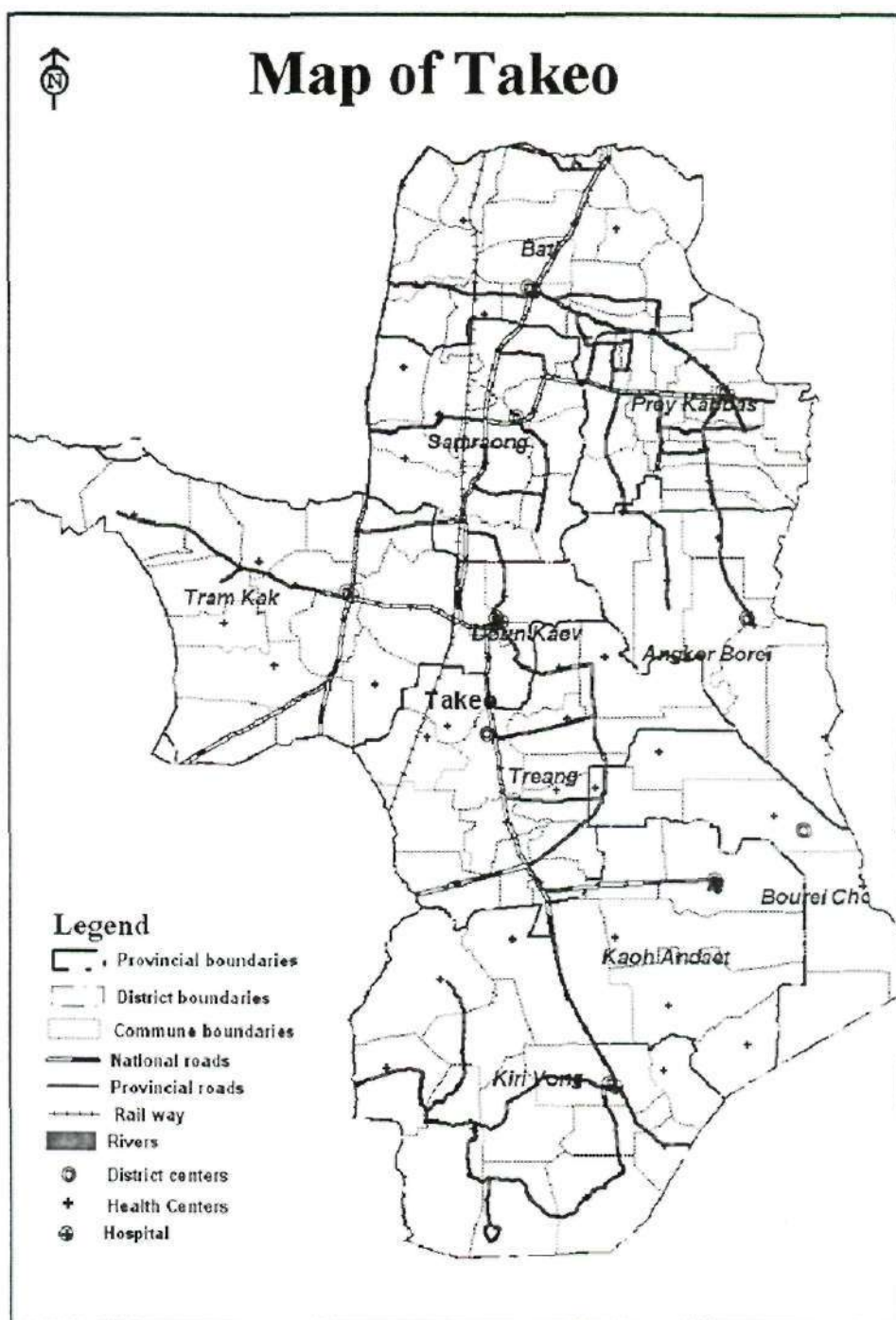


Fig. 17 Map of Takeo province.

According to the CIPS 2004 Report # 2 (NIS, 2005a), adult literacy rate is 75% (Male, 89% and female, 63%); 95.1% of population in the age group of 10-14 years have

attended school, 56% have not completed primary school, 75% of employed population (Male, 88% and female 64%) is literate people and 48% are unpaid family workers (Male, 35% and female 60%) (Table 1.9). Approximately 84% have been employed in agriculture sector (including fisheries and forestry), 4% in industry and 12% in services. The poverty rate in Takeo is 12.22%, which is significantly lower than the national average of 36.1% in 1997 (Table 1.3).

Takeo has an area of 369,120 ha, of which 240,814 ha is rice paddy land, comprising 144,157 ha and 19,553 ha, and 59,946 ha and 17,158 ha of wet season rainfed and supplemental irrigated rice land, and full-irrigated and recession dry season land, respectively (Table 1.9). The total production of wet and dry season rice is 197,378 tons (Average yield, 1.2 t/ha) and 174,351 tons (Average yield, 2.3 t/ha), respectively.

According to the DoF Fisheries Statistics 2005, freshwater fish catch in Takeo is, in total, 10,800 tons, comprising 1,300 tons from large-scale, commercial fishery (i.e. fishing lots), 3,500 tons from family and middle-scale fisheries and 6,000 tons from rice field fishery (Table 1.10). Aquaculture production has increased rapidly from 60 tons in 1992 to 815 tons in 2004. This production is mainly from fish pond aquaculture (97.5%), and another 2.5% comes from fish cage aquaculture. It contributes approximately 7% to the total freshwater fish production. The number of ponds used for fish culture is 2,230 with a total area of 372,600 m². Eight private (farmer's) hatcheries, previously supported by AIT/A ARM project and one public (government's) hatchery, namely Ksoeung Fisheries Station, constructed by JICE and technically supported by AIT/AARM produced 2,003,000 fish fry to supply fish pond aquaculture. The fish seed species produced include silver barb, common carp, silver carp, tilapia and mrigal. In recent years AIT/AARM and MRC/READ projects have terminated the small-scale aquaculture activities in Takeo (Table 1.7). FAO is going to terminate its small-scale aquaculture development activities by the end of this year. However, MRC/AIMS project continues supporting on-farm research, i.e. the promotion of on-nurseries and hatcheries of Mekong indigenous fish species.

1.7 Comprehensive household baseline survey

1.7.1 Survey purpose

The specific purposes of this baseline survey were:

1. To identify objectively verifiable indicators for monitoring and evaluation (M&E) of the FAIEX activity;
2. To obtain baseline information on socio-economics of pond owning households and currently practising aquaculture or with potential to practice aquaculture (including gender role) in the FAIEX target areas, i.e. the four provinces of Kampong Speu, Kampot, Prey-Veng and Takeo (Fig. 1.1); and
3. To prepare Commune and Village Profiles of the FAIEX target communes and villages. The profiles report is made in another separate volume.

1.7.2 Survey target areas and target households and key informants

FAIEX has initially selected four communes where the FAIEX is going to provide intensive small-scale aquaculture extension services and one village where FAIEX is going to implement activities on community-based fish refuge pond management in each FAIEX target province. Hence a total of 16 communes and 4 villages were initially selected to start FAIEX activities (see the details in Table 1.8).

Individual interview with rural households was conducted in two selected communes out of the four target communes mentioned above in each FAIEX target province. The two selected communes were located in two geographically and topographically distinct districts in each FAIEX province. In total, eight communes were selected from the four FAIEX provinces for conducting individual interview (Table 1.11).

Table 1.11 Target communes and villages for individual and group interview.

Commune/Village	Individual interview	Commune group interview	Village group interview
1. Kampong Speu province			
Kat Pkluk (Boseth district)	X	X	
Phcari Mean Chey (Boseth district)		X	
Phong (Boseth district)		X	
Veal (Kong Pisei district)	X	X	
Phcari (Pheari Mean Chey commune)			X
2. Kampot province			
Krang Sbov (Chhuk district)		X	
Krang Snay (Chhuk district)	X	X	
Ankor Meas (Dang Tong district))		X	
Damnak Sokram (Dang Tong district)	X	X	
Damnak Trop Khang Cheung (Krang Sany commune)			X
3. Prey Veng province			
Bocng Preah (Ba Phnom district)		X	
Chrey (Kompong Trabek district)		X	
Lvca (Preah Sdach district)	X	X	
Chca Khlang (Prey Veng district)	X	X	
Samrong (Chrey commune)			X
4. Takeo province			
Ponley (Ankor Borei district)	X	X	
Angk Prasath (Kiri Vong district)		X	
Trapeang Thum Khang Cheung (Tram Kak district)	X	X	
Trapang Thum Khang Tboung (Tram Kak district)		X	
Prey Kduach (Trapeang Kranhung commune)			X

Stratified random sampling was conducted in villages with sufficient ponds. Where there were insufficient ponds, all households with ponds were selected for the survey. In each commune, at least 20 currently practising small-scale aquaculture households namely aquaculture or fish culture farmers and at least 20 non-practising aquaculture households namely non-aquaculture or non-fish culture farmers were selected and interviewed. Of the non-fish culture farmers 50% are having intension to start aquaculture activity in this short coming season and 50% do not have intention to start aquaculture activity this year. Therefore, a total of 327 households were selected, i.e. 84 from Kampong Speu, 80 from Kampot, 80 from Prey Veng and 83 from Takeo (Appendix 3). A standard questionnaire was developed, pre-test, revised and used for

the survey during August and November 2005. The questionnaire survey format was attached as Appendix 5.

Group interview (i.e. discussion) with key informants was conducted in all the 16 target communes and 4 villages of FAIEX. A total of 20 meetings were held in the communes and villages, i.e. one meeting in commune or village. The key informants participated in each meeting included commune chief, commune council member, commune secretary, village chief, fish seed producing farmer and elder (a total of at least five participants) (Appendix 4). A standard questionnaire was developed, pre-test, revised and used for the survey during August and November 2005. The questionnaire survey format was attached as Appendix 6.

In addition, this survey involved brainstorming sessions with the staff of the Aquaculture and Planning Divisions of DoF and the staff of Provincial Fisheries Divisions of Kampong Speu, Kampot, Prey Veng and Takeo.

1.7.3 Data collection

This baseline survey considered three major types of data, which were briefed as follows.

1. Secondary data (i.e. available literature) was collected on natural environmental conditions, socio-economic characteristics, fisheries administration and the importance of fisheries and aquaculture development situation in Cambodia as a whole and in the four FAIEX provinces (see the above sections).
2. Field survey data collected by conducting individual interview with 320 rural households included household demographics, farm size and land use pattern, household rice consumption patterns, ownership of assets, household economic profiles, household capture fisheries situation, pond characteristics, reasons for culturing and discontinuing fish culture and household fish consumption patterns.
3. Field survey data for preparing commune and village profiles collected by conducting group interview with key formants included geographical conditions, transportation and accessibility, demography, basic economic status and freshwater aquaculture development of the 16 communes and 4 villages.

1.7.4 Data analysis

Data collected from individual interview were checked for accuracy before being entered onto computers in the database software programme Excel®. Outliers, missing data and other data problems were checked before the data were analysed using Excel® and simple statistical tools including means, standard deviations, maximums, minimums, percentages, and frequency distribution. Households with ponds were the unit of analysis. Analysis was done by province. The survey results are presented in the next chapters.

CHAPTER 2 HOUSEHOLD AND FARM CHARACTERISTICS

2.1 Demographic profile of households

Household size affects the need for fish and other animal protein and the availability of labour for farm activities, including fish culture. The number of household members ranged from 2 to 11 in the four provinces. Average household size varied from 4.9 in Kampot to 6.1 in Kampong Speu province, with an average of 5.6 for the total sample (n=327) from the four provinces (Table 2.1), which is slightly higher than the national figure of 5.0 reported for rural areas (NIS, 2004). Most of the households (> 90%) had 3 - 9 members in each surveyed province, while only 3.6% had more than 9 members in Kampong Speu and 1.5% in Kampot. Respondents reported that all of their household members were healthy.

Table 2.1 Household size

Description	Kampong Speu (N=84)		Kampot (N=80)		Prey Veng (N=80)		Takeo (N=83)	
	No.	%	No.	%	No.	%	No.	%
<3	2	2.38	5	6.25	3	3.75	5	6.02
3-5	34	40.48	46	57.50	40	50.00	28	33.73
6-9	45	53.57	28	35.00	37	46.25	50	60.25
>9	3	3.57	1	1.25	0	0	0	0
Total	84	100	80	100	80	100	83	100
Average	6.10		4.88		5.49		5.80	
Standard deviation	1.9		2.0		2.0		1.8	

The percentage of woman-headed households was 14.1% of the total surveyed households (Table 2.2), which is significantly lower than the national figure of 29 (Table 1.1). The proportion of female-headed households was 11.9%, 21.3%, 10.0 and 13.3 in Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively. The low proportion of female-headed households in the sample is probably because male household members generally construct ponds; meaning that a sample of pond owning households is likely to be biased towards male household members. Labour requirements for pond construction may be an important barrier to participation of women in aquaculture.

The age distribution of household heads was similar for the four provinces with approximately 95% of household heads and their spouses being of working age or between 18-60 years old. Each surveyed province had the highest proportion of household heads between 30 and 50 years (Table 2.2). Kampong Speu province with the largest mean household size (6.1) also had the highest proportion of household heads below 30 years of age; 18% compared to 14%, 11% and 11% for Kampot and Prey Veng and Takeo provinces, respectively.

Table 2.2 Age distribution of household heads

Province	Age group	Male		Female		Total	
		Number	%	Number	%	Number	%
Kampong Speu	<30	11	13.10	4	4.76	15	17.86
	30-50	41	48.81	4	4.76	45	53.57
	51-60	20	23.81	1	1.19	21	25.00
	>60	2	2.38	1	1.19	3	3.57
Total	43.14	74	88.10	10	11.90	84	100.00
Kampot	<30	10	12.50	1	1.25	11	13.75
	30-50	42	52.50	13	16.25	55	68.75
	51-60	8	10.00		0.00	8	10.00
	>60	3	3.75	3	3.75	6	7.50
Total	40.65	63	78.75	17	21.25	80	100.00
Prey Veng	<30	9	11.25	0	0.00	9	11.25
	30-50	40	50.00	5	6.25	45	56.25
	51-60	21	26.25	3	3.75	24	30.00
	>60	2	2.50	0	0.00	2	2.50
Total	43.63	72	90	8	10.00	80	100
Takeo	<30	8	9.64	1	1.20	9	10.84
	30-50	40	48.19	7	8.43	47	56.63
	51-60	18	21.69	3	3.61	21	25.30
	>60	6	7.23	0	0.00	6	7.23
Total	45.84	72	86.75	11	13.25	83	100.00

The age distributions of male and female household members were generally similar (Table 2.3). In Kampong Speu, Kampot and Takeo the male to female ratio was nearly equal, though there were slightly less males (46.5%) than females (53.5%) in Prey Veng province (Table 2.3). Over 96% of household members were less than or equal to 60 years of age and moreover between 40-42% of household members were under 18 years of age for the total four province sample.

Most sampled households have young children, implying that both the labour force and the demand for food and fish will increase significantly in the next one or two decades. Approximately 3% of household members were older than 60, so the availability of senior household members to assist with fish culture and pond management is limited.

2.2 Education

Educational background affects ability of household members to search for and to take advantage of new income earning opportunities. The majority of household heads were literate, i.e. could read and write to a degree and had varying degrees of education. Literacy rates of household heads were 89, 94, 96 and 95% in Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively (Table 2.4), which is much higher than the national average of 72%, reported for the rural areas of Cambodia (Table 1.2). Pond owning households may be better off economically and thus receive

Table 2.3 Age distribution of household members (N=327)

Province	Age group	Male		Female		Total	
		Number	%	Number	%	Number	%
Kampong Speu	<13	65	12.9	52	10.4	117	23.3
	13-17	39	7.8	44	8.8	83	16.5
	18-30	81	16.1	88	17.5	169	33.7
	31-45	30	6.0	39	7.8	69	13.7
	46-60	26	5.2	27	5.4	53	10.6
	>60	3	0.6	8	1.6	11	2.2
	Total	244	48.6	258	51.4	502	100.0
Kampot	<13	57	11.9	64	13.3	121	25.2
	13- 17	48	10.0	35	7.3	83	17.3
	18-30	65	13.5	60	12.5	125	26.0
	31 -45	38	7.9	40	8.3	78	16.2
	46-60	25	5.2	29	6.0	54	11.2
	>60	8	1.7	12	2.5	20	4.2
	Total	241	50.1	240	49.9	481	100.0
Prey Veng	<13	43	11.3	47	12.3	90	23.6
	13-17	30	7.9	34	8.9	64	16.8
	18-30	50	13.1	55	14.4	105	27.6
	31 -45	28	7.3	32	8.4	60	15.7
	46-60	21	5.5	30	7.9	51	13.4
	>60	5	1.3	6	1.6	11	2.9
	Total	177	46.5	204	53.5	381	100.0
Takeo	<13	52	12.6	43	10.4	95	23.1
	13-17	36	8.7	35	8.5	71	17.2
	18-30	57	13.8	54	13.1	111	26.9
	31 -45	27	6.6	32	7.8	59	14.3
	46-60	32	7.8	27	6.6	59	14.3
	>60	8	1.9	9	2.2	17	4.1
	Total	212	51.5	200	48.5	412	100.0

greater education opportunities. Approximately 6.5% of surveyed households was illiterate, 19% of which was woman-headed households or 81% of which was man-headed households (data not shown). While no household heads from Kampot and Prey Veng provinces were educated beyond secondary school/diploma level, 1% and 4% of household heads in Kampong Speu and Takeo received vocational training.

Table 2.4 Education of household heads

Education attainment	Kampong Speu (N=84)		Kampot (N=84)		Prey Veng (N=84)		Takeo (N=84)		Total (N=327)	
	No.	%	No.	%	No.	%	No.	%	No.	%
No education	9	10.7	5	6.3	3	3.8	4	4.8	21	6.4
Primary School not completed	5	5.9	1	1.3	5	6.3	4	4.8	15	4.6
Primary School	41	48.8	39	48.8	38	47.5	36	43.4	154	47.1
Lower Secondary School	12	14.3	27	33.8	19	23.8	26	31.3	84	25.7
Secondary School/diploma	16	19.1	8	10.0	15	18.8	10	12.1	49	14.9
Vocational training	1	1.2	0	0.0	0	0.0	3	3.6	4	1.2

2.3 Household occupation

An overwhelming majority (range = 89-98%) of household heads in the four provinces reported rice farming as their main activity, with mostly cultivating one rain-fed crop each year (Table 2.5). The remaining 6% of household heads considered animal raising, fish culture, government officers (including teaching), daily labour and small trading as their main occupation. No household heads from the four provinces were primarily fishermen. In Kampong Speu province 1% of household heads were primarily fish farmers.

Table 2.5 Occupation of household heads

Occupation	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N= 83		Total N= 327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Main occupation										
Rice farming	75	89.29	78	97.5	75	93.75	80	96.39	308	94.19
Animal raising	1	1.19	1	1.15	1	1.25	0	0	3	0.92
Fish culture	1	1.19	0	0	0	0	0	0	1	0.31
Local officer	5	5.95	1	1.25	3	3.75	2	2.41	11	3.36
Wage labour	2	2.38	0	0	1	1.25	0	0	3	0.92
small business	0	0	0	0	0	0	1	1.20	1	0.31
Secondary occupation										
Rice farming	2	2.38	1	1.25	5	6.25	3	3.61	11	3.36
Animal raising	43	51.19	53	66.25	36	45.00	48	57.83	180	55.05
Fish culture	9	10.71	7	8.75	11	13.75	15	18.07	42	12.84
Local officer	2	2.38	0	0	1	1.25	0	0.00	3	0.92
Wage labor	12	14.29	7	8.75	14	17.75	2	2.41	35	10.70
small business	3	3.57	0	0	3	3.75	2	1.20	7	2.14
Vegetable grow	9	10.76	11	13.75	10	12.5	12	14.46	42	12.84
Other	4	4.76	1	1.25	0	0	2	2.41	7	2.14

A large number of household heads (55%) reported animal raising as secondary occupation (Table 2.5). About 13%, 13% and 11% of household heads reported fish culture, vegetable growing and daily labour as secondary occupation, respectively. The number of household heads reported fish culture as secondary occupation was higher in Takeo province (18%) than in Kampong Speu (11%), Kampot (9%) and Prey Veng (14%).

2.4 Household income

Respondents reported sources of income as from on-farm and off-farm activities. The household income was the money value of the produce from rice farming, animal rearing, fish culture and vegetable growing, and cash value of salary of government officers (including teacher), labourers (on-farm and off farm), remittance and small business (including sellers) (Table 2.6). Average annual total household income in Kampong Speu, Prey Veng and Takeo was nearly equal, though there was much lower household income in Kampot province. While rice cultivation was the most important household farming activity in terms of land area farmed and use of time (Table 2.5), rice cultivation was only the main income sources in the four provinces (Table 2.6). Livestock rearing was cited as the second main household income source in Kampot,

Prey Veng and Takeo and was the third most important income source in Kompog Speu province. The second most important household income source in Kampong Speu province was from labourers, reflecting some industry development in areas near Phnom Penh. Very few people receive income from off-farm employment and when household members migrate in search of work they seldom send regular remittances to the household. Approximately 6-10%, 6-8%, 1-3%, 2-6% and 1-8% of total household income was provided by vegetable growing, fish culture, remittance, government officers and small business.

Average annual total household income for the four provinces was between Riel 2.1-3.6 million (overall mean = Riel 3.2 million), equivalent to US\$ 517-899 (overall mean = US\$ 793). Higher income from rice cultivation compensated for low income from livestock rearing in Takeo province. Average annual total household income was highest in Prey Veng and lowest in Kampot (Table 26).

Table 2.6 Household income in US\$ from various enterprises (N=327)

Description	Kampong Speu	Kampot	Prey Veng	Takeo
Rice farming	313	200	257	509
Animal raising	120	122	212	105
Vegetable growing	62	52	83	50
Fish culture	35	31	75	71
Labourer	232	60	159	92
Remittance	29	5	19	23
Local officer	51	8	55	28
Small business	22	40	39	11
Total	864	517	899	890

2.5 Type of house

House type is commonly used as an indicator of socio-economic status. All respondents reported that they owned houses. Construction materials used for building a house indicate its quality and whether a house is a permanent or temporary structure.

Roof: About 73%, 69%, 53%) and 83% of houses in Kampong Speu, Kampot, Prey Veng and Takeo, respectively, used tile as the roofing material, with an average of about 69% for the total sample (Table 2.7). This figure significantly increased from the national average of 32% for the rural areas in 1999 (NIS, 1999). Overall, about 14% of the total surveyed households owned a house with thatch or palm leaf as temporally roofing material, which declined from the national figure of 45% for the rural areas in 1999.

Table 2.7 House distribution by type of materials used for building roofs (N=327)

Type of material	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.		No.	%	No.	%
Tile	61	72.6	55	68.8	42	52.5	69	83.1	227	69.4
Galvanized iron (tin)	11	13.1	8	10.0	24	30.0	10	12.0	53	16.2
Thatch or palm leaf	12	14.3	17	21.3	14	17.5	4	4.8	47	14.4

Wall: Table 2.8 shows that 68% of the surveyed households used plywood for outer walls, which increased from the national figure of 35% for the rural areas in 1999 (NIS, 1999). Highest number of households used temporal thatch or palm leaf for walls in Prey Veng (51%) and lowest number in Kampong Speu (13%). Permanent materials such as galvanized iron (tin) was not used in Kampong Speu and Kampot provinces and cement/brick was not used in Takeo province.

Table 2.8 House distribution by type of materials used for building walls (N=327)

Type of material	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cement/brick	3	3.6	1	1.25	4	5.0	0	0.0	8	2.5
Galvanized iron (tin)	0	0.0	0	0.0	2	2.5	2	2.4	4	1.2
Plywood	66	78.6	52	65.00	33	41.3	70	84.3	221	67.6
Thatch or palm leaf	15	12.8	27	33.8	41	51.3	11	13.3	94	28.6

Floor: Table 2.9 shows that 90% of the surveyed households used wooden planks or bamboo strips for building floor, which is higher than the national average of 72% for rural areas in 1999 (NIS, 1999). Only 1% of the surveyed households used brick tile for floors, 2% used cement and 7% used earth/clay.

Table 2.9 House distribution by type of materials used for building floors (N=327)

Type of material	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cement	4	4.8	0	0.0	3	3.8	0	0.0	7	2.1
Brick (i.e. tile)	3	3.6	0	0.0	0	0.0	1	1.2	4	1.2
Wooden plank	63	75.0	67	83.8	14	17.5	54	65.1	198	60.6
Bamboo strip	5	5.9	5	6.3	61	76.3	25	30.1	96	29.4
Earth/Clay	9	10.7	8	10.1	0	0.0	0	0.0	22	6.7

2.6 Source of lighting

The percentage of households using battery as the main source of lighting was similar in Kampong Speu (92%), Prey Veng (94%) and Takeo (92%) provinces, though there was slightly lower in Kampot (83%). Similarly, kerosene was nearly equally used as source of lighting in Kampong Speu, Prey Veng and Takeo provinces and more used in Kampot province (Table 2.10). Overall, about 74% of the total surveyed households

Table 2.10 Percentage distribution of household main source of lighting (N=327)

Source of light	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83	
	No.	%	No.	%	No.	%	No.	%
Public electricity	0	0	0	0	0	0	0	0
Generator	5	6.0	0	0	0	0	3	3.6
Kerosene	59	70.2	70	87.5	52	65.0	62	74.7
Candle	9	10.7	3	3.8	2	2.5	14	16.9
Battery	77	91.7	66	82.5	75	93.8	76	91.6

used kerosene for lighting, which is slightly lower than the national average of 84% for rural households in 1999(NIS, 1999). Only 6% of households in Kampong Speu used generator to generate electricity for lighting and no households used this source in other three provinces.

2.7 Source of drinking water

All surveyed households were in rain-fed areas the availability of year round water sources was crucial to the success of household livelihoods. In wet season, the majority of the surveyed households (over 90%) in Kampong Speu, Kampot and Takeo provinces used rainwater as the main source of drinking water, though there was a much lower number of households used rainwater in Prey Veng province (46%). The most important source of drinking water in Prey Veng province in both wet and dry seasons was from dug well, i.e. 100% of surveyed households used dug well for their drinking water supply (Table 2.11). Numerous development projects have supported the construction of wells (called dug wells including hand tube wells and ring wells), so water sources are more plentiful than a decade ago. This reflects that a larger number of the households in this 2005 survey used dug wells as compared to the average number of about 50% for rural sector in 1999 (NIS, 1999). A small number of households were using other sources of drinking water in wet season such as homestead ponds (18%, 33%, 0% and 8%), community ponds (5%, 3%, 0% and 5%) and lakes/reservoirs (0%, 0%, 0% and 1% in Kampong Speu, Kampot, Prey Veng and Takeo, respectively).

Table 2.11 Main source of drinking water (N=327)

Drinking water source	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83	
	No.	%	No.	%	No.	%	No.	%
Wet season								
Dug well	52	61.9	27	33.8	80	100	56	67.5
Rainwater	77	91.7	77	96.3	37	46.2	79	95.2
Homestead pond	15	17.9	26	32.5	0	0	7	8.4
Community pond	4	4.8	2	2.5	0	0	4	4.8
Lake/reservoir	0	0	0	0	0	0	1	1.2
Dry season								
Dug well	59	70.2	53	66.3	80	100	74	89.2
Rainwater	0	0	0	0	0	0	0	0
Homestead pond	22	26.2	25	31.3	0	0	10	12.1
Community pond	10	11.9	4	5.0	0	0	4	4.8
Lake/reservoir	0	0	0	0	0	0	0	0

In dry season, the most important source of drinking water was dug well for the four provinces (81%), followed by homestead (17.5%) and community (5.5%) ponds (Table 2.11). The lower number of households using dug wells was compensated by the higher number of households using homestead ponds in Kampot province.

Drinking water source ownership was similar in all four provinces. Individual households owned most ponds. Dug wells with potable water were generally considered as a common property resource and were normally shared by several households. Community ponds were public ponds, which are commonly used and managed by villagers. Lakes or swamps and reservoirs were generally public property and the surrounding population shared water usage.

While distance to water sources was not a major problem, the availability of year-round water and especially drinking water was problematic with most water sources drying up during the dry season months of April and early May, before the arrival the monsoon rains.

2.8 Fuel used for cooking

Practically, all the surveyed households (100%) were using firewood as the main source of fuel for cooking in the four provinces (Table 2.12). Comparing this figure to the national one for the rural sector in 1999 (NIS, 1999), there was no significant different. A small number of households (Range = 1-5%, average = 3%) used charcoal for cooking in the four provinces, which was slightly higher that the national average of about 1% for the rural sector of Cambodia. No rural household used LPG or electricity for cooking and moreover cow dung was used in Prey Veng and kerosene in Takeo as other sources of fuel for cooking.

Table 2.12 Main source of fuel used for cooking (N=327)

Fuel source	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83	
	No.	%	No.	%	No.	%	No.	%
Firewood	84	100.0	80	100.0	80	100.0	83	100.0
Charcoal	4	4.8	1	1.3	1	1.3	3	3.6
Kerosene	0	0	0	0	0	0	2	2.4
LPG	0	0	0	0	0	0	0	0
Electricity	0	0	0	0	0	0	0	0
Cow dung	0	0	0	0	1	1.25	0	0

2.9 Toilet facility within premise

Types of household toilet reflect primary health and sanitation levels and also the socio-economic status of households. Open toilet is a toilet not locating on the premises of a farmhouse, meaning no toilet available at farmhouse, while closed toilet is a toilet built on the premises of a farmhouse. Table 2.13 shows that 83%, 86%, 80% and 66% of the surveyed households in Kampong Speu, Kampot, Prey Veng and Takeo, respectively, has closed toilets. Only 21% of the total surveyed households had open toilets, indicating that the percentage of households who did not have toilet facilities appears to have declined significantly from the national figure of 84% in 1999 for the rural areas (NIS, 1999). The decreased number of open toilets reflects the development efforts of governmental and non-governmental and international organizations during a decade ago.

Table 2.13 Percentage distribution of households by toilet facility (N=327)

Type of toilet	Kampong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83	
	No.	%	No.	%	No.	%	No.	%
Open toilet	14	16.67	11	13.75	16	20.00	28	33.73
Closed toilet	70	83.33	69	86.25	64	80.00	55	66.27

2.10 Household durables and assets

Consumer durables: The only consumer or audio/visual durables owned by surveyed households were televisions, DVD players, CD/VCD players, video players, radios and cassette players, despite few households having electricity. The majority of consumer durables were powered by rechargeable batteries or occasionally generators. The most common item owned by a large number of the surveyed households in the four provinces was television sets, with 73% in Kampong Speu, 66% in Kampot, 84% in Prey Veng, 81% in Takeo and 76% in the total sample (Table 2.14). This figure is significantly higher than the national average of 20% for the rural areas in 1999 (NIS, 1999). Extension materials on "Small-scale aquaculture technology" should be available on TV's program. The next two commonly owned items were radios and cassette players. A small number of households had DVD players, CD/VCD players and video players. Only three surveyed household owned DVD players.

Table 2.14 Household durable and asset (N=327)

Type of durable/ asset	Kampong Speu N=84		Kampot N= 30		Prey Veng N= 80		Takeo N=83	
	No.	%	No.	%	No.	%	No.	%
Audio/visual durable								
Television	61	72.62	53	66.25	67	83.75	67	80.72
DVD player	2	2.38	0	0.00	0	0.00	1	1.20
CD/VCD player	5	5.95	3	3.75	5	6.25	7	8.43
Video player	3	3.57	1	1.25	3	3.75	6	7.23
Radio	35	41.67	38	47.50	39	48.75	41	49.40
Cassette player	20	23.81	19	23.75	34	42.50	31	37.35
Transportation								
Motorbike	37	44.05	21	26.25	31	38.75	36	43.37
Bicycle	65	77.38	70	87.50	74	92.50	79	95.18
Production asset								
Tractor	0	0	0	0	0	0	0	0
water pump	19	22.62	7	8.75	28	35.00	40	48.19
Fishing gear								
Gill net	1	1.19	17	21.25	7	8.75	25	30.12
Cast net	12	14.29	10	12.50	8	10.00	18	21.69
Hapa net	1	1.19	0	0.00	3	3.75	4	4.82
Fish trap	28	33.33	8	10.00	10	12.50	12	14.46
Hook and line	19	22.62	20	25.00	15	18.75	37	44.58
Other	2	2.38	1	1.25	2	2.50	7	8.43

Transportation: Surveyed households in the four provinces owned both motorbikes and bicycles (Table 2.14). Bicycles, owned by 77%, 88%, 93% and 95% of households in Kampong Speu, Kampot, Prey Veng and Takeo provinces respectively were by far the most important means of transportation. These averages are higher than the national average of 67% for the rural sector in 1999 (NIS, 1999). Around 44% % of households in Kampong Speu owned a motorcycle, compared to 26%, 39% and 43% in Kampot, Prey Veng and Takeo provinces, respectively.

Production assets: Although rice cultivation is the most important income generation activity in the four provinces (Table 2.5 and 2.6), no surveyed household owned a tractor. This reflects that rice cultivation is traditional and extensive using animals (e.g. cow or buffalo) as the main force for ploughing (see section 2.11 for more details about household ownership of these animals). This situation is similar to the one of the 1999 socio-economic survey (NIS, 1999). Around 23% of households in Kampong Speu owned a water pump, compared to 9% in Kampot, 35% in Prey Veng and 48% in Takeo province.

Fishing gears: Surveyed households in Takeo province owned the most fishing gear options and in Prey Veng province the least (Table 2.14). The surveyed areas were in fish deficit areas, well away from rivers and other larger natural water bodies and as a result only a small number of surveyed households in the four provinces owned gill nets, cast nets, hapa nets, fish traps or hooks and lines, i.e. on average 15% in Kampong Speu, 14% in Kampot, 11% in Prey Veng and 23% in Takeo. In Kampong Speu province, only one surveyed household owned a gill net due to a lack of important natural water bodies in this province compared to the other three provinces.

2.11 Land holding and ownership

Land is the most important asset of rural households. The average total land holding of 327 sampled households was 1.50 ha, with average land holdings of sampled households in Kampong Speu, Kampot, Prey Veng and Takeo provinces of 1.49, 1.08, 1.68 and 1.74 ha respectively (Table 2.15). The ratio of land per person was 0.24, 0.22, 0.31 and 0.30 ha person⁻¹ in Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively, with the average of 0.27 ha person⁻¹ for the total sample. The least land owned was 0.10, 0.21, 0.15 and 0.12 ha in Kampong Speu, Kampot, Prey Veng and Takeo respectively and the maximum area of land owned was 4.16, 3.00, 5.60 and 7.07 ha in Kampong Speu, Kampot, Prey Veng and Takeo respectively.

Paddy land was the most important land type in the four provinces with 98% of surveyed households having paddy land, with the average holding being 1.26 ha. Average paddy land area was 1.31, 0.85, 1.44 and 1.44 ha for Kampong Speu, Kampot, Prey Veng and Takeo respectively. Houses were built on residential land with an average area of 0.28 ha.

Land tenure and ownership affects farmer motivation to invest time and money in long-term projects such as construction of a fish pond on their land. Surveyed households owned 100%) of land holdings in the four provinces and there were no arrangements made to rent, borrow or share crop land.

Table 2.15 Household land holding (N=327)

Province	Type of land	Number	Average area (ha)	Standard deviation
Kampong Speu	Paddy land	80	1.31	0.79
	Residential land	84	0.27	0.16
	Total	84	1.49	0.88
Kampot	Paddy land	80	0.85	0.60
	Residential land	80	0.23	0.13
	Total	80	1.08	0.70
Prey Veng	Paddy land	78	1.44	0.90
	Residential land	80	0.31	0.16
	Total	80	1.68	0.96
Takeo	Paddy land	83	1.44	1.15
	Residential land	83	0.30	0.29
	Total	83	1.74	1.29
Total	Paddy land	321	1.26	0.86
	Residential land	327	0.28	0.18
	Total	327	1.50	0.96

The majority of surveyed households owning paddy land had 2.79 paddy plots per household, with average number of paddy plots of 2.86 in Kampong Speu, 2.43 in Kampot, 2.86 in Prey Veng and 3.00 in Takeo (Table 2.16). Highest number of households having 3-5 paddy plots was in Kampong Speu province and lowest in Prey Veng province. Around 6% of the surveyed households for the four provinces had more than five paddy plots.

Table 2.16 Number of paddy land plots

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80	100	80	100	78	100	83	100	321	100.00
1-2	32	40.00	47	58.75	43	55.13	41	49.40	163	50.82
3-5	45	56.25	32	40.00	30	38.46	33	39.76	140	43.62
>5	3	3.75	1	1.25	5	6.41	9	10.84	18	5.56
Average	2.86		2.43		2.86		3.00		2.79	
Maximum	7		7		12		8		12	
Minimum	1		1		1		1		1	
Standard D	1.40		1.18		1.89		1.79		1.60	

If surveyed households had 2 or more than 2 paddy plots, those paddy plots would be located at maximal and minimal distances from the house. Table 2.17 shows that around 70% of paddy plots were within a maximal distance of 1,000 m of the house. In Kampot the majority of paddy plots were within 50-500 m of the house and in Kampong Speu, Prey Veng and Takeo within 201-1,000 m of the house or greater than 1,000 m away. Travel time to more distant land plots was not considered excessive or a problem by households.

Table 2.17 Distance to paddy land plots from the house (m)

	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Maximal distance to paddy plot										
<50	1	1.25	4	5.00	3	3.85	3	3.61	11	3.43
50-200	12	15.00	26	32.50	9	11.54	12	14.46	59	18.37
201-500	21	26.25	27	33.75	19	24.36	20	24.10	87	27.11
501-1000	23	28.75	12	15.00	21	26.92	17	20.48	73	22.79
>1000	23	28.75	11	13.75	26	33.33	31	37.35	91	28.30
Total	80	100	80	100	78	100	83	100	321	100
Minimal distance to paddy plot										
<50	17	21.25	46	57.50	12	15.38	32	38.55	107	33.17
50-200	46	57.5	28	35.00	30	38.46	27	32.53	131	40.87
201-500	15	18.75	4	5.00	25	32.05	13	15.66	57	17.87
>500	2	2.5	2	2.50	11	14.10	11	13.25	26	8.09
Total	80	100	80	100	78	100	83	100	321	100

Approximately 92% of paddy plots were within a minimal distance of 500 m of the house (Table 2.17). In Kampong Speu, Kampot and Takeo provinces the majority of paddy plots were within 200 m of the house, while in Prey Veng the majority were within 50-500 m of the house.

2.12 Livestock

For most rural households, large ruminants (i.e. cows and buffalos) are the next most important assets after land. In the surveyed area, cows were the most important large ruminants owned by households. Table 2.18 lists the livestock holding profiles and the average number of livestock owned by households in the surveyed provinces. In Kampong Speu, Kampot, Prey Veng and Takeo provinces 88, 90, 51 and 93% of households (total average 81%) owned an average of 3.47, 2.88, 2.80 and 3.30 cows (total average of 3.11). There were very few buffalos in the surveyed households. Three households in Kampong Speu, thirteen households in Prey Veng and one household in Takeo had 4.00, 2.23 and 2.00 buffalos per household (total average of 2.06), respectively. No household of the 80 surveyed households in Kampot province owned a single buffalo. Pigs were important for household cash income and were owned by 73% of the households surveyed. Around 65, 93, 60 and 72% of households in Kampong Speu, Kampot, Prey Veng and Takeo provinces respectively had an average of 2.75, 1.81, 2.58 and 2.38 pigs per household (total average of 2.38). Generally in rural Cambodia pigs are allowed to free range during the day and are only penned at night. This strategy reduces the need for expensive feeding that is required if pigs are penned day and night. As a result, however, only limited quantities of pig manure were available for other farm activities. Goats were not common livestock in the four provinces as well as in other rural areas of Cambodia and were owned by only three surveyed households in Kampong Speu and no households in other three provinces owned a single goat. Chickens were the most common livestock for both household food and income and were owned by 95% of surveyed households. Around 91, 98, 95 and 96% of surveyed households owned an average number of 16.1 in Kampong Speu, 22.5 in Kampot, 15.9 in Prey Veng and 20.8 chickens per household in Takeo, respectively. The proportion of households owning chickens and the average number

Table 2.18 Ownership of livestock (N=327)

Province	Animal type	No. of households	Avg. no. of animals	Maximum	Minimum	Standard deviation
Kampong Speu	Buffalo	3	4.00	6	2	2.00
	Cow	74	3.47	10	1	1.72
	Pig	55	2.75	10	1	2.42
	Goat	3	33.33	40	30	5.77
	Chicken	76	16.08	50	2	12.78
	Duck	23	10.43	22	2	6.85
Kampot	Buffalo	0	0.00	0	0	0.00
	Cow	72	2.88	7	1	1.36
	Pig	74	1.81	8	1	1.17
	Goat	0	0.00	0	0	0.00
	Chicken	78	22.53	100	3	14.43
	Duck	55	15.31	100	2	15.19
Prey Veng	Buffalo	13	2.23	4	1	1.01
	Cow	41	2.80	6	1	1.35
	Pig	48	2.58	12	1	2.62
	Goat	0	0.00	0	0	0.00
	Chicken	76	15.95	80	1	14.70
	Duck	20	8.45	30	1	7.98
Takeo	Buffalo	1	2.00	2	2	0.00
	Cow	77	3.30	10	1	1.70
	Pig	60	2.38	10	1	2.04
	Goat	0	0.00	0	0	0.00
	Chicken	80	20.78	116	1	22.61
	Duck	43	11.67	50	1	12.18
Total	Buffalo	17	2.06	3	1.25	0.75
	Cow	264	3.11	8.25	1	1.53
	Pig	237	2.38	10	1	2.06
	Goat	3	8.33	10	7.5	1.44
	Chicken	310	18.84	86.5	1.75	16.13
	Duck	141	11.47	50.5	1.5	10.55

owned was highest in Kampot province. Chickens were also given free range to scavenge and were only occasionally fed rice bran and broken rice. Approximately 43% of surveyed households owned 11.5 ducks per household. The average number of ducks owned was highest at 15.3 ducks per household in Kampot province (69% owning ducks) followed by 10.4 in Kampong Speu (27%), 8.5 in Prey Veng (25%) and 11.7 in Takeo (52%). Ducks were more common again in Kampot than the other three provinces both in terms of mean number of ducks owned and the proportion of households with ducks. The proportion of households owning ducks and the average number owned was lowest in Prey Veng province. Ownership of ducks was strongly linked with nearby water sources.

The number and type of livestock owned by a household sets the upper limit to the amount of on-farm organic manure that is available. The livestock rearing system however, determines how much of the available organic manure can easily be collected and used for integrated farming. Cow, buffalo and pig manure were collected in greatest

quantities and used for rice field fertilization. Although sampled households owned large numbers of chickens and ducks, because both were allowed to scavenge free-range, the use of poultry and duck manure for rice was negligible. Only limited quantities of this organic manure was used for other crops. Penning animals to allow more convenient collection of organic wastes and the possibility of greater on-farm integration involves greater feeding costs that many poor rural farmers in Cambodia cannot afford.

2.13 Money saving and debt

Traditionally the majority of rural households of Cambodia do not save their money at bank, although they have lots of money. In this survey around 90% of the total surveyed households did not saving money at bank or home indicating that most households were poor and therefore the correct target group for FAIEX. All (100%) surveyed households in Kampong Speu province did not saving money, 99% in Kampot, 80% in Prey Veng and 81% in Takeo (Table 2.19).

Debt was found in some surveyed households. Approximately one-third of surveyed households had debt (Table 2.19). In Kampong Speu province 32% of surveyed households had debt, in Kampot 24%, in Prey Veng 35% and in Takeo 37%. Much of the debt was used to pay for medicine, when a household member was ill.

Table 2.19 Percentage: distribution of household by money saving at bank and dept

Money saving/dept	Kampong Speu N= 84		Kampot N=80		Prey Veng N=80		Takeo N=83	
	No.	%	No.	%	No.	%	No.	%
Money saving								
Saving	0	0	1	1.25	16	20.00	16	19.28
No saving	84	100	79	98.75	64	80.00	67	80.72
Debt								
Debt	27	32.14	19	23.75	28	35.00	31	37.35
No debt	57	67.86	61	76.25	52	65.00	52	62.65

2.14 Rice consumption and production

12.14.1 Rice consumption

Rice and fish are the mainstays of food security for most inhabitants in Cambodia. All surveyed households for the four provinces consumed averagely 1636 kg of rice per household per year, with an average of 1,692, 1,360, 1,633, 1,847 kg in Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively (Table 2.20). The ratio of rice consumption per person per year in Kampong Speu, Kampot, Prey Veng and Takeo provinces was nearly equal, being 277, 278, 297 and 318 kg (average of 297 kg per person per year for the total sample). Over 80% of households for the four provinces consumed 1,000-2,000 kg or greater than 2,000 kg of rice per household per year, with

Table 2.20 Household rice consumption (kg)

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	84	100	80	100	80	100	83	100	327	100
<1,000	13	15.48	20	25.00	9	11.25	9	10.84	51	15.6
1,000-1,500	30	35.71	37	46.25	38	47.5	24	28.92	129	39.45
1,501-2,000	16	19.05	15	18.75	15	18.75	23	27.71	69	21.1
>2,000	25	29.76	8	10	18	22.5	27	32.53	78	23.85
Average	1,691.9		1,360.1		1,632.6		1,847.1		1,635.6	
Standard D	701.6		618.2		701.6		681.4		696.3	

similar proportions in Kampong Speu (85%), Prey Veng (89%) and Takeo (89%)) provinces and slightly lower proportion in Kampot province (75%). Around 16% of households consumed less than 1,000 kg of rice per household per year.

2.14.2 Rice production

80 surveyed households or 95% in Kampong Speu, 80 or 100% in Kampot, 78 or 98% in Prey Veng and 83 or 100% in Takeo produced at least one crop of rice. Over 70% of surveyed households in the four provinces produced only one crop of rice production per year (Table 2.21). The proportions in Kampong Speu (96%) and Kampot (94%) were nearly equal, though lowest proportion was found in Takeo, 33% compared to 74% in Prey Veng province.

Overall, only 23% of surveyed households produced two crops of rice production per year, with the highest proportion in Takeo (54%) and lowest in Kampong Speu (4%), i.e. wet season rice (June - December) and dry season rice (January-May). Three crops of rice production were produced in Takeo only. The infrastructure of irrigation systems reflects the number of rice production crops.

Table 2.21 Number of rice production crops per year

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80	100	80	100	78	100	83	100	321	100
One	77	96.25	75	93.75	58	74.36	27	32.53	237	73.83
Two	3	3.75	5	6.25	20	25.64	45	54.22	73	22.74
Three	0	0	0	0	0	0	11	13.25	11	3.43

Rice farming in Cambodia is mainly depending on rainfall. In good years with lots of rainfalls farmers produced higher rice yield (referred here as maximal yield or production) and in bad years with little rainfalls farmers produced lower rice yield (referred here as minimal yield or production).

Maximal rice production: Surveyed households produced an overall maximal rice production of 2.87 tons per household per year (Table 2.22) or 2.28 tons/ha per year, based on average paddy area shown in Table 2.15. In Kampong Speu the rice production was 2.39 ton or 1.82 tons/ha per year per household, in Kampot 2.12 tons or

2.49 tons/ha, in Prey Veng 2.74 tons or 1.90 ton/ha and in Takeo highest, 4.17 tons or 2.90 tons/ha. These figures are much higher than the provincial averages of 0.51 tons/ha in Kampong Speu, 1.00 tons/ha in Kampot, 1.64 tons/ha in Prey Veng and 1.73 tons/ha in Takeo (Table 1.9).

Around 10% of households produced less than 1 ton of rice per year per household, 40% produce 1-2 tons and 50% produced more than 2 tons (Table 2.22). Highest proportion of household in Kampot produced less than 1 ton or within 1-2 tons of rice and lowest in Takeo. However, the proportion of households producing within 2.01-3 tons or greater than 3 tons was highest in Takeo province and lowest in Kampot.

In good years, rice production per household was higher than rice consumption per household for the four surveyed provinces (Table 2.20). Hence there was surplus of rice production in good year.

Table 2.22 Household maximal rice production (ton/household/year)

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Tota	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80		80		78		83		321	
<1	7	8.75	16	20.00	7	8.97	1	1.2	31	9.66
1-2	34	42.5	42	52.50	31	39.74	20	24.1	127	39.56
2.01-3	22	27.5	10	12.50	18	23.08	26	31.33	76	23.68
>3	17	21.25	12	15.00	22	28.21	36	43.37	87	27.10
Average	2.39		2.12		2.74		4.17		2.87	
Standard D	1.43		1.98		1.81		3.3		2.39	

Minimal rice production: Surveyed households produced an overall minimal rice production of 1.91 tons per year per household (Table 2.23) or 1.52 tons/ha per year per household, based on average paddy area shown in Table 2.15. In Kampong Speu the rice production was 1.60 ton or 1.22 tons/ha per year per household, in Kampot 1.67 tons or 1.96 tons/ha, in Prey Veng 1.32 tons or 0.92 ton/ha and in Takeo highest, 3.01 tons or 2.09 tons/ha. These figures are much slightly higher than the three provincial averages of 0.51 tons/ha in Kampong Speu, 1.00 tons/ha in Kampot and 1.73 tons/ha in Takeo and slightly lower than another provincial average of 1.64 tons/ha in Prey Veng (Table 1.9).

Around 35% of households produced less than 1 ton of rice per year per household, 42% produce 1-2 tons and 23% produced more than 2 tons (table 2.23). The proportions of households producing less than 1 ton of rice were similar in three surveyed provinces, though lowest proportion was found in Takeo province. The proportions of households producing 1-2 tons of rice in the four provinces were nearly equal. The proportion of households producing greater than 2 tons of rice per year was highest in Takeo (46%) and lowest in Prey Veng (13%).

In bad years, rice production per household was nearly equal to rice consumption per household in Kampong Speu, Kampot and Prey Veng and higher than rice consumption

in Takeo province (Table 2.20). Hence there was no surplus of rice production in Kampong Speu, Kampot and Prey Veng in bad year, while rice surplus was detected in Takeo province in both good and bad years as there is better infrastructure of irrigation systems in Takeo province compared to other three surveyed provinces.

Table 2.23 Household minimal rice production (ton/year)

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80		80		78		83		321	
<1	31	38.75	36	45.00	33	42.31	12	14.46	112	34.89
1-2	35	43.75	32	40.00	35	44.87	33	39.76	135	42.06
2.01-3	9	11.25	3	3.75	7	8.97	13	15.66	32	9.97
>3	5	6.25	9	11.25	3	3.85	25	30.12	42	13.08
Average	1.60		1.67		1.32		3.01		1.91	
Standard D	1.64		2.07		1.04		2.71		2.07	

2.14.3 Pesticide application for rice production

Around 15% of surveyed households in the four provinces applied pesticide at an average of 323 ml/ha for their rice production after 2 to 3 months of transplantation (Table 2.24). Only one household in Kampong Speu and Kampot applied pesticide at 250 ml/ha and 450 ml/ha respectively, followed by 18% in Prey Veng at 222 ml/ha and 40% in Takeo at 369 ml/ha. Highest number of households using pesticide and highest dose of pesticide was detected in Takeo province.

Table 2.24 Percentage distribution of households by pesticide application and its amount (ml/ha)

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80		80		78		83		321	
No application	79	98.75	79	98.75	64	82.05	50	60.24	272	84.74
Application	1	1.25	1	1.25	14	17.95	33	39.76	49	15.26
	No.	ml/ha	No.	ml/ha	No.	ml/ha	No.	ml/ha	No.	ml/ha
Average	1	250	1	450	14	222	33	369	49	323

2.14.4 Main purpose of rice production

Surveyed households had different purposes of rice production including household consumption, selling and both. The most important purpose of rice production was for consumption in the four provinces, being 76% in Kampong Speu, 89% in Kampot, 76% in Prey Veng and 58% in Takeo (average 74% for the total sample) (Table 2.25). Around 25% of households producing rice were for both consumption and selling, with highest proportion in Takeo (41%) and lowest proportion in Kampot (11%). Only one household in Takeo province produced rice for selling. The price of rice varied from 300 to Riel 600 per kilo according to rice varieties and levels of its abundance.

Table 2.25 Main purpose of rice production

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80	100	80	100	78	100	83	100	321	100
Consumption	60	75.95	71	88.75	59	75.64	48	57.83	238	74.38
Selling	0	0	0	0	0	0	1	1.21	1	0.31
Both	20	24.05	9	11.25	19	24.36	34	40.96	81	25.31

Approximately 65% of the total respondents reported they had enough rice to consume in a year, being 60% in Kampong Speu, 64% in Komport, 55% in Prey Veng and 82% in Takeo (Table 2.26). This is in agreement with the figure resulted from household rice consumption (Table 2.20) and household rice production (Table 2.22) that overall there was household rice deficit in Kampong Speu and Prey Veng, just enough rice for household consumption in Kampot and surplus of rice in Takeo in bad years (see also section 2.14.1 and 2.14.2).

Table 2.26 Whether rice production is enough or not for household consumption

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	80	100	80	100	78	100	83	100	321	100
Enough	48	60.00	51	63.75	43	55.13	68	81.93	210	65.42
Not enough	32	40.00	29	36.25	35	44.87	15	18.07	111	34.58

2.15 Household expenditure for buying rice

Table 2.26 lists the proportions of households whose rice production was not enough for household consumption. Therefore these households had to buy rice to meet their yearly household consumption.

Maximal expenditure: Table 2.27 shows that surveyed households spent a maximal amount of Riel 308,422 per household per year to buy rice. Kampong Speu, Kampot and Prey Veng households spent similar amount of money to buy rice, while Takeo households spent slightly lower amount. Overall 41% of surveyed households spent greater than Riel 300,000 to buy rice per year, with similar household proportions in the four provinces. Similar proportions of households in Kampong Speu (34%), Kampot (38%) and Takeo (33%) spent within Riel 150,000-300,000, though there was highest household proportion (51%) spending the same amount of money in Prey Veng province. Around 25% of households in Kampong Speu, Kampot and Takeo spent less than Riel 150,000 to buy rice and 6% in Prey Veng.

Table 2.27 Maximal expenditure for buying rice per year (Riel '000)

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	32	100	29	100	35	100	15	100	111	100
<150	8	25.00	7	24.14	2	5.71	4	26.67	21	18.92
150-200	4	12.50	4	13.79	10	28.57	2	13.33	20	18.02
201-300	7	21.88	7	24.14	8	22.86	3	20.00	25	22.52
>300	13	40.63	11	37.93	15	42.86	6	40.00	45	40.54
Average	317.127		305.028		314.900		281.300		308.422	
Standard D	235.043		190.195		150.661		204.598		194.507	

Minimal expenditure: Table 2.28 shows that surveyed households spent a minimal amount of Riel 194,605 per household per year to buy rice to meet the annual rice consumption in the family. Kampong Speu, Kampot, Prey Veng and Takeo households spent similar amount of money to buy rice. Overall 24% of surveyed households spent greater than Riel 300,000 to buy rice per year, with similar household proportions in the Kampong Speu, Kampot and Prey Veng and highest proportion in Takeo. Highest proportion of households in Prey Veng (40%) and lowest in Takeo (13%) spent within Riel 150,000-300,000 to buy rice, followed by 17% in Kampot and 22% in Kampong Speu. Over 50% of households in Kampong Speu, Kampot and Takeo spent less than Riel 150,000 to buy rice and 40% in Prey Veng.

Table 2.28 Minimal expenditure for buying rice per year (Riel '000)

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	32	100	29	100	35	100	15	100	111	100
<150	17	53.13	17	58.62	14	40.00	8	53.33	56	50.45
150-200	4	12.50	2	6.90	8	22.86	0	0	14	12.61
201-300	3	9.38	3	10.34	6	17.14	2	13.33	14	12.61
>300	8	25.00	7	24.14	7	20.00	5	33.33	27	24.32
Average	189.658		188.828		201 121		209.987		194.605	
Standard D	175.431		148.088		151.875		197.117		156.734	

Four surveyed households in Kampong Speu and two in Prey Veng who did not own paddy (table 2.15) land did not produce rice (Table 2.22 and 2.23). These households had to spend money to buy rice for household consumption. On average Kampong Speu households spent Riel 1,122,500 per year per household and Prey Veng households spent Riel 630,000.

2.16 Household fish and animal consumption

Fish is the most important source of protein supply for rural Cambodia in terms of food and nutrition security.

2.16.1 Distribution offish and other animal protein intake

Table 2.29 shows average fish and other animal protein intake and percentage distribution of household by fish and other animal protein intake in the four surveyed provinces in wet and dry seasons. Surveyed households for the four provinces consumed slightly more fish in wet season (68% of total animal protein) than in dry season (61%). These figures are closed to the national average of 70% for the whole Cambodia (So Nam & Nao Thuok, 1999; So Nam & Buoy Roitana, 2005). In wet season the contribution of fish to total animal protein intake was almost equal, being 67.0% in Kampong Speu, 69.7% in Kampot, 67.4% in Prey Veng and 67.3% in Takeo province. In dry season highest contribution of fish to total animal protein intake was in Kampot (66.9%) and lowest in Prey Veng province (55.1%), followed 58.2% in Takeo and 60.7% in Kampong Speu province. Surveyed households in Kampot province consumed slightly more fish than households in other three provinces in both seasons.

In wet season approximately 31% of the total surveyed households consumed fish at a rate of more than 70% of the total animal protein intake in wet season, 65% at a rate

Table 2.29 Percentage distribution of household by fish and other animal protein intake

Description*	Kompong Speu N=84		Kompot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	Fish	Meat	Fish	Meat	Fish	Meat	Fish	Meat	Fish	Meat
Wet season										
<=30	6.0	63.1	3.8	73.8	8.8	70.0	1.2	63.9	4.9	67.6
31-50	7.1	25.0	7.5	15.0	7.5	15.0	9.6	25.3	8.0	20.2
51-70	56.0	9.5	55.0	10.0	51.3	11.3	63.9	10.8	56.6	10.4
71-100	31.0	2.4	33.8	1.3	32.5	3.8	25.3	0.0	30.6	1.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Average	67.0	33.0	69.7	30.3	67.4	32.6	67.3	32.7	67.8	32.2
Standard D	16.1	16.1	15.8	15.8	17.7	17.7	13.6	13.6	15.8	15.8
Dry season										
<=30	9.5	53.6	3.8	63.8	25.0	36.3	8.4	43.4	11.6	49.2
31-50	9.5	26.2	10.0	22.5	11.3	27.5	22.9	25.3	13.5	25.4
51-70	58.3	17.9	57.5	12.5	43.8	17.5	51.8	27.7	52.9	19.0
71-100	22.6	2.4	28.8	1.3	20.0	18.8	16.9	3.6	22.0	6.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Average	60.7	39.3	66.9	33.2	55.1	44.9	58.2	41.8	60.7	39.3
Standard D	17.9	17.9	15.6	15.6	21.5	21.5	16.0	16.0	17.9	17.9

Note: * Fish = Fish meat/protein; Meat = Other animal meat/protein

within 31-70% and 5% at a rate of less than or equal to 30%. Similar fish consumption pattern was detected in dry season; 22% of households consumed fish at a rate of more than 70% of total animal protein intake, 66% at a rate within 31-70%) and 12% at a rate of less than or equal to 30%.

2.16.2 Fish consumption

Fish consumed by surveyed households came from captured wild fish (both purchased and self caught) and cultured fish (both purchased and self cultured). Table 2.30 shows that the amount of fish consumed by each family was very similar in both wet and dry seasons for the four provinces, being on average of 0.47 kg per household day per in wet season and 0.44 kg in dry season for the total sample (N=327). The majority of households consumed 0.3-0.5 kg offish per day and the least consumed greater than 0.7 kg per household per day. Based on mean family size in all four provinces each surveyed household member consumed approximately 84 g of fish per day in wet season and 79 g in dry season. This fish consumption rate is much lower than the national requirement rate of 250 g per person per day for rural people and a cause for concern.

Based on the average household size (Table 2.1), the proportion of household fish protein intake (Table 2.29), daily household fish consumption (Table 2.30) in each surveyed province, mean annual per capita fish consumption was calculated as 18.15, 20.86, 18.29 and 18.95 kg per person for Kampong Speu, Kampot, Prey Veng and Takeo provinces. So Nam and Nao Thuok (1999) estimated that mean annual fish consumption for Cambodia was 31 kg per person, while Ahmed *et al* (1998) reported a mean annual fish consumption of 71 kg per person around the fish rich area of Tonle Sap. The survey results confirm that the Kampong Speu, Kampot, Prey Veng and Takeo provinces are fish scarce areas, where fish consumption is well below the national average.

Table 2.30 Quantity offish consumed in the family (kg/day)

Description	Kompong Speu N=84		Kompot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wet season										
<0.3	8	9.5	15	18.8	11	13.8	6	7.2	40	12.2
0.3-0.5	59	70.2	56	70.0	61	76.3	63	75.9	239	73.1
0.5-0.7	9	10.7	6	7.5	0	0.0	5	6.0	20	6.1
>0.7	8	9.5	3	3.8	8	10.0	9	10.8	28	8.6
Total	84	100	80	100	80	100	83	100	327	100
Average	0.47		0.42		0.48		0.48		0.47	
Standard deviation	0.22		0.21		0.28		0.19		0.22	
Dry season										
<0.3	5	5.95	18	22.5	10	12.5	7	8.43	40	12.23
0.3-0.5	63	75	56	70	64	80	58	69.88	241	73.7
0.5-0.7	8	9.52	2	2.5	2	2.5	5	6.02	17	5.2
>0.7	8	9.52	4	5	4	5	13	15.66	29	8.87
Total	84	100	80	100	80	100	83	100	327	100
Average	0.48		0.4		0.42		0.48		0.44	
Standard deviation	0.19		0.21		0.24		0.20		0.21	

2.17 Capture fisheries

Capture of freshwater wild fish in the four provinces was operated in two seasons, wet season starting from June to December and dry season from January to May. This household fishing is small-scale fishing using a variety of small-scale fishing gears including gill nets, cast nets, hooks and lines and fish traps, which are made of bamboos (Table 2.14). Therefore, wild fisheries play an important role in the livelihood strategies of rural people.

2.17.1 Number of fishers and fishing days

Around 38% of households in Kampong Speu, 56% in Kampot, 45% in Prey Veng and 70% in Takeo (total over 50%) did fishing in both seasons (Table 2.31). The proportion of households engaged in fish capture was highest in Takeo where 58 out of 83 households were fishers. These households fished 1 to 7 days per week (average = 4.17 days per week) in wet season and 1 to 6 days per week (average = 3.14 days) in dry season. The number of days spent on fishing was nearly equal in both seasons for the four provinces. Over 60% of households fished 3 to 5 days per week in both seasons, while 13% fished less than 2 or equal to 2 times per week in wet season and 37% fished the same number of days in dry season. Only one household in Takeo province fished greater than 5 days per week in dry season, while 28% in Kampong Speu and Prey Veng, 18% in Kampot and 22% in Takeo fished the same number of days in wet season.

Table 2.31 Proportion of households capturing wild fish and number of fishing days

Description	Kompong Speu N=84		Kompot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wet season										
<=2	4	12.5	4	8.89	5	13.89	10	17.24	23	13.45
3-5	19	59.38	33	73.33	21	58.33	35	60.34	108	63.16
>5	9	28.13	8	17.78	10	27.78	13	22.41	40	23.39
Total	32	100	45	100	36	100	58	100.0	171	100
Average	4.25		4.04		4.81		4.17		4.29	
Standard deviation	1.68		1.48		1.85		1.73		1.69	
Dry season										
<=2	9	28.13	24	53.33	14	38.89	16	27.59	63	36.84
3-5	23	71.88	21	46.67	22	61.11	41	70.69	107	62.57
>5	0	0	0	0	0	0	1	1.72	1	0.58
Total	32	100	45	100	36	100	58	100	171	100
Average	3.06		2.47		2.92		3.14		2.87	
Standard deviation	1.05		0.92		0.96		1.21		1.07	

2.17.2 Main fishing grounds

Surveyed households mostly fished in their village or nearby villages within the same commune. The most important fishing locations in terms of quantities of fish caught were rice fields (68%), including 91% in Kampong Speu province, 64% in Kampot and Prey Veng and 52% in Takeo (Table 2.32). The lowest percentage of households capturing fish from rice fields in Takeo was compensated by the highest percentage of households capturing fish from streams (38%) and lakes (40%). The proportion of households taking fish from canals (42%) and roadside ponds (8%) was greatest in Prey Veng province. The proportion of households taking fish from community ponds was greatest in Kampong Speu province (25%) and lowest in Prey Veng province (11%). Only one household in Takeo province captured fish from river. One household in Kampong Speu province, 2 in Kampot, 3 in Prey Veng and 6 in Takeo captured fish from trap ponds.

Table 2.32 Main fishing grounds in FAIEX provinces in 2005 (N=327)

Description	Kompong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	32		45		36		58		171	
Trap pond	1	3.1	2	4.4	3	8.3	6	10.3	12	6.6
River	0	0.0	0	0.0	0	0.0	1	1.7	1	0.4
Stream	6	18.8	8	17.8	3	8.3	22	37.9	39	20.7
Lake	.	3.1	1	2.2	3	8.3	23	39.7	28	13.3
Rice field	29	90.6	29	64.4	23	63.9	30	51.7	111	67.7
Canal	9	28.	16	35.6	15	41.7	13	22.4	53	31.9
Roadside pond	0	0.0	0	0.0	3	8.3	0	0.0	3	2.1
Community pond	8	25.0	6	13.3	4	11.1	7	12.1	25	15.4

2.17.3 Fish capture from trap ponds

2.17.3.1 Trap pond characteristics

In total, 16 trap ponds were detected in the four provinces, i.e. 1 in Kampong Speu province, 3 in Kampot and Prey Veng and 9 in Takeo (Table 2.33). The maximal sizes of trap ponds varied from 25.0 m² in Kampong Speu province to 600.0 m² in Prey Veng, while the minimal sizes from 10 m² in Takeo province to 150 m² in Prey Veng province. Prey Veng province had highest minimal, maximal and average sizes of trap ponds. Average size of trap ponds was 25.0 m² in Kampong Speu, 108.0 in Kampot, 316.7 m² in Prey Veng and 76.1 m² in Takeo.

Table 2.33 Number of trap ponds and their sizes

	Kampong Speu	Kampot	Prey Veng	Takeo	Total
Number of trap ponds	1	3	3	9	16
Average size (m ²)	25.0	108.0	316.7	76.1	131.4
Maximum size (m ²)	25.0	200.0	600.0	225.0	600.0
Minumun size (m ²)	25.0	60.0	150.0	10.0	10.0
Standard deviation	-	79.7	246.6	68.5	144.8

2.17.3.2 Major fish species and fish catch from trap ponds

Table 2.34 shows that snakehead and walking catfish were the most important fish species caught by all surveyed households owning trap ponds in all four provinces. Rasbora carp, Anbantoidei fish, climbing perch and small shrimp were captured by the majority of households in the four provinces. Mystus catfish were caught by around 33% of households in Kampot province and 89% of households in Takeo province. Other 15 fish species were captured from trap ponds in Takeo province only. The most frequently caught fish species were peacock eel (56%) and Asian red tail catfish (56%), followed by kissing gourami (22%) and Henichorhynchus carp (22%). The less frequently caught species in Takeo province included 11 species.

Table 2.34 Fish species and fish catch from trap ponds in 2004

Fish species			Kompong Spcu N=1		Kampot N=3		Prey Veng N=3		Takeo N=9	
Khmer name	Common name	Scientific name	No.	%	No.	%	No.	%	No.	%
Phtouk/ros	Snakehead murrel	<i>Channa striata</i>	1	100.0	3	100.0	3	100.0	9	100.0
Andeng	Walking catfishes	<i>Clariid sp.</i>	1	100.0	3	100.0	3	100.0	9	100.0
Changva	Rasbora carp	<i>Rasbora sp.</i>	1	100.0	1	33.3	1	33.3	6	66.7
Kompleanh	Anbantoidei fishes	<i>Trichogaster sp.</i>	1	100.0	2	66.7	2	66.7	5	55.6
Kanhchos	Mystus catfishes	<i>Mystus sp.</i>	-	-	1	33.3	-	-	8	88.9
Kranh	Climbing perch	<i>Anabas sp.</i>	1	100.0	1	33.3	3	100.0	4	44.4
Chhlounh	Peacock eel	<i>Macrogynathus sp.</i>	-	-	-	-	-	-	5	55.6
Chhlang	Asian red tail catfish	<i>Heminbagrus spilopterus</i>	-	-	-	-	-	-	5	55.5
Antong	Swamp eel	<i>Monopterus albus</i>	-	-	-	-	-	-	-	11.1
Kompeus	Small shrimp	-	1	100.0	2	66.7	1	33.3	-	44.4
Chra Keng	Puntioplites barb	<i>Puntioplites falcifer</i>	-	-	-	-	-	-	-	11.1
Chhpim	Puntius barb	<i>Puntius sp.</i>	-	-	-	-	-	-	-	11.1
Kantrob	Helostoma temminckii	<i>kissing gourami</i>	-	-	-	-	-	-	-	22.2
Kdam	Crap	-	-	-	-	-	-	-	-	11.1
Kchorng	Abalone	-	-	-	-	-	-	-	-	11.1
Kros	Osteochilus carp	<i>Osteochilus sp.</i>	-	-	-	-	-	-	-	11.1
Kangkeb	Frog	-	-	-	-	-	-	-	-	11.1
Ta Aon	Butter catfish	<i>Ompok sp.</i>	-	-	-	-	-	-	-	11.1
Phtoung	Congaturi halfbeal	<i>Hyporhamphus ilmbatus</i>	-	-	-	-	-	-	-	11.1
Riel	Henichorhynchus carp	<i>Henichorhynchus sp.</i>	-	-	-	-	-	-	-	22.2
Kes	Silurid catfishes	<i>Micronema sp.</i>	-	-	-	-	-	-	-	11.1
Slalh	Bronze featherback	<i>Notopterus notopterus</i>	-	-	-	-	-	-	*	11.1
Average fish catch (kg/trap pond/year)			50		32.5		40		19.5	
Maximal fish catch			50		50		50		42	
Minimal fish catch			50		15		20		2	
Standard deviation					24.75		17.32		15.07	

Table 2.34 shows that fish catch from trap ponds varied from 2 to 50 kg per trap pond per year in all four provinces. The total average of fish production per trap pond per year was 29.3 kg or 22.3 kg/100 m², with an average of 50.0 kg or 200.0 kg/100 m² in Kampong Speu, 32.5 kg or 30.1/100 m² in Kampot, 40.0 kg or 12.6 kg/100 m² in Prey Veng and 19.5 kg or 25.6 kg/100 m² in Takeo province.

2.17.4 Fish capture from other fishing grounds

In addition to fishing in trap ponds, surveyed households captured wild fish from several other fishing grounds (Table 2.32).

2.17.4.1 Major fish species and fish catch from other fishing grounds

Besides fishing in trap ponds, rural households caught fish at a number of other fishing locations in both wet and dry seasons (Table 2.32). In wet season the majority of surveyed households captured fish from rice fields, canals and community ponds, while

in dry season they caught fish from lakes, streams, community ponds and canals before these fishing grounds are dried up.

Similarly to trap ponds, snakehead, walking catfish and climbing perch were also the most important and dominant fish species and captured from other fishing grounds in all four provinces; meaning that 90%, 86% and 96% of surveyed households capturing snakehead, walking catfish and climbing perch, respectively (Tale 2.35). The second dominant fish species were Rasbora carps and peacock eel which wee caught by 58% and 55% of surveyed households, respectively. The third common species were small shrimps, crabs and abalones.

Table 2.35 Fish species and fish catch from other fishing grounds in 2004

Fish species			Kampong Speu N=32		Kampot N=46		Prey Veng N=36		Takeo N=58	
Kmer name	Common name	Scientific name	No.	%	No.	%	No.	%	No.	%
Phtouktras	Snakehead murrel	<i>Channa striata</i>	30	93.8	40	88.9	32	88.9	52	89.7
Andang	Walking catfishes	<i>Clariid sp.</i>	29	90.6	34	75.6	31	86.1	52	89.7
Changva	Rasbora carp	<i>Rasbora sp.</i>	26	81.3	28	62.2	18	50.0	23	39.7
Kompleanh	Anabantoid fishes	<i>Trichogaster sp.</i>	12	37.5	21	46.7	8	22.2	22	37.9
Kanhchos	Mystus catfishes	<i>Mystus sp.</i>	6	18.8	19	42.2	18	50.0	26	44.8
Kranh	Climbing perch	<i>Anabas sp.</i>	32	100.0	43	95.6	33	91.7	57	98.3
Chhlounh	Peacock eel	<i>Macrogathus sp.</i>	24	75.0	22	40.9	16	44.4	31	53.4
Chhlang	Asian red tail catfish	<i>Hemibagrus spilopterus</i>	1	3.1	9	20.0	1	2.8	4	6.9
Antong	Swamp eel	<i>Monopterus albus</i>	4	12.5	6	13.3	3	8.3	8	13.8
Kompeas	Small shrimp	-	11	34.4	27	60.0	12	33.3	22	37.9
Chra Kang	Puntipolites barb	<i>Puntipolites falcifer</i>	0	0.0	0	0.0	1	2.8	1	1.7
Chhpin	Puntius barb	<i>Puntius sp.</i>	0	0.0	1	2.2	1	2.8	4	6.9
Kantrob	Helostoma temminckii	<i>kissing gourami</i>	0	0.0	0	0.0	1	2.8	1	1.7
Kdam	Crap	-	5	15.6	20	44.4	8	22.2	13	22.4
Kchong	Abalona	-	3	9.4	9	20.0	6	16.7	7	12.1
Kros	Osteochilus carp	<i>Osteochilus sp.</i>	0	0.0	1	2.2	1	2.8	3	5.2
Kangkab	Frog	-	5	15.6	10	22.2	5	13.9	7	12.1
Ta Aon	Butter catfish	<i>Ompok sp.</i>	3	9.4	4	8.9	3	8.3	5	8.6
Phtoung	Congatur halfbeal	<i>Hyporhamphus limbatus</i>	0	0.0	4	8.9	1	2.8	1	1.7
Riel	Henichorhynchus carp	<i>Henichorhynchus sp.</i>	0	0.0	1	2.2	1	2.8	4	6.9
Kes	Silurid catfishes	<i>Micronema sp.</i>	0	0.0	0	0.0	1	2.8	2	3.4
Slath	Bronze featherback	<i>Notopterus notopterus</i>	0	0.0	0	0.0	1	2.8	1	1.7
Average fish catch (kg/year)			30.31		35.34		62.98		47.52	
Maximal fish catch			35		46		70		55	
Minimal fish catch			3		5		3		5	
Standard deviation			18.99		16.9		33.58		24.85	

The average catch of these species was 44.14 kg per year, being 30.31 kg in Kampong Speu, 35.34 kg in Kampot, 62.98 kg in Prey Veng and 47.52 kg in Takeo (Table 2.35). Surveyed households reported that they were harvesting less wild fish at the time of the survey than they did a decade earlier and they suspected that pesticides were impacting negatively on wild catch especially on the rainy season wild fish catch in Takeo province, where highest use of pesticides (i.e. both highest proportion of households and dose) were recorded (Table 2.24).

Based on the average family size for each surveyed province, capture fisheries provided each household member with 5.0, 7.2, 11.5 and 8.2 kg of fish in 2004, in Kampong Speu, Kampot, Prey Veng and Takeo respectively. This is far below the national average fish consumption rate of 31 kg per capita per year (So Nam & Nao Thuok, 1999) and is a cause for concern. While average fish catch from trap ponds (Table 2.34) was added to average fish catch from other fishing locations, capture fisheries provided each family member with 13.2 kg in Kampong Speu, 13.8 kg in Kampot, 18.7 kg in Prey

Veng and 11.6 kg in Takeo. These figures also lower than the national average of 31 kg caput year'' . This shortage of fish consumption should be compensated by small-scale aquaculture development, which is the main purpose of FAIEX.

All households doing fishing in Kampong Speu, Kampot and Prey Veng and the majority of household in Takeo reported that the most important purpose of capturing wild fish was for household consumption (Table 2.36). The majority of these households reported that fish catch was not enough for household consumption in a year (Table 2.37). Only 2 households in Takeo province caught fish for purposes of household consumption and selling. The selling price varied, according to fish species/size and season, from Riel 1,800 to 7,000 per kilo (average = Riel 3,802/kg) in wet season and Riel 3,000 to 9000/kg (average = Riel 5,369/kg; US\$ 1 = Riel 4,000) in dry season.

Table 2.36 Main purpose of fishing

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	32	100	45	100	36	100	58	100	171	100
Consumption	32	100	45	100	36	100	56	97	169	99
Selling	0	0	0	0	0	0	0	0	0	0
Both	0	0	0	0	0	0	2	3	2	1

Table 2.37 Whether wild fish catch is enough or not for household consumption

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No,	%	No.	%	No.	%	No.	%	No.	%
Number	32	100	45	100	36	100	56	100	169	100
Not enough	30	93.75	39	86.67	26	72.22	49	87.50	144	85.21
Enough	2	6.25	6	13.33	10	27.78	7	12.50	25	14.79

2.17.5 Household expenditure for buying fish

As stated above wild fish catch was not enough for household consumption so these households spent some money to buy fish from market. Overall the proportion of surveyed housed regularly buying fish from market was 27% in wet season compared to 48% in dry season (Table 2.38). Highest number of household regularly buying fish was in Kampot province in wet season and in Kampong Speu in dry season, while lowest number of household regularly buying fish was in Prey Veng province in wet season

Table 2.38 How often a household buys fish (for household capturing wild fish)

Description	Kampong Speu		Kampot		Prey Vena		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	30		39		26		49		144	
Wet season										
Regular	8	28.13	15	39.53	5	18.75	11	23.21	39	27.41
Occasional	16	53.13	21	53.49	11	43.75	24	48.21	72	49.65
Never	6	18.75	3	6.98	10	37.50	14	28.57	33	22.95
Dry season										
Regular	21	68.75	14	35.90	11	43.75	22	44.64	68	48.26
Occasional	8	28.13	15	38.46	13	50.00	17	35.71	53	38.08
Never	1	3.13	10	25.64	2	6.25	10	19.64	23	13.67

and in Kampot province in dry season. Higher number of households (50%) occasionally buying fish was found in wet season than those (38%) in dry season. Highest proportion of households (38%) in Prey Veng never bought fish from market and lowest in Kampot in wet season, while in dry season highest proportion of households never bought from market was detected in Kampot province (26%) and lowest in Kampong Speu province (3%). The majority of households bought fish from market, i.e. 77% in wet season and 86% in dry season. This indicates that the Kampong Speu, Kampot and Prey Veng and Takeo provinces are fish shortage areas, where capture fisheries could not provide enough wild fish for household consumption.

The majority of surveyed households who did not fish bought fish from market, being 97% in wet season and 92% in dry season for the four provinces (Table 2.39). These figures are much higher than the ones of households doing fishing (Tabcic 2.38). The Proportions of households who bought fish regularly were highest, being 83% in Kampong Speu, 74% in Kampot, 86% in Prey Veng and 72% in Takeo in wet season and in dry season 71, 66, 64 and 64% in Kampong Speu, Kampot, Prey Veng and Takeo, respectively.

Table 2. 39 How often a household buys fish (for household not capturing wild fish)

Description	Kompong Speu		Kompot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	52		35		44		25		156	
Wet season										
Regular	4.3	12.69	26	74.29	31	86.36	11	72.00	12.5	78.83
Occasional	9	17.31	8	22.16	5	11.36	5	20.00	27	17.88
Never	0	0	1	2.86	1	2.27	2	8.00	4	3.28
Dry season										
Regular	37	71.15	23	65.71	28	63.64	16	64.0	104	66.13
Occasional	1.2	23.01	9	25.71	12	27.27	7	28.0	40	26.02
Never	3	5.77	3	8.57	4	9.09	2	1.0	12	7.86

Table 2.40 shows that average expenditure for buying fish in wet and dry season was nearly equal for the four province, being Riel 26,642 per month per household in wet season and Riel 28,053 per month per household in dry season. In wet season Kampong Speu (Riel 30,192 per month per household) and Prey Veng (Riel 29,250) households spent slightly more money to buy fish than those of Kampot (Riel 24,058) and Takeo (25,615) provinces. Similarly in dry season highest expenditure for buying fish was detected in Kongpong Speu households (Riel 37,739), while lowest expenditure was found in Kampot (21,058) province, followed by Riel 26,300 per month for Prey Veng province and Riel 27,369 for Takeo province. The majority of households spent less than or equal to Riel 50,000 for buying fish per month in both seasons, being 97% in wet season and 91%) in dry season. Expenditure within Riel 10,001-30,000 per month was paid by a large number of households to buy fish in wet and dry season (57% and 47%, respectively). Based on the above mean selling price of fish, the mean quantity of fish bough per month per household in wet season was calculated as 7.94 kg in Kampong Speu, 6.33 kg in Kampot, 7.69 kg in Prey Veng and 6.74 kg in Takeo. Similarly the mean quantity of fish bought per month per household in dry season was

computed as 7.03 in Kampong Speu, 3.92 kg in Kampot, 4.90 kg in Prey Veng and 5.10 kg in Takeo.

Table 2.40 Household expenditure for buying fish in 2004 (for households capturing wild fish) (Riel/month, US\$ 1 = Riel 4,000)

Description	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wet season										
Number	24		36		16		35		111	
<=10,000	3	11.5	5	12.5	5	30.0	9	25.0	22	19.8
10,001-30,000	13	53.9	27	75.0	6	40.0	17	47.5	63	56.7
30,01-50,000	6	26.9	4	10.0	3	20.0	9.0	25.7	22	20.1
>50,000	2	7.7	0	0.0	2	10.0	0	0.0	4	3.6
Average (Riel/month)	30,192		24,058		29,250		25,615		26,642	
Standard deviation	18,324		10,889		23,357		18,668		17,378	
Dry season										
Number	29		29		24		39		121	
<= 10,000	3	10.3	8	27.6	4	16.7	3	7.7	18	14.9
10,001-30,000	7	24.1	17	58.6	10	41.7	23	59.0	57	47.1
30,01-50,000	14	48.3	3	10.3	7	29.2	10	25.6	34	28.1
>50,000	5	17.2	1	3.4	3	12.5	3	7.7	12	9.9
Average (Riel/month)	37,739		21,058		26,300		27,369		28,053	
Standard deviation	21,024		12,984		14,288		20,513		18,647	

Table 2.41 shows monthly expenditure for buying fish in households who did not capture wild fish from any fishing grounds listed in Table 2.32. In wet season, the household monthly expenditure for buying fish was highest in Kampong Speu (Riel 49,725 and lowest in Kampot (Riel 32,730), followed by Riel 34,168 in Prey Veng and Riel 35,288 in Takeo province. In dry season the expenditures were slightly lower than the ones in wet season in all four provinces, being 46,194, 30,800, 28,833 and Riel 31,418 in Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively. The expenditures for buying fish in households not capturing wild fish for the four provinces were higher than the ones of households catching wild fish for household consumption (Table 2.40).

Table 2.41 Household expenditure for buying fish in 2004 (for households not capturing wild fish) (Riel/month, US\$ 1 = Riel 4,000)

Description	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	52		35		44		25		156	
Wet season										
<=10,000	2	3.85	1	2.86	3	6.82	1	4.00	7	4.4
10,001-30,000	15	28.85	21	60.00	18	40.91	13	52.00	67	45.4
30,01-50,000	19	36.54	10	28.57	18	40.91	9	36.00	56	35.5
>50,000	16	30.77	3	8.57	5	11.36	2	8.00	26	14.7
Average (Riel/month)	49,725		32,730		34,168		35,288		39,218	
Standard deviation	31,983		14,734		14,947		16,985		23,150	
Dry season										
<= 10,000	2	3.85	1	2.86	6	13.64	2	8.00	11	7.1
10,001-30,000	22	42.31	18	51.43	22	50.00	14	56.00	76	49.9
30,01-50,000	16	30.77	15	42.86	15	34.09	6	24.00	52	32.9
>50,000	12	23.08	1	2.86	1	2.27	3	12.00	17	10.1
Average (Riel/month)	46,194		30,800		28,833		31,418		35,386	
Standard deviation	38,342		11,975		16,416		19,478		26,429	

Based on the above mean selling price of fish, the mean quantity of fish bought per month per household in wet season was calculated as 13.08 kg in Kampong Speu, 8.61 kg in Kampot, 8.99 kg in Prey Veng and 9.28 kg in Takeo. Similarly the mean quantity of fish bought per month per household in dry season was computed as 8.60 in Kampong Speu, 5.74 kg in Kampot, 5.37 kg in Prey Veng and 5.85 kg in Takeo.

2.18 Current situation offish refuge ponds

Only a small number of surveyed households responded there were fish refuge ponds in their villages, being 26% in Kampong Speu, 4% in Kampot, 5% in Prey Veng and 28% in Takeo (Table 2.42). The majority of these households had benefit from these common/public ponds in terms offish for human and water for animals and vegetables. Most of these ponds were managed by community or villagers, although there has been no any proper management system, so far. Rules and regulations regarding to fishing activities included: (1) No electrical fishing was allowed; (2) Only family fishing gears were allowed; and (3) Access by other villagers was not allowed.

Table 2.42 Fish refuge ponds - availability, benefit, management and rule

Description	Kompong Speu N=84		Kampot N=80		Prey Veng N=80		Takeo N=83		Total N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Availability										
Number	84		(0		80		S3		327	
No	62	73.81	77	96.25	76	95.00	60	72.29	275	84.34
Yes	22	26.19	3	3.75	4	5.00	23	27.71	52	15.66
Benefit										
Number	22		3		4		23		52	
No	5	22.73	0	0	0	0	4	17.39	9	17.31
Yes	17	77.27	3	100	4	100	19	82.61	43	82.69
Management										
Number	22		3		4		23		52	
Community/villagers	22	100.00	2	66.70	1	25.00	23	100.00	48	72.93
Commune council	0	0.00	1	33.30	3	75.00	0	0.00	4	27.08
Rule										
Number	22		3		4		23		52	
No electrical fishing	18	81.82	2	66.67	4	100	16	69.57	40	76.92
Family fishing gear	0	0	0	0	0	0	2	8.7	2	3.85
No access by other villages	4	18.18	1	33.33	0	0	5	21.74	10	19.23

2.19 Current status of household ponds

Overall 96% of surveyed household owned 1 to 9 ponds, with 94% in Kampong Speu, 99% in Kampot, 93% in Prey Veng and 99% in Takeo (Table 2.43). The majority of households owned 1 pond, being 81, 94, 77 and 89% in Kampong Speu, Kampot, Prey Veng and Takeo, respectively, and 85% for all four provinces. Approximately 10, 3 and 2% of the total sample owned 2, 3 and greater than 3 ponds, respectively.

Average pond areas were nearly equal in Kampong Speu (215.15 m²), Kampot (250.29 m²) and Prey Veng (240.29 m²), while largest pond area was detected in Takeo province (319.66 m²) (Table 2.44). A large number of households owning ponds with areas within 100-400 m², being 62, 74, 62 and 59% in Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively, and 64% for the total sample. Around 20% and 16%

Table 2.43 Percentage distribution of households by ownership of ponds

	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	N=84		N=80		N=80		N=83		N=327	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number	79		79		74		82		314	
1	64	81.01	74	93.67	57	77.03	73	89.02	258	85.35
2	12	15.19	3	3.8	10	13.51	8	9.76	33	10.51
3	2	2.53	1	1.27	5	6.76	0	0	8	2.55
>3	1	1.27	1	1.27	2	2.7	1	1.22	5	1.59
Average	1.27		1.15		1.42		1.13		1.24	
Max	6		8		9		4		9	
Min	1		1		1		1		1	
Std	0.71		0.83		1.11		0.44		0.81	

of total surveyed households owned ponds with average areas of less than 100 m² and greater than 400 m², respectively. The average depth of household ponds was 2.36 m for total ponds in all four provinces and almost equal in each surveyed province (Table 2.44).

Table 2.44 Pond area (m²) and depth (m) (N=373)

	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
No. of ponds	97		86		98		92		373	
<100	26	26.8	10	11.63	24	24.49	15	16.30	75	20.11
100-200	44	45.36	38	44.19	36	36.73	30	32.61	148	39.68
201-400	16	16.49	26	30.23	25	25.51	24	26.09	91	24.40
>400	11	11.34	12	13.95	13	13.27	23	25.00	59	15.82
Average pond size	215.15		250.29		240.48		319.66		255.69	
Standard deviation	288.17		176.27		247.69		307.9		263.11	
Average pond depth	2.42		2.46		2.16		2.39		2.36	
Standard deviation	1.08		0.63		1.63		0.73		1.02	

The main purpose of pond construction in the past was for collecting and storing rainwater for household utilization (drinking, bathing and washing), watering vegetable and animal in wet and dry seasons (Table 2.45). Almost all surveyed households for the four provinces have dug their ponds for the above purpose. Only one household in Kampot and three in Prey Veng have dug their ponds for harvesting wild fish. Family member's labour was the major source used to construct ponds (Table 2.46). Around 20% of the surveyed households hired labour for pond construction.

Table 2.45 Main purpose of pond construction and present use of the ponds (N=314)

	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
No. of households	79		79		74		82		314	
Purpose of pond construction										
Wild fish	0	0	1	1.27	3	4.05	0	0	4	1.27
Water	79	100	78	98.73	71	95.95	82	100	310	98.73
Purpose of present use										
Fish culture	75	94.94	75	94.94	68	91.19	79	96.34	297	94.59
Water	4	5.06	4	5.06	6	8.11	3	3.66	17	5.41

Table 2.46 Main source of pond construction labour (N=314)

	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
No. of households	79		79		74		82		314	
Family members' labour	60	75.95	68	86.08	62	83.78	60	73.17	250	79.62
Hired labour	19	24.05	11	13.92	12	16.22	22	26.83	64	20.31

In contrast, the major purpose of present use of the dug ponds was for fish culture due to drastically decrease in wild fish stocks during the past years. Around 95% of surveyed households wanted to use their ponds to stock fingerling for growing out (Table 2.45). The main purpose of fish culture was for household consumption (Table 2.47). In Kampong Speu 81% of households responded that the main purpose offish culture was for family consumption; similarly 77% in Kampot, 76% in Prey Veng and 75% in Takeo reported the same purpose.

About 5% of households decided not using their ponds to stock fingerling because most of them wanted to use the ponds to collect and store rainwater as the primary purpose or reason. The other reasons for this decision included: (1) lack of family labour to dig another pond or to do fish culture, (2) lack offish culture knowledge, (3) lack of money to buy seed, (4) too small ponds and (5) keeping ponds for harvesting wild fish.

Table 2.47 Main purpose offish culture

	Kompong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
No. of households	75		75		68		79		297	
Consumption	61	81.33	58	77.33	52	76.47	59	74.61	230	77.46
Selling	0	0.00	2	2.67	0	0.00	1	1.27 *	3	0.91
Both	9	12.00	11	14.67	14	20.59	17	21.52	51	17.19
Excess for sailing	5	6.67	4	5.33	2	2.94	3	3.10	14	4.61

2.20 Summary

Demographic data showed that surveyed household heads were relatively young with a quite high percentage of children under the age of 13, implying that both the labour force and the demand for food and fish will grow considerably in the next two decades. There was low percentage of older household members, meaning that the availability of senior household members to assist with fish culture and pond management is limited. The percentage of economically productive household members was high, indicating that the availability of productive labour force in surveyed households to construct new ponds and to search for natural fish feed is sufficient. Sampled households had more family members and higher literacy levels than the national average for the rural sector of Cambodia, suggesting that they have higher ability to take advantage of this new fish culture technology introduction. Surveyed household heads were predominately male, suggesting that access to male labour for pond construction may be a constraint to the participation of women in aquaculture.

Rice cultivation was the most important activity in the surveyed areas and the predominant occupation of household heads, and provided highest household income. Livestock rearing was second most important activity in the four surveyed provinces

and provided second highest household income. A small proportion of surveyed household heads were fish culture farmers, local government officers (including teachers) and petty traders. Limited on- and off-farm employment opportunities were encouraging household members to migrate in search of work; if the situation remains like this for years it will be on a sufficient scale to cause social concern.

All surveyed households owned houses and toilets. A large proportion of toilets were closed toilets, which increased significantly from the national figure for rural areas. This reflects primary health improved and sanitation levels increased and the development efforts of governmental and non-governmental and international organizations during a decade ago. While distance to water sources was not a major problem, the availability of year-round water and especially drinking water was problematic because many water sources drying up during the dry season months of April and early May, before the arrival the monsoon rains, including even dug wells for drinking water during drought periods. The majority of sampled households used battery and kerosene as the main sources of lighting, though the proportion of surveyed household the using the latter source is slightly lower than the national average for the rural areas of Cambodia. All surveyed households were using firewood as the main source of fuel for cooking.

The majority of sampled households owned television sets, indicating that extension materials relating to farming technologies (including fish culture) should be available on TV's program. Radios and cassette players were the second common durables in the surveyed areas. Bicycles were by far the most important means of transportation in the four survey province, followed by motorcycles, which are the second most important means of transportation. No surveyed household owned a tractor, although rice cultivation is the most important income generation activity in the surveyed areas. This reflects that rice cultivation is traditional and extensive using animals (e.g. cow or buffalo) as the main force for ploughing. The surveyed areas were in fish deficit areas, well away from rivers and other larger natural water bodies and as a result only a small number of surveyed households owned gill nets, cast nets, hapa nets, fish traps or hooks and lines.

The overall average land area owned by surveyed households was less than the average area for three of the four provinces. Having slightly smaller land holdings and more household members indicates that households need to intensify their production systems to achieve the same standard of living. The construction of a fish pond allows households to intensify and diversify their production activities and since all sampled farm lands are owned by individuals, land tenure is not a problem of digging fish ponds. Fanning activities were generally extensive, though there is gradual intensification with the introduction of new rice varieties and associated inputs. Inorganic fertilizers were commonly used at low levels to increase rice production and to a much lesser extent for vegetable cultivation. In contrast, the application of pesticides for rice cultivation was not encouraged and less common in the survey areas. The lesser extent of use of pesticides reflects the Integration Pest Management IPM efforts of the government and NGOs during the past years.

Most surveyed households owned two or three cows, one or two pigs and 15 or 20 chickens. Around half of sampled households owned a small number of ducks (i.e. 9-15

ducks per household). Livestock were mainly free range and there was only limited scope for integration, because penning livestock requires feed that many target households cannot afford. Only manure from large ruminants was collected and this was primarily used for rice fields. The use of improved stocks and vaccines is increasing slowly only.

The majority of surveyed households produced only one crop of rice, with an overall maximal rice production of 2.87 tons per household per year in good years (sufficient rainfall) and minimal rice production of 1.91 tons per household per year in bad year (drought). All surveyed households for the four provinces consumed averagely 1.64 tons of rice per household per year. Therefore there is a high surplus of rice in good years and rice production and consumption is nearly equal in bad years.

All surveyed households consumed more fish in wet season than in dry season. Fish contributed around 65% of the total animal protein intake, which is much closed to the national average for the whole country. Average annual per capita fish consumption was 18.15, 20.86, 18.29 and 18.95 kg per person for Kampong Speu, Kampot, Prey Veng and Takeo provinces, respectively. The survey results confirm that the Kampong Speu, Kampot, Prey Veng and Takeo provinces are fish scarce areas, where fish consumption is well below the national average.

Wild fisheries play an important role in the livelihood strategies in the surveyed areas. Most households captured wild fish 3 to 5 days a week from various fishing grounds including rivers/streams, lakes, rice fields, community ponds, trap ponds and roadside ponds. Capture fisheries provided each family member with 13.2 kg in Kampong Speu, 13.8 kg in Kampot, 18.7 kg in Prey Veng and 11.6 kg in Takeo. All of these households reported that wild fish catches were not enough for household consumption. Most of these households spent about Riel 26,642 (US\$ 1 = Riel 4,000) to buy 6.21 kg offish per month in wet and dry seasons. As for households who did not capture wild fish spent more money (Riel 37,302) to buy more fish (8.19 kg) per month in both seasons. These should be objectively verifiable indicators for monitoring and evaluation of FAIEX activities.

Based upon an overview of socio-economic indicators including consumer durables, ownership of land, production and transport and other assets etc. sampled households were of slightly higher socio-economic status than the average for rural households in the surveyed areas of Kampong Speu, Kampot, Prey Veng and Takeo provinces. Analysis of current patterns of resource use and availability show that surveyed households have sufficient resources to undertake fish culture as a new activity. Moreover current fish consumption levels of surveyed households are relatively low, demand and preference for fish is high and around 95% of households owning ponds were interested in trying fish culture. Therefore, these surveyed households will require only minimal encouragement to grow fish.

CHAPTER 3 CURRENT STATUS OF SMALL-SCALE AQUACULTURE IN FAIEX PROJECT AREAS

This chapter describes bio-physical characteristics of fish ponds, farmers' experience and motivation in culturing fish, the culture system and fish species, the availability of extension support services and finally the major technical and financial constraints to fish culture in all four surveyed provinces are discussed.

3.1 Bio-physical pond characteristics

3.1.1 Pond characteristics

No arrangement of pond renting or borrowing was found in the four provinces, meaning that all fish ponds were owned by individual fish farmers. Approximately 81.9% of surveyed aquaculture farmers (40 in each province) owned only one pond, 12.5% two ponds, 3.1% three pond and another 2.5% owned more than three ponds (Table 3.1). In total sampled aquaculture farmers in Kampong Speu, Kampot, Prey Veng and Takeo province owned 57, 50, 63 and 48 ponds, respectively (total 218 ponds).

Table 3.1 Number offish ponds (N=160)

Number of ponds	Kampong Speu N=40		Kampot N=40		Prey Veng N=40		Takeo N=40		Total N = 160	
	No.	0/0	No.	0/0	No.	0/0	No.	0/0	No.	0/0
1	29	72.5	37	92.5	31	77.5	34	85	131	81.88
2	1	2.5	2	5	5	12.5	5	12.5	20	12.5
3	2	5	0	0	3	7.5	0	0	5	3.13
>3	1	2.5	1	2.5	1	2.5	1	2.5	4	2.5

Physical pond condition

Surveyed aquaculture farmers in the four provinces had either a closed pond (92.7%) or a pond connected to a rice field (7.3%) (Table 3.2). Highest number of ponds connected to rice fields was detected in Prey Veng province and lowest in Kampong Speu province. Fish ponds connected to rice field generally was not practised by the farmers due to lack of technical knowledge, hydrological factors of rice field, agrochemicals (pesticides) application for rice production and distance to rice field from the homestead pond. PADEK- Fisheries program and AIT Outreach/AARM experience in Svay Rieng Province shows that while ponds connected to rice fields were more productive than closed ponds because fish have access to additional food sources in the rice fields, there were increased problems with predatory fish species.

Pond area and depth

Average pond size in the four provinces ranged from 262.95 m² in Kampot province to 364.42 m² in Takeo province with an overall average for the four provinces of 290.27 m² (Table 3.3). This pond area was moderate and optimally usable for profitable fish

Table 3.2 Physical conditions offish pond (N=218)

Pond type	Kompong Speu		Kompot		Preyveng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Closed pond	56	98.25	48	96.00	56	88.89	42	87.50	202	92.66
Open pond*	1	1.75	2	4.00	7	11.11	6	12.50	16	7.34
Total	57	100.00	50	100.00	63	100.00	48	100.00	218	100.00

* Pond connected to a rice field

culture in the surveyed areas. This reflects the suggest of PADEK-Fisheries program that each family should own at least a pond of 200 m² and to be able to produced 60-100 kg fish in order to meet at least part of the family fish requirement. Average pond depth varied from 2.04 m in Prey Veng to 2.67 m in Kampot, with an overall average of 2.36 m. Pond size and shape did not vary greatly between the four provinces. Ponds in Kampot were slightly smaller, but deeper than other three provinces, while ponds in Takeo were larger, but slightly shallower than ponds in Kampot, and slightly deeper than ponds in other two provinces.

Table 3.3 Pond area (m²) and depth (m) (N=218)

Province	Area (m2)			Depth (m)		
	Average	Number	Standard deviation	Average	Number	Standard deviation
Kompong Speu	263.15	57	359.67	2.36	57	1.11
Kompot	262.95	50	169.83	2.67	50	0.55
Prey Veng	270.56	63	289.88	2.04	63	1.17
Takeo	364.42	48	359.95	2.38	48	0.68
Total	290.27	218	294.83	2.36	218	0.88

Pond construction assistance

Most fish ponds were originally dug to hold water in the dry season (Table 2.45) and water depth typically varied greatly between the monsoon and dry season. For fish culture the major considerations are the minimum water depth in dry season and whether the pond is prone to flooding in wet season. The majority of fish farmers' ponds were constructed by household members, followed by 20.8% by hiring labour and 10.5% by using machine (Table 3.4).

Table 3.4 Pond construction assistance (N=218)

Assistance	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Machine	14	24.6	0	0	2	2.5	7	15.0	23	10.5
Hiring labor (manual)	16	28.1	6	12.5	11	17.5	12	25.0	45	20.8
Family member (manual)	27	47.4	44	87.5	50	80	29	60.0	150	68.7
Total	57	100	50	100	63	100	48	100	218	100

Pond construction cost

68 ponds were constructed by hiring labour and using machine (Table 3.4). Table 3.5 shows average cost for constructing a pond. Overall average cost was Riel 839,921, ranging from Riel 434,667 in Prey Veng to Riel 1,198,087 in Takeo. Based on average pond volume (length m x width m x depth m = m³), average cost of pond construction per m³ was computed as Riel 1,128, 1,462, 788, and 1,381 in Kampong Speu, Kampot, Prey Veng and Takeo respectively. This cost would probably not be high that most of farmers can pay themselves without any supports from external assistance. The lower cost found in Prey Veng province probably due to older pond age in Prey Veng than in other three provinces (Table 3.6)

Table 3.5 Pond construction cost (N=68)

Province	Average cost (Riel per pond)	Number	Standard deviation
Kompong Speu	700,741	30	898,973
Kompot	1,026,190	6	1,945,483
Prey Veng	434,667	13	401,859
Takeo	1,198,087.	19	2,627,771
Total	839,921	68	1,468,522

Pond age

In rural Cambodia pond turbidity is a major constraint to fish culture. Generally older ponds are less turbid than newly constructed ponds. Survey results showed that average pond age was 8.6, 8.1, 10.9 and 8.8 years old in Kampong Speu, Kampot, Prey Veng and Takeo, respectively, with an overall average age of 9.1 years old (Table 3.6). Turbidity can, however be reduced by pond management practices including adding lime and organic manure, though these require some investment costs and efforts.

Table 3.6 Pong age (N=218)

Province	Average pond age (year)	Number	Standard deviation
Kompong Speu	8.60	57	6.5
Kompot	8.09	50	8.02
Prey Veng	10.96	63	7.32
Takeo	8.81	48	7.78
Total	9.12	218	7.405

Pond water source

Surveyed households were located in a rain-fed ecosystem and the majority of fish farmers filled their ponds with rainwater (Table 3.7). Around 22.5, 7.5, 35, 35% offish farmers in Kampong Speu, Kampot, Prey Veng and Takeo, respectively, filled the ponds by pumping water from irrigation canals, dug wells, lakes and community ponds. The overall pumping cost was Riel 40,500 per pond, ranging from 36,667 in Kampong Speu to Riel 43,143 per pond in Takeo (Table 3.8).

Availability of water source

All of farmers depending solely on rainwater to fill the ponds engaged in fish culture only when water is available in wet season (Table 3.9). The majority of fish farmers who filled the ponds by pumping water from irrigation canals, dug wells, lakes and community ponds could not engage in fish culture throughout the year because most of these water sources were dried up during dry season (Table 3.9). Therefore, a lack of water sources is the major constraint to fish culture for the majority of households in the surveyed areas.

Table 3.7 Pond water source (N=160)

Water source	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rain	31	77.5	37	92.5	26	65.0	26	65.0	120	75.0
Others (pumping)	9	22.5	3	7.5	14	35.0	14	35.0	40	25.0
Irrigation canal	6	15.0	3	7.5	4	10.0	8	20.0	21	13.1
Dug well	0	0.0	0	0.0	10	25.0	4	10.0	14	SS
Lake	2	5.0	0	0.0	0	0.0	0	0.0	2	1.3
Community pond	1	2.5	0	0.0	0	0.0	2	5.0	3	1.9

Table 3.8 Pond water pumping cost

Province	Average cost (Riel per pond)	Number	Standard deviation
Kompong Speu	36,667	17	34,885
Kompot	43,000	10	30,610
Prey Veng	39,189	27	32,233
Takeo	43,143	17	22,336
Total	40,500	71	30,016

Table 3.9 Availability of water source

Water source availability	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rainwater										
- Wet season Not enough	0	0	0	0	1	3.8	0	0	1	1.0
Enough	31	100	37	100	25	96.2	26	100	119	99.0
Total	31	100	37	100	26	100	26	100	120	100
- Dry season Not enough	26	83.9	30	81.1	20	76.9	21	80.8	97	80.7
Enough	5	16.1	7	18.9	6	23.1	5	19.2	23	19.3
Total	31	100	37	100	26	100	26	100	120	100
Others*										
Available throughout a year	1	11.1	0	0.0	4	28.6	3	21.4	8	20.0
Available Not throughout a year	8	88.9	3	100.0	10	71.4	11	78.6	32	80.0
Total	9	100	3	100	14	100	14	100	40	100

* Other sources including irrigation canals, dug wells, lakes and community ponds.

Pond water level

Overall average water level of fish ponds filled with rainwater ranged from 2.43 m in wet season to 0.76 m in dry season (Table 3.10). In Kampong Speu average pond water

level was 2.41 and 0.71 m in wet and dry season respectively; in Kampot 2.71 m and 0.75, in Prey Veng 2.21 and 0.77m and in Takeo 2.40 and 0.82 m. Average levels of pond water were almost equal in each season for the four provinces. Fish cannot grow or survive in ponds with such minimal water level in dry season, especially in March and April. Most of the fish farmers did final fish harvest during this period and drained their fish ponds by different ways (Table 3.11)

Table 310 Pond water level

Province	Wet season			Dry season		
	Average pond water level (m)	Number	Standard deviation	Average pond water level (m)	Number	Standard deviation
Komong Speu	2.41	31	0.50	0.71	31	0.23
Kompot	2.71	37	0.45	0.75	37	0.27
Prey Veng	2.21	26	0.48	0.77	26	0.18
Takeo	2.40	26	0.49	0.82	26	0.2
Total	2.43	120	0.51	0.76	120	0.23

Pond water draining

After harvesting fish pond should be drained and dried very well to remove all predatory species, especially snakehead fish, clariid catfishes, swamp eels and frogs, before restocking the ponds. Overall 56.3 % of fish farmers drained water from their ponds by sun in dry season, 43.1% by using water pumps and only one farmer in Prey Veng by using his and his family members' powers (Table 3.11). In Kampong Speu highest percentage of fish farmers drained water from fish ponds by sun in dry season and lowest percentage by using water pumps. In contrast, in Takeo province the percentage of fish farmers draining water from their ponds using water pumps was highest and by sun in dry season was lowest.

Table 3.11 Pond water draining

	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Drained by sun	30	75.0	24	60.0	20	50.0	16	40.0	90	56.3
Drained by water pump	10	25.0	16	40.0	19	47.5	24	60.0	69	43.1
Drained manpower	0	0.0	0	0.0	1	2.5	0	0.0	1	0.6
Total	40	100	40	100	40	100	40	100	160	100

Pond water retention

Pond water retention determines period of fish culture. Different ponds generally have different levels of water holding capacity due to soil types. The majority of fish ponds (97%) had good or fair water retention (Table 3.12). The soil type of most of these ponds was loamy (composing of clay and sand) and some was red clay or yellow clay. Only 3 fish ponds in Kampong Speu and 2 in Prey Veng had bad water retention. Sandy soil determines water holding capacity of the ponds.

Table 3.12 Pond water retention

Water retention	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Good	28	70.0	34	85.0	30	75.0	35	87.5	127	79.4
Fair	9	22.5	6	15.0	8	20.0	5	12.5	28	17.5
Bad	3	7.5	0	0.0	2	5.0	0	0.0	5	3.1
Total	40	100	40	100	40	100	40	100	160	100

Pond water condition

Before and after stocking the ponds with fish seed, water conditions of fish ponds should be regularly checked to make sure that fish in ponds are healthy and grow well. About 81% offish farmers reported that their pond water was fertile and 3% responded it was not fertile (Table 3.13). Pond water pollution was faced by about 3% of fish farmers probably due to pond soil erosion or over fertilization of ponds. Around 12.5% of fish farmers did not have any idea relating to their pond water condition probably due to a lack offish culture knowledge. When a question was asked relating to water quality of fish pond (acid or alkaline), all surveyed fish farmers had no idea or could not provide any correct answer.

Table 3.13 Pond water condition

Water condition	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Fertile	30	75.0	34	85.0	31	77.5	35	87.5	130	81.3
Not fertile	2	5.0	1	2.5	2	5.0	0	0.0	5	3.1
Polluted	1	2.5	2	5.0	1	2.5	1	2.5	5	3.1
No idea	7	17.5	3	7.5	6	15.0	4	10.0	20	12.5
Total	40	100	40	100	40	100	40	100	160	100

3.2 Farmer's experience in aquaculture

3.2.1 Years of experience

There is no traditional pond aquaculture practiced in Cambodia. However, with recent development of small-scale aquaculture, the practices where a variety of fish species are stocked and fed/fertilised were relatively new for the farmers. For the 160 fish growing households, 28.8% had only one year of experience in practicing the current small-scale aquaculture, 14.4% had two or five years of experience, 15.6% had three years of experience, 9.4% had four years of experience and 17.5% had more than five years of experience (Table 3.14).

Table 3.14 Years of experience in current aquaculture

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Year										
Before 2000	6	15.0	2	5.0	17	42.5	3	7.5	28	17.5
In 2000	2	5.0	14	35.0	3	7.5	4	10.0	23	14.4
In 2001	6	15.0	3	7.5	1	2.5	5	12.5	15	9.4
In 2002	6	15.0	11	27.5	5	12.5	3	7.5	25	15.6
In 2003	7	17.5	4	10.0	5	12.5	7	17.5	23	14.4
In 2004	13	32.3	6	15.0	9	22.5	18	45.0	46	28.8
Total	40	100	40	100	40	100	40	100	160	100
Aquaculture type	Number	Average (year)	Number	Average (year)	Number	Average (year)	Number	Average (year)	Number	Average (year)
Grow-out	39	2.1	39	3.5	38	5.1	40	3.0	156	3.8
Nursing	1	2.0	1	1.0	1	1.0	0	-	3	1.3
Breeding/hatching	0		0		1	8.0	0		1	5.0

Among the 156 grow-out farmers (97.5%), the fish farmers in Prey Veng province had longest years of experience (5.8 years), followed by fish farmers in Kampot (3.5 years), in Takeo (3.0 years) and in Kampong Speu (2.8 years). Only one farmer in Prey Veng province had 5 years of experience in fish seed production. Among three fish seed nursing farmers, one in Kampong Speu had two years of experience, one in Kampot and Prey Veng had one year of experience.

3.2.2 Major purpose of fish culture

As mentioned earlier the four provinces are wild fish scarce areas and capture fisheries could not provide sufficient amount of fish for household consumption (section 2.16 and 2.17). Small-scale aquaculture is of crucial activity to increase family fish production and might fill up this gap. The survey results confirm that the major purpose of fish culture was for household consumption (Table 3.15). Around 69% of fanners grew fish for family consumption, 26% grew fish for both consumption and selling and 2.5% grew fish for only selling or when excess is for selling.

Table 3.15 Main purpose of fish culture

Purpose	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Consumption	29	72.5	30	75.0	29	72.5	23	57.5	111	69.4
Selling	0	0.0	0	0.0	0	0.0	4	10.0	4	2.5
Both	11	27.5	7	17.5	10	25.0	13	32.5	41	25.6
Excess for selling	0	0.0	3	7.5	1	2.5	0	0.0	4	2.5
Total	40	100	40	100	40	100	40	100	160	100.0

3.2.3 Major source of information

The main sources of information on small-scale aquaculture technology were composed of training, extension materials and extension services. The ones provided by FAIEX project are not included in this section.

Training course on fish culture

Among 160 fish farmers, only 58.1% had attended basic training course on small-scale aquaculture techniques before they started practicing this activity in the surveyed areas (Table 3.16). Highest percentage of fish farmers in Kampot (92.5%) attended such training course, followed by 50% in Prey Veng and Takeo and 40% in Kampong Speu attended fish culture training course.

Percentage of farmers participating in training course on fish culture increased gradually from 15% in 2000 to 29% in 2004 (Table 3.16). Before year 2000, around 5.4% farmers had participated in this training. In 2004 highest number of farmers participating in fish culture training course was found in Takeo (55%) and lowest number was found in Kampot (16.2%). In 2003, Prey Veng had highest number of fish farmers (30%) participating in the training and Kampot had lowest (10.8%). In 2002, Kampot had highest number (29.7%) and Prey Veng lowest number (5%) of fish farmers participating in the training. In 2001 Kampong Speu (37.5%) had highest number and Kampot (8.1%) had lowest number of farmers participating in the training course. In

2000, Kampot (35.1%) had highest number of farmers and Kampong Speu and Prey Veng had no farmer participating in the training course. Before 2000, only 25% of surveyed farmers participated in the training course and no training course on fish culture was organised in other three provinces.

Table 3.16 Fish culture training course, farmer's attendance, year of attendance and course organizer

Description	KampongSpeu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Attenance of training										
No attendance	24	60.0	3	7.5	20	50.0	20	50.0	67	41.9
With attendance	16	40.0	37	92.5	20	50.0	20	50.0	93	58.1
Total	40	100	40	100	40	100	40	100	160	1 00
Year of attendance										
Before 2000	0	0	0	0.0	5	25.0	0	0.0	5	5.4
In 2000	0	0	13	35.1	0	0.0	1	5.0	14	15.1
In 2001	6	37.5	3	8.1	2	10.0	2	10.0	13	14.0
In 2002	2	12.5	11	29.7	1	5.0	2	10.0	16	17.2
In 2003	4	25	4	10.8	6	30.0	4	20.0	18	19.4
In 2004	4	25	6	16.2	6	30.0	11	55.0	27	29.0
Total	16	100	37	100.01	20	100	20	100	93	100
Organizer of training										
Provincial fisheries division	16	100.0	0	0.0	3	15.0	17	85.0	36	38.7
APHEDA	0	0.0	34	91.9	0	0.0	0	0.0	34	36.6
PADEK, PRASAC and DoF	0	0.0	0	0.0	17	85.0	0	0.0	17	18.3
GTZ	0	0.0	3	8.1	0	0.0	0	0.0	3	3.2
CEDAC	0	0.0	0	0.0	0	0.0	3	15.0	3	3.2
Total	16	100	37	100	20	100	20	100	93	100

Training course on fish culture was organized by several government and non-government and donor organizations (Table 3.16). Among 93 fish farmers, 38.7% reported that fish culture training course was organized by extension staff of respective provincial fisheries division, 36.6% of the training course was organized by APHEDA, 18% was organized by PADEK in cooperation with DoF aquaculture division, 3.2% was organized by GTZ or CEDAC. Most of training courses on small-scale aquaculture were focussing on grow-out techniques and generally organized for duration of two days. Only two farmers in Prey Veng reported that they had attended a more specific training course on small-scale fish seed production, which was organized by PADEK, one in 1996 and another in 2004. This course was organized for duration of 3-5 days. No specific training course focussing on fish marketing was provided in the surveyed areas.

Extension materials

The second major source of information for practicing small-scale aquaculture in the four surveyed provinces was extension materials. Extension materials on small-scale aquaculture technology, which have been produced by various national and international organizations as formats of posters and booklets were provided to fish farmers for practicing this new technology (Table 3.17).

Among 160 fish farmers, 57.5% of fish culture farmers received the above extension materials. Highest percentage of fish farmers in Kampot province (90%) received

extension materials followed by Takeo (52.5%), Prey Veng (50.0%) and Kampong Speu (37.5%) (Table 3.17).

Among 92 fish farmers, around 28.3% of fish farmers received extension materials in 2004, while only 9.8% of fish farmers received extension materials before 2000. Percentage of fish farmers receiving the materials between 2000 and 2003 was nearly equal (Table 3.17).

Table 3.17 Extension materials, receivers, years of receiving and providers

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Receiving extension material										
Not received	25	62.5	4	10.0	20	50.0	19	47.5	68	42.5
Received	15	37.5	36	90.0	20	50.0	21	52.5	92	57.5
Total	40	100	40	100	40	100	40	100	160	100
Year of receiving extension material										
Before 2000	0	0.0	0	0.0	8	40.0	1	4.8	9	9.8
In 2000	0	0.0	14	38.9	0	0.0	1	4.8	15	16.3
In 2001	6	40.0	2	5.6	2	10.0	1	4.8	11	12.0
In 2002	1	6.7	11	30.6	1	5.0	3	14.3	16	17.4
In 2003	4	26.7	3	8.3	5	25.0	3	14.3	15	16.3
In 2004	4	26.7	6	16.7	4	20.0	12	57.1	26	28.3
Total	15	100	36	100	20	100	21	100	92	100
Received from organization										
DoF/FPD	13	86.7	0	0.0	1	5.0	15	71.4	29	40.8
PADEK	0	0.0	0	0.0	17	85.0	0	0.0	17	21.3
APHEDA	0	0.0	33	91.7	0	0.0	0	0.0	33	22.9
PRASAC	2	13.3	0	0.0	2	10.0	1	4.8	5	7.0
GTZ	0	0.0	2	5.6	0	0.0	0	0.0	2	1.4
CEDAC	0	0.0	0	0.0	0	0.0	4	19.0	4	4.8
SH	0	0.0	1	2.8	0	0.0	0	0.0	1	0.7
MARR	0	0.0	0	0.0	0	0.0	1	4.8	1	1.2
Total	15	100	36	100	20	100	21	100	92	100.0
Present status of extension materials										
Not used	1	6.7	1	2.8	2	10.0	3	14.3	7	8.4
Used	14	93.3	35	97.2	18	90.0	18	85.7	85	91.6
Total	15	100	36	100	20	100	21	100	92	100

To promote aquaculture in rural areas, government and non-government organizations, including Department of Fisheries (DoF), respective Provincial Fisheries Division (PFD), PADEK, APHEDA, PRASAC, GTZ, CEDAC, SH and MARR have produced and provided extension materials on small-scale aquaculture technologies to farmers to encourage them to do better aquaculture practices (Table 3.17). Most of extension materials were provided by DoF/PFD (40.8%), APHEDA (22.9%) and PADEK (21.3%) followed by EU-PRASAC (7.0%), CEDAC (4.8%), GTZ (1.4%), MARR (1.2%) and SH (0.7%).

Among 92 fish farmers, Over 90% of farmers have still been using the received extension materials as basic knowledge or information for practicing fish culture. Around 97.2% of fish farmers in Kampot province have still been using the materials compared to 93.3 % in Kampong Speu, 90.0% in Prey Veng and 85.7% in Takeo (Table 3.17).

Extension services

The third main source of information on aquaculture technologies can be received from extension services or programs of respective provincial fisheries divisions, NGOs/IOs (listed in Table 3.17), fish seed producers and fish farmers (Table 3.18). Based on the survey outputs indicate that 71.3% of sampled fish farmers received information on fish culture through the extension services or programs. 95% of farmers in Kampot province received extension services followed by Prey Veng (67.5%), Takeo (65%) and Kampong Speu (57.5%).

Table 3.18 Major source of extension service

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Receiving extension service										
Not received	17	42.5	2	5.0	13	32.5	14	35.0	46	28.8
Received	23	57.5	38	95.0	27	67.5	26	65.0	114	71.3
Total	40	100	40	100	40	100	40	100	160	100
Received from organization										
Provincial fisheries division	15	65.2	19	50.0	17	63.0	18	69.2	69	60.5
Seed producer	6	26.1	0	0.0	5	18.5	5	19.2	16	14.0
Fish farmer	1	4.4	0	0.0	0	0.0	0	0.0	1	0.9
Donor/NGO	1	4.4	19	50.0	5	18.5	3	11.5	28	24.6
Total	23	100	38	100	27	100	26	100	114	100
Frequency of receiving extension service										
1-2 times/year	22	95.7	33	86.8	24	88.9	25	96.2	104	91.2
3-6 times/year	1	4.4	5	13.2	3	11.1	1	3.9	10	8.8
Total	23	100	38	100	27	100	26	100	114	100

Among 114 fish farmers, 60.5% received extension service from respective provincial fisheries division, 24.6% received the service from various donors/NGOs (named in Table 3.17), 14.0% received the services from fish seed producers and 0.9% received the service from (model) fish farmers (Table 3.18).

The majority of fish farmers (91.2%) received information on fish culture from extension program 1-2 times per year. Highest percentage offish farmers in Kampong Speu province received this information 1-2 times per year from the extension program, 95.7% compared to 86.8% in Kampot, 88.9% in Prey Veng and 96.2% in Takeo. Such information was provided 3-6 times per year to one farmer in Kampong Speu and Takeo, 5 farmers in Kampot and 3 farmers in Prey Veng.

3.2.4 Fish farmer's record

Keeping good record is very useful for both fish fanners and extension staff to follow up aquaculture progress and finally project can obtain accurate information relating to the farmers' practices of aquaculture. Therefore, a recording book with standard format and required information should be prepared and delivered to fish farmers for keeping information offish culture activities. Among 160 fish farmers, only 31.3% had record books and kept record on aquaculture activities (Table 3.19). Highest number of fish farmers in Takeo province had record books, 42.5% compared to 37.5% in Kampong Speu, 27.5% in Prey Veng and 17.5% in Kampot.

Information recorded included liming, fertilization, water conditioning, stocking, feed and feeding, partially harvesting, totally harvesting and fish selling (Table 3.19). Around 90% of fish farmers kept information of stocking fish seed in their record book, while percentages of fish farmers keeping other kinds of information did not vary greatly, excepting percentage of fish farmers keeping information of fish selling was lowest.

Table 3.19 Farmer s record on aquaculture activities

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Keeping record										
No	25	62.5	33	82.5	29	72.5	23	57.5	no	68.8
Yes	15	37.5	7	17.5	11	27.5	17	42.5	50	31.3
Total	40	100	40	100	40	100	40	100	160	100
Recorded information										
Liming	5	33.3	1	14.3	2	18.2	2	11.8	10	20.0
Fertilization	8	53.3	2	28.6	2	18.2	2	11.8	14	28.0
Water quality/condition	3	20.0	1	14.3	0	0.0	5	29.4	9	18.0
Stocking	11	73.3	6	85.7	11	100.0	17	100.0	45	90.0
Feed and feeding	2	13.3	3	42.9	2	18.2	5	29.4	12	24.0
Partially harvesting	6	40.0	3	42.9	3	27.3	2	11.8	14	28.0
Total harvesting	1	6.7	1	14.3	3	27.3	3	17.7	8	16.0
Fish selling	0	0.0	0	0.0	2	18.2	1	5.9	3	6.0

3.2.5 Fish species cultured

Seven popular fish species, including silver barb, common carp, silver carp, tilapia, mrigal, sutchi catfish and clarias catfish, were cultured in all four surveyed provinces (Table 3.20). Among 160 fish farmers, the most popular fish stocked was tilapia, which was stocked by 66% of the farmers. Next to tilapia, the next three most frequently stocked fish species were silver barb, common carp and silver carp. Indian carp, mrigal was also an important fish species in the surveyed areas.

The sizes of the five most popular fish species greatly varied from 1 cm to 6 cm, but their average sizes were nearly equal (Table 3.20). The prices of these five species were also almost equal due to their similar sizes. The largest size of fingerling stocked was sutchi catfish at an average size of 6.1 cm, followed by clarias catfish (5.1 cm), which are the popular size preferred by fish farmers for stocking. According to their larger sizes, the prices of the two indigenous catfish species were also higher than those of the five exotic species. The sizes of the five exotic fish species were very small probably leading to a high mortality rate, though their prices were low. Fish seed size is one of the important indicators for evaluation of levels of success in aquaculture activity. Quality of fish seed (i.e. genetic diversity) is also another important indicator for determining levels of success in the activity. Hence much attention should be paid on brookstock management in both private and public hatcheries.

All 160 fish farmers stocked fish seed only once per year. An overall average number of fish seed stocked was 975 per household (Table 3.21). Highest number of fish seed socked was found in Kampot province, 1,145 compared 1,036 in Kampong Speu, 907 in Prey Veng and 811 in Takeo. The majority of fish farmers stocked within 201-2000 heads offish seed (76.2%). Small numbers of households stocked more than 2000 heads (8.8%) and less than or equal to 200 heads (15.0%).

Table 3.20 Size and price of popular stocking fish species (N=160)

	Max-Min size (cm)	Average size (cm)	Number	Max-Min price (Riel/head)	Average price (Riel/head)
Silver barb	1-5	2.6	98	40-70	50.2
Common carp	1-5	2.9	87	40-70	51.1
Silver carp	1-5	2.9	84	40-75	51.8
Tilapia	1-6	2.7	105	20-70	48.6
Mrigal	1.5-6	3.0	53	30-70	50.4
Sutchi catfish	2-15	6.1	22	50-130	96.0
Clarias catfish	2-7	5.1	9	30-160	94.6

Table 3.21 Number of fish seed stocked per household

No. of seed	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=200	4	10.0	2	5.0	11	27.5	7	17.5	24	15.0
201-400	17	42.5	5	12.5	10	25.0	3	7.5	35	21.9
401-700	6	15.0	16	40.0	7	17.5	9	22.5	38	23.8
701-1000	3	7.5	3	7.5	5	12.5	13	32.5	24	15.0
1001-2000	5	12.5	10	25.0	3	7.5	7	17.5	25	15.6
>2000	5	12.5	4	10.0	4	10.0	1	2.5	14	8.8
Total	40	100	40	100	40	100	40	100	160	100
Average	1036.1		1144.8		906.8		811.3		975.0	
Std	1330.5		1332.2		1328.6		591.9		1,185.0	

Fish seed supply is very important for aquaculture activity. There were two main sources of fish seed supply, private or farmer's hatcheries and nurseries and public or government hatcheries. In Kampong Speu, most of fish farmers bought fish seed from local fish seed producers and some obtained fish seed which were taken from Bati hatchery in Prey Veng and Chrang Chamres hatchery in Phnom Penh by development project staff. In Kampot around 80% of fish farmers bought fish seed from Chhouk station and the rest bought fish seed from local fish seed producers. In Prey Veng, 50% of fish fanners bought fish seed from Bati hatchery and another 50% from local fish seed producers. In Takeo most of farmers bought fish seed from local fish seed producers and some bought fish seed which were taken by development project staff from hatcheries in Phnom Penh.

Table 3.22 shows that fish farmers in the surveyed areas could obtained fish seed from two directions, i.e. supplier came to farmers' houses to sell fish seed or farmers went to suppliers to buy fish seed. The majority of fish farmers went to suppliers to buy fish seed. 75, 90, 65 and 65% of fish farmers in Kampong Speu, Kampot, Prey Veng and Takeo, respectively went to suppliers to buy fish seed. Only 26.3% of fish farmers reported that suppliers, i.e. local fish seed producers, came to their houses to sell fish seed and afterwards provided them fish culture knowledge.

Table 3.22 Direction for Fish seed supply

	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Supplier come to farmer's house to sell seed	10	25.0	4	10.0	14	35.0	14	35.0	42	26.3
Firmer go to supplier to buy seed	30	75.0	36	90.0	26	65. G	26	65.0	118	73.8
Total	40	100	40	100	40	100	40	100	160	100

The surveyed results confirm that sufficient amount of fish seed could not be produced locally to meet the demand of local farmers. Therefore, fish supply is in general a major constraint to aquaculture development in the surveyed areas. A suitable number of local fish seed producers should be promoted in the surveyed provinces. The main role of public hatcheries is to transfer researched technologies and new knowledge to private or farmers' hatcheries. The farmers' hatcheries should play an important role of producing good quality offish seed to supply to fish farmers.

3.2.6 Pond preparation and fertilization

Proper pond preparation and fertilization is a requirement for successful aquaculture. All surveyed fish farmers carried out pond preparation by draining and drying the ponds using three different methods (Table 3.11), although most of them could not dry the ponds very well. No farmer removed mudflat after draining the pond as this activity is labour, money and time consuming.

Among the surveyed fish farmers, 81% reported that they fertilized their ponds (Table 3.23). Around 19% of the respondents reported that they did not fertilize their ponds before stocking fish. These farmers never attended any fish culture training course or leant any aquaculture knowledge from extension program or from extension materials, though they were interested in fish culture.

Table 3.23 Pond fertilization

Pond fertilization	Kampong Speu		Kampot		Prey Veng		Tikeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	30	75	37	92.5	27	67.5	35	87.5	129	80.6
No	10	25	3	7.5	13	32.5	5	12.5	31	19.4
Total	40	100	40	100	40	100	40	100	160	100

Available on-farm organic fertilizers included animal manure (cow, buffalo, pig, chicken and duck) and green manure and off-farm commercial or inorganic fertilizers including di-ammonium phosphate (DAP) and urea were available at commune or district market (Table 3.24). Among 129 fish farmers, 93.5, 20.8 and 21.8% fertilized their ponds with cow/buffalo, pig and chicken/duck manure. 84.8% offish farmers used green manure to fertilize ponds and in addition 59.6% of fish farmers used inorganic fertilizer to fertilize their ponds. The percentage distributions of fish farmers using organic and inorganic fertilizers were different for the four provinces. Highest percentage of fish farmers used cow/buffalo or green manure was found in Kampot province and lowest in Takeo province. In contrast, highest percentage of fish farmers used pig or chicken/duck manure was found in Takeo and lowest in Kampong Speu. The same percentage of fish farmers in Kampong Speu and Takeo used inorganic

fertilizers, 60% compared to 70.3% in Kampot and 48.1%) in Prey Veng. Urea was costed for Riel 800-1,200 per kilo, while DAP was costed for Riel 1,100-1,600 per kilo.

Table 3.24 Type of fertilizer used for fish pond (N=129)

Type of fertilizer	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial fertilizer	18	60.0	26	70.3	13	48.1	21	60.0	78	59.6
Cow/buffalo dung	29	96.7	37	100.0	24	88.9	31	88.6	121	93.5
Pig dung	5	16.7	8	21.6	6	22.2	8	22.9	27	20.8
Chicken/duck droppings	3	10.0	9	24.3	5	18.5	12	34.3	29	21.8
Green manure	25	83.3	37	100.0	22	81.5	26	74.3	110	84.8

3.2.7 Rearing duration

Duration of rearing varied with water levels retaining in fish ponds. Rearing duration ranged from 100 to 360 days for the four surveyed provinces, with an overall average of 247.4 days per cycle of fish production (Table 3.25). Shortest rearing duration was found in Kampong Speu province (225.0 days), followed by Prey Veng (245.3 days), Takeo (257.3 days) and Kampot (262.0 days). Highest percentage of farmers reared fish for more than 240 days, while only 3.1% of farmers reared fish for less than or equal to 120 days.

Table 3.25 Rearing duration offish

Rearing period	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=120	3	7.5	1	2.5	0	0.0	1	2.50	5	3.1
121-180	11	27.5	5	12.5	11	27.5	6	15.00	33	20.6
181-240	14	35.0	13	32.5	15	37.5	13	32.50	55	34.4
>240	12	30.0	21	52.5	14	35.0	20	50.00	67	41.9
Total	40	100	40	100	40	100	40	100	160	100
Average	225.0		262.0		245.3		257.3		247.4	
Max	360.0		360.0		360.0		360.0		360.0	
Min	120.0		100.0		180.0		120.0		100.0	
Std	63.7		65.6		55.1		60.7		62.5	

3.2.8 Feed

Availability of pond inputs and their costs are among the most important factors determining viability of aquaculture. Among 160 surveyed fish farmers, 158 farmers fed fish in ponds and two farmers in Kampong Speu did not feed fish because these two farmers stocked indigenous Clarias catfish seed and did not know what kind of feed should be fed to this carnivorous fish species. Among 158 fish farmers, 84.2% fed their fish 1 to 2 times per day, while only 15.8% fed fish 3 times per day (Table 3.26). Considering how many times per week farmers feed fish, the majority of fish farmers fed fish 4 to 14 times per week. Only 16.5% of farmers fed fish 15-21 times per week and a very small number of fanners (1.9%) fed fish 3 times per week.

Table 3.26 Feeding frequency

Feeding duration	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Times per day										
1 time	8	21.1	11	27.5	23	57.5	16	40.0	58	36.7
2 times	22	57.9	16	40.0	15	37.5	22	55.0	75	47.5
3 times	8	21.1	13	32.5	2	5.0	2	5.0	25	15.8
Total	38	100	40	100	40	100	40	100	158	100
Times per week										
3 times	3	7.9	0	0.0	0	0.0	0	0.0	3	1.9
4-7 times	9	23.7	16	40.0	25	62.5	20	50.0	70	44.3
8-14 times	18	47.4	11	27.5	13	32.5	17	42.5	59	37.3
15-21 times	8	21.1	13	32.5	2	5.0	3	7.5	26	16.5
Total	38	100	40	100	40	100	40	100	158	100
Average	12.8		12.9		9.7		9.9		11.3	
Standard deviation	5.8		6.2		4.4		4.8		5.5	

Table 3.27 shows on and off-farm feed inputs for fish culture in all four provinces. Among 158 fish farmers, the main feed input was rice bran, which was used by all fish farmers (100%). While rice bran was the by-product of rice which was produced by most farmers in rice milling houses, farmers had the option of taking rice bran back and instead pay for milling fee or used their rice bran as milling fee and purchase back different grades of rice bran from rice milling houses for raising fish and livestock. In the sampled fish farmers, 81.6% of farmers purchased rice bran for fish culture. The next four main feed inputs were vegetables, kitchen waste, duckweed and termites, which were most readily available either on-farm or could be collected nearby at no cash cost. Duckweed and termite collection is not problematic when few households are culturing fish. In the long term however, if the number of households culturing fish increased, collection of termites in particular might not be sustainable.

Pelleted feed was mostly used for sutchi catfish monoculture. In the first one or two months of stocking, farmers usually use pelleted feed to feed their fish. When fish were grown bigger enough, other inputs listed in Table 3.27, including the five main feed inputs, pig dung, broken rice corn and red ant were used.

Table 3.27 Major feed inputs for fish culture (N=158)

Feed type	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rice bran	38	100.0	40	100.0	40	100.0	40	100.0	158	100.0
Vegetables	27	71.1	37	92.5	22	55.0	24	60.0	110	69.6
Kitchen waste	20	52.6	27	67.5	13	32.5	23	57.5	83	52.5
Duck weed	21	55.3	21	52.5	22	55.0	19	47.5	83	52.5
Termites	19	50.0	20	50.0	9	22.5	11	27.5	59	37.3
Pelleted feed	4	10.5	1	2.5	5	12.5	4	10.0	14	8.9
Broken rice	3	7.9	4	10.0	4	10.0	2	5.0	13	8.2
Pig dung	1	2.6	0	0.0	3	7.5	0	0.0	4	2.5
Corn	0	0.0	1	2.5	0	0.0	0	0.0	1	0.6
Red ant	0	0.0	0	0.0	0	0.0	1	2.5	1	0.6

As mentioned above, rice bran was the most important purchased off-farm feed for fish culture (Table 3.28). Other than rice bran only a limited number of sampled farmers purchased feeds such as pelleted feed from district or provincial town market, broken rice from rice milling house and vegetable and corn from neighbouring farm. A few

farmers in Prey Veng and Takeo also hired children to collect duckweed and termites, respectively. Off-farm feed costs were similar across the four surveyed areas. Rice bran was Riel 200-500 per kilo and broken rice Riel 700-1,000 per kilo depending on quality. Where available, vegetables and corn was Riel 300-500 per kilo. The market price of pelleted feed varied from Riel 1,200 to 1,600 per kilo. In cash scarce rural economies, very few of the surveyed farmers had enough cash to purchase feeds for fish.

Table 3.28 Purchased feed for fish culture (N=158)

Feed type	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rice bran	31	81.6	37	92.5	27	67.5	34	85.0	129	81.6
Pellet feed	4	10.5	1	2.5	5	12.5	4	10.0	14	8.9
Broken rice	2	5.3	0	0.0	2	5.0	0	0.0	4	2.6
Vegetables	2	5.3	1	2.5	0	0.0	2	5.0	5	3.2
Duckweed	0	0.0	0	0.0	2	5.0	0	0.0	2	1.3
Cora	0	0.0	1	2.5	0	0.0	0	0.0	1	0.6
Termites	0	0.0	0	0.0	0	0.0	1	2.5	1	0.6

3.2.9 Harvesting

Farmers raised fish for an average period of 7.5-8.5 months (Table 3.25). Fish were regularly harvested many times per cycle for household consumption. Final fish harvest was often carried out in dry season months, March or April when pond water was lower than 0.5 m.

Fish production and yield

Since all surveyed farmers practiced multiple harvests for household consumption, accurate information on actual fish production and yield was not easy to obtain through household interview. The actual fish production and yield figure reported here are therefore to be used with caution. As a whole, actual fish production and yield in closed pond culture system 74.0 kg per household and 33.1 kg per 100 m², respectively (Table 3.29). As per surveyed province, average actual fish production ranged from 44.6 kg per household in Kampong Speu to 105.7 kg per household in Takeo. Average yield varied from 25 kg per 100 m² in Kampong. Speu to 40.8 kg per 100 m² in Kampot. As for rice-cum-fish culture or open pond culture system, overall average actual fish production was 45.3 kg per household, ranging from 20.0 kg in Kampong Speu to 56.7 kg in Takeo. Fish yield in this system was highest in Takeo, 40.6 kg per 100 m² compared to 37.1 kg per 100 m² in Kampong Speu, 33.3 kg per 100 m² in Kampot and 32.1 kg per 100 m² in Prey Veng. The survey outputs indicate that slightly lower fish yield detected in Kampong Speu was probably resulted from shorter rearing period (Table 3.25). Overall, fish yield in the open pond culture system was slightly higher than yield in closed pond culture system. This finding is concordant with the results reported by PADEK- Fisheries program and AIT Outreach project in Svay Rieng Province that ponds connected to rice fields were more productive than closed ponds because fish have access to additional food sources in the rice fields.

Size and price offish at harvest

Fish size at harvest varied from species to species. Among the seven cultured fish species, the size of harvested fish ranged from 100 g to 1,500 g (Table 3.30). The mean

Table 3.29 Actual household fish production and yield by culture systems

Description	Pond fish culture system (closed pond culture system)					Rice-cum-fish culture system (open pond culture system)				
	Kompong Speu	Kompot	Prey Veng	Takeo	Total	Kompong Speu	Kompot	Prey Veng	Takeo	Total
Average fish production (kg/household)	44.6	89.8	56.8	185.7	74.0	20.0	50.0	54.4	56.7	45.3
Number of households	39	38	33	34	144	1	2	7	6	16
Standard deviation	34.7	28.6	73.3	46.5	43.3	-	14.1	21.6	11.6	15.8
Average fish yield (kg/100 sq. m)	25.0	40.8	26.6	49.2	33.1	37.04	33.3	32.1	40.6	35.8
Number of ponds	56	48	56	42	202	1	2	7	6	16
Standard deviation	12.3	15.0	16.8	13.9	14.5	-	8	2.3	11.2	4.5

size of silver barb was 401.0 g, common carp was 463.6 g, silver carp was 464.0 g, tilapia was 385.9 g, mrigal was 429.4 g, sutchi catfish was 383.0 g and clarias catfish was 261.1 g. It was noted that fish size at harvest mentioned here was based on only size offish which were sold. Among 160 fish farmers, around 38% sold their fish, being 35% in Kampong Speu, 38% in Kampot, 28% in Prey Veng and 53% in Takeo (Table 3.30 & 3.31)

Table 3.30 Fish size at harvest (gram)

		Fish size at harves (g)						
		Silver barb	Common carp	Silver carp	Tilapia	Mrigal	Sutchi catfish	Clarias catfish
Kompong Speu (N=14)	Number	8	9	8	9	4	-	3
	Average	487.5	561.1	556.3	516.7	687.5	-	183.3
	Maximum	1000	1000	1000	1000	1000	-	200
	Minimum	200	200	200	200	250	-	150
	Standard deviation	330.3	344.4	320.1	364.0	375.0	-	28.9
Kompot (N=15)	Number	15	12	14	14	10	2	-
	Average	283.3	329.2	317.9	264.3	330.0	200.0	-
	Maximum	500	600	600	500	600	300	-
	Minimum	150	200	200	100	200	100	-
	Standard deviation	101.2	132.2	132.4	127.7	141.8	141.4	-
PreyVeng (N=11)	Number	6	6	3	6	3	1	2
	Average	558.3	483.3	566.7	516.7	366.7	506.3	200.0
	Maximum	1500	700	700	1500	500	800	300
	Minimum	150	300	300	200	300	300	100
	Standard deviation	504.4	160.2	230.9	495.6	115.5	200.8	141.4
Takeo (N=21)	Number	12	13	13	12	6	7	2
	Average	275.0	480.8	415.4	245.8	333.3	442.9	400.0
	Maximum	600	800	700	400	500	600	500
	Minimum	100	200	200	100	100	300	300
	Standard deviation	128.8	213.6	142.0	91.6	163.3	113.4	141.4
Total (N=61)	Number	41	40	38	41	23	17	7
	Average	401.0	463.6	464.0	385.9	429.4	383.0	261.1
	Maximum	1500	1000	1000	1500	1000	800	500
	Minimum	100	200	200	100	100	100	100
	Standard deviation	266.2	212.6	206.4	269.7	198.9	151.9	103.9

The price of fish at harvest varied more from species to species than from size to size in the survey areas. The price offish ranged from Riel 2,500 per kilo to Rile 7,000 per kilo (Table 3.31). The price of indigenous (local) fish species was generally more expensive than exotic fish species. Fish price at harvest was similar in all four provinces and the overall average price was Riel 4,265.6 per kilo.

Most of the farmers (66.3%) reported that they sold harvested fish at farm gate (i.e. home), 26% sold fish in the village and a small number of farmers (7.5%) sold fish at

commune or district market. In general, the price of harvested fish did not greatly varied among the three selling places.

Table 3.31 Fish selling place and price at harvest

Description	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Selling place										
Home	9	62.5	11	75.0	7	62.5	14	65.0	41	66.3
Village	4	30.0	3	17.5	3	27.5	6	30.0	16	26.3
Market	1	7.5	1	7.5	1	10.0	1	5.0	4	7.5
Total	14	100	15	100	11	100	21	100	61	100
Fish price (Riel/kg)										
Average	4,425.0		4,300.0		4,212.5		4,125.0		4,265.6	
Maximum	5,000		5,000		7000		7,000		7,000	
Minimum	3,000		3,000		3000		2,500		2,500	
Standard deviation	693.8		563.9		767.0		889.8		739.5	

Table 3.32 shows household gross income from fish culture. This gross income was calculated based on actual household fish production and price of harvested fish. The gross income varied from Riel 197,134 in Kampong Speu to Riel 436,178 per household in Takeo. The other two-province income was Riel 239,460 and Riel 382,765 in Prey Veng and Kampot, respectively.

Table 3.32 Household income from fish culture

Income (Riel)	Kampong Speu		Kampot		Prey Veng		Takeo		Overall	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=100,000	7	17.5	6	15.0	2	5.0	4	10.0	19	11.9
100,001-200,000	10	25.0	C	0.0	17	42.5	5	12.5	32	20.0
200,001-400,000	15	37.5	16	40.0	17	42.5	14	35.0	62	38.8
400,001-600,000	4	10.0	16	40.0	0	0.0	10	25.0	30	18.8
>600,000	4	10.0	2	5.0	4	10.0	7	17.5	17	10.6
Total	40	100	40	100	40	100	40	100	160	100
Average (Riel)	197,134		382,765		239,460		436,178		313,884	
Sandard deviation	135,637		291.223		177,775		327,132		232,942	

3.2.10 Household member's participation in fish culture

Most of the households for all four surveyed provinces had not enough money to hire external labour to help in fish culture. Hence fish culture was operated by household members in the existing ponds, which were constructed. Household members including husband (man), wife (woman) and children involved in all fish culture activities such as pond digging, pond draining and drying, pond rehabilitation, pond filling, pond liming, fertilization, water conditioning, stocking, feeding, pond management, partially and totally harvesting and fish selling (Table 3.33). Overall, men always took higher responsibility for fish culture, i.e. 60% of fish culture activities were operated by men compared 20% by women and 20% by children. Evidently, 58, 22 and 20% of pond construction work was actually contributed by men, women and children, respectively. Men played a significant role in pond preparation (i.e. pond filling, liming, fertilization and water conditioning) and stocking (i.e. searched for and bought fish seed and stocked

Table 3.33 Household member's participation in fish culture

Fish culture activity	Province	Household member					
		Husband		Wife		Children	
		%	Std	%	Std	%	Std
Pond construction	Kompong Speu (N=24)	60.00	22.07	21.00	14.00	19.00	18.00
	Kompot (N=33)	55.00	18.24	22.58	15.96	22.42	22.75
	Prey Veng (N=23)	63.14	22.04	21.00	16.00	15.87	19.23
	Takeo (N=22)	52.73	13.16	25.00	18.13	22.27	15.94
	Total (N=102)	57.72	18.88	22.40	16.02	19.89	18.98
Pond darning/drying	Kompong Speu (N=40)	33.25	22.46	17.50	17.06	49.25	27.68
	Kompot (N=40)	56.25	31.19	20.00	28.51	23.75	34.57
	Prey Veng (N=40)	70.00	24.91	12.63	16.79	17.38	19.48
	Takeo (N=40)	52.50	28.08	13.50	20.82	34.00	28.54
	Total (N=160)	53.00	26.66	15.91	20.80	31.09	27.57
Pond rehabilitation	Kompong Speu (N=25)	52.75	29.78	8.25	13.57	39.00	32.64
	Kompot (N=30)	56.75	21.65	22.00	19.37	21.25	25.74
	Prey Veng (N=22)	73.25	26.35	10.75	14.39	16.00	18.65
	Takeo (N=27)	50.75	20.77	9.75	12.5	39.50	20.72
	Total (N=104)	58.38	24.64	12.69	14.96	28.94	24.44
Pond filling	Kompong Speu (N=40)	58.75	39.04	6.00	14.99	35.25	40.51
	Kompot (N=40)	81.25	31.39	8.25	21.59	10.5	25.81
	Prey Veng (N=40)	76.00	35.36	4.00	16.92	20	33.59
	Takeo (N=40)	76.50	32.15	4.25	13.18	19.25	28.95
	Total (N=160)	73.13	34.49	5.63	16.67	21.25	32.22
Liming	Kompong Speu N=30)	75.00	42.37	2.50	15.81	22.50	40.00
	Kompot (N=37)	87.50	31.52	7.50	24.15	5.00	22.07
	Prey Veng (N=27)	77.50	40.75	6.25	23.17	16.25	36.49
	Takeo (N=35)	87.50	33.49	0.00	0.00	12.50	33.49
	Total N=129)	81.88	37.03	4.06	15.78	14.06	33.01
Fertilizin	Kompong Speu N=30)	70.75	40.97	10.25	25.37	19.00	36.64
	Kompot N=37)	73.75	42.35	11.25	26.52	15.00	34.34
	Prey Veng N=27)	53.25	42.57	25.00	35.81	21.75	31.53
	Takeo (N=35)	71.75	40.50	6.75	16.70	21.50	36.41
	Total N=129)	67.38	41.60	13.31	26.10	19.31	34.73
Water conditioning	Kompong Speu (N=30)	64.25	42.66	12.25	26.46	23.50	38.80
	Kompot N=37)	77.00	41.21	15.75	31.94	7.25	19.74
	Prey Veng N=27)	71.75	34.91	10.25	19.38	18.00	28.75
	Takeo (N=35)	77.38	26.72	6.875	10.36	15.75	26.71
	Total (N=129)	72.59	36.38	11.28	22.04	16.13	28.50
Stocking	Kompong Speu (N=40)	71.25	37.36	19.25	30.50	9.50	26.79
	Kompot (N=40)	82.50	30.38	12.75	29.00	4.75	17.83
	Prey Veng (N=40)	75.00	40.82	16.00	33.57	9.00	24.26
	Takeo (N=40)	81.00	33.57	4.50	10.85	14.50	32.89
	Total (N=160)	77.44	35.53	13.13	25.98	9.44	25.44
Feeding	Kompong Speu (N=38)	42.00	29.37	31.00	25.09	27.00	28.93
	Kompot (N=40)	37.75	22.36	48.00	23.42	14.25	15.79
	Prey Veng (N=40)	46.50	27.41	32.75	22.76	20.75	20.18
	Takeo (N=40)	47.75	28.96	31.38	23.83	20.88	23.69
	Total (N=158)	43.50	27.03	35.78	23.78	20.72	22.15
Pond management	Kompong Speu (N=30)	63.25	35.40	19.75	28.15	17.00	32.04
	Kompot (N=37)	80.00	33.59	16.25	30.78	3.75	13.34
	Prey Veng (N=27)	70.50	35.01	18.00	28.21	11.50	25.47
	Takeo (N=35)	74.50	26.46	12.25	21.66	13.25	24.74
	Total N=129)	72.06	32.62	16.56	27.20	11.38	23.90
Partially harvesting	Kompong Speu (N=40)	46.75	41.10	11.00	21.10	42.25	40.79
	Kompot N=40)	62.50	38.81	11.50	20.58	26.00	37.13
	Prey Veng N=40)	48.00	35.17	15.50	24.17	36.50	39.19
	Takeo (N=40)	50.00	32.42	9.00	15.49	41.00	35.21
	Total N=160)	51.81	36.88	11.75	20.34	36.44	38.08
Totally harvesting	Kompong Speu (N=40)	46.00	16.73	25.00	17.50	29.00	21.82
	Kompot (N=40)	48.75	18.28	31.00	18.47	20.25	23.48
	Prey Veng (N=40)	41.63	21.19	28.63	19.11	29.75	23.48
	Takeo (N=40)	46.75	26.74	16.75	18.03	36.50	26.75
	Total (N=160)	45.78	20.74	25.34	18.28	28.88	23.88
Fish selling	Kompong Speu N=12)	16.67	12.12	83.33	31.23	0.00	0.00
	Kompot (N=16)	12.50	11.07	81.25	33.45	6.25	5.75
	Prey Veng (N=15)	6.67	5.67	86.67	37.27	6.67	6.11
	Takeo (N=27)	11.11	9.98	85.19	40.01	3.70	2.38
	Total (N=70)	11.74	9.71	84.11	35.49	4.16	3.56
Total	Kompong Speu	53.90	31.65	20.54	21.60	25.56	29.59
	Kompot	62.42	28.62	23.70	24.90	13.88	22.95
	Prey Veng	59.48	30.17	22.11	23.66	18.42	25.11
	Takeo	60.02	27.15	17.32	17.04	22.66	25.88
	Total	58.95	29.40	20.92	21.80	20.13	25.88

the pond), while women played the most important role in fish selling. Feeding fish or feed forecasting was mainly involved by women, while men and children involved in searching for fish feed. Beside men, children also play an important role in pond draining and drying, pond rehabilitation and partially and totally harvesting. The surveyed results confirm that the percentage distributions of fish culture activities operated by men, women and children in all surveyed provinces were not much different. Availability of labour was not seen as a major constraint to fish culture in the surveyed areas.

3.3 Constraints to fish culture

Although most of surveyed farmers were successful in their fish culture, they faced a number of technical problems including (1) a lack offish culture knowledge, (2) a lack of water source, (3) high fish mortality, (4) poor quality seed, (5) lack of fish seed suppliers, (6) polluted water, (7) poaching and (8) small size offish seed (Table 3.34). Among 160 surveyed fish farmers, 56.3% reported that they did not have enough fish culture knowledge, though some of them had attended fish culture training course organized by local provincial fisheries divisions and donor-funded development projects (Table 3.16). In general, most of participants in fish culture training course were men, but women also played an important role in fish culture (Table 3.33). Hence fish culture knowledge should be provided to both men and women equally to enable rural households to operate successful aquaculture and to enhance fish food security. The second major constrain faced by 22% of fish farmers was a lack of water sources because most of them were dried up during dry season, even dug wells were also dried during drought month(s). The third main problem was high fish mortality reported by 9% of fish farmers. Fish mortality can be resulted from various factors such as (1) predation by wild fish due to poor pond preparation (see section 3.2.6), (2) small size fish seed stocked (Table 3.20 and 3.34), (3) poor handling of fish seed by long distance transportation e.g. hatcheries in Phnom Penh (see section 3.2.5), (4) polluted water (Table 3.13 and 3.34), (5) poaching probably due to ponds located far from the house (Table 3.34). The fourth main problem was poor quality of fish seed (i.e. genetic quality) faced by 5% of sampled fish farmers who reported their fish in the ponds did not growth bigger with times and were stunted fish. The fifth major problem was a lack of local fish seed suppliers, which retarded small-scale aquaculture development in the surveyed areas.

Table 3.34 Major technical constraints faced by fish culture farmers

Type of problem	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of fish culture knowledge	25	62.5	18	45.0	26	65.0	21	52.5	90	56.3
Lack of water source	7	17.5	10	25.0	8	20.0	10	25.0	35	21.9
High fish mortality	2	5.0	7	17.5	3	7.5	2	5.0	14	8.8
Poor quality offish seed	4	10.0	1	2.5	2	5.0	1	2.5	8	5.0
Lack of fish seed supplier	0	0.0	1	2.5	i	2.5	5	12.5	7	4.4
Polluted water	1	2.5	1	2.5	0	0.0	1	2.5	3	1.9
Poaching	1	2.5	1	2.5	0	0.0	0	0.0	2	1.3
Small size offish seed	0	0.0	1	2.5	0	0.0	0	0.0	1	0.6
Total	40	100	40	100	40	100	40	100	160	100

Beside technical problems, a major financial constraint was also faced by fish farmers. Among 160 fish farmers in the surveyed areas, 78.1% did not have enough cash money to buy fish seed and feed for aquaculture operation. The remaining 21.9% of fish farmers had no any financial problem. Equally higher percentage of fish farmers in Kampot and Takeo provinces than those in Kampong Speu and Prey Veng provinces were facing a lack of money to buy fish seed and feed (Table 3.35)

Table 3.35 Major financial constrain faced by fish culture farmers

Type of problem	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of money to buy fish seed and:	29	72.5	33	82.5	30	75.0	33	82.5	125	78.1
No problem	11	27.5	7	17.5	10	25.0	7	17.5	35	21.9
Total	40	100	40	100	40	100	40	100	160	100

3.4 Farmer's assessment and attitude to fish culture

3.4.1 Fish culture farmer

Among 160 sampled fish culture farmers, none wanted to stop the aquaculture activity (Table 3.36). All farmers wanted to continue aquaculture at different scales, i.e. at present, a more expanded or a reduce scale. The majority of fish famers wanted to expand their aquaculture activity, 70% compared to 27.5% who wanted to continue the activity at the present scale and only 2.5% wanted to continue the activity at a reduced scale. The percentage distributions of fish farmers who wanted to continue aquaculture at different scales were similar in all four provinces.

Table 3.36 Farmer's attitude to future aquaculture development

Future fish culture scale	Campong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
A the present scale	9	22.5	11	27.5	14	35.0	10	25.0	44	27.5
At a more expanded scale	28	70.0	29	72.5	26	65.0	29	72.5	112	70.0
At a reduced scale	3	7.5	0	0.0	0	0.0	1	2.5	4	2.5
Stop the activity	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	40	100	40	100	40	100	40	100	160	100

The most important purpose of fish farmers who wanted to continue aquaculture at a more expanded scale was for both household fish consumption and income, which was reported by 56.3% of 112 fish farmers (Table 3.37). Around 22.3% of fish farmers continuing aquaculture at a more expanded scale reported they wanted to increase household income, while 21.4% wanted to increase fish production.

Table 3.37 Reasons for continuing aquaculture at a more expanded scale

Reason	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Increase in family income	8	28.6	4	13.8	4	15.4	9	31.0	25	22.3
Increase fish production	2	7.1	7	24.1	7	26.9	8	27.6	24	21.4
Consumption and selling	18	64.3	18	62.1	15	57.7	12	41.4	63	56.3
Total	28	100	29	100	26	100	29	100	112	100

Those fish fanners wanted to continue fish culture at the present scale because the majority of them had a limited land area (Table 3.38; see also Table 2.15). Fish farmers wanted to continue fish culture at a reduced scale as most of them did not have enough money to buy fish seed and feed or lacked household labour for fish culture operation. Most of the latter type farmers were elders normally aged greater than 60 years.

Table 3.38 Reasons for continuing aquaculture at the present or reduced scale

Reason	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of land space	5	41.7	5	45.5	9	64.3	6	54.6	25	52.1
Lack of labour	2	16.7	0	0.0	2	14.3	1	9.1	5	10.4
Lack of money	5	41.7	6	54.6	3	21.4	4	36.4	18	37.5
Total	12	100	11	100	14	100	11	100	48	100

3.4.2 Non-fish culture farmer

Non-fish culture farmers were farmers who have never engaged in fish culture before. The first two main reasons that they did not engage in fish culture were lack of money to fish seed and other pond inputs and lack of fish culture knowledge which was reported by 28.6 and 27.9% of the total 167 sampled farmers (Table 3.39). The second two main reasons was that 14.2% of farmers had no ponds and 13.1% wanted to keep pond water for household utilization. A small number of farmers had other reasons including (1) no fish seed available locally (3.1%), (2) lack of land space (4.0%), (3) lack of labour (1.2%) and no plan to grow fish (3.0%).

Table 3.39 Reasons for not engaging in fish culture in the past

Reason	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lack of water	1	2.3	4	10.0	2	5.0		2.3	8	4.9
Lack of money	15	34.1	9	22.5	11	27.5	13	30.2	48	28.6
Lack of technology	7	15.9	13	32.5	16	40.0	10	23.3	46	27.9
No pond	8	18.2	3	7.5	6	15.0		16.3	24	14.2
No fish seed available	0	0.0	3	7.5	1	2.5		2.3	5	3.1
Water utilization	7	15.9	6	15.0	3	7.5		14.0	22	13.1
Lack of land space	5	11.4	0	0.0	1	2.5		2.3	7	4.0
Lack of labor	1	2.3	0	0.0	0	0.0		2.3	2	1.2
No plane to grow fish	0	0.0	2	5.0	0	0.6	3	7.0	5	3.0
Total	44	100	40	100	40	100	43	100	167	100

Among 167 non-fish culture farmers who never practiced fish culture previously, the majority of them (97%) were interested in starting fish culture (Table 3.40). Only 5 (3%) farmers had no interest in starting this activity, 2 in Kampot and 3 in Takeo. The main reasons for the 2 Kampot fanners not interested in growing fish was lack of money and keeping pond water for household utilization. Among the 3 Takeo farmers, one wanted to keep pond water for utilization, one (i.e. a Buddhist elder) did not want to eat fish and another had a limited family labour.

The most important types of fish culture extension materials needed by farmers were booklets and posters, which were reported by 98.2 and 90.1% of the 162 non-fish farmers who were interested in starting fish culture, respectively (Table 3.41). The next

two important types of fish culture extension materials were narrative videos and leaflets.

Table 3.40 Farmer's interest in starting fish culture

Farmer's interest	Kampong Speu		Kampot		Prey Veng		Talceo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Interest	44	100.0	38	95.0	40	100.0	40	93.0	162	97.0
No interest	0	0.0	2	5.0	0	0.0	3	7.0	5	3.0
Total	44	100	40	100	40	100	43	100	167	100

Table 3.41 Type of aquaculture extension materials needed by farmers

Type of extension material	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Number of households	44		38		40		40		162	
Booklet	44	100.0	38	100.0	40	100.0	37	92.5	159	98.2
Leaflet	17	38.6	20	52.6	18	45.0	13	32.5	68	42.0
Poster	40	90.9	38	100.0	37	92.5	31	77.5	146	90.1
Narrative video	24	54.6	21	55.3	17	42.5	16	40.0	78	48.2

Among 162 farmers who were willing to start fish culture, 63.6% expected that they will grow fish for family consumption only and 31.5% grow fish for both consumption and selling (Table 3.42). 3.1% of farmers expected that they will have additional income (saving) from fish culture, while 1.9% expected reduction in expense for buying fish.

Table 3.42 Farmer's expectations from fish culture

Farmer's expectation	Kampong Speu		Kampot		Prey Veng		Takeo		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Consumption	29	65.9	24	63.2	26	65.0	24	60.0	103	63.6
Consumption & selling	15	34.1	9	23.7	12	30.0	15	37.5	51	31.5
Expense reduction for buying fish	0	0.0	2	5.3	1	2.5	0	0.0	3	1.9
Income (saving)	0	0.0	3	7.9	1	2.5	1	2.5	5	3.1
Total	44	100	38	100	40	100	40	100	162	100

3.5 Summary

Household members dug the majority of household ponds and the ponds were multi-purpose, being used for vegetable watering, livestock and household use (bathing, washing and drinking). The survey outputs showed that there was no tradition of fish culture practice in the four provinces and that the majority of farmers started culturing fish in the last five years. While a large number of fish farmers had learnt fish culture knowledge from several sources including training courses, extension materials, television and radio organized and produced by the government (i.e. DoF/PFDs) and various NGOs, they had little basic knowledge on the subject.

Most ponds were closed and a small number open or connected to rice fields. All rain-fed ponds were several years old and between 263-364 m² in area and between 2.0-3.0 m deep. The pond area and depth was usable for profitable fish culture in the surveyed areas. Nearly all ponds were constructed within the homestead, which would deter theft

and would allow all household members to participate in fish culture. Water retention of the majority of fish ponds was reported to be good or fair and between 7-9 months per year. Moreover water condition of most ponds, which were fertilized with organic animal and green manure, supplemented by a small amount of inorganic fertilizers before stocking were fertile. With supplementary feeds such as rice bran, vegetables, kitchen waste, duckweed and termites, sampled fish farmers could produce between 45-106 kg fish per household or 25-41 kg fish per 100m² in the closed pond culture system and between 20-57 kg fish per household or 32-41 kg fish per 100m² in the open pond or pond connected to rice field culture system. Fish yield in the open pond culture system was slightly higher than yield in closed pond culture system. This finding is concordant with the results reported by PADEK- Fisheries program and AIT Outreach project in Svay Rieng Province that while ponds connected to rice fields were more productive than closed ponds because fish have access to additional food sources in the rice fields, there were increased problems with predatory fish species.

Farmers identified major effects of fish culture such as (1) increase fish availability thereby its contribution to household food security, (2) reduction in expense for buying fish from market leading some household saving, (3) additional household income from selling fish and better use of unused on-farm resources.

Fish farmers were facing a number of technical problems including (1) lack of fish culture knowledge, (2) lack of water source during dry season, (3) high fish mortality, (4) inadequate availability of good quality seed, (5) lack of local fish seed suppliers, i.e. fish seed have to be obtained from distance places, (6) polluted pond water, (7) poaching and (8) small size of fish seed. Other problems such as lack of capital, credit availability and the high interest rate remain as major issues constraints farmers to fish culture.

Although fish culture farmers facing several problems as mentioned above, all were willing to continue the activity and the majority of them wanted to expand their fish culture activities for both household fish consumption and sale. Interestingly, 97% of sampled non-fish culture farmers who never engaged in fish culture previously were interested in starting fish culture and expected meeting part of household fish consumption as wild fish catch is far below household requirement and this was an important factor in household motivation and interest in trying fish culture as a new activity.

Most households were poor and marginal with little cash income therefore fish culture recommendations must be low cost and low risk. This requires relying primarily on on-farm resources like organic animal and green manures and supplementary feeds such as rice bran, vegetables, kitchen waste, duckweed and termites.

REFERENCES

- ADB, 2004. Tonle Sap sustainable livelihoods. The Tonle Sap Initiatives: Future Solutions Now www.adb.org/Project/Tonle_Sap/. Asian Development Bank, Phnom Penh
- Ahmed, Navy, Vuthy and Tiongco, 1998. Socioeconomic Assessment of Freshwater Capture Fisheries of Cambodia. Report on a Household Survey. MRC/DANIDA/DoF, Department of Fisheries, Phnom Penh. 185 p.
- CDC 2005. Seila Commune Database. Cambodia Development Council, Phnom Penh, Cambodia. Website: www.seila.org
- Deap. L 1998. Catch Statistic of Cambodian Freshwater Fisheries. DOF/MRC/DANIDA- Capture Fisheries Management project.
- DoF (2004a). Fisheries Law (draft). *Unofficial translation supported by ADB/FAO TA project on improvement the regulatory and management framework for inland fisheries*. Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh, Cambodia.
- DoF (2004b). Fisheries Development Action Plan 2005-2008 (Version 3: November 18th 2004). Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh, Cambodia.
- DoF 2005. Fisheries Statistics and Data (1984-2004). Statistic Division, Department of Fisheries, Phnom Penh, Cambodia.
- FACT/EJF, 2002. Feast or Famine? Solutions to Cambodia's fisheries conflicts. Fisheries Action Coalition Team, Phnom Penh, Cambodia.
- FAO 1999. Food and Agriculture Organization (FAO) data collection and statistics, Rome (Italia).
- FAO/UNDP 2003. Cambodia Assessment and Localization of the Millennium Development Goal on Reducing Poverty and Hunger. Food and Agriculture Organization and United Nations Development Programme, Phnom Penh, Cambodia.
- Hortle, K.G., S. Lieng and J. Valbo-Jorgensen. 2004. An introduction to Cambodia's inland fisheries. Mekong Development Series No. 4. Mekong River Commission, Phnom Penh, Cambodia. 41 pages. ISSN 1680-4023.
- Jensen J, 2000. Save the Fish or lose the food security. MRCS in Mekong Fish Catch and Culture, Vol. 6, p 1-2, September 2000. Mekong River Commission Secretariat, Phnom Penh, Cambodia.
- MoP/WFP 2002. Estimates of poverty rates at commune level in Cambodia, Phnom Penh, Cambodia.
- Murshid KAS (1998). Food Security in an Asian Transitional Economy. The Cambodian Experience. Working Paper 6, Cambodia. Development Resource Institute/United Nations Research Institute for Social Development, Phnom Penh, Cambodia.
- Nao Thuok and Hav Viseth 2004. The Role of NGOs in Aquaculture Development in Cambodia, Lessons learned. Department of Fisheries, Phnom Penh, Cambodia.
- NIS 1999. Cambodia Socio-economic Survey 1999. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- NIS 2004. Cambodia's Inter-Censal Population Survey 2004 (CIPS) General Report. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- NIS 2005. National Accounts of Cambodia 1993-2004. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- NIS 2005a. Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 05- Kampong Speu Province. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- NIS 2005b. Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 07- Kampot Province and 23- Kep Province. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- NIS 2005c. Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 14- Prey Veng Province. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- NIS 2005d. Cambodia Intern-Censal Population Survey 2004, Report # 2: General Report at Provincial Level, 21- Takeo Province. National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia.
- Olin PG 2000. North American review on trends in aquaculture development. In Book of Synopses, International Conference on Aquaculture in the third Millennium, 20-25 February 2000, Bangkok, Thailand.

- So Nam and Nao Thuok 1999. Aquaculture Sector Review (1984-1999) and Aquaculture Development Plan (2000-2020). Consultancy report for World Bank/APIP. Department of Fisheries, Phnom Penh, Cambodia.**
- So Nam, 2000. Geographic analysis of poverty status and aquatic resources use- focusing especially on the livelihoods of the poor- in Cambodia. Consultancy report for DFID. Department of Fisheries, Phnom Penh, Cambodia.**
- So Nam, Eng Tong, Souen Norng and Kent Hortle, 2005. Use of freshwater low value fish for aquaculture development in the Cambodia's Mekong basin. Consultancy report for Mekong River Commission - Assessment of Mekong Capture Fisheries Project, Department of Fisheries, Phnom Penh, Cambodia.**
- So Nam and Buoy Roitana 2005. A Review of Inland Fisheries Management in Cambodia. The paper submitted to the International Seminar on Inland Fisheries Management, 21-26 September 2005, New Delhi, India. Department of Fisheries, Phnom Penh, Cambodia.**

APPENDICES

Appendix 1 Terms of Reference

1. Purpose of the Survey

There are 3 major purposes for conducting the baseline survey, which are as follows:

- (1) To identify objectively verifiable indicators for monitoring and evaluation (M&E) of the Project activity;
- (2) To obtain basic information on socio-economics and aquaculture activity in the Project target areas in the 4 provinces of Takeo, Prey-Veng, Kampong Speu and Kampot; and
- (3) To prepare Commune/Village Profiles of the Project target communes and villages.

2. Survey Type

The baseline survey will be consisted of the 3 types of survey: 1) Secondary data collection and documentation consulting existing information and documents; 2) Field survey and analysis through individual interview to rural farmers using questionnaire; and 3) Field survey for preparing commune/village profiles through key informant group interview.

3. Survey Target Area and Target People

The Project is now selecting the initial 4 communes where the Project is going to provide intensive extension services and 1 village where the Project is going to implement activities on fish refuge pond management in each Project target province (initially total 16 communes and 4 villages).

Individual interview to rural farmers will be conducted in the 2 communes out of the 4 communes mentioned above per Project target province (total 8 communes). In each commune, 20 small-scale aquaculture farmers and 20 non- aquaculture farmers but having intension to start aquaculture activity in future will be selected and interviewed using questionnaire (total 320 samples).

Key informant group interview will be conducted in the 16 communes and the 4 villages mentioned above. Key informants might be leaders and other key persons in the communes and the villages.

4. Survey Method

The Project will entrust the baseline survey to a local consultant. The consultant shall organize a survey team to be consisted of 1 survey manager, 8 field surveyors and 2 surveyors for secondary data collection and other necessary experienced personnel for data entry, data analysis and report writing. Among the 10 surveyors, 5 should be experts on aquaculture and the rest on socio-economics.

The survey will be consisted of the 3 types of survey as mentioned earlier. Survey method of each survey type is briefly explained below.

- (1) Secondary data collection and documentation consulting existing information and documents:

Secondary data on socio-economic situation, fishery administration and aquaculture situation of Cambodia as a whole and of the target 4 provinces will be collected through existing information and documents. The information might be available at National Institute of Statistics (NIS), Department of Fisheries (DoF), corresponding divisions at provincial level and so on.

- (2) Field survey and analysis through individual interview to rural farmers using questionnaire: Primary data on household economy and aquaculture activity of the 320 small-scale farmers in the target 4 provinces will be collected through individual interview using questionnaire. As for the selection of the farmers, DoF and Provincial Fisheries divisions of MAFF will be requested for assistance.

- (3) Field survey for preparing commune/village profiles through key informant group interview: Key informant group interview will be organized to obtain information for making commune/village profiles of the 16 communes and the 4 villages. Information of the 16 communes will be collected for small-scale aquaculture development. Information of the 4 villages will be collected for fish refuge pond (community pond) management. As for the selection of the key informants, DOF and Provincial Fisheries Division of MAFF will be requested for assistance.

5. Output

- (1) Full report of the baseline survey in English with electrical data and the filled-up questionnaire. The report should contain location map of the surveyed area and photos.
- (2) Commune/village profiles for the 16 communes and 4 villages in English with electrical data.

The output should be submitted to the Project by not later than the last day of the Contract to be agreed by the Project and a local consultant (i.e. 12 November 2005).

6. Proposed Schedule (90 days)

	August 2005	September	October	November
1. Signing contract	○			
2. Secondary data collection and documentation	_____	(14 days)		
3. Preparation for field survey (translation of the questionnaire, pre-test and revision)	_____	(5 days)		
4. Field survey and data checking				
(1) Prey-Veng		_____	(28 days)	
(2) Takeo		_____	(28 days)	
(3) Kampong-Speu		_____	(28 days)	
(4) Kampot		_____	(28 days)	
5. Data entry		_____	(20 days)	
6. Data analysis			_____ (15 days)	
7. Draft final report writing			_____	(21 days)
8. Draft final report submit				○
9. Examination of the report				_____ (5 days)
10. Final report writing				_____ (7 days)
11. Final report submit				○

Appendix 2 Baseline survey team members

Team member	Qualification and experience
A. Supervisor/Team leader	
1. Dr. So Nam	<ul style="list-style-type: none"> • Education: Ph.D. in Biology (Belgium), M.Sc. in Aquaculture (Belgium) and B.Sc. in Aquaculture and Fisheries Sciences (Cambodia). • Work experience: Manager/coordinator, supervisor, researcher and consultant on various projects related to aquaculture/fisheries and socio-economic aspects.
B. Field surveyor	
(a) Aquaculture specialist	
1. Mr. engTong	<ul style="list-style-type: none"> • Education: B.Sc. in Aquaculture and Fisheries Sciences, Royal University of Agriculture, Phnom Penh. • Work experience: (1) Field survey on use of trash fish for aquaculture in seven provinces in Cambodia; (2) Data collection of fish consumption at Tonle Sap Great Lake; and (3) Taxonomy/characterization of fish species in the Mekong River.
2. Mr. Thao Lo	<ul style="list-style-type: none"> • Education: B.Sc. in Aquaculture and Fisheries Sciences, Royal University of Agriculture, Phnom Penh. • Work experience: (1) Fisheries Researcher in Prey Veng, Kompong Cham and Siem Reap provinces and (2) Field survey on Socio-economic characteristics of fishing households in Kompong Thom province.
3. Mr. SoeunNorng	<ul style="list-style-type: none"> • Education: B.Sc. in Fisheries Science, Prek Leap Agriculture College, Phnom Penh. • Work experience: (1) Field survey on use of trash fish for aquaculture in seven provinces in Cambodia; (2) Data collection of fish consumption at Tonle Sap Great Lake; (3) Field study on valuation of household fishing and fish culture; (4) Field data collection of fish catches and species identification at fishing lots of Tonle Sap Great Lake.
4. Mr. Meas Vichit	<ul style="list-style-type: none"> • Education: B.Sc. in Fisheries, University of Fisheries in Nha Trang, Vietnam. • Work experience: (1) Aquaculture extension; (2) Bloodstock management, fish breeding, nursing and growth-out; (3) Field survey on fish consumption at Tonle Sap Great Lake; and (4) Economic valuation of aquatic resources and fish processing market.
(b) Socio-economic specialists	
1. Mr. Seng Leang	<ul style="list-style-type: none"> • Education: B.Sc. in Aquaculture and Fisheries Sciences, Royal University of Agriculture, Phnom Penh. • Work experience: (1) Socio-economic baseline survey

of freshwater capture fisheries at Tonle Sap Great Lake (including gender issues); (2) Filed survey on fish trade, marketing and distribution and role of women in fisheries sector; (3) Data collection and field research on fish fights over fish rights (World Fish Center); (4) Fisheries community studies; and (5) Inventory and management of Cambodia wetlands.

2. Ms. Hing Sopheavy

- Education: B.Sc. in Fisheries Science, Prek Leap Agriculture College, Phnom Penh.
- Work experience: (1) Field survey on fish consumption at Tonle Sap Great Lake; (2) Filed survey on socio-economic data collection of inland fisheries in the Mekong Plain region, Cambodia.

3. Mr. Ngo Sarakmony

- Education: B.Sc. in Agriculture Economics and Rural Development, Royal University of Agriculture, Phnom Penh.
- Work experience: Field survey on use of safe water in Takeo province.

4. Miss Hy Tang Horn

- Education: Diploma of Fisheries, Prek Leap Agriculture College, Phnom Penh
- Work experience: (1) Field survey on socio-economic impact of small-scale fish seed production in Takeo province; (2) Field survey on socio-economic impact of hydropower plant in Kampot district, Kampot province; and (3) Field survey on livelihoods of rural people living along the Mekong River in Siem Pang district, Stung Treng province.

Data entering specialist

1. Miss Tan Phalla

- Education: B.Sc. in Business and Administration, National University of Phnom Penh, Phnom Penh
- Work experience: Entering of aquaculture, fisheries and socio-economic data for more than 3 years with Mekong River Commission Freshwater Capture Fisheries Project in Cambodia.

D. Secondary data collector

1. Mr. ChhorBanly

- Education: B.Sc. in Aquaculture and Fisheries Sciences, Royal University of Agriculture, Phnom Penh.
- Work experience: Aquaculture and socio-economic data collection.

2. Mr. Sen Rotha

- Education: B.Sc. in Aquaculture and Fisheries Sciences, Royal University of Agriculture, Phnom Penh.
- Work experience: Aquaculture, Fisheries and socio-economic data collection and management.

Appendix 3 List of farmers for individual interview

Farmer's code*	Farmer's type	Farmer's name	Village	Commune	District	Province
1	a	Von Veun	Chea Khlang	Chea Khlang	Pray Veng	Pray Veng
2	a	Sin Toeng	Dean Ny	Lvea	Pras Sdach	Pray Veng
3	a	Nut Sun	Boeng Snou	Lvea	Pras Sdach	Pray Veng
4	a	Doeng Dorn	Doun Yu	Chea Khlang	Pray Veng	Pray Veng
5	a	Chory Pisot	Chres	Chea Khlang	Pray Veng	Pray Veng
6	a	Chhoun Soka	Tnung	Chea Khlang	Pray Veng	Pray Veng
7	a	Touch Khorn	Takok	Lvea	Pras Sdach	Pray Veng
8	a	Seang Samat	Boeng Snou	Lvea	Pras Sdach	Pray Veng
9	a	Bun Hun	Svay Kdeab	Lvea	Pras Sdach	Pray Veng
10	a	Ye Hoan	Chhike Kon	Chea Khlang	Pray Veng	Pray Veng
11	a	Sun Saroen	Chhnung	Chea Khlang	Pray Veng	Pray Veng
12	a	Kat Lonh	Takok	Lvea	Pras Sdach	Pray Veng
13	a	Chea Choeak	Prom Ksach	Lvea	Pras Sdach	Pray Veng
14	a	Chork Rula	Chres	Chea Khlang	Pray Veng	Pray Veng
15	a	Soun Oun	Boeng Snou	Lvea	Pras Sdach	Pray Veng
16	a	Chea Chhoeen	Chhike Kon	Chea Khlang	Pray Veng	Pray Veng
17	a	Pav Thun	Chhike Kon	Chea Khlang	Pray Veng	Pray Veng
18	a	Much Ed	Keach	Lvea	Pras Sdach	Pray Veng
19	a	Ly Eeam	Takok	Lvea	Pras Sdach	Pray Veng
20	na1	Prang Tim	Takok	Lvea	Pras Sdach	Pray Veng
21	na1	Sun Py	Chres	Chea Khlang	Pray Veng	Pray Veng
22	na2	Chan Sus	Takok	Lvea	Pras Sdach	Pray Veng
23	a	Nhem Raksmeay	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
24	na1	Chev Chhoeen	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
25	na1	Oum Kor	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
26	a	Ouk Chen	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
27	a	Soun Kunthea	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
28	a	Ty Saroen	Lva	Krang Snay	Chhouk	Kampot
29	a	En Koy	Lva	Krang Snay	Chhouk	Kampot
30	a	Koem Phai	Lva	Krang Snay	Chhouk	Kampot
31	na2	Kruy Soan	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
32	na2	Em Sary	Lva	Krang Snay	Chhouk	Kampot
33	a	Houn Kim	Ponlay	Ponlay	Angkor Borey	Takeo
34	a	Tet Mul	Tlouk Yul	Ponlay	Angkor Borey	Takeo
35	a	Soam Cha	Som Rong	Ponlay	Angkor Borey	Takeo
36	a	Som Houn	Pray Sbat	Trapang Thorm KC	Tramkork	Takeo
37	a	Touch Chib	Ta Soun	Trapang Thorm KC	Tramkork	Takeo
38	a	Chom Hun	Som Rong	Trapang Thorm KC	Tramkork	Takeo
39	na1	Prek Kro	Som Rong	Trapang Thorm KC	Tramkork	Takeo
40	na1	Met Nhunh	Prey Sbat	Trapang Thorm KC	Tramkork	Takeo
41	na1	Muk Heng	Prey Sbat	Trapang Thorm KC	Tramkork	Takeo
42	na1	Chak Ry	Sromuk	Ponlay	Angkor Borey	Takeo
43	na2	Chhen Chor	Ponlay	Ponlay	Angkor Borey	Takeo
44	a	Ngan Sokka	Roka Thorm	Kat Phluk	Bor Seth	Kampong Speu
45	a	Eang Touch	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
46	a	Choun Chantha	Prey Klung	Veal	Khorng Pesay	Kampong Speu
47	na1	Koo Samjen	Krol Krosang	Veal	Khorng Pesay	Kampong Speu
48	na1	Morm Kan	Pom Cham	Veal	Khorng Pesay	Kampong Speu
49	na1	Morm Ngath	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
50	na2	Khoem Noen	Krosang Chimea	Veal	Khorng Pesay	Kampong Speu
51	na2	Ouk Oul	Roka Kong	Kat Phluk	Bor Seth	Kampong Speu
52	na2	Ngeth Sok	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
53	na2	Preab Seyha	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
54	a	Mang Nat	Prom Ksach	Lvea	Pras Sdach	Pray Veng
55	a	Hak Dorn	Keach	Lvea	Pras Sdach	Pray Veng
56	a	Sie Sy	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
57	a	Nhab Thy	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
58	a	Soung Horig	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
59	a	Chhoeen Eam	Ta Nan	Krang Snay	Chhouk	Kampot
60	a	Morm Sarem	Ta Nan	Krang Snay	Chhouk	Kampot
61	na1	Lean Sorn	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
62	na1	Soun Sambath	Ta Nan	Krang Snay	Chhouk	Kampot
63	na1	Mork Sin	Ta Nan	Krang Snay	Chhouk	Kampot
64	na2	Nork Chanthorn	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
65	na2	Hin Sim	Krang Rolous	Krang Snay	Chhouk	Kampot
66	na2	Ton Los	Krang Rolous	Krang Snay	Chhouk	Kampot
67	na2	Thoeng Maan	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
68	a	Mom Doun	Chhnung	Chea Khlang	Pray Veng	Pray Veng
69	a	Ouk Ang	Takok	Lvea	Pras Sdach	Pray Veng
70	a	Pin Kim	Som Rong	Lvea	Pras Sdach	Pray Veng
71	a	Pom Phai	Boeng Snou	Lvea	Pras Sdach	Pray Veng
72	a	Seth Raksa	Chres	Chea Khlang	Pray Veng	Pray Veng
73	na1	Mak San	Prom Ksach	Lvea	Pras Sdach	Pray Veng
74	na1	Dien Ang	Chres	Chea Khlang	Pray Veng	Pray Veng
75	na2	Som Mao	Chhike Kon	Chea Khlang	Pray Veng	Pray Veng

Appendix 3 Continue

Farmer's code	Farmer's type	Farmer's name	Village	Commune	District	Province
76	na2	Som Chhoen	Prom Keach	Lvea	Pras Sdach	Prey Veng
77	na2	Kan Ly	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
78	a	Yin Tuy	Som Roung	Ponlay	Angkor Borey	Takeo
79	a	Choeng Nang	Sromuk	Ponlay	Angkor Borey	Takeo
80	a	Bo Say	Tlouk Yul	Ponlay	Angkor Borey	Takeo
81	a	Loung Ys	Prey Taly	Trapang Thorm KC	Tramkork	Takeo
82	a	Mie Chin	Prey Taly	Trapang Thorm KC	Tramkork	Takeo
83	na1	Thuk Haek	Prey Kvav	Trapang Thorm KC	Tramkork	Takeo
84	na1	Sork Boen	Angkor Pheak	Trapang Thorm KC	Tramkork	Takeo
85	na1	Hun Sakum	Prey Kvav	Trapang Thorm KC	Tramkork	Takeo
86	na1	Breng	Som Roung	Ponlay	Angkor Borey	Takeo
87	na2	Lay Phoeun	Ang Trav	Trapang Thorm KC	Tramkork	Takeo
88	a	Kec Nim	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
89	a	Morm Muth	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
90	a	Lun Sokleab	Prey Klung	Veal	Khorng Pesay	Kampong Speu
91	a	Meas Leang	Prey Klung	Veal	Khorng Pesay	Kampong Speu
92	a	Tho Som	Veal Lveang	Kat Phluk	Bor Seth	Kampong Speu
93	na1	May Oi	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
94	na1	Math Boen	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
95	na1	Sun Nary	Trapang Po	Veal	Khorng Pesay	Kampong Speu
96	na1	Touch Pring	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
97	na1	Pho Mean	Roka kong	Kat Phluk	Bor Seth	Kampong Speu
98	na2	Phes Sophath	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
99	na2	Prak Mao	Trapang Kroloun	Veal	Khorng Pesay	Kampong Speu
100	na2	Yors Nhak	Krosang Chimes	Veal	Khorng Pesay	Kampong Speu
101	a	Ong Phluch	Touch	Krang Snay	Chhouk	Kampot
102	a	Nhang Sakorn	Angkor Pheak	Damnak Sokrom	Dong Tong	Kampot
103	a	Noun Samon	Trapang Rasy	Damnak Sokrom	Dong Tong	Kampot
104	a	Outh Kan	Touch	Krang Snay	Chhouk	Kampot
105	a	Khorn Bros	Lva	Krang Snay	Chhouk	Kampot
106	na1	Theb Lun	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
107	na1	Ang Vuthy	Lva	Krang Snay	Chhouk	Kampot
108	na2	Sok Sary	Lva	Krang Snay	Chhouk	Kampot
109	na2	Theav Theavy	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
110	na2	Soem Porn	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
111	na2	Puth Kamra	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
112	a	Phai Sopak	Chres	Chea Khlang	Prey Veng	Prey Veng
113	a	Phang Vy	Trung	Chea Khlang	Prey Veng	Prey Veng
114	a	Yan Oun	Pheany	Lvea	Pras Sdach	Prey Veng
115	a	Kun Thea	Svay Anthor	Chea Khlang	Prey Veng	Prey Veng
116	a	Eng Voeng	Trung	Chea Khlang	Prey Veng	Prey Veng
117	na1	Sang Moeung	Takok	Lvea	Pras Sdach	Prey Veng
118	na1	Kan Veasna	Takok	Lvea	Pras Sdach	Prey Veng
119	na2	Nhan Anathi	Keach	Lvea	Pras Sdach	Prey Veng
120	na2	Doch Vay	Boeng Snou	Lvea	Pras Sdach	Prey Veng
121	a	Men Hleng	Prey Sbat	Trapang Thorm KC	Tramkork	Takeo
122	a	Thuy Phom	Ta Soun	Trapang Thorm KC	Tramkork	Takeo
123	a	Koem Horn	Ponlay	Ponlay	Angkor Borey	Takeo
124	a	Mao Sarin	Ponlay	Ponlay	Angkor Borey	Takeo
125	a	Khorn Pheap	Som Roung	Ponlay	Angkor Borey	Takeo
126	na1	Dak Saran	Prey Doekpor	Trapang Thorm KC	Tramkork	Takeo
127	na1	Long Phai	Ta Soun	Trapang Thorm KC	Tramkork	Takeo
128	na1	Kao Anem	Sromuk	Ponlay	Angkor Borey	Takeo
129	na1	Chum Samnang	Tlouk Yul	Ponlay	Angkor Borey	Takeo
130	na2	Riel Son	Prey Taly	Trapang Thorm KC	Tramkork	Takeo
131	na2	Chen Ngoem	Prey Doekpor	Trapang Thorm KC	Tramkork	Takeo
132	a	Yan Thinh	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
133	a	Dung Samath	Veal Lveang	Kat Phluk	Bor Seth	Kampong Speu
134	a	Doem Dus	Roka kong	Kat Phluk	Bor Seth	Kampong Speu
135	a	Thoeng Thay	Cham	Veal	Khorng Pesay	Kampong Speu
136	a	Tan Nam	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
137	na1	Sou Ye	Chhoetheal Chron	Veal	Khorng Pesay	Kampong Speu
138	na1	Ben Sopheap	Roka kong	Kat Phluk	Bor Seth	Kampong Speu
139	na2	Hong Sarlith	Kro Longthorn	Kat Phluk	Bor Seth	Kampong Speu
140	na2	Muk Thoem	Prey Phlung	Veal	Khorng Pesay	Kampong Speu
141	na2	Soem Bunnth	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
142	na2	Hong Doen	Krol Kou	Kat Phluk	Bor Seth	Kampong Speu
143	na1	Phor Chea	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
144	na1	Veng Oun	Takok	Lvea	Pras Sdach	Prey Veng
145	na1	Hem Nak	Takok	Lvea	Pras Sdach	Prey Veng
146	na2	Duch Kioun	Chea Khlang	Chea Khlang	Prey Veng	Prey Veng
147	na2	Chea Chorn	Prom Ksach	Lvea	Pras Sdach	Prey Veng
148	a	Sok Sien	Tlouk Yul	Ponlay	Angkor Borey	Takeo
149	a	Svay Oun	Trapang Svay	Trapang Thorm KC	Tramkork	Takeo
150	a	Nun Nom	Trapang Svay	Trapang Thorm KC	Tramkork	Takeo

Appendix 3 Continue

Farmer's code	Farmer's type	Farmer's name	Village	Commune	District	Province
151	a	Chhay Ngeth	Ponlay	Ponlay	Angkor Borey	Takeo
152	a	Yor Sun	Prey Taly	Trapang Thorm KC	Tramkork	Takeo
153	na1	Koem Samoen	Sorn Roung	Ponlay	Angkor Borey	Takeo
154	na1	Sun Phorn	Ponlay	Ponlay	Angkor Borey	Takeo
155	na1	Chum Chhlang	Pak Bongom	Trapang Thorm KC	Tramkork	Takeo
156	na2	Bun Somoen	Sromuk	Ponlay	Angkor Borey	Takeo
157	na2	Ouch Ngorn	Ponlay	Ponlay	Angkor Borey	Takeo
158	a	Chhoem Horng	Damnak Srok	Krang Snay	Chhouk	Kampot
159	a	Khoem Born	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
160	a	Kiev Trang	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
161	a	Doek Im	Damnak Trob	Krang Snay	Chhouk	Kampot
162	a	Buth Rattha	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
163	a	Deang Sreyov	Damnak Trob	Krang Snay	Chhouk	Kampot
164	na1	Neang Kakda	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
165	na1	Chea Kimheng	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
166	na1	Horn Saron	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
167	na2	Toek Thul	Krang Rolous	Krang Snay	Chhouk	Kampot
168	na2	Hem Mul	Krang Rolous	Krang Snay	Chhouk	Kampot
169	a	Chem Sovat	Kambork	Kat Phluk	Bor Seth	Kampong Speu
170	a	Keo Vanny	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
171	a	Ros En	Roka kong	Kat Phluk	Bor Seth	Kampong Speu
172	a	My Lis	Trapang Po	Veal	Khorng Pesay	Kampong Speu
173	a	Neang Chorn	Yong Tong	Kat Phluk	Bor Seth	Kampong Speu
174	na1	Chea Bum	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
175	na1	Prak Song	Trapang Veng	Veal	Khorng Pesay	Kampong Speu
176	na1	Kut Phun	Prey Somphor	Kat Phluk	Bor Seth	Kampong Speu
177	na1	Prak Nam	Chrey Hophnov	Veal	Khorng Pesay	Kampong Speu
178	na2	Mao Dom	Ro Kankong	Kat Phluk	Bor Seth	Kampong Speu
179	na2	Em Sien	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
180	na1	Hak Vanny	Tskok	Lvea	Pras Sdach	Prey Veng
181	na1	Sorn Sao	Chros	Chea Khlang	Prey Veng	Prey Veng
182	na1	Nong Yat	Chros	Chea Khlang	Prey Veng	Prey Veng
183	na2	Mak Hoen	Prom Ksach	Lvea	Pras Sdach	Prey Veng
184	na2	Chhun Ra	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
185	na2	Hun Chhun	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
186	a	Tun Veng	O	Kat Phluk	Bor Seth	Kampong Speu
187	a	Yin Pieng	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
188	a	Sorn Mao	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
189	a	Kiev Vanthorn	Trapang Veng	Veal	Khorng Pesay	Kampong Speu
190	a	Long Phath	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
191	na1	Tuy Phalla	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
192	na1	Mom Young	Cham	Veal	Khorng Pesay	Kampong Speu
193	na1	Morn Hak	Ro Kankong	Kat Phluk	Bor Seth	Kampong Speu
194	na2	Tes Somoen	Boeng	Veal	Khorng Pesay	Kampong Speu
195	na2	Kie Ngeth	Ro Kankong	Kat Phluk	Bor Seth	Kampong Speu
196	a	Iem Romdoul	Ponlay	Ponlay	Angkor Borey	Takeo
197	a	Sang Kin	Sromuk	Ponlay	Angkor Borey	Takeo
198	a	Ros Sambath	Ampil	Ponlay	Angkor Borey	Takeo
199	a	Ben Chey	Prey Taly	Trapang Thorm KC	Tramkork	Takeo
200	a	Chhoeng Lun	Prey Taly	Trapang Thorm KC	Tramkork	Takeo
201	na1	Bich Sovan	Prey Kvav	Trapang Thorm KC	Tramkork	Takeo
202	na1	Pors Lao	Prey Kvav	Trapang Thorm KC	Tramkork	Takeo
203	na1	Mean Moen	Tlouk Yul	Ponlay	Angkor Borey	Takeo
204	na1	Lach Ponlay	Ponlay	Ponlay	Angkor Borey	Takeo
205	na1	Chouy Bun	Ponlay	Ponlay	Angkor Borey	Takeo
206	na2	Ngeth soka	Ang Trav	Trapang Thorm KC	Tramkork	Takeo
207	a	Ieng Sang	Ta Nan	Krang Snay	Chhouk	Kampot
208	a	Phoeng Sarin	Ta Nan	Krang Snay	Chhouk	Kampot
209	a	Tik Chanthit	Krang Rolous	Krang Snay	Chhouk	Kampot
210	a	Nhab Sam	Krang Rolous	Krang Snay	Chhouk	Kampot
211	a	Korng Thy	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
212	a	Chea Sarun	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
213	na1	Dib That	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
214	na1	Chab Dong	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
215	na1	Yang Sokchea	Ta Nan	Krang Snay	Chhouk	Kampot
216	na1	Tun Chhuk	Krang Rolous	Krang Snay	Chhouk	Kampot
217	na2	Huy Bros	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
218	na2	E Yoek	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
219	a	Prak Soveat	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
220	a	Sang Nin	Veal Lveang	Kat Phluk	Bor Seth	Kampong Speu
221	a	Koem Veng	Prey Boeng	Veal	Khorng Pesay	Kampong Speu
222	a	Doung Kunly	Cham	Veal	Khorng Pesay	Kampong Speu
223	a	Oum Roen	Tlouk By	Kat Phluk	Bor Seth	Kampong Speu
224	a	Poon Sophy	Yong Tong	Kat Phluk	Bor Seth	Kampong Speu
225	na1	Phan Somath	Ro Kankong	Kat Phluk	Bor Seth	Kampong Speu

Appendix 3 Continue

Farmer's code	Farmer's type	Farmer's name	Village	Commune	District	Province
226	na1	Sao Som	Veal Lveang	Kat Phluk	Bor Seth	Kampong Speu
227	na1	Os Somnang	Prek Sdach	Veal	Khorng Pesay	Kampong Speu
228	na2	Sy Van	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
229	na2	Oum Nhom	Trav	Veal	Khorng Pesay	Kampong Speu
230	a	Thang Sokang	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
231	a	Rinh Vichika	Trapang Rsey	Damnak Sokrom	Dong Tong	Kampot
232	a	Koem Ven	Lva	Krang Snay	Chhouk	Kampot
233	a	Nak En	Ta Nan	Krang Snay	Chhouk	Kampot
234	a	Kong Chok	Lva	Krang Snay	Chhouk	Kampot
235	a	Siv Tuk	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
236	na1	Lang Sarin	Krang Rolous	Krang Snay	Chhouk	Kampot
237	na1	Nub Vanny	Damnak Trob	Krang Snay	Chhouk	Kampot
238	na1	Soung Hun	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
239	na2	Nhan Nem	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
240	na2	Duy Somath	Lva	Krang Snay	Chhouk	Kampot
241	a	Klok Savun	Takok	Lvea	Pras Sdach	Prey Veng
242	a	Eng Saron	Takok	Lvea	Pras Sdach	Prey Veng
243	a	Loeb Sophal	Chras	Chea Khlang	Prey Veng	Prey Veng
244	a	Doung Sab	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
245	a	Dun Thoen	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
246	na1	Em Chettra	Som Roung	Lvea	Pras Sdach	Prey Veng
247	na1	Eieng Chamroen	Chea Khlang	Chea Khlang	Prey Veng	Prey Veng
248	na1	To Sophy	Trung	Chea Khlang	Prey Veng	Prey Veng
249	na2	Som Chham	Som Roung	Lvea	Pras Sdach	Prey Veng
250	na2	Sary Vanna	Som Roung	Lvea	Pras Sdach	Prey Veng
251	a	Chhang Moen	Ponlay	Ponlay	Angkor Borey	Takeo
252	a	Say Srey	Som Roung	Ponlay	Angkor Borey	Takeo
253	a	Chea Vun	Ta Soun	Trapang Thorm KC	Tramkork	Takeo
254	a	Mao Chhin	Po Dus	Trapang Thorm KC	Tramkork	Takeo
255	a	En Sombol	Po Dus	Trapang Thorm KC	Tramkork	Takeo
256	na1	Bul Thoeik	Ponlay	Ponlay	Angkor Borey	Takeo
257	na1	Chhang Ot	Thouk Yul	Ponlay	Angkor Borey	Takeo
258	na1	Kan Samy	Po Dus	Trapang Thorm KC	Tramkork	Takeo
259	na1	Chom Saron	Som Roung	Trapang Thorm KC	Tramkork	Takeo
260	na1	Ly Sok	Som Roung	Trapang Thorm KC	Tramkork	Takeo
261	na1	Kuy Samorn	Sromuk	Ponlay	Angkor Borey	Takeo
262	na2	Hem Saron	Po Dus	Trapang Thorm KC	Tramkork	Takeo
263	a	Kong Pha	Damnak Trob	Krang Snay	Chhouk	Kampot
264	a	Mao Sarun	Touch	Krang Snay	Chhouk	Kampot
265	a	Tam Vandy	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
266	a	Moeng Mean	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
267	a	Touch Vithol	Krang Ampov	Damnak Sokrom	Dong Tong	Kampot
268	a	Kang Phoen	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
269	na1	Long Ti	Damnak Trob	Krang Snay	Chhouk	Kampot
270	na1	Kun Sopheap	Damnak Trob	Krang Snay	Chhouk	Kampot
271	na1	Ky Phon	Damnak Trob	Krang Snay	Chhouk	Kampot
272	na1	Kong Mao	Krang Rolous	Krang Snay	Chhouk	Kampot
273	na2	Sun Koamsan	Krang Rolous	Krang Snay	Chhouk	Kampot
274	na2	Keom Phary	Krang Rolous	Krang Snay	Chhouk	Kampot
275	na2	Soun Hen	Ang Rophak	Damnak Sokrom	Dong Tong	Kampot
276	na1	Yo Sothea	Trung	Chea Khlang	Prey Veng	Prey Veng
277	na1	Van Sothea	Chea Khlang	Chea Khlang	Prey Veng	Prey Veng
278	na1	Long Phoen	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
279	na1	Chea Phal	Svay Kdeab	Lvea	Pras Sdach	Prey Veng
280	na1	Soeng Sem	Trung	Chea Khlang	Prey Veng	Prey Veng
281	na2	Vong Sron	Trung	Chea Khlang	Prey Veng	Prey Veng
282	na2	Mess Sokphun	Chhke Kon	Chea Khlang	Prey Veng	Prey Veng
283	a	Em Saran	Pek Bongom	Trapang Thorm KC	Tramkork	Takeo
284	a	Ngeth Ngoem	Ang Trav	Trapang Thorm KC	Tramkork	Takeo
285	a	Yang Ma	Ang Trav	Trapang Thorm KC	Tramkork	Takeo
286	a	Sun Rattana	Ponlay	Ponlay	Angkor Borey	Takeo
287	a	Ngeth Pheap	Ponlay	Ponlay	Angkor Borey	Takeo
288	na1	Yoeng Saram	Pek Bongom	Trapang Thorm KC	Tramkork	Takeo
289	na1	En Nat	Po Dus	Trapang Thorm KC	Tramkork	Takeo
290	na1	Kam Ham	Prey Doeopor	Trapang Thorm KC	Tramkork	Takeo
291	na1	Som Yun	Thouk Yul	Ponlay	Angkor Borey	Takeo
292	na2	Sang Klen	Sromuk	Ponlay	Angkor Borey	Takeo
293	a	Phoen Lon	Chhcheal Chhon	Veal	Khorng Pesay	Kampong Speu
294	a	Yan Thy	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
295	a	Phon Bunthoen	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
296	a	Veth Sophon	Ro Kathom	Kat Phluk	Bor Seth	Kampong Speu
297	a	Keo Sam	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
298	na1	Nang Ny	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
299	na1	Mouy Nan	Krol Krosang	Kat Phluk	Bor Seth	Kampong Speu
300	na2	Van Thoen	Ro Kathom	Kat Phluk	Bor Seth	Kampong Speu

Appendix 3 Continue

Farmer's code	Farmer's type	Farmer's name	Village	Commune	District	Province
301	na2	Kiev Sophal	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
302	na2	Soung Sokna	Ro Kathorm	Kat Phluk	Bor Seth	Kampong Speu
303	a	Leang Soka	Chras	Chea Khlang	Prey Veng	Prey Veng
304	a	Houn Savoen	Tnung	Chea Khlang	Prey Veng	Prey Veng
305	a	Vong Thuch	Boeng Snou	Lvea	Pras Sdach	Prey Veng
306	a	Bun Sangkong	Takok	Lvea	Pras Sdach	Prey Veng
307	na1	Mao Puth	Takok	Lvea	Pras Sdach	Prey Veng
308	na2	Bonh Long	Chhka Kon	Chea Khlang	Prey Veng	Prey Veng
309	na2	Ien An	Chhka Kon	Chea Khlang	Prey Veng	Prey Veng
310	na2	Buk An	Prom Keach	Lvea	Pras Sdach	Prey Veng
311	na2	Nat Sarin	Som Rong	Lvea	Pras Sdach	Prey Veng
312	a	Long Ngou	Sromuk	Ponlay	Angkor Borey	Takeo
313	a	Bo Kong	Prey Sbat	Trapang Thorm KC	Tramkork	Takeo
314	a	Kong Roth	Tlouk Yul	Ponlay	Angkor Borey	Takeo
315	a	Chan Von	Ta Soun	Trapang Thorm KC	Tramkork	Takeo
316	na1	Seng Phun	Prey Sbat	Trapang Thorm KC	Tramkork	Takeo
317	na1	Ouch Vanny	Ponlay	Ponlay	Angkor Borey	Takeo
318	na1	Hou Sarom	Prey Sbat	Trapang Thorm KC	Tramkork	Takeo
319	na2	Bun Vanna	Ponlay	Ponlay	Angkor Borey	Takeo
320	a	Prak Mao	Prey Tothoeng	Veal	Khorng Pesay	Kampong Speu
321	a	Lan Lem	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
322	a	Keo Saron	Krosang Chimea	Veal	Khorng Pesay	Kampong Speu
323	a	Morm Houth	Ro Kathorm	Kat Phluk	Bor Seth	Kampong Speu
324	a	Keo Phoy	Veal Lveang	Kat Phluk	Bor Seth	Kampong Speu
325	a	Ieng Hong	Prey Sampor	Kat Phluk	Bor Seth	Kampong Speu
326	na1	Yas Thun	Tbong Phnom	Veal	Khorng Pesay	Kampong Speu
327	na2	En Sy	Chhoetheal Chron	Veal	Khorng Pesay	Kampong Speu

Note: * The farmers's codes are the same codes as in the filled questionnaires.

a: aquaculture or fish culture farmers; na1: non-aquaculture or non-fish culture farmers having intention to start fish culture in this short coming season;

na2: non-aquaculture or non-fish culture farmers having no intention to start fish culture this year

Appendix 4 List of key informants for group interview/discussion

No.	Full name	Commune/Village	Position
A. Kampong Speu province			
• <u>Commune meeting</u>			
1.	Mr. Seang Chhat	Kat Phluk commune	Chief
2.	Mr. Ben Bunthin	Kat Phluk commune	First vice-chief
3.	Mr. Ros Chantha	Kat Phluk commune	Second vice-chief
4.	Mr. Chem Sovath	Kat Phluk commune	Commune council
5.	Mr. Lang Thhuk	Kat Phluk commune	Secretary
6.	Mr. Nuon Vong	Pheari Mean Chey commune	Chief
7.	Mr. Dim Chhem	Pheari Mean Chey commune	Second vice-chief
8.	Mr. Sang San	Pheari Mean Chey commune	Commune council
9.	Mr. Meas Sokhom	Pheari Mean Chey commune	Secretary
10.	Mr. Chap Sokha	Phong commune	Chief
11.	Mr. Yang Seun	Phong commune	First vice-chief
12.	Mr. Suos Sarmeth	Phong commune	Second vice-chief
13.	Mr. Muol Sarin	Phong commune	Commune council
14.	Mr. Ouch Channeun	Phong commune	Secretary
15.	Mr. Nob Onn	Veal commune	Chief
16.	Mr. Ly Soun	Veal commune	First vice-chief
17.	Mr. Sok Mao	Veal commune	Commune council
18.	Mr. Yun Sok	Veal commune	Secretary
• <u>Village meeting</u>			
1.	Mr. Pel Neth	Pheari village	Chief
2.	Mr. Yin Yorn	Pheari village	Vice-chief
3.	Mr. Suos Yath	Pheari village	Elder
4.	Mr. Tuon Dy	Pheari village	Elder
5.	Mr. Soum Phear	Pheari village	Farmer
6.	Mr. Nan Muon	Pheari village	Farmer
B. Kampot province			
• <u>Commune meeting</u>			
1.	Mr. Tit Ren	Angkor Meas commune	Chief
2.	Mr. Hun Morn	Angkor Mmeas commune	Council
3.	Mr. Khuon Hak	Angkor Mmeas commune	Secretary
4.	Mr. Paov Pril	Angkor Mmeas commune	Chief
5.	Mr. Pot Chhom	Trapeang Rang village	Chief
6.	Mr. Suong Horn	Damnak Sokrom commune	Chief
7.	Mr. Am Om	Damnak Sokrom commune	First vice-chief
8.	Mr. Oum Stock	Damnak Sokrom commune	Second vice-chief
9.	Mr. Doo Meas	Damnak Sokrom commune	Secretary
10.	Mr. Khim Boun	Ang Ropak village	Chief
11.	Mr. Prak Sy	Krang Sbov commune	Chief
12.	Mr. Hing Pheng	Krang Sbov commune	First vice-chief
13.	Mr. Uy Sophath	Krang Sbov commune	Secretary
14.	Mr. Chum Rin	Krang Sbov commune	Chief
15.	Mr. Moeun Sao	Chor Dom village	Chief
16.	Ouk Noun	Krang Snay commune	Chief

Appendix 4 Continue

No.	Full name	Commune/Village	Position
17.	Mr. In Oun	Krang Snay commune	First vice-chief
18.	Mr. Ouk Kring	Krang Snay commune	Second vice-chief
19.	Mr. Seng Sopich	Krang Snay commune	Secretary
20.	Mr. In Konn	Lve village	Chief
°	Village meeting		
21.	Mr. Long Oeun	Damnak Trop KC village	Chief
22.	Mr. Long Eav	Damnak Trop KC village	Farmer
23.	Mr. Suth Tarb	Damnak Trop KC village	Farmer
24.	Mr. Im Phearith	Damnak Trop KC village	Farmer
25.	Ms. Kong Samorn	Damnak Trop KC village	Farmer
C. Prey Veng province			
•	Commune meeting		
1.	Mr. Nob Chith	Boeng Preah commune	Chief
2.	Mr. Khin Chhorn	Boeng Preah commune	First vice-chief
3.	Mr. Bun Saovin	Angkrorng village	Chief
4.	Mr. Hin Nov	Svay Tan village	Elder
5.	Mr. Lao Tun	Ta Chey village	Chief
6.	Mr. Oub Searth	Chea Khlang commune	Chief
7.	Mr. Phin Suong	Chea Khlang commune	Commune council
8.	Mr. Yoeun Seang	Chkairkorn village	Chief
9.	Mr. Yin Hearng	Chea Khlang commune	Second vice-chief
10.	Mr. Pheng Vy	Chea Khlang village	Fish seed producer
11.	Mr. Seng Ny	Chea Khlang commune	Commune council
12.	Mr. Oub Searn	Thnong village	Chief
13.	Mr. Earn An	Chea Khlang commune	Commune council
14.	Mr. Suon Sophaneth	Chea Khlang commune	Secretary
15.	Ms. Seak Kheng	Chea Khlang commune	First vice-chief
16.	Sin Sunheng	Chea Khlang village	Chief
17.	Lim Sophal	Chres village	Chief
18.	Mr. Chap Youk	Chrey commune	Chief
19.	Mr. Chey Ham	Chrey commune	First vice-chief
20.	Mr. Khan Pheach	Chrey commune	Commune council
21.	Mr. Hem Sam Onn	Chrey commune	Commune council
22.	Mr. Tik Savin	Chrey commune	Secretary
23.	Mr. Sou Sam	Traok village	Chief
24.	Mr. Porl Phath	Phnov village	Chief
25.	Mr. Puth Choeung	Chrey village	Chief
26.	Mr. Pen Harn	Chambok village	Chief
27.	Mr. San Chan	Samrong village	Chief
28.	Mr. Meas Rom	Svaypak village	Chief
29.	Mr. Nuon Un	Doung village	Chief
30.	Mr. Mei Rarn	Trapeang Re village	Chief
31.	Mr. Yim Sophal	Lvea commune	Chief
32.	Mr. Sor Chom	Lvea commune	Commune council
33.	Mr. Nov Ham	Khom village	Chief
34.	Mr. Ean Sak	Lvea commune	Fish seed producer
35.	Mr. Roth Karn	Lvea commune	Commune council

Appendix 4 Continue

No.	Full name	Commune/Village	Position
• Village meeting			
1.	Mr. Sor Chan	Samrong village	Chief
2.	Mr. Va Ear	Samrong village	Elder
3.	Mr. Sok Sem	Samrong village	Elder
4.	Mr. Ngin Los	Samrong village	Elder
5.	Mr. Mam Nhor	Samrong village	Elder
6.	Mr. Chap Youk	Chrey commune	Chief
D. Takeo province			
• Commune meeting			
1.	Mr. Noug Chorn	Angk Prasath commune	Chief
2.	Mr. Ong Soeun	Angk Prasath commune	Commune council
3.	Mr. Seng Loun	Phnom Rontas village	Chief
4.	Mr. Porn Toun	Phnom Rontas village	Elder
5.	Mr. Lay Touch	Angk Prasath commune	Secretary
6.	Mr. Prum Ngoo	Ponley commune	Chief
7.	Miss Say Heang	Ponley commune	Secretary
8.	Mr. Yim Khim	Ponley KC village	Chief
9.	Mr. Taing Keav	Ponley KT village	Chief
10.	Mr. Chhoeung Neng	Sra Mok village	Chief
11.	Mr. Chhay Nheng	Trapeang Thum KC commune	Chief
12.	Mr. Riel Sorn	Trapeang Thum KC commune	First vice-chief
13.	Mr. Touch Chip	Ta Suon village	Chief
14.	Mr. Nun Norm	Trapeang Svay village	Chief
15.	Mr. Ouch Hoeun	Trapeang Thum KT commune	Chief
16.	Mr. Ping Mal	Trapeang Khorn village	Elder
17.	Mr. Yuos Hoeun	Trapeang Thum KT commune	Commune council
18.	Mr. Touch Koeun	Trapeang Thum KT commune	First vice-chief
19.	Mr. Ouch Phao	Trapeang Thum KT commune	Third vice-chief
20.	Mrs. Ouk Chanthy	Trapeang Thum KT commune	Secretary
• Village meeting			
1.	Mr. Mouth Hun	Prey Kduoch village	Chief
2.	Mr. Cheap Neang	Trapeang Kranhung commune	Chief
3.	Mr. Keo Sok	Trapeang Kranhung commune	Commune council
4.	Mr. Hun Oun	Prey Kduoch village	Elder
5.	Mr. Sman Theun	Trapeang Kranhung commune	Commune council

Appendix 5 Questionnaire survey format for individual farmer's interview

Questionnaire for Aquaculture Farmers

Freshwater Aquaculture Improvement and Extension Project in Cambodia

Date:

Interviewer:

I. GENERAL INFORMATION

1. Name of farmer:_____Age_____Sex

2. Address

Village :
Commune :
District :
Province :

3. Farmer's occupation

Main :
Secondary :
Tertiary :
Other

4. Educational attainment of farmer

a. None	b. Primary not completed	c. Primary school
d. Lower secondary	e. Secondary/Diploma	f. Vocational training
g. College/University	h. Other (specify)	

5. Are you a member of a farmers' group? a. Yes b. No

If "Yes", please answer the following questions.

5.1. What is the name of the group? :

5.2. Who are the members of the group?

a. Family members	b. Relatives	c. Fish farmers
d. Employees	e. Businessmen	f. Government officials
g. Other (Specify)		

5.3. Membership of the group: male____and female____(total____members)

5.4. Main activity of the group:

II. HOUSEHOLD ECONOMY

6. Household members including yourself who *are living in the same household*

	Name	Relationship with Household Head	Age	Sex	Main Occupation (Grade in case of student)	Health Condition
1	Household Head					
2						
3						
4						
5						
6						
7						
8						
9						
10						

Sex: a. Male; b. Female and Health condition: a. Good; b. Fair; c. Poor

7. Source of household income (in case of remittance, please specify the person who remits)

Income source	Average income per year (Riel)
Rice cultivation	
Animal husbandry	
Vegetable cultivation	
Fish culture	
Worker	
Remittance	

8. Main source of power (light)

- a. City power
- b. Generator
- c. Kerosene
- d. Candle
- e. Battery
- f. Other (Specify)

9. Main source of drinking water

- (1) Wet season :

a. Piped water

b. Tube / Pipe well

c. Dug well

d. Rain

e. Pond

f. Spring, River, Stream, Lake

g. Bought

h. Other (Specify)
- (2) Dry season :

a. Piped water

b. Tube / Pipe well

c. Dug well

d. Rain

e. Pond

f. Spring, River, Stream, Lake

g. Bought

h. Other (Specify)

10. Main cooking fuel

- a. Firewood
- b. Charcoal
- c. Kerosene
- d. Liquefied Petroleum Gas (LPG)
- e. Electricity
- f. Other (Specify)

11. Toilet facility within premises

- a. Available
- b. Not available

12. Detail of land holding

12.1. Does your family own land? a. Yes b.No

If "Yes, please answer the following questions.

12.1.1. Land area

Total land area (ha)	Area of paddy	Area of homestead	Area of vegetable
----------------------	---------------	-------------------	-------------------

--	--	--	--

12.1.2. In how many places paddy field is located?

12.1.3. What is the maximum and minimum distance from the house to the paddy field?

Maximum	m
Minimum	m

12.1.4. Is there any unused land? a. Yes b. No

12.1.5. If "Yes" to the above question 12.1.4., what is the reason?

13. Detail of the house

13.1. Does your family own house? a. Yes b. No

13.2. Type of the house

(1) Roof : a. Tile b. Iron c. Bamboo d. Thatch e. Other (Specify)

(2) Wall : a. Cement b. Iron c. Brick d. Wood e. Bamboo f. Thatch
g. Mud h. Other (Specify)

(3) Floor : a. Cement b. Brick c. Wood d. Bamboo e. Thatch
f. Mud g. Other (Specify)

14. Household goods (Endurance consumption material and Equipment used for economic activities)

- | | | |
|---------------|--------------|--------------------|
| a. TV | b. DVD | c. CD/VCD |
| d. Video | e. Radio | f. Cassette player |
| g. Motor bike | h. Bicycle | i. Tractor |
| j. Water pump | k. Gill net | l. Cast net |
| m. Hapa net | n. Fish trap | o. Hook and line |

15. Property

(1) Money savings at bank/cooperative a. Yes b. No

(2) Debt a. Yes b. No

(3) Livestock

	Number	Purpose
a. Water buffalo		
b. Cow		
c. Pig		
d. Goat		
e. Chicken		
f. Duck		

16. Rice consumption and production

16.1. How many kilos of rice does your family consume per year approximately? _____kg

16.2. Do you produce rice? a. Yes b. No

If "Yes", please answer the questions 16.3. to 16.9.

If "No", please proceed to the question 16.10.

For those who produce rice

16.3. How many times do you produce rice per year?

16.4. When is the production season? From _____to

From _____to

16.5. How many tons of rice do you produce per year?

Maximum	tons/year
Minimum	tons/year

16.6. Do you apply inorganic fertilizers and chemicals/pesticide in producing rice? a. Yes

b. No

If "Yes", please answer the following questions.

16.6.1 When do you apply inorganic fertilizers?_____ (month)

16.6.2. How much quantity of inorganic fertilizers do you apply in a year? (kg)

16.6.3. When do you apply chemicals/pesticide? _____ (month)

16.6.4. How much quantity of chemicals/pesticide do you apply in a year?_____ (l)

16.7. What is the main purpose of rice production?

- a. for family consumption b. for selling c. both for consumption and selling**

16.8. If you produce rice for family consumption, is the harvest enough for your family to consume in a year? a. Yes b. No

16.8.1. If "No", how much money does your family spend for buying rice per year?

Minimum	Riel/year
Maximum	Riel/year

16.9. If you produce rice for selling, how much is the selling price?

Minimum	Riel/kg
Maximum	Riel/kg

For those who do not produce rice

16.10. How much money does your family spend for buying rice per year?_____Riel

17. Fish consumption and source

17.1. Approximate intake of animal/fish meat of your family

	Wet season	Dry season
Meat (beef, pork, chicken, eggs, etc)	%	%
Fish (fresh fish, dried fish, etc)	%	%
Total	100%	100%

17.2. How many kilos offish does your family consume per day approximately?

Wet season	kg/day (wild fish, cultured fish or bought fish)
Dry season	kg/day (wild fish, cultured fish or bought fish)

17.3. Do you fish? a. Yes b. No

If "Yes", please answer the questions 17.4. to 17.13.

If "No", please proceed to the questions 17.14. and 17.15.

For those who fish

17.4. When is the fishing season? Wet season From _____ to _____

Dry season **From** **to**

17.5. How often per week do you fish during the season? Wet season_____ **times per week**

Dry season	times per week
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

17.6. Where do you go for fishing?

- a. just in the village b. to a nearby village
c. to the other commune d. to the other district

17.7. Where do you fish?

- a. my trap pond b. river c. stream
d. spring e. lake f. other (specify)

17.8. If you fish in your trap pond, please answer the following questions.

17.8.1. Size and the number of the ponds

Trap pond	Dimension (m)			Area (m ²)
	Length	Width	Depth	
Trap pond 1				
Trap pond 2				
Trap pond 3				

17.8.2. What kind of species do you fish in the trap pond(s) and how many kilos do you harvest in a year approximately? Dry season?

Species	Harvest year (Kg)

17.9. If you fish in the places other than trap pond, where and what kind of species do you fish and how many kilos do you harvest in a year approximately?

Season	Place	Species	Harvest in a year (Kg)
Wet season			
Dry season			

17.10. Is there any fish refuge pond in your village? a. Yes b. No

If "Yes", please answer the following questions.

17.10.1. Do you benefit from the fish refuge pond? a. Yes b. No

17.10.2 Who manages the fish refuge pond?

17.10.3. Rules and regulations on the fish refuge pond, if you know

17.11. What is the main purpose of fishing?

- a. for family consumption b. for selling c. both for consumption and selling

17.12. If you fish for family consumption, is the fish catch enough for your family to consume in a year? a. Yes b. No

If "No", please answer the following questions.

17.12.1. How often does your family buy fish from market?

Wet season	a. regularly	b. occasionally	c. Never
Dry season	a. regularly	b. occasionally	c. Never

17.12.2. How much money does your family spend for buying fish per month?

Wet season	Riel/month
Dry season	Riel/month

17.13. If you fish for selling, how much is the selling price?

Wet season	Riel/kg
Dry season	Riel/kg

For those who do not fish

17.14. How often does your family buy fish from market?

Wet season	a. regularly	b. occasionally	c. Never
Dry season	a. regularly	b. occasionally	c. Never

17.15. How much money does your family spend for buying fish per month?

Wet season	Riel/month
Dry season	Riel/month

18. Do you have any pond within premises? a. Yes b. No

If 'Yes', please answer the following questions.

18.1. How many ponds do you have? _____ ponds

18.2. Please answer for each pond.

	Dimension (m)			Area (m ²)	Purpose of Construction (history)	Assisted by	Purpose of Present Use
	L	W	D				
Pond 1							
Pond 2							
Pond 3							
Pond 4							
Pond 5							

18.3. Are you going to use the pond(s) for culturing fish which at this moment you do not use for aquaculture? a. Yes b. No

18.3.1. If "Yes", for what purpose?

- | | |
|-------------------------------------|----------------------------------|
| a. mainly for family consumption | b. mainly for selling |
| c. both for consumption and selling | d. only if excess desire to sell |

18.3.2. If "No", why?

- | | |
|--|------------------------------|
| a. keep pond water for present purpose | b. lack of labor |
| c. lack of technology | d. lack of money to buy seed |
| e. other (specify) | |

III. EXPERIENCE OF AQUACULTURE

19. When did you start aquaculture activity? Since

20. Why did you start the activity?

- | | |
|----------------------------------|----------------------------------|
| a. Mainly for family consumption | b. Mainly for marketing |
| c. For consumption and selling | d. Only if excess desire to sell |
| c. Other (specify) | |

21. What is your experience in aquaculture?

- | | | |
|----------------------------------|------------------------|-------------------------|
| a. Breeding/Hatching (____years) | b. Nursing (____years) | c. Grow-out (____years) |
|----------------------------------|------------------------|-------------------------|

22. Have you ever attended training program on aquaculture? a. Yes b. No

22.1. If "Yes", please fill in the blanks.

Year	Training duration (days)	Program organizer	Topic of Training				
			Seed production technique	Grow-out technique	Business management	Marketing	Other (specify)

23. Have you ever been provided with materials for aquaculture activity? a. Yes b. No

23.1. If "Yes", please fill in the blanks.

Year	Materials	Provider	Present status (used or not)

24. Have you ever received extension service/program on aquaculture? a. Yes b. No

24.1. If "Yes", from which organization?

- a. Local fisheries agency b. Fish farmer group c. Seed producer
d. Aquaculture farmer e. Donors/NGOs (specify)
f. Other (specify)

24.2. If "Yes", how often?

- a. Less than 3 times per year b. 3 - 6 times per year c. 7 - 9 times per year
d. 10-12 times per year e. more than 12 times per year

25. What is your current aquaculture activity?

- a. Breeding/ Hatching b. Nursing c. Grow-out

26. What kind of culture system do you adopt for grow-out?

- a. Earthen pond system b. Rice-cum-fish culture system

27. Do you have production record book?

- a. Yes b. No

27.1. If "Yes", what kind of information do you keep in the book?

- a. b.
c. d.
e. f.

28. Do you use labor in your present aquaculture activity?

- a. Yes b. No

28.1. If "Yes", who helps you in the activity?

- a. paid labor b. family member(s) c. relative(s)
d. fish farmer group members e. other (specify)

29. Do you want to continue your aquaculture activity?

- a. Yes, at the present scale b. Yes, at the more expanded scale
c. Yes, but at reduced scale d. No, I want to stop the activity

30. Please briefly explain the reason for the above answer.

For those who adopt Earthen Pond System, please proceed to 31. Grow-out with Earthen Pond System.

For those who adopt Rice-cum-Fish Culture System, please proceed to 32. Grow-out with Rice-cum-Fish Culture System.

IV. CULTURE SYSTEM

31. Grow-out with Earthen Pond System

31.1. How many ponds do you have for grow-out?_____ponds

31.2. Please answer for each pond you have.

	Dimension (m)			Area (m ²)	How to dig (a.,b,c	Year of completion	Cost of Digging (Riel)	Status (Own or Rent)
	L	W	D					
Pond 1								
Pond 2								
Pond 3								
Pond 4								
Pond 5								

*) a. by using machine b. by hiring labor (manual) c. family members (manual): Husband %
Wife% Son/daughter%

31.3. When are you engaged in the activity?

- a. throughout a year b. only when water is available (from____to____)

31.4. How do you fill the pond with water?

- a. waiting for rain b. using pump c. other (specify)

31.5. If you answer "a" to the question 31.4., please answer the following questions.

31.5.1. Average water level of the pond

- (1) Wet season: (maximum)_____m
(2) Dry season: (minimum)_____m

31.5.2. Is the water in the pond enough for the activity?

- (1) Wet season : a. extremely not enough b. not enough c. enough d. more than enough
(2) Dry season : a. extremely not enough b. not enough c. enough d. more than enough

31.6. If you answer "b" to the question 31.4., please answer the following questions.

31.6.1. Where is the water source?

- a. spring b. river c. irrigation canal
d. other (specify)

31.6.2. Is the water source available throughout a year?

- a. Yes. Normally available.
b. No. Available only from_____to_____(month)

31.6.3. How much is the cost for pumping water?

- a. completely free of charge b._____Riel

31.7. How do you drain water from the pond?

- a. waiting for dry season b. using pump c. using drain
d. other (specify)

31.8. Water retention of the pond and soil type (Clay, clay-sand, sand, mixture,....)

- a. good b. fair c. bad

31.9. Water condition

- a. fertile b. not fertile c. polluted (explain_____)
d. no idea

31.10. Water quality

- a. acid b. alkaline c. no idea

31.11. Species produced

	Species	No. of production cycles per year	Ave volume, of production per cycle (Kg)	Rearing period (days)	Purpose of production (a., b., or c .*)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

* a. mainly for family consumption b. mainly for selling c. for consumption and selling

31.12. If you produce several species, do you produce them in poly-culture? a. Yes b. No

31.12.1. If "Yes", which species do you produce in poly-culture?

31.13. If you produce for selling, please fill in the following blanks.

	Species	Processed or not	Destination	Size in selling (fresh) (cm or g)	Selling price per Kg (Riel)	Average income per cycle (Riel)
(1)	Silver barb	fresh				
		dried				
		smoked				
(2)	Common carp	fresh				
		dried				
		smoked				
(3)	Silver carp	fresh				
		dried				
		smoked				
(4)	Tilapia	fresh				
		dried				
		smoked				
(5)	Mrigal	fresh				
		dried				
		smoked				
(6)	Pangasius catfish	fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				

31.14. Where do you obtain seeds?

	Species	Supplier of seeds	Purchasing price per seed (Riel)	Size of seeds in purchasing (cm)	Average number of purchase per cycle (seed)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

31.15. When you get seeds, how do you get them?

- a. Suppliers come to my place to sell seeds. Who buy fish seed:
b. I go to the supplier to buy seeds. Who buy fish seed:

31.16. Do you feed fish?

- a. Yes b. completely no

If "Yes", please answer the following questions.

31.16.1. How often do you feed fish per day or per week? ____per day or ____per week

31.16.2. What kind of feed do you give?

- a. commercial feed b. rice bran c. kitchen waste
d. vegetable waste e. other (specify)

31.16.3. If you buy feed, please fill in the following blanks.

Item	Supplier	Price per Kg (Riel)

31.17. Do you fertilize the pond?

- a. Yes b. No

If "Yes", please answer the following questions.

31.17.1. What kind of fertilizer do you use?

- a. commercial fertilizer b. chicken droppings c. cow dung d. pig dung
e. green manure f. other (specify)

31.17.2. If you buy fertilizer, please fill in the following blanks.

Item	Supplier	Price per Kg (Riel)

31.18. Division of labor

	Labor	Family/Relatives			Hiring labor		
		Husband %	Wife %	Son/daughter %	Only men	Only women	Both
(1)	Pond drying						
(2)	Pond rehabilitation						
(3)	Filling pond						
(4)	Liming						
(5)	Fertilizing						
(6)	Water conditioning						
(7)	Stocking						

(8)	Feeding						
(9)	Disease control/pond management						
(10)	Partially harvesting						
(11)	Totally harvesting						
(12)	Processing (dry, smoke)						
(13)	Selling						

31.19. If you hire labor, how much do you pay per day?

(1) Male labor : _____ Riel (type of labor: _____)

(2) Female labor : _____ Riel (type of labor: _____)

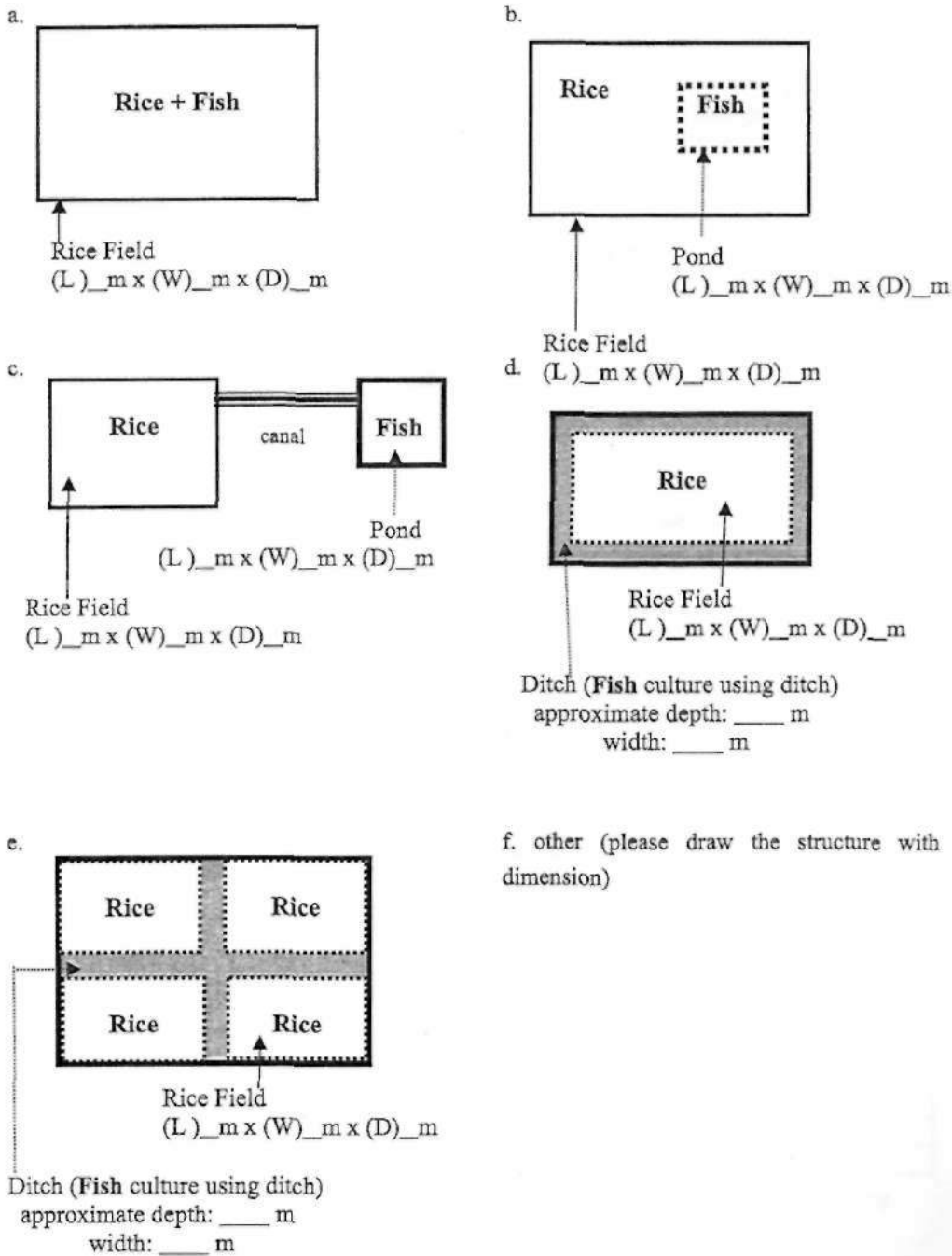
31.20. What are the major technical constraints in your aquaculture activity?

31.21. What are the major financial constraints in your aquaculture activity?

Thank you very much for your cooperation.

32. Grow-out with Rice-cum-Fish Culture System

32.1. Adopting system and dimension



Those who chose "a." in the question 32.1.. please answer the following questions.

32.2. When are you engaged in the activity?

- a. throughout a year b. only when water is available (from ____ to ____)

32.3. How do you get water for the activity?

- a. waiting for rain b. using pump c. other (specify)

32.4. If you answer "a" to the question 32.3., please answer the following questions.

32.4.1. Average water level

(1) Wet season : _____cm

(2) Dry season : _____cm

32.4.2. Is the water enough for the activity?

(1) Wet season : a. extremely not enough b. not enough c. enough d. more than enough

(2) Dry season : a. extremely not enough b. not enough c. enough d. more than enough

32.5. If you answer "b" to the question 32.3., please answer the following questions.

32.5.1. Where is the water source?

a. spring b. river c. irrigation canal

d. other (specify)

32.5.2. Is the water source available throughout a year?

a. Yes. Normally available.

b. No. Available only from _____ to _____ (month)

32.5.3. How much is the cost for pumping water?

a. completely free of charge b. _____Riel

32.6. How do you drain water?

a. waiting for dry season b. using pump c. using drain

d. other (specify)

32.7. Water retention (Clay, clay-sand, sand, mixture,...)

a. good b. fair c. bad

32.8. Water condition

a. fertile b. not fertile c. polluted (explain _____)

d. no idea

32.9. Water quality

a. acid b. alkaline c. no idea

32.10. Species produced

	Species	No. of production cycles per year	Ave volume, of production per cycle (Kg)	Rearing period (days)	Purpose of production (a.,b., or c.)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

a. mainly for family consumption b. mainly for selling c. for consumption and selling

32.11. If you produce several species, do you produce them in poly-culture? a. Yes b. No

32.11.1. If "Yes", which species do you produce in poly-culture?

32.12. If you produce for selling, please fill in the following blanks.

	Species	Processed or not	Destination	Size in selling (fresh) (cm or g)	Selling price per Kg (Riel)	Average income per cycle (Riel)

(1)	Silver barb	fresh				
		dried				
		smoked				
(2)	Common carp	fresh				
		dried				
		smoked				
(3)	Silver carp	fresh				
		dried				
		smoked				
(4)	Tilapia	fresh				
		dried				
		smoked				
(5)	Mrigal	fresh				
		dried				
		smoked				
(6)	Pangasius catfish	fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				

32.13. Where do you obtain seeds?

	Species	Supplier of seeds	Purchasing price per seed (Riel)	Size of seeds in purchasing (cm)	Average number of purchase per cycle (seed)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

32.14. When you get seeds, how do you get them?

- Suppliers come to my place to sell seeds.
- I go to the supplier to buy seeds.

32.15. Do you feed fish?

- Yes
- completely no

If "Yes", please answer the following questions.

32.15.1. How often do you feed fish per day or per week? ____per day or ____per week

32.15.2. What kind of feed do you give?

- a. commercial feed b. nee bran c. kitchen waste
d. vegetable waste e. other (specify)

32.15.3. If you buy feed, please fill in the following blanks.

Item	Supplier	Price per Kg (Riel)

32.16. Do you fertilize the rice field for the activity? a. Yes b. No

If "Yes", please answer the following questions.

32.16.1. What kind of fertilizer do you use?

- a. commercial fertilizer b. chicken droppings c. cow dung d. pig dung
e. green manure f. other (specify)

32.16.2. If you buy fertilizer, please fill in the following blanks.

Item	Supplier	Price per Kg (Riel)

32.17. Division of labor

	Labor	Family/Relatives			Hiring labor		
		Husband %	Wife %	Children %	Only men	Only women	Both
(1)	Rice field drying						
(2)	Rice field rehabilitation						
(3)	Filling rice field						
(4)	Liming						
(5)	Fertilizing						
(6)	Water conditioning						
(7)	Stocking						
(8)	Feeding						
(9)	Disease control/rice field management						
(10)	Partially harvesting						
(11)	Totally harvesting						
(12)	Processing (dry, smoke)						
(13)	Selling						

32.18. If you hire labor, how much do you pay per day?

- (1) Male labor : _____ Riel (Labor type:)
(2) Female labor : _____ Riel (Labor type:)

32.19. What are the major technical constraints in your aquaculture activity?

32.20. What are the major financial constraints in your aquaculture activity?

Thank you very much for your cooperation

Those who chose "b." or "c." in the question 32.1., please answer the following questions.

32.21. How did you dig the pond?

- a. by using machine b. by hiring labor (manual) c. by myself (manual)

32.22. How much did you pay for digging? _____ Riel

32.23. When are you engaged in the activity?

- a. throughout a year b. only when water is available (from _____ to _____)

32.24. How do you get water for the activity?

- a. waiting for rain b. using pump c. other (specify)

32.25. If you answer "a" to the question 32.24., please answer the following questions.

32.25.1. Average water level of the pond

(1) Wet season : _____ m

(2) Dry season : _____ m

32.25.2. Is the water enough for the activity?

- (1) Wet season : a. extremely not enough b. not enough c. enough d. more than enough
(2) Dry season : a. extremely not enough b. not enough c. enough d. more than enough

32.26. If you answer "b" to the question 32.24., please answer the following questions.

32.26.1. Where is the water source?

- a. spring b. river c. irrigation canal
d. other (specify)

32.26.2. Is the water source available throughout a year?

- a. Yes. Normally available.
b. No. Available only from _____ to _____ (month)

32.26.3. How much is the cost for pumping water?

- a. completely free of charge b. _____ Riel

32.27. How do you drain water?

- a. waiting for dry season b. using pump c. using drain
d. other (specify)

32.28. Water retention (Clay, clay-sand, sand, mixture,...)

- a. good b. fair c. bad

32.29. Water condition

- a. fertile b. not fertile c. polluted (explain _____)
d. no idea

32.30. Water quality

- a. acid b. alkaline c. no idea

32.31. Species produced

	Species	No. of production cycles per year	Ave volume, of production per cycle (Kg)	Rearing period (days)	Purpose of production (a.,b.,or c.*)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

* a. mainly for family consumption b. mainly for selling c. for consumption and selling

32.32. If you produce several species, do you produce them in poly-culture? a. Yes b. No

32.32.1. If "Yes", which species do you produce in poly-culture?

32.33. If you produce for selling, please fill in the following blanks.

	Species	Processed or not	Destination	Size in selling (fresh) (cm or g)	Selling price per Kg (Riel)	Average income per cycle (Riel)
(1)	Silver barb	fresh				
		dried				
		smoked				
(2)	Common carp	fresh				
		dried				
		smoked				
(3)	Silver carp	fresh				
		dried				
		smoked				
(4)	Tilapia	fresh				
		dried				
		smoked				
(5)	Mrigal	fresh				
		dried				
		smoked				
(6)	Pangasius catfish	fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				

32.34. Where do you obtain seeds?

	Species	Supplier of seeds	Purchasing price per seed (Riel)	Size of seeds in purchasing (cm)	Average number of purchase per cycle (seed)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

32.40. What are the major technical constraints in your aquaculture activity?

32.41. What are the major financial constraints in your aquaculture activity?

Thank you very much for your cooperation

Those who chose "d." or "e", in the question 32.1., please answer the following questions.

- 32.42. How did you dig the ditch in the rice field?
a. by using machine b. by hiring labor (manual) c. by myself (manual)
- 32.43. How much did you pay for digging? _____ Riel
- 32.44. When are you engaged in the activity?
a. throughout a year b. only when water is available (from ____ to ____)
- 32.45. How do you get water for the activity?
a. waiting for rain b. using pump c. other (specify)
- 32.46. If you answer "a" to the question 32.45., please answer the following questions.
- 32.46.1. Average water level of the ditch
(1) Wet season : _____ cm
(2) Dry season : _____ cm
- 32.46.2. Is the water enough for the activity?
(1) Wet season : a. extremely not enough b. not enough c. enough d. more than enough
(2) Dry season : a. extremely not enough b. not enough c. enough d. more than enough
- 32.47. If you answer "b" to the question 32.45., please answer the following questions.
- 32.47.1. Where is the water source?
a. spring b. river c. irrigation canal
d. other (specify)
- 32.47.2. Is the water source available throughout a year?
a. Yes. Normally available.
b. No. Available only from _____ to _____ (month)
- 32.47.3. How much is the cost for pumping water?
a. completely free of charge b. _____ Riel
- 32.48. How do you drain water?
a. waiting for dry season b. using pump c. using drain
d. other (specify)
- 32.49. Water retention (Clay, clay-sand, sand, mixture,...)
a. good b. fair c. bad
- 32.50. Water condition
a. fertile b. not fertile c. polluted (explain _____)
d. no idea
- 32.51. Water quality
a. acid b. alkaline c. no idea
- 32.52. Species produced

	Species	No. of production cycles per year	Ave volume, of production per cycle (Kg)	Rearing period (days)	Purpose of production (a., b., or c. *)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

* a. mainly for family consumption b. mainly for selling c. for consumption and selling

32.53. If you produce several species, do you produce them in poly-culture? a. Yes b. No

32.53.1. If "Yes", which species do you produce in poly-culture?

32.54. If you produce for selling, please fill in the following blanks.

	Species	Processed or not	Destination	Size in selling (fresh) (cm or g)	Selling price per Kg (Riel)	Average income per cycle (Riel)
(1)	Silver barb	fresh				
		dried				
		smoked				
(2)	Common carp	fresh				
		dried				
		smoked				
(3)	Silver carp	fresh				
		dried				
		smoked				
(4)	Tilapia	fresh				
		dried				
		smoked				
(5)	Mrigal	fresh				
		dried				
		smoked				
(6)	Pangasius catfish	fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				
		fresh				
		dried				
		smoked				

32.55. Where do you obtain seeds?

	Species	Supplier of seeds	Purchasing price per seed (Riel)	Size of seeds in purchasing (cm)	Average number of purchase per cycle (seed)
(1)	Silver barb				
(2)	Common carp				
(3)	Silver carp				
(4)	Tilapia				
(5)	Mrigal				
(6)	Pangasius catfish				

- 32.56. When you get seeds, how do you get them?
- a. Suppliers come to my place to sell seeds. Who buy seed?
 - b. I go to the supplier to buy seeds. Who buy seed?

- 32.57. Do you feed fish?
- a. Yes
 - b. completely no

If "Yes", please answer the following questions.

32.57.1. How often do you feed fish per day or per week? _____per day or _____per week

- 32.57.2. What kind of feed do you give?
- a. commercial feed
 - b. rice bran
 - c. kitchen waste
 - d. vegetable waste
 - e. other (specify)

32.57.3. If you buy feed, please fill in the following blanks.

Item	Supplier	Price per Kg (Riel)

- 32.58. Do you fertilize the rice field for the activity? a. Yes b. No

If "Yes", please answer the following questions.

- 32.58.1. What kind of fertilizer do you use?
- a. commercial fertilizer
 - b. chicken droppings
 - c. cow dung
 - d. pig dung
 - e. green manure
 - f. other (specify)

32.58.2. If you buy fertilizer, please fill in the following blanks.

Item	Supplier	Price per Kg (Riel)

32.59. Division of labor

	Labor	Family/Relatives			Hiring labor		
		Husband %	Wife %	Children %	Only men	Only women	Both
(1)	ditch drying						
(2)	Ditch rehabilitation						
(3)	Filling ditch						
(4)	Liming						
(5)	Fertilizing						
(6)	Water conditioning						
(7)	Stocking						
(8)	Feeding						
(9)	Disease control/ditch management						
(10)	Partially harvesting						
(11)	Totally harvesting						
(12)	Processing (dry, smoke)						
(13)	Selling						

- 32.60. If you hire labor, how much do you pay per day?
- (1) Male labor : _____Riel (Labor type: _____)
 - (2) Female labor : _____Riel (Labor type: _____)

32.61. What are the major technical constraints in your aquaculture activity?

32.62. What are the major financial constraints in your aquaculture activity?

Thank you very much for your cooperation

Questionnaire for Non-Aquaculture Farmers
Freshwater Aquaculture Improvement and Extension Project in Cambodia

Date:
Interviewer:

I. GENERAL INFORMATION

1. Name of farmer: _____ Age _____ Sex _____
2. Address
- Village :
Commune :
District :
Province :
3. Farmer's occupation
- Main :
Secondary :
Tertiary :
Other :
4. Educational attainment of farmer
- a. None b. Primary not completed c. Primary school
d. Lower secondary e. Secondary/Diploma f. Vocational training
g. College/University h. Other (specify)
5. Are you a member of a farmers' group? a. Yes b. No
- If "Yes", please answer the following questions.
- 5.1. What is the name of the group? :
- 5.2. Who are the members of the group?
- a. Family members b. Relatives c. Fish farmers
d. Employees e. Businessmen f. Government officials
g. Other (Specify)
- 5.3. Membership of the group: male _____ and female _____ (total _____ members)
- 5.4. Main activity of the group:

II. HOUSEHOLD ECONOMY

6. Household members including yourself who *are living in the same household*

	Name	Relationship with Household Head	Age	Sex	Main Occupation (Grade in case of student)	Health Condition
1	Household Head					
2						
3						

4						
5						
6						
7						
8						
9						
10						

Sex: a. Male; b. Female and Health condition: a. Good; b. Fair; c. Poor

7. Source of household income (in case of remittance, please specify the person who remits)

Income source	Average income per year (Riel)
Rice cultivation	
Animal husbandry	
Vegetable cultivation	
Fish culture	
Worker	
Remittance	

8. Main source of power (light)

- a. City power b. Generator c. Kerosene
d. Candle e. Battery f. Other (Specify)

9. Main source of drinking water

- (1) Wet season : a. Piped water b. Tube / Pipe well c. Dug well
 d. Rain e. Pond f. Spring, River, Stream, Lake
 g. Bought h. Other (Specify)
(2) Dry season : a. Piped water b. Tube / Pipe well c. Dug well
 d. Rain e. Pond f. Spring, River, Stream, Lake
 g. Bought h. Other (Specify)

10. Main cooking fuel

- a. Firewood b. Charcoal c. Kerosene d. Liquefied Petroleum Gas (LPG)
e. Electricity f. Other (Specify)

11. Toilet facility within premises

- a. Available b. Not available

12. Detail of land holding

12.1. Does your family own land? a. Yes b. No

If "Yes, please answer the following questions.

12.1.1. Land area

Total land area (ha)	Area of paddy	Area of homestead	Area of vegetable

12.1.2. In how many places paddy field is located?

12.1.3. What is the maximum and minimum distance from the house to the paddy field?

Maximum	m
Minimum	m

12.1.4. Is there any unused land? a. Yes b. No

12.1.5. If "Yes" to the above question 12.1.4., what is the reason?

13. Detail of the house

13.1. Does your family own house? a. Yes b. No

13.2. Type of the house

- (1) Roof : a. Tile b. Iron c. Bamboo d. Thatch e. Other (Specify)
(2) Wall : a. Cement b. Iron c. Brick d. Wood e. Bamboo f. Thatch
g. Mud h. Other (Specify)
(3) Floor : a. Cement b. Brick c. Wood d. Bamboo e. Thatch
f. Mud g. Other (Specify)

14. Household goods (Endurance consumption material and Equipment used for economic activities)

- | | | |
|---------------|--------------|--------------------|
| a. TV | b. DVD | c. CD/VCD |
| d. Video | e. Radio | f. Cassette player |
| g. Motor bike | h. Bicycle | i. Tractor |
| j. Water pump | k. Gill net | l. Cast net |
| m. Hapa net | n. Fish trap | o. Hook and line |

15. Property

- (1) Money savings at bank/cooperative a. Yes b. No
(2) Debt a. Yes b. No
(3) Livestock

	Number	Purpose
a. Water buffalo		
b. Cow		
c. Pig		
d. Goat		
e. Chicken		
f. Duck		

16. Rice consumption and production

16.1. How many kilos of rice does your family consume per year approximately? ____kg

16.2. Do you produce rice? a. Yes b. No

If "Yes", please answer the questions 16.3. to 16.9.

If "No", please proceed to the question 16.10.

For those who produce rice

16.3. How many times do you produce rice per year?

16.4. When is the production season? . From_____to

From_____to

16.5. How many tons of rice do you produce per year?

Maximum	tons/year
Minimum	tons/year

16.6. Do you apply inorganic fertilizers and chemicals/pesticide in producing rice?

a. Yes b. No

If "Yes", please answer the following questions.

16.6.1 When do you apply inorganic fertilizers?_____(month)

16.6.2. How much quantity of inorganic fertilizers do you apply in a year? (kg)

16.6.3. When do you apply chemicals/pesticide?_____(month)

16.6.4. How much quantity of chemicals/pesticide do you apply in a year?_(l)

16.7. What is the main purpose of rice production?

- a. for family consumption b. for selling c. both for consumption and selling

Trap pond 3				
-------------	--	--	--	--

17.8.2. What kind of species do you fish in the trap pond(s) and how many kilos do you harvest in a year approximately? Dry season?

Species	Harvest year (Kg)

17.9. If you fish in the places other than trap pond, where and what kind of species do you fish and how many kilos do you harvest in a year approximately?

Season	Place	Species	Harvest in a year (Kg)
Wet season			
Dry season			

17.10. Is there any fish refuge pond in your village? a. Yes b. No

If "Yes", please answer the following questions.

17.10.1. Do you benefit from the fish refuge pond? a. Yes b. No

17.10.2 Who manages the fish refuge pond?

17.10.3. Rules and regulations on the fish refuge pond, if you know

17.11. What is the main purpose of fishing?

a. for family consumption b. for selling c. both for consumption and selling

17.12. If you fish for family consumption, is the fish catch enough for your family to consume in a year? a. Yes b. No

If "No", please answer the following questions.

17.12.1. How often does your family buy fish from market?

Wet season	a. regularly	b. occasionally	c. Never
Dry season	a. regularly	b. occasionally	c. Never

17.12.2. How much money does your family spend for buying fish per month?

Wet season	Riel/month
Dry season	Riel/month

17.13. If you fish for selling, how much is the selling price?

Wet season	Riel/kg
Dry season	Riel/kg

For those who do not fish

17.14. How often does your family buy fish from market?

Wet season	a. regularly	b. occasionally	c. Never
Dry season	a. regularly	b. occasionally	c. Never

17.15. How much money does your family spend for buying fish per month?

Wet season	Riel/month
Dry season	Riel/month

18. Do you have any pond within premises? a. Yes b. No

If 'Yes', please answer the following questions.

18.1. How many ponds do you have? _____ ponds

18.2. Please answer for each pond.

	Dimension (m)			Area (m ²)	Purpose of Construction (history)	Assisted by	Purpose of Present Use
	L	W	D				
Pond 1							
Pond 2							
Pond 3							
Pond 4							
Pond 5							

18.3. Are you going to use the pond(s) for culturing fish which at this moment you do not use for aquaculture? a. Yes b. No

18.3.1. If "Yes", for what purpose?

- a. mainly for family consumption
- b. mainly for selling
- c. both for consumption and selling
- d. only if excess desire to sell

18.3.2. If "No", why?

- a. keep pond water for present purpose
- b. lack of labor
- c. lack of technology
- d. lack of money to buy seed
- e. other (specify)

III. EXPERIENCE OF AQUACULTURE

19. Have you ever been engaged in aquaculture activity before? a. Yes b. No

If "Yes", please answer the questions 20. to 27.

If "No", please answer the questions 28. to 29.

For those who have been engaged in aquaculture activity before.

20. When were you engaged in the aquaculture activity? From _____ to

21. Why did you start the activity?

- a. Mainly for family consumption
- b. Mainly for marketing
- c. For consumption and selling
- d. Only if excess desire to sell
- e. Other (specify)

22. What was your experience in aquaculture?

- a. Breeding/Hatching (____years)
- b. Nursing (____years)
- c. Grow-out (____years)

23. Have you ever attended training program on aquaculture? a. Yes b. No

23.1. If "Yes", please fill in the blanks.

Year	Training duration (days)	Program organizer	Topic of Training				
			Seed production technique	Grow-out technique	Business management	Marketig	Other (specify)

24. Have you ever been provided with materials for aquaculture activity? a. Yes b. No

24.1. If "Yes", please fill in the blanks.

Year	Materials	Provider

25. Have you ever received extension service/program on aquaculture? a. Yes b. No

25.1. If "Yes", from which organization?

- a. Local fisheries agency b. Fish farmer group c. Seed producer
d. Aquaculture farmer e. Donors/NGOs (specify)
f. Other (specify)

25.2. If "Yes", how often?

- a. Less than 3 times per year b. 3 - 6 times per year c. 7 - 9 times per year
d. 10-12 times per year e. more than 12 times per year

26. Why did you give up the aquaculture activity? Please explain the reason briefly.

27. Are you interested in starting aquaculture activity again if the reason mentioned above is solved?

a. Yes b. No

If "Yes",

27.1. What species do you like to culture?

27.2. What type of aquaculture extension materials do you like?

- a. booklet b. leaflet c. poster
d. narrative video e. other (specify)

If "No",

27.3. What is the reason?

For those who have never been engaged in aquaculture activity.

28. Why you have never been engaged in aquaculture activity? Please explain the reason briefly.

29. Are you interested in starting aquaculture activity if the reason mentioned above is solved?

a. Yes b. No

If "Yes",

29.1. What species do you like to culture?

29.2. What type of aquaculture extension materials do you like?

a. booklet

b. leaflet

c. poster

d. narrative video

e. other (specify)

29.3. What kind of effects do you expect from aquaculture activity?

If "No",

29.4. What is the reason?

Thank you very much for your cooperation.

Appendix 6 Questionnaire survey format for key informant group discussion

Commune profile

Commune: C District: B Province: A

I. LOCATION

Map

Province A

District

District B

Commune C

Geographical Condition (including flood situation in wet season):

Transportation Accessibility (Available means of transportation, especially in wet season):

II. GENERAL INFORMATION

Name of the Commune Chief and his/her Term	Industry other than Agriculture:
Total No. of Population: (Male: Female:)	Nutrition Status of the Population:
Total No. of H/Hs: (Male-Headed: Female-Headed:)	
Total No. of Farming H/Hs: (Male-Headed: Female-Headed:)	Main Source of Animal Protein Wet Season: Dry Season:
Total No. of Landless H/Hs: (Male-Headed: Female-Headed:)	
No. of Farmers' Groups: Main Activity:	Total No. or Area of Ponds (including trap ponds) Private : Community (Public) : Pagoda :

Rice Production Season (month): from (planting) to (harvesting)	No. of Trap Ponds:
	Average Size of Trap Pond:
Use of Chemicals/Pesticide for Rice Production When: What Kind: Amount:	Major Fish Species Caught in Trap Ponds:
	Productivity of Trap Ponds:

III. FRESHWATER AQUACULTURE

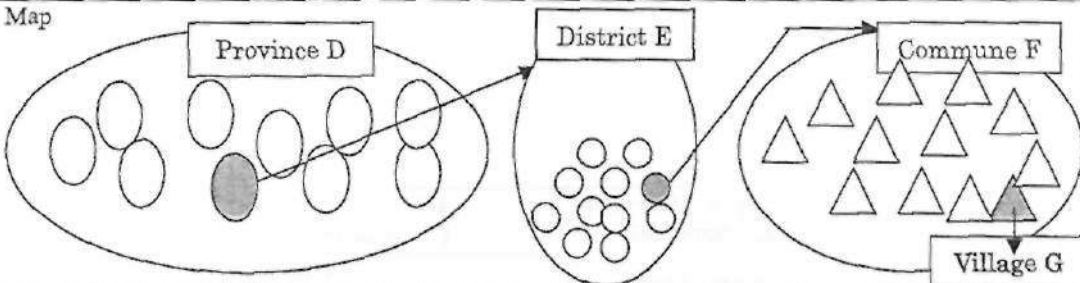
How aquaculture started in the commune?	
Total No. of Aquaculture H/Hs: H/Hs (Male-Headed: Female-Headed:)	Major Culture Species Seed Production: Seed Nursery: Grow-Out:
Seed Production: H/Hs (Male-Headed: Female-Headed:)	
Seed Nursery: H/Hs (Male-Headed: Female-Headed:)	
Grow-out with Earthen Ponds System: H/Hs (Male-Headed: Female-Headed:)	Main Source of Seeds by Major Species and their Availability (constant or not):
Grow-out with Rice-cum-Fish Culture System: HHs (Male-Headed: Female-Headed:)	
No. or Area of Aquaculture Ponds Private Community (Public) : Pagoda :	Average Price of Seeds by Major Species and their Size:
Aquaculture Season (Month): from to	
Major Water Source for Aquaculture Activity:	Main Destination of Cultured Fish by Major Species:
Water Availability for Aquaculture Activity (extremely enough, enough, short, extremely short)	
	Average Selling Price of Cultured Fish by Major Species Wet Season:

Present Conditions of Fish Refuge Pond Management, if any:	Dry Season:
	Average Market Price of Cultured Fish by Major Species Wet Season:
	Dry Season:
Experience/Present Situation on Fish Disease Outbreak and Predators:	Main Feed Stuff and its Supplier:
	Main Fertilizer and its Supplier:
Present situation/past experience of assistance on freshwater aquaculture development/extension including fish refuge pond management from the government, NGOs and/or donor agencies:	

Village profile

Village: _____G_____ Commune: F District: E Province: _____D

I. LOCATION

	
<p>Geographical Condition (including flood situation in wet season):</p> 	<p>Transportation Accessibility</p> <p>Available means of transportation, especially in wet season:</p>
<p>Season of Inundation and Area</p> <p>Season (month): Beginning _____</p> <p style="padding-left: 100px;">Peak _____</p> <p style="padding-left: 100px;">End _____</p> <p>Area : Maximum _____ m²</p> <p style="padding-left: 40px;">Minimum _____ m²</p>	<p>Accessibility to/from the Project target communes nearby:</p>

II. GENERAL INFORMATION

Name of the Commune Chief and his/her Term	Industry other than Agriculture:
Total No. of Population: (Male: _____ Female: _____)	Nutrition Status of the Population:
Total No. of H/Hs: (Male-Headed: _____ Female-Headed: _____)	Main Source of Animal Protein
Total No. of Farming H/Hs: (Male-Headed: _____ Female-Headed: _____)	Wet Season:
Total No. of Landless H/Hs: (Male-Headed: _____ Female-Headed: _____)	Dry Season:
No. of Farmers' Groups: Main Activity:	Total No. or Area of Ponds (including trap ponds)
	Private:
	Community (Public) :
	Pagoda:
Rice Production Season (month): from _____ (planting)	No. of Trap Ponds:
to _____ (harvesting)	Average Size of Trap Pond:
	Major Fish Species Caught in Trap Ponds:

Use of Chemicals/Pesticide for Rice Production When: What Kind: Amount:	
	Productivity of Trap Ponds:

III. FRESHWATER AQUACULTURE

How aquaculture started in the commune?	
Total No. of Aquaculture H/Hs: H/Hs (Male-Headed: Female-Headed:)	Major Culture Species Seed Production: Seed Nursery: Grow-Out:
Seed Production: H/Hs (Male-Headed: Female-Headed:)	
Seed Nursery: H/Hs (Male-Headed: Female-Headed:)	
Grow-out with Earthen Ponds System: H/Hs (Male-Headed: Female-Headed:)	Main Source of Seeds by Major Species and their Availability (constant or not):
Grow-out with Rice-cum-Fish Cultures (Male-Headed: Female-Headed:)	
No. or Area of Aquaculture Ponds Private Community (Public) : Pagoda :	Average Price of Seeds by Major Species and their Size:
Aquaculture Season (Month): from to	Main Destination of Cultured Fish by Major Species:
Major Water Source for Aquaculture Activity:	
Water Availability for Aquaculture Activity (extremely enough, enough, short, extremely short)	Average Selling Price of Cultured Fish by Major Species Wet Season: Dry Season:
Present Conditions of Fish Refuge Pond Management, if any:	

	Average Market Price of Cultured Fish by Major Species Wet Season: Dry Season:
Experience/Present Situation on Fish Disease Outbreak and Predators:	Main Feed Stuff and its Supplier:
	Main Fertilizer and its Supplier:
Present situation/past experience of assistance on freshwater aquaculture development/extension including fish refuge pond management from the government, NGOs and/or donor agencies:	