



Study of the Catch and Market Chain of Low Value Fish along Tonle Sap River, Cambodia- Implications for Management of Their Fisheries

A preliminary study

Consultancy Report

For

WorldFish Center's Greater Mekong Region

By

SO Nam¹, LENG Sy Vann¹ & KURA Yumiko²

¹ Inland Fisheries Research and Development Institute, Phnom Penh

² WorldFish Center's Greater Mekong Region, Phnom Penh

Phnom Penh July 2007

Executive Summary

The Tonle Sap dai fishery plays a crucial role in providing seasonal employment opportunities to many rural people and enhancing food and nutrition security of millions of the rural poor, especially towards the end of dry season when fish is scarce and during closed fishing season. The dai fishery yields its highest ever catch of 28,300 tones in 2005-2006, contributing an estimated 9 percent of the total inland catch in Cambodia and generating an estimated 720 million riel (US\$ 176,000) in revenue from license fees. The estimated value of catch was 25.3 billion riel (US\$ 6.2 million), accounting for an estimated 4 percent of the total value of total inland catch in Cambodia. It also employs tens of thousands of rural people and other relevant actors actively involved in the supply and market chain for the trade of Tonle Sap dai low value fish.

To examine the current conditions under which Tonle Sap dai low value fish are caught and marketed, this study assess the catch and market structure of dai low value fish at Tonle Sap landing site, the largest landing site of low value fish in Cambodia. Findings are based on nearly 70 semi-structured interviews carried out with dai operators, traders/middlepersons/collectors, wholesalers, local and international fisheries experts, and government fisheries officials.

A methodology is designed, through extensive literature reviews and consultations with all relevant stakeholders at different levels in the market chain for low value fish trade, followed by testing in the field, and used for this study. The method will hopefully be beneficial for future studies in the future.

The total catch of combined 61 dais is estimated around 18,000 tones in the 2006-07 season, while the average catch of each dai is around 300 tones, varying from 59 tones to 603 tones. More than 95 percent of total dai fish catch is low value or small-sized fish. Of which, the most dominant species is *trey riel* (*Henicorhynchus spp.*, 52%), followed by *trey slak russey* (*Paralaubuca typus*, 20%), *trey khnorng veng* (*Dangila spp.*, 12%), and *trey bandol ampeou* (*Corica laciniata*, 5%). The size of low value fish species is declining, over the past six years, representing a decreasing rate of 5% per year.

Tonle Sap dai low value fish is supplied to both internal (nearly 85%) and external (around 15%) markets to use as human food (84%), and fish and other animal feed (16%).

The market chain for low value fish trade is complex, involving tens of thousands of actors/stakeholders, many different trade routes and methods (e.g. by road and waterway), and many intermediaries (e.g. dai operators, traders, wholesalers, exporters, processing operators, and many others). Most of these intermediaries are in debt to formal or/and informal existing financial/credit systems.

Prices are set at Tonle Sap landing sites through negotiation between dai operators and buyers relying on knowledge of the previous day's fish price and catch, and 'word-of-

mouth' information on prices from other dai operators. Different types of buyers bought low value fish from dai operators with different prices. Over the past ten years, the prices of low value fish and fish products at Tonle Sap land sites gradually increase.

Tonle Sap dai fishery operation business is generally profitable. The average amount of profit earned by each dai operator is Riel 31,097,558 (US\$ 7,678) in 2006-07 fishing season.

In the supply and market chain of Tonle Sap dai low value fish, the intermediaries encounter several major problems: (1) lack of capitals to operate the business, (2) difficulty managing laborers, (3) difficulty recruiting laborers, (4) natural catastrophe (i.e. strong river water flows/currents and waves, and strong winds), (5) plenty of wastes trapped in their dais (i.e. plastic bags and tree stumps); (6) limited spaces for drying fish under the sun, and (7) gangs and poaching.

There are several suggestions/recommendations proposed by the above intermediaries in order to improve as well as stabilize their businesses. Those suggestions include (1) cracking down illegal fishing activities/gears, (2) provision of loans with a low interest rate, (3) protection of fish sanctuaries in Tonle Sap Lake, (4) implementation of dai burden book, and (5) lifting the ban on snakehead culture.

As this is a preliminary or exploratory study, at the end of this research, many applicable research needs and activities are proposed to in-depth analyze marketing structure, fees, costs and constraints, importance and flow, utilization and its impacts, diversity, stocks and dai catching efforts/catchability of low value fish species in Tonle Sap River as well as other rivers and their floodplains in Cambodia. The detailed primary information and data will be useful for developing policy and business decisions concerning the use and management of low value fish species, including trade-offs between aquaculture/animals and human consumption.

Acronyms and Abbreviations

| | |
|--------|---|
| AFTA | ASEAN Free Trade Agreement |
| ASEAN | Association of South East Asia Nations |
| FEVM | Fisheries Ecology, Valuation and Mitigation |
| FiA | Fisheries Administration |
| GDP | Gross Domestic Product |
| IFReDI | Inland Fisheries Research and Development Institute |
| Kg | Kilogram |
| KSFRS | Kandal Stung Fisheries Research Station |
| LVF | Low Value Fish (small-sized fish species) |
| MAFF | Ministry of Agriculture, Forestry and Fisheries |
| MEF | Ministry of Economics and Finance |
| MoC | Ministry of Commerce |
| MRC | Mekong River Commission |
| NGOs | Non-Government Organizations |
| R/Rial | Cambodia currency (Riel 4,050 = US\$ 1) |
| RGC | Royal Government of Cambodia |
| US\$ | US dollars |
| WTO | World Trade Organization |

Khmer words

| | |
|---------------------------|--|
| <i>Dai</i> | Bagnet or stationary trawl |
| <i>Prahok</i> | Fermented low value fish paste |
| <i>Trey bandol ampeou</i> | Small cyprinid (carp, <i>Corica laciniata</i>) |
| <i>Trey khnorng veng</i> | Small cyprinid (carp, <i>Dangila spp.</i>) |
| <i>Trey riel</i> | Small cyprinid (carp, <i>Henicorhynchus spp.</i>) |
| <i>Trey slak russey</i> | Small cyprinid (carp, <i>Paralaubuca typus</i>) |

Acknowledgements

The authors are grateful to WorldFish Center for providing financial support to Inland Fisheries Research and Development Institute (IFReDI) of the Fisheries Administration to conduct this research.

We are grateful to the many people, including dai operators, traders, wholesalers, distributors, low value *prahok* operators and low value fish drying operators, and government officials of the Fisheries Administration (Mr. Chhun Haingtong, Mr. Chhil Phalla, and Mr. Phlong Norin), Kandal Fisheries Office (Mr. Klaing Vanthol, Mr. Keo Pitoo, Mr. Keo Roth, and Mr. Ros Thim), and Phnom Penh Fisheries Office (Mr. Kong Puthearith, Mr. Nun Sophy, Mr. Em Vannarith, Mr. Hut Van Deun, and Mr. Tith Khan) for kindly participating in the interviews and providing field guidance and detailed information about their catch data, business, activities, and legal and regulatory issues. Without their contribution, this research would not have been possible.

We also extend our appreciation to Mr. Eng Tong and Ms. Sim Thavary, our colleagues and fellow researchers at IFReDI, and Miss. Van Pahnith, undergraduate student at Faculty of Aquaculture and Fisheries Science of the Royal University of Agriculture, for their support in field research and data collection.

Last but not least, the authors also thanks Dr. Ashley Halls, coordinator of FEVM Component of the MRC Fisheries Program, and Mr. Ngor Pengby, database manager of the FEVM Component, for kindly providing discussions about the MRC database of Tonle Sap dai landings.

Phnom Penh, July 2007

So Nam¹, Leng Sy Vann¹ & Yumiko Kura²

¹Inland Fisheries Research and Development Institute

²WorldFish Center

Table of Contents

| | |
|---|----|
| Executive Summary..... | 1 |
| Acronyms and Abbreviations | 3 |
| Acknowledgements | 4 |
| 1. Introduction | 6 |
| 2. Objectives | 7 |
| 3. Research Methodology | 8 |
| 3.1 Literature reviews | 8 |
| 3.2 Consultations with fisheries officials and inspectors | 9 |
| 3.3 Pre-testing of methodologies | 9 |
| 3.4 Actual field survey | 9 |
| 4. Management and harvesting regime of dai fishery | 13 |
| 5. Utilization of Tonle Sap dai low value fish..... | 13 |
| 5.1 Annual low value fish catch of each individual dai along Tonle Sap River .. | 13 |
| 5.2 Utilization of Tonle Sap low value fish..... | 18 |
| 6. Market chain for low value fish trade..... | 19 |
| 6.1 Dai fishing operators | 22 |
| 6.2 LVF traders/middlepersons/LVF collectors | 23 |
| 6.3 LVF wholesalers..... | 25 |
| 6.4 Medium/large scale LVF prahok operators | 25 |
| 6.5 Small-scale LVF prahok operators | 26 |
| 6.6 LVF drying operators | 26 |
| 6.7 LVF retailers..... | 27 |
| 6.8 LVF sauce manufacturers..... | 27 |
| 6.9 Fish and animal raising farmers | 27 |
| 6.10 LVF exporters..... | 27 |
| 6.11 CP Cambodia Co. Ltd..... | 27 |
| 6.12 Other actors in the market chain..... | 28 |
| 6.13 Prices of low value fish | 28 |
| 7. Economic analysis of <i>dai</i> fishery | 30 |
| 8. Major problems, future plans and suggestions | 31 |
| 9. Further research needs | 33 |
| 10. Conclusions | 34 |
| References | 36 |
| Annex A Dai operator survey form | 38 |
| Annex B Trader/Middleperson/Collector survey form | 45 |
| Annex C Wholesaler/Distributor survey form..... | 51 |

1. Introduction

Cambodia has adopted free market principles more than a decade ago, and taken significant steps to increase its integration into regional and international markets such as the ASEAN Free Trade Agreement (AFTA) and accession to the World Trade Organization (WTO). In this sense, economic development policies of the Royal Government of Cambodia (RGC) has been increasingly taking into considerations on improving marketing and trade conditions and the investment climate. Recognizing this important approach the Ministry of Commerce (MoC) is promoting a “pro-poor trade” strategy aimed at bringing trade and export opportunities to the rural poor to help reduce poverty. However, for such “pro-poor trade” efforts to succeed, domestic market integration and trade efficiencies will need to be improved, especially within and from rural areas.

Fish has long been critical to all Cambodians. It is a major source of nutritious food in the daily diet, a primary source of income and has strong cultural and religious significance. Freshwater fisheries matter a great deal to the millions of people who live on the banks of the country’s rivers, particularly those living in and around the Tonle Sap Great Lake (So et al., 2006). Cambodians are considered one of the highest per capita consumers of freshwater fish in the world (a recent estimate of 67 kg per person per year from household surveys) (Hortle & Bush, 2006). Fisheries contribute 10 to 12% of the Cambodia’s GDP accounting for 31 percent of the GDP contribution of the primary sector. Since 2000 Cambodian freshwater capture fisheries ranks fourth in the world in terms of total catch (i.e. around 400,000 tons per year). This is considerable as the country is rather small (181,035 km²) and its population is also small (13.6 million in 2005). Actually, with an average 30 kilograms of freshwater fish caught per Cambodian per year, the country has the most intense freshwater fisheries in the world (Baran, 2005).

The bagnet ‘dai’ fishery along Tonle Sap yielded its highest ever catch of 28,300 tones in 2005-2006, contributing an estimated 9 percent of the total inland catch in Cambodia (FiA, 2007) and generating an estimated 720 million riel (US\$ 176,000) in revenue from license fees (Halls et al., 2007). The estimated value of catch was 25.3 billion riel (US\$ 6.2 million), accounting for an estimated 4 percent of the total value of total inland catch in Cambodia. The fishery also plays a crucial role in providing seasonal employment opportunities to many rural people and enhancing food and nutrition security of millions of the rural poor, especially towards the end of dry season when fish is scarce and during closed fishing season.

Freshwater fish are one of the Cambodia’s most traded commodities, particularly at domestic markets – sold live in containers, fresh on ice, and in a wide variety of processed products (i.e. fermented, salted, sauced, smoked, dried and steamed). Recently there have been many existing reports on marketing and trade of freshwater fish and fisheries products in Cambodia, only several of them based on primary data and information (E.g. Rab et al., 2005; Vanna, 2005; Yim & Mckenney, 2003a, b). Rab et al (2005) generated a very broad picture of marketing infrastructure, distribution channel and trade patterns of freshwater fisheries resources in Cambodia, and identified

major constraints to marketing and trade of fish and fish products encountered by different stakeholders. Vanna (2005) independently studied fish markets at three big markets in Phnom Penh, Siem Reap and Sihanouk Ville, with emphasis on the different wholesale and retail outlets in terms of supply of fish, operation as institutions, stakeholders involved, and how these markets provide the needs to different consumer groups. Studying constraints, transaction costs, and market distortions in the export of fish from Tonle Sap Great Lake to Thailand, and quantifying the costs for these constraints and assessing their impacts was conducted Yim & Mckenny (2003a). The second study of Yim & Mckenny (2003b) was to improve current understanding about domestic market structure, and marketing costs and efficiencies for fish trade from Tonle Sap Great Lake to Phnom Penh. All the four studies also made useful policy recommendations for improving fish marketing and trade conditions in order to support government objectives to reduce poverty and increase pro-poor trade. Touch & Todd (2002); Hap & So (2001) and Nao, So & Thor (2001) comprehensively reviewed existing data and information on the fishery sector as a whole, largely based on official and unofficial secondary information. The above authors, from their experiences and observations, also provided many interesting information on general status and issues of fish marketing, trade and fish processing for domestic and international markets. However, these reports lacked scientific basis to be generalized for policy purposes, although they generated many interesting questions regarding proper working of the system as a whole, and could provide useful background data and information for those, particularly the above scientific based studies, to have better designs and methodologies to achieved objectives of their studies.

All the above studies have generated information on marketing structure, trade and processing of overall fish species and most focused on high value fish species. In other words, there has been very limited or no assessment and documentation of market chain and trade of freshwater low-valued or small-sized fish species in Cambodia. Much of what is known is anecdotal. An important issue is whether better understanding about the flow and the utilization/importance of low value fish (LVF) for different purposes (i.e. fish food for human consumption, particularly the poor; direct feed for fish and other animals; and fish/animal meals for fish/animal farm production) can yield a better return for the limited resource. Analysis of market chain, trade and the utilization/importance of LVF and their processed products will allow development of policy recommendations for improving current harvesting and management regime of LVF species in Tonle Sap River in order to utilize this limited resource sustainably.

2. Objectives

In the sense of little information and lack of in-depth analysis of market chain for low value, the so called, small-sized fish trade, the overall objectives of this research are to generate meaningful primary information and data on current status, market chain, and trade of low value fish used as aquaculture and other animal feed, and nutritious food in the daily human diets in Cambodia. This study has important implications for developing policy and business decisions relating to importance, utilization, and management of low value fish, including trade-offs between aquaculture and human consumption.

The specific objectives of the preliminary study are to:

1. collect existing data and literature on trade issues (within Cambodia and cross border), and current harvesting and management practices of low value fish (LVF) in Cambodia;
2. design and test a method for collecting the above information;
3. preliminarily analyze and document information/data on current harvesting and management regime, utilization and marketing and trade of LVF, economic analysis of dai fishery along Tonle Sap River, and problems, future plans and suggestions; and
4. identify needs for further studies and activities.

3. Research Methodology

The design of a methodology is one of the specific objectives of this research. The research methodology developed in this study was used for achieving each of the above specific objectives (Section 2) and will hopefully be beneficial for future researches, which were identified in Section 9 of this study.

The methodology was developed through extensive literature reviews and consultations followed by testing in the field and, during the first study along Tonle Sap River of the Kandal province and Phnom Penh capital, a constant review of the methods being used with a view to refining them and, eventually, standardizing them as far as possible. The study design is detailed and comprehensive in that it takes into account stakeholders at different levels in the market chain for low value fish trade; for instance, marketing of low value fish begins from *dai* fishing grounds up to middlemen, wholesalers, exporters, *prahok* operators, fish drying operators, fish sauce manufacturers, retailers and finally to consumers.

3.1 Literature reviews

The study used secondary information from government and other sources to complement primary data and observations. Literature was extensively reviewed regarding marketing, distribution channels and trade patterns of fish and fish products in Cambodia as well as in the other countries of the Mekong River basin (i.e. Laos, Thailand and Vietnam). In total, twelve reports of fish marketing and trade and many others of capture fishery of low value fish as well as use of low value fish for aquaculture development were reviewed and listed in Section 8: References. Then three semi-open survey questionnaires were drafted for further consultations and reviews with relevant stakeholders.

3.2 Consultations with fisheries officials and inspectors

Several consultations with fisheries officials and inspectors at Kandal and Phnom Penh Fisheries Offices and at District Fisheries Inspection Units of both offices (Table 1) were organized to study the current status of marketing and trade and importance and utilization of low value fish along Tonle Sap River and to identify all relevant stakeholders involved in the market chain for low value fish trade. In addition consultations with the database manager and coordinator of Fisheries Ecology, Valuation and Mitigation Component of the MRC Fisheries Program were also made to understand what kinds of dai fishery catch data have been collected for past twelve years along Tonle Sap River and could be made available for sharing with other interesting researchers. After the above extensive consultations, the questionnaires were reviewed and revised for pre-testing in the field.

3.3 Pre-testing of methodologies

Prior to pre-testing of methodologies and questionnaires in the fields, questionnaires were translated into Khmer and data collectors were trained to understand and familiarize the methodologies and questionnaires. The pre-testing in the field was conducted by all data collectors to interview bagnet ‘dai’ fishing operators, and traders and wholesalers of low value fish (LVF) along Tonle Sap River in order to test the three drafted questionnaires, (1) dai fishing operator survey form, (2) LVF trader survey form, and (3) LVF wholesaler survey form.

As a result of pre-testing of methodologies, a survey methodology was developed that was comfortable for the data collectors to use and that included elements of both formal questionnaires as well as visual methodologies, such as the use of Cambodia map for LVF flow identification, general flow chart of fish marketing for drawing market chain for LVF trade and the use of fish picture cards for species identification (see Annex A, B & C). The actual field survey was preceded by a pre-survey that was intended to see if there were any additional factors that would need to be accounted for in the full survey and to identify the respondent groups who would provide the information. During the pre-survey criteria were developed that could be used at each site (See details below), with assistance of district fisheries inspectors, to identify suitable dai fishers and LVF traders and help ensure that the information that they were able to provide covered an adequate time period and geographical area.

3.4 Actual field survey

Research for this study focused on both dai harvesting regime and marketing and trade of low value, a so called, small-sized fish along the Tonle Sap River in Kandal province (i.e. Poun Nhealeu district) and Phnom Penh (i.e. Russey Keo district) (Fig. 1). Using the developed questionnaires, Nearly 70 semi-structured interviews were conducted at landing sites along the Tonle Sap River in Poun Nhealeu district (Kandal province) and Russey Keo district (Phnom Penh) (Table 1). Although the focus was on collecting

| | | | | | | |
|--|-----------------|----|--------|------------|-----|------------|
| 17. | Chin San | 50 | Female | 012663615 | 10D | Kandal |
| 18. | Nuan Kring | 54 | Male | 012638142 | 11A | Kandal |
| 19. | Van Da | 41 | Male | 012443843 | 11C | Kandal |
| 20. | Kong Huy | 58 | Male | 012736585 | 12B | Kandal |
| 21. | Sok Leuy | 59 | Male | 012478179 | 12C | Kandal |
| 22. | Chhun Haingtong | 43 | Male | 012824858 | 13A | Kandal |
| 23. | Chin Sar | 55 | Male | 012661645 | 14A | Kandal |
| 24. | Sok Sen | 60 | Male | 012787908 | 14C | Kandal |
| 25. | Sok Pov | 48 | Male | 012785737 | 15C | Kandal |
| <u>LVF middlemen/traders</u> | | | | | | |
| 26. | Tay Pheuk | 38 | Female | 012644732 | NA | Kandal |
| 27. | Em Phath | 31 | Female | 012234579 | NA | Kandal |
| 28. | Sok Chea | 34 | Male | 012791754 | NA | Kandal |
| 29. | Lam Lasing | 30 | Female | 012596747 | NA | Kandal |
| 20. | Phang Nhemteang | 61 | Male | 012984530 | NA | Kandal |
| 31. | Keo Sey | 45 | Female | 012109339 | NA | Kandal |
| 32. | Sok Roeun | 48 | Male | 012614205 | NA | Kandal |
| 33. | Neag Leng | 43 | Female | 016857794 | NA | Kandal |
| 34. | Kheng Kong | 33 | Male | 0121730292 | NA | Kandal |
| 35. | Sam Breng | 62 | Male | 012451739 | NA | Kandal |
| 36. | Chen Thang | 42 | Male | 012971305 | NA | Kandal |
| 37. | Keth Dung | 38 | Male | 092495416 | NA | Kandal |
| 37. | Phung Yang Chua | 52 | Male | 012284769 | NA | Kandal |
| 38. | Leng Mean | 43 | Female | 011208588 | NA | Phnom Penh |
| 39. | Un Sokna | 50 | Male | 011238902 | NA | Phnom Penh |
| 40. | Sok Ka | 45 | Male | 012639792 | NA | Phnom Penh |
| 41. | So Yeam | 55 | Male | 012989251 | NA | Phnom Penh |
| 42. | Hea Tiptan | 38 | Male | 012098275 | NA | Phnom Penh |
| 43. | Yang Hong | 57 | Male | 012582340 | NA | Phnom Penh |
| 44. | Seng Ly | 50 | Male | 012964916 | NA | Phnom Penh |
| <u>LVF wholesalers</u> | | | | | | |
| 45. | Ho Sokha | 50 | Male | 012894990 | NA | Kandal |
| 46. | Sok Phath | 53 | Male | 012112908 | NA | Kandal |
| <u>LVF prahok operators</u> | | | | | | |
| 47. | Porl Sera | 24 | Male | 012190322 | NA | Kandal |
| 48. | Porl Chomroeun | 26 | Male | 012251641 | NA | Kandal |
| 49. | Kuy Chea | 45 | Male | 012865701 | NA | Phnom Penh |
| 50. | Hak Sothy | 46 | Male | 012475393 | NA | Kandal |
| 51. | Bun Neng | 66 | Male | 012432110 | NA | Kandal |
| 52. | Chey Narung | 32 | Male | 012758063 | NA | Phnom Penh |
| 53. | Klek Dara | 30 | Male | 012757220 | NA | Phnom Penh |
| <u>LVF drying operators</u> | | | | | | |
| 54. | Sar Kimly | 56 | Female | 0121901183 | NA | Kandal |
| <u>Fisheries officers/researchers</u> | | | | | | |
| 55. | Klaing Vanthol | 44 | Male | 012177881 | NA | Kandal |
| 56. | Keo Pitoo | 40 | Male | 012882733 | NA | Kandal |
| 57. | Keo Roth | 44 | Male | 012350508 | NA | Kandal |
| 58. | Ros Thim | 42 | Male | 012777240 | NA | Kandal |
| 59. | Kong Puthearith | 36 | Male | 012627404 | NA | Phnom Penh |
| 60. | Nun Sophy | 41 | Male | 012845170 | NA | Phnom Penh |
| 61. | Em Vannarith | 43 | Male | 011974796 | NA | Phnom Penh |
| 62. | Hut Van Deun | 40 | Male | 012870160 | NA | Phnom Penh |
| 63. | Tith Khan | 52 | Male | 011227652 | NA | Phnom Penh |
| 64. | Chhun Haingtong | 43 | Male | 012824858 | NA | Kandal |
| 65. | Chhil Phalla | 45 | Male | 012914398 | NA | Kandal |
| 66. | Phlong Norin | - | Male | 012858742 | NA | Kandal |

NA: Not Applicable; - : Not available; LVF = Low Value Fish; *Prahok*, in Khmer, is meant salted fish paste.

With assistance of district fisheries inspectors, 25 dai fishing operators were randomly selected for interviews, representing more than 40% of total numbers of dai fishing operators along the Tonle Sap River of Kandal and Phnom Penh. Interviews with dai fishing operators were carried out at all rows of dais in Tonle Sap River (total, 14 rows) (Fig. 2). A random selection of 22 LVF traders and wholesalers, 8 LVF *prahok* and drying operators were interviewed at the landing sites along Tonle Sap River. Ten government fisheries officials and inspectors and two fisheries researchers were also interviewed. The interviews were conducted in March 2007, the end of dai fishing season. This timeframe was selected because all actors had enough time provide better information according to the prepared questionnaires. By interviewing actors and key informants in dai LVF harvesting regime and market chain for LVF trade, it was possible to collect more extensive information on LVF catches by each individual dai operated along Tonle Sap River (total, 61 dais), economic aspects of dai fishery business and LVF trade and to implement a thorough crosscheck of information (e.g. prices, costs, fees, catches).

There were a number of limitations to be noticed in this research. First, this research only covered dai LVF harvesting and production, and market chain of fresh LVF along Tonle Sap River in Kandal and Phnom Penh. LVF harvesting and production from other types of fishing gears, and market chain of other LVF products (processed fish, marine LVF or trash fish) from other important landing sites of other fisheries productive rivers (Mekong, Bassac and elsewhere) and floodplains (Great Lake and elsewhere) were not addressed in this study due to resource constraints.

Figure 2 One row of fishing bagnet ‘dai’ operated in Tonle Sap River, Cambodia
(Photo by: FEVM Component of the MRC Fisheries Program).



4. Management and harvesting regime of dai fishery

Tonle Sap bagnet ‘dai’ or stationary trawl fishery is, by law, one of the large or commercial scale fisheries in Cambodia (Table 2 & 3). The operation of commercial-scale dai fishery is subject to payment of annual fees to the Ministry of Economics and Finance (MEF) and carried out according to fisheries law and regulations. Auction is required every two years. In addition, auction is not needed for the other type of dais, the so called, research dais, which are used for research purposes, i.e. research on biological, ecological, social and economic aspects of migratory fishes, particularly large-sized and giant fish species, including Mekong giant catfish (*Pangasianodon gigas*) and giant barb (*Catlocapio siamensis*). Before 2005, there were only four research dais implemented by Kandal Stung Fisheries Research Station (KSFRS) under the supervision of Inland Fisheries Research and Development Institute (IFReDI) and Fisheries Administration (FiA) (Table 2 & 3). By recognizing the importance of conservation of large-sized and giant fish species, the FiA made further decisions in 2005 that the four dais of row # 2 were also operated by KSFRS.

Dai fishery operates during receding floodwaters between October and March each year in Tonle Sap River to filter migratory fish species, particularly small cyprinids of the genus *Henicorhynchus* (i.e. *trey riel* in Khmer), migrating from the Great Lake floodplains, via Tonle Sap River, to the Mekong River. Within this timeframe, there are, normally, two peak migration periods, one being at the end of December and the other at the end of January each year. Each peak period lasts for 6 – 10 days before the full moon (Leng, 2006). Each dai yields up to a maximal catching rate of approx. 500 – 1000 kg of low value or small-sized fish per 15 - 30 minutes of fishing operation in peak periods in Tonle Sap River (van Zalinge et al. 2001; Keo Pitoo & Em Vannarith, pers. comm.).

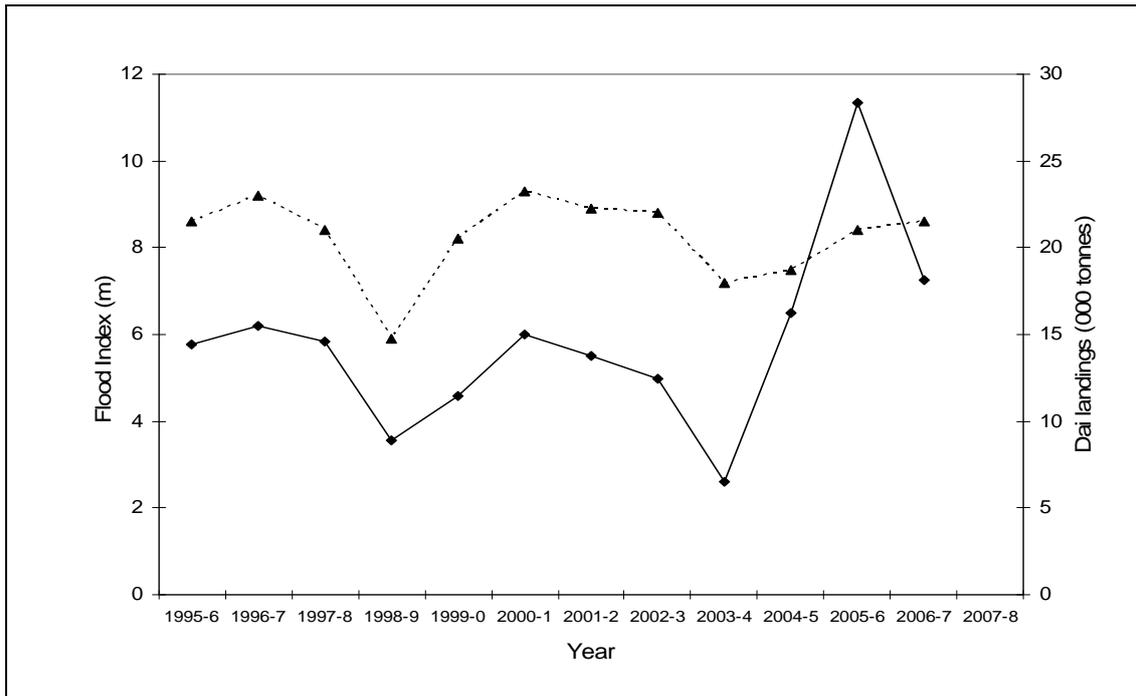
5. Utilization of Tonle Sap dai low value fish

5.1 Annual low value fish catch of each individual dai along Tonle Sap River

The Tonle Sap dai fishery in Kandal province and Phnom Penh municipality has been monitored by Fisheries Administration since 1980 and more formally with support from the MRC Fisheries Program since 1995 using a methodology described by Ngor and van Zalinge (2001). Since then estimates of TOTAL annual dai catches have been reported and updated by many authors (FiA, 2007; Halls et al., 2007; Mattson et al., 2006; Leng, 2006; Hortle et al., 2005; Hortle et al., 2004; van Zalinge et al., 2002; Ngor & van Zalinge, 2001; Baran et al., 2001; Ngor & Hom, 2000; Lieng et al., 1995) (Fig. 3). All authors explain the large inter-annual variations in total dai catches due to variations in hydrological conditions (i.e. water levels). Some authors (e.g. Mattson et al., 2006; Hortle et al., 2004) consider other variables which have included changes in fishing pressures, illegal fishing gear use as well as training and awareness. Similarly, without records of INDIVIDUAL annual dai catch, some authors (Ngor & Hom, 2000; Baran et al., 2001) use estimates of TOTAL annual dai catches and a range of

alternative flood indices to develop empirical models to predict the influence of forecasted changes in basin hydrology on future dai and other fisheries catches. Recently Halls et al. (2007) assume Tonle Sap dai catches will also depend on other variables or indicators such as fishing efforts (e.g. fishing days or ‘soak hours’) and catchability of individual dai, and current velocity.

Figure 3 Trends of TOTAL annual total dai fish catches (solid line) and peak flood indices (broken line) in Tonle Sap River, Cambodia.



Therefore, this study, the first time, provided detailed estimates of annual low fish catch of EACH INDIVIDUAL dai operated in Tonle Sap River, based on data collected from district fisheries inspectors and dai operators in Kandal and Phnom Penh (Table 2). Within the past four years, there was an approx. 10 percent to 30 percent decrease in total annual dai catches obtained from this study compared to the published or official catch figures (Fig. 4). Annual catch of each of the 61 dais along Tonle Sap was calibrated based on the different amount of catch between survey and published data in each year (i.e. 2003-2004, 2004-2005, 2005-2006 and 2006-2007) (Table 3). The annual catch of dai # 15E was ranked first in the past four years, followed by dai # 13A (2nd), 14A (3rd), while the lowest annual catch was dai # 6G, ranking 61st. The ranks of annual catch of all dais were shown in Table 2 & 3.

This study showed that more than 95 percent of total dai fish catch was low value or small-sized fish. The most dominant species was *trey riel* (*Henicorhynchus spp.*, 52%), followed by *trey slak russey* (*Paralaubuca typus*, 20%), *trey khnorng veng* (*Dangila spp.*, 12%), and *trey bandol ampeou* (*Corica laciniata*, 5%) (Fig. 4). Figure 4 also revealed the species compositions of low value fish caught during not peak periods. The

Table 2 Variations in estimated annual fish catches (tones) by individual *dai* in Tonle Sap River, Cambodia (March 2007).

| <i>Dai</i> location | <i>Dai</i> Row # | Type of <i>Dais</i> * | <i>Dai</i> ID # | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | Rank** |
|---------------------|------------------|-----------------------|-----------------|-----------|-----------|-----------|-----------|--------|
| Phnom Penh | 2 | Researched dai | 2A | 73.4 | 235.0 | 274.0 | 220.0 | 37th |
| Phnom Penh | 2 | Researched dai | 2B+ | 67.2 | 215.0 | 220.0 | 180.0 | 45th |
| Phnom Penh | 2 | Researched dai | 2C | 81.3 | 260.0 | 285.0 | 220.0 | 35th |
| Phnom Penh | 2 | Researched dai | 2D | 76.6 | 245.0 | 260.0 | 196.0 | 40th |
| Phnom Penh | 3 | Auctioned dai | 3A+ | 57.8 | 185.0 | 220.0 | 180.0 | 48th |
| Phnom Penh | 3 | Auctioned dai | 3B+ | 51.6 | 165.0 | 230.0 | 215.0 | 46th |
| Phnom Penh | 3 | Auctioned dai | 3C | 68.8 | 220.0 | 245.0 | 165.0 | 42nd |
| Phnom Penh | 3 | Auctioned dai | 3D+ | 64.1 | 205.0 | 235.0 | 180.0 | 44th |
| Phnom Penh | 4 | Auctioned dai | 4A | 50.0 | 160.0 | 185.0 | 150.0 | 53rd |
| Phnom Penh | 4 | Auctioned dai | 4B+ | 54.7 | 175.0 | 200.0 | 145.0 | 50th |
| Phnom Penh | 4 | Auctioned dai | 4C | 67.2 | 215.0 | 285.0 | 220.0 | 39th |
| Phnom Penh | 4 | Auctioned dai | 4D+ | 60.9 | 195.0 | 260.0 | 180.0 | 43rd |
| Phnom Penh | 5 | Auctioned dai | 5B+ | 67.2 | 215.0 | 275.0 | 185.0 | 41st |
| Phnom Penh | 5 | Auctioned dai | 5C | 59.4 | 190.0 | 220.0 | 160.0 | 49th |
| Phnom Penh | 5 | Auctioned dai | 5D+ | 57.8 | 185.0 | 245.0 | 160.0 | 47th |
| Phnom Penh | 5 | Auctioned dai | 5E | 50.0 | 160.0 | 185.0 | 45.0 | 58th |
| Phnom Penh | 5 | Auctioned dai | 5F | 45.3 | 145.0 | 160.0 | 125.0 | 56th |
| Phnom Penh | 6 | Auctioned dai | 6C+ | 46.9 | 150.0 | 180.0 | 135.0 | 54th |
| Phnom Penh | 6 | Auctioned dai | 6D | 45.3 | 145.0 | 160.0 | 115.0 | 57th |
| Phnom Penh | 6 | Auctioned dai | 6E+ | 39.1 | 125.0 | 130.0 | 120.0 | 59th |
| Phnom Penh | 6 | Auctioned dai | 6F | 35.9 | 115.0 | 130.0 | 115.0 | 60th |
| Phnom Penh | 6 | Auctioned dai | 6G | 25.0 | 80.0 | 120.0 | 85.0 | 61st |
| Kandal | 7 | Auctioned dai | 7C+ | 42.0 | 153.8 | 208.0 | 162.5 | 51st |
| Kandal | 7 | Auctioned dai | 7D | 49.0 | 134.8 | 208.0 | 169.0 | 52nd |
| Kandal | 7 | Auctioned dai | 7E | 54.0 | 127.5 | 434.0 | 185.0 | 38th |
| Kandal | 7 | Auctioned dai | 7F | 57.4 | 125.1 | 434.0 | 198.0 | 36th |
| Kandal | 7 | Auctioned dai | 7G | 82.5 | 194.7 | 477.0 | 206.0 | 32nd |
| Kandal | 8 | Auctioned dai | 8C | 62.4 | 186.4 | 483.5 | 236.0 | 31st |
| Kandal | 8 | Auctioned dai | 8D | 66.3 | 207.5 | 484.0 | 235.5 | 29th |
| Kandal | 8 | Auctioned dai | 8E | 72.0 | 213.9 | 474.0 | 237.5 | 28th |
| Kandal | 8 | Auctioned dai | 8F+ | 74.7 | 210.5 | 495.0 | 236.0 | 26th |
| Kandal | 8 | Auctioned dai | 8G | 74.3 | 236.9 | 486.0 | 246.0 | 22nd |
| Kandal | 8 | Auctioned dai | 8H+ | 86.0 | 228.9 | 471.5 | 242.0 | 24th |
| Kandal | 9 | Researched dai | 9A | 58.3 | 160.7 | 535.0 | 266.0 | 25th |
| Kandal | 9 | Researched dai | 9B+ | 57.4 | 158.3 | 513.0 | 231.0 | 33rd |
| Kandal | 9 | Researched dai | 9C | 60.0 | 84.7 | 510.5 | 220.0 | 34th |
| Kandal | 10 | Auctioned dai | 10A | 100.5 | 305.3 | 562.0 | 272.0 | 15th |
| Kandal | 10 | Auctioned dai | 10B+ | 97.5 | 296.7 | 581.0 | 276.0 | 14th |
| Kandal | 10 | Auctioned dai | 10C+ | 81.0 | 292.4 | 572.0 | 273.0 | 16th |
| Kandal | 10 | Auctioned dai | 10D+ | 77.0 | 254.8 | 554.0 | 268.5 | 19th |
| Kandal | 10 | Auctioned dai | 10E | 72.6 | 220.5 | 564.0 | 286.0 | 21st |
| Kandal | 10 | Auctioned dai | 10F | 60.0 | 209.2 | 547.5 | 215.0 | 23rd |
| Kandal | 10 | Auctioned dai | 10G | 38.5 | 99.1 | 205.5 | 150.0 | 55th |
| Kandal | 11 | Auctioned dai | 11A" | 76.0 | 291.9 | 571.0 | 335.5 | 13th |
| Kandal | 11 | Auctioned dai | 11A+ | 115.6 | 283.3 | 599.5 | 347.5 | 11th |
| Kandal | 11 | Auctioned dai | 11B | 82.1 | 276.0 | 596.5 | 250.0 | 17th |
| Kandal | 11 | Auctioned dai | 11C+ | 93.0 | 237.3 | 619.0 | 200.0 | 20th |
| Kandal | 11 | Auctioned dai | 11D | 13.7 | 220.0 | 588.5 | 164.0 | 30th |
| Kandal | 12 | Auctioned dai | 12A | 123.4 | 390.2 | 645.0 | 220.0 | 7th |
| Kandal | 12 | Auctioned dai | 12B+ | 122.5 | 355.0 | 657.0 | 231.0 | 8th |
| Kandal | 12 | Auctioned dai | 12C+ | 120.0 | 358.8 | 617.0 | 261.0 | 10th |
| Kandal | 12 | Auctioned dai | 12D | 121.3 | 296.1 | 619.0 | 270.0 | 12th |
| Kandal | 12 | Auctioned dai | 12E | 147.0 | 293.3 | 650.0 | 271.0 | 9th |
| Kandal | 13 | Researched dai | 13A+ | 81.0 | 408.6 | 661.0 | 445.0 | 2nd |
| Kandal | 14 | Auctioned dai | 14A+ | 135.0 | 385.0 | 668.0 | 390.0 | 3rd |
| Kandal | 14 | Auctioned dai | 14B | 116.0 | 377.5 | 615.0 | 368.0 | 5th |
| Kandal | 14 | Auctioned dai | 14C+ | 100.0 | 351.8 | 646.0 | 342.0 | 6th |
| Kandal | 15 | Auctioned dai | 15B | 90.0 | 176.7 | 512.0 | 233.0 | 27th |
| Kandal | 15 | Auctioned dai | 15C+ | 96.5 | 246.3 | 567.0 | 276.0 | 18th |
| Kandal | 15 | Auctioned dai | 15D | 116.0 | 334.0 | 701.0 | 346.0 | 4th |
| Kandal | 15 | Auctioned dai | 15E | 137.8 | 438.7 | 750.0 | 462.0 | 1st |

Data source: Field surveys (March 2007). * The bagenets '*dais*' are classified into two types: (1) auctioned *dais*, *dais* are sold to the highest bidders for harvesting fishes for two years by the Fisheries Administration of Ministry of Agriculture, Forestry and Fisheries; (2) research *dais*, *dais* are not auctioned and kept for serving biological, ecological, social and economical research purposes, which are under the responsibility of Inland Fisheries Research and Development Institute of the Fisheries Administration.

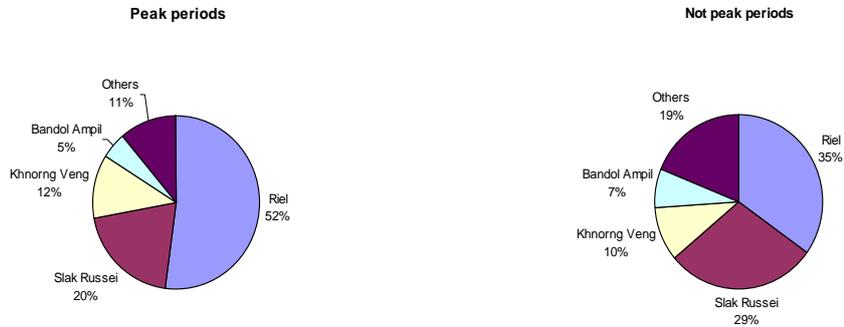
** The bagenets '*dais*' are ranked according to fish catches during the past four years.

Table 3 Variations in calibrated annual fish catches (tones) by individual *dai* in Tonle Sap River, Cambodia (March 2007).

| <i>Dai</i> location | <i>Dai</i> Row # | Type of <i>Dais</i> * | <i>Dai</i> ID # | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | Rank** |
|---------------------|------------------|-----------------------|-----------------|-----------|-----------|-----------|-----------|--------|
| Phnom Penh | 2 | Researched dai | 2A | 100.6 | 272.6 | 301.4 | 288.2 | 36th |
| Phnom Penh | 2 | Researched dai | 2B+ | 92.0 | 249.4 | 242.0 | 235.8 | 45th |
| Phnom Penh | 2 | Researched dai | 2C | 111.3 | 301.6 | 313.5 | 288.2 | 35th |
| Phnom Penh | 2 | Researched dai | 2D | 104.9 | 284.2 | 286.0 | 256.8 | 40th |
| Phnom Penh | 3 | Auctioned dai | 3A+ | 79.2 | 214.6 | 242.0 | 235.8 | 48th |
| Phnom Penh | 3 | Auctioned dai | 3B+ | 70.6 | 191.4 | 253.0 | 281.7 | 46th |
| Phnom Penh | 3 | Auctioned dai | 3C | 94.2 | 255.2 | 269.5 | 216.2 | 42nd |
| Phnom Penh | 3 | Auctioned dai | 3D+ | 87.8 | 237.8 | 258.5 | 235.8 | 44th |
| Phnom Penh | 4 | Auctioned dai | 4A | 68.5 | 185.6 | 203.5 | 196.5 | 53rd |
| Phnom Penh | 4 | Auctioned dai | 4B+ | 74.9 | 203.0 | 220.0 | 190.0 | 50th |
| Phnom Penh | 4 | Auctioned dai | 4C | 92.0 | 249.4 | 313.5 | 288.2 | 38th |
| Phnom Penh | 4 | Auctioned dai | 4D+ | 83.5 | 226.2 | 286.0 | 235.8 | 43rd |
| Phnom Penh | 5 | Auctioned dai | 5B+ | 92.0 | 249.4 | 302.5 | 242.4 | 41st |
| Phnom Penh | 5 | Auctioned dai | 5C | 81.3 | 220.4 | 242.0 | 209.6 | 49th |
| Phnom Penh | 5 | Auctioned dai | 5D+ | 79.2 | 214.6 | 269.5 | 209.6 | 47th |
| Phnom Penh | 5 | Auctioned dai | 5E | 68.5 | 185.6 | 203.5 | 59.0 | 58th |
| Phnom Penh | 5 | Auctioned dai | 5F | 62.1 | 168.2 | 176.0 | 163.8 | 56th |
| Phnom Penh | 6 | Auctioned dai | 6C+ | 64.2 | 174.0 | 198.0 | 195.0 | 54th |
| Phnom Penh | 6 | Auctioned dai | 6D | 62.1 | 168.2 | 176.0 | 150.7 | 57th |
| Phnom Penh | 6 | Auctioned dai | 6E+ | 53.5 | 145.0 | 143.0 | 157.2 | 59th |
| Phnom Penh | 6 | Auctioned dai | 6F | 49.2 | 133.4 | 143.0 | 150.7 | 60th |
| Phnom Penh | 6 | Auctioned dai | 6G | 34.3 | 92.8 | 132.0 | 111.4 | 61st |
| Kandal | 7 | Auctioned dai | 7C+ | 57.5 | 178.4 | 228.8 | 212.9 | 51st |
| Kandal | 7 | Auctioned dai | 7D | 67.1 | 156.3 | 228.8 | 221.4 | 52nd |
| Kandal | 7 | Auctioned dai | 7E | 74.0 | 147.9 | 477.4 | 242.4 | 39th |
| Kandal | 7 | Auctioned dai | 7F | 78.6 | 145.1 | 477.4 | 259.4 | 37th |
| Kandal | 7 | Auctioned dai | 7G | 113.0 | 225.8 | 524.7 | 269.9 | 32nd |
| Kandal | 8 | Auctioned dai | 8C | 85.5 | 216.2 | 531.9 | 309.2 | 30th |
| Kandal | 8 | Auctioned dai | 8D | 90.8 | 240.7 | 532.4 | 308.5 | 29th |
| Kandal | 8 | Auctioned dai | 8E | 98.6 | 248.1 | 521.4 | 311.1 | 28th |
| Kandal | 8 | Auctioned dai | 8F+ | 102.3 | 244.1 | 544.5 | 309.2 | 26th |
| Kandal | 8 | Auctioned dai | 8G | 101.8 | 274.7 | 534.6 | 322.3 | 22nd |
| Kandal | 8 | Auctioned dai | 8H+ | 117.8 | 265.5 | 518.7 | 317.0 | 23rd |
| Kandal | 9 | Researched dai | 9A | 79.9 | 186.4 | 588.5 | 348.5 | 25th |
| Kandal | 9 | Researched dai | 9B+ | 78.6 | 183.6 | 564.3 | 302.6 | 33rd |
| Kandal | 9 | Researched dai | 9C | 82.2 | 98.3 | 561.6 | 288.2 | 34th |
| Kandal | 10 | Auctioned dai | 10A | 137.7 | 354.2 | 618.2 | 356.3 | 15th |
| Kandal | 10 | Auctioned dai | 10B+ | 133.6 | 344.2 | 639.1 | 361.6 | 14th |
| Kandal | 10 | Auctioned dai | 10C+ | 111.0 | 339.2 | 629.2 | 357.6 | 16th |
| Kandal | 10 | Auctioned dai | 10D+ | 105.5 | 295.6 | 609.4 | 351.7 | 20th |
| Kandal | 10 | Auctioned dai | 10E | 99.5 | 255.7 | 620.4 | 374.7 | 21st |
| Kandal | 10 | Auctioned dai | 10F | 82.2 | 242.7 | 602.3 | 281.7 | 24th |
| Kandal | 10 | Auctioned dai | 10G | 52.7 | 114.9 | 226.1 | 196.5 | 55th |
| Kandal | 11 | Auctioned dai | 11A" | 104.1 | 338.6 | 628.1 | 439.5 | 13th |
| Kandal | 11 | Auctioned dai | 11A+ | 158.4 | 328.6 | 659.5 | 455.2 | 10th |
| Kandal | 11 | Auctioned dai | 11B | 112.5 | 320.2 | 656.2 | 327.5 | 17th |
| Kandal | 11 | Auctioned dai | 11C+ | 127.4 | 275.3 | 680.9 | 300.0 | 19th |
| Kandal | 11 | Auctioned dai | 11D | 18.8 | 255.2 | 647.4 | 214.8 | 31st |
| Kandal | 12 | Auctioned dai | 12A | 169.1 | 452.6 | 709.5 | 288.2 | 7th |
| Kandal | 12 | Auctioned dai | 12B+ | 167.8 | 411.8 | 722.7 | 302.6 | 9th |
| Kandal | 12 | Auctioned dai | 12C+ | 164.4 | 416.2 | 678.7 | 341.9 | 11th |
| Kandal | 12 | Auctioned dai | 12D | 166.2 | 343.5 | 680.9 | 353.7 | 12th |
| Kandal | 12 | Auctioned dai | 12E | 201.4 | 340.2 | 715.0 | 355.0 | 8th |
| Kandal | 13 | Researched dai | 13A+ | 111.0 | 474.0 | 727.1 | 583.0 | 2nd |
| Kandal | 14 | Auctioned dai | 14A+ | 185.0 | 446.5 | 734.8 | 510.9 | 3rd |
| Kandal | 14 | Auctioned dai | 14B | 158.9 | 437.8 | 676.5 | 482.1 | 5th |
| Kandal | 14 | Auctioned dai | 14C+ | 137.0 | 408.0 | 710.6 | 448.0 | 6th |
| Kandal | 15 | Auctioned dai | 15B | 123.3 | 204.9 | 563.2 | 305.2 | 27th |
| Kandal | 15 | Auctioned dai | 15C+ | 132.2 | 285.7 | 623.7 | 361.6 | 18th |
| Kandal | 15 | Auctioned dai | 15D | 158.9 | 387.4 | 771.1 | 453.3 | 4th |
| Kandal | 15 | Auctioned dai | 15E | 188.8 | 508.9 | 825.0 | 605.2 | 1st |

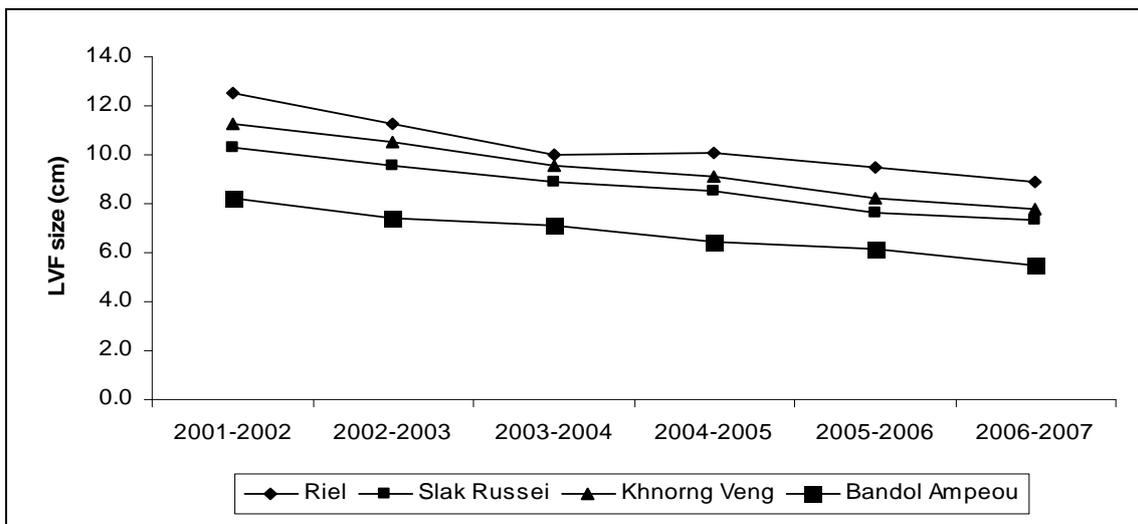
Data source: Field surveys (March 2007) and FiA Fisheries Statistics (2007). * The bagenets '*dais*' are classified into two types: (1) auctioned *dais*, *dais* are sold to the highest bidders for harvesting fishes for two years by the Fisheries Administration of Ministry of Agriculture, Forestry and Fisheries; (2) research *dais*, *dais* are not auctioned and kept for serving biological, ecological, social and economical research purposes, which are under the responsibility of Inland Fisheries Research and Development Institute of the Fisheries Administration. ** The bagenets '*dais*' are ranked according to fish catches during the past four years.

Figure 4 Species compositions of low value fish caught by dai in Tonle Sap River (March 2007). *Trey riel* = *Henicorhynchus* spp.; *trey slak russey* (*Paralaubuca typus*); *trey khnornng veng* (*Dangila* spp.); *trey bandol ampeou* (*Corica laciniata*).



size of these four dominant low value fish species declined by approx. 30% compared to the past six years, on average representing a 5% decline each year (Fig. 5). There are several reasons for the decline in fish size, including higher fishing pressures in Tonle Sap Great Lake, illegal fishing gear use, illegal fishing activities, and changes in hydrological regime of the basin (flood levels, flood durations, and flood times). Recently Robert et al. (2007) reported that fish size of all classes (i.e. large, medium and small-size fish species) decreases in Tonle Sap basin due to increasing gear efficiency, increasing fishers numbers, population increase, low value/small fish used fish feed, pesticides, clearing flooded forest, electro fishing.

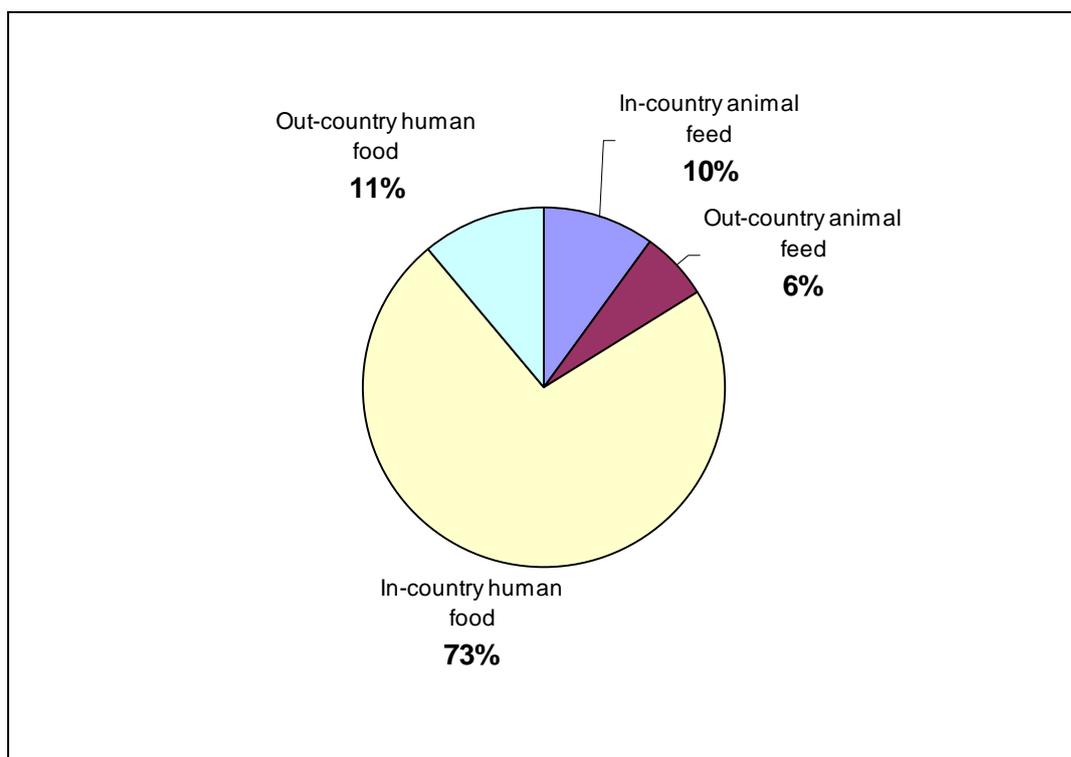
Figure 5 Size of four dominant low value fish species caught by Tonle Sap dai (March 2007).



5.2 Utilization of Tonle Sap low value fish

Low value fish traditionally used for making *prahok*, fermented fish paste, which is a vital protein source and favorable ingredient for most of the Cambodian population, particularly the rural poor during the closed fishing season and at the end of the dry season when fish are not abundant. In the past two decades low, value fish are also utilized for feeding fish and other animals (So & Nao, 1999; So et al., 2005). Recently, low value fish caught by Tonle Sap dais have directly been exported to Vietnam for human consumption and fish and other animal feed. Figure 6 shows the proportions of Tonle Sap low value fish utilized for human nutrition and food, and fish and other animal feeds inside and outside the country. Around 85% of the total dai low value fish production in 2006-2007 in Tonle Sap River was locally utilized for human food (i.e. fresh fish, and *prahok* and other forms of processed fish) and fish/ other animal feed, and the rest was exported, particularly to Vietnam in both half-processed and fresh forms for human consumption and animal feed, respectively.

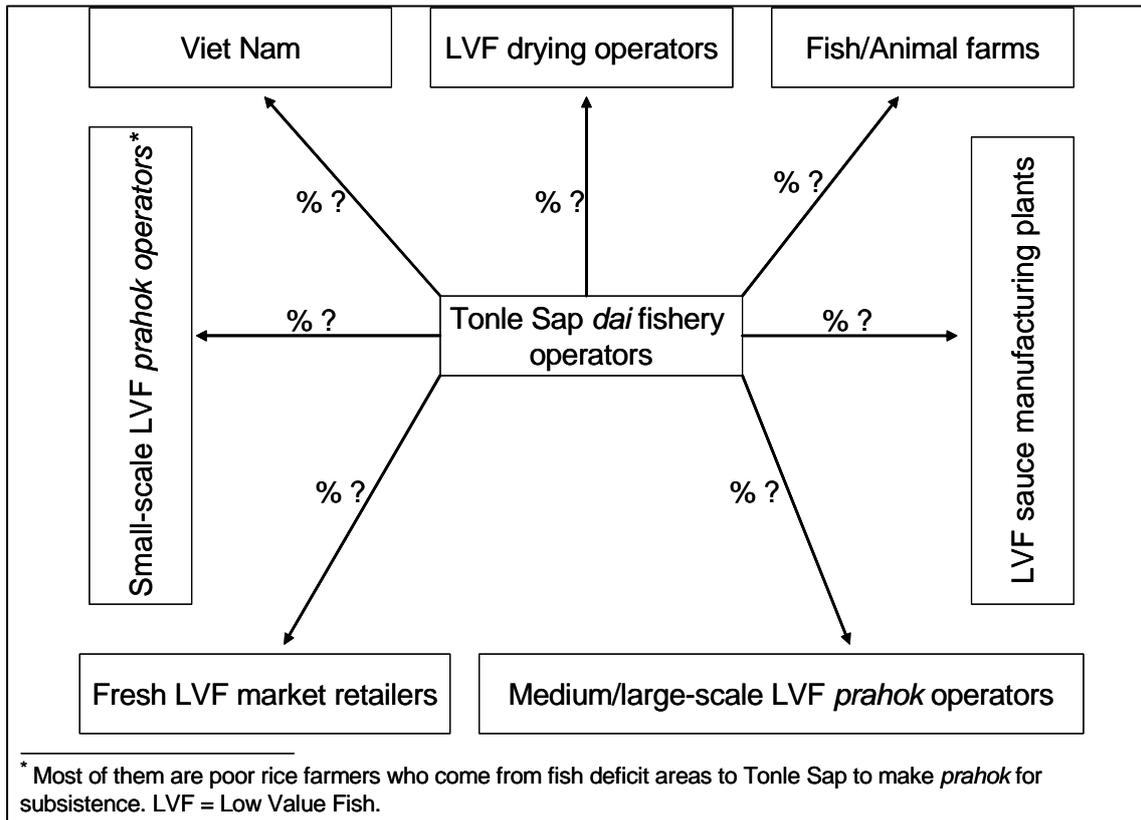
Figure 6 Utilization of Tonle Sap dai low value fish (March 2007).



Many stakeholders utilize low value fish harvested from dai in Tonle Sap River (Fig. 7). They included small-, medium- and large-scale *prahok* operators, fresh LVF market retailers, LVF sauce manufacturers, LVF drying operators, fish and animal raising

farmers, and local Vietnamese nationals' consumers. The descriptions of these stakeholders are detailed in Section 6.

Figure 7 Flow of Tonle Sap dai low value fish (March, 2007).



6. Market chain for low value fish trade

Tonle Sap dai low value fish (LVF) supply and market chain is seasonally operated for about five months a year, starting from October to March. Mapping the market chain for low value along Tonle Sap River is a very challenging issue because of its commercial dai fishery, tens of thousands of actors/stakeholders involved in the market chain and supply, and many trade routes and methods (e.g. by road and waterway). Hence it is a quite complicated market chain. Rab et al. (2005), Vanna (2005), Yim & Mckenney (2003a, b), Touch & Todd (2002) and Hap & So (2001) reported that Cambodia freshwater fish supply and market structure is also complex as similarly involving many intermediaries. Fish are supplied by small-, medium- and large-scale (e.g. fishing lots and dai fishery) fishers, rice-field fishers, and fish farmers or aquaculturists to a variety of collectors, traders, wholesalers, semi-wholesalers, processors, distributors, and

exporters, who sell the fish or fish products to domestic retail markets or export markets.

For this trade, it is possible to describe: (1) Market chain for fresh low value fish trade; (2) Market chain for LVF *prahok* trade; and (3) Market chain for dried LVF trade along Tonle Sap River. Fresh LVF trade involved dai fishing operators, fish collectors/middlepersons/traders, wholesalers, rice farmers (small-scale *prahok* operators), market retailers, fish and animal raisers, fish sauce manufacturers, and exporters (Fig. 8). LVF *pahok* operators involved dai fishing operators, small-, medium- and large- scale operators, traders, wholesalers, and exporters (Fig. 9). Figure 10 shows the trade of dried LVF along Tonle Sap River involving dai fishing operators, LVF drying operators, traders, wholesalers, fish and animal raisers and CP Cambodia Co. Ltd. Company.

Figure 8 Market chain for Tonle Sap dai fresh low value fish trade (March 2007).

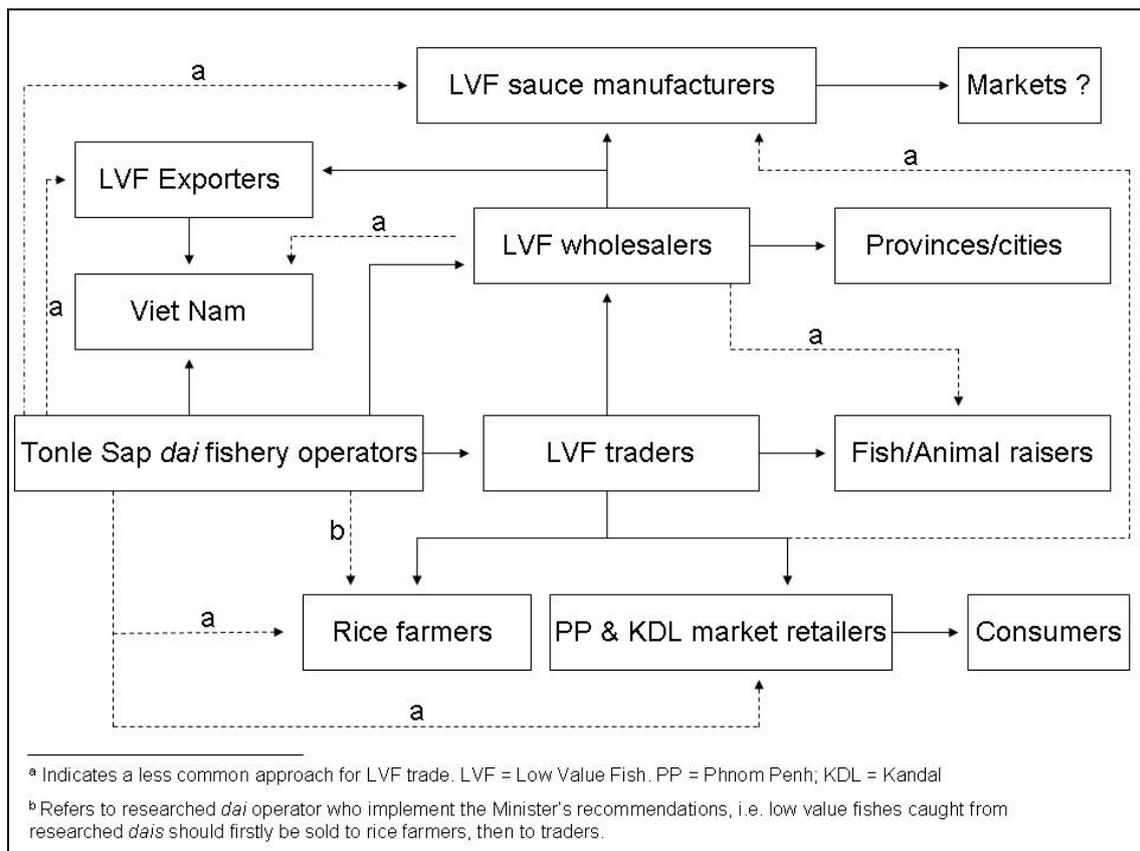


Figure 9 Market chain for Tonle Sap dai LVF *prahok* trade (March 2007).

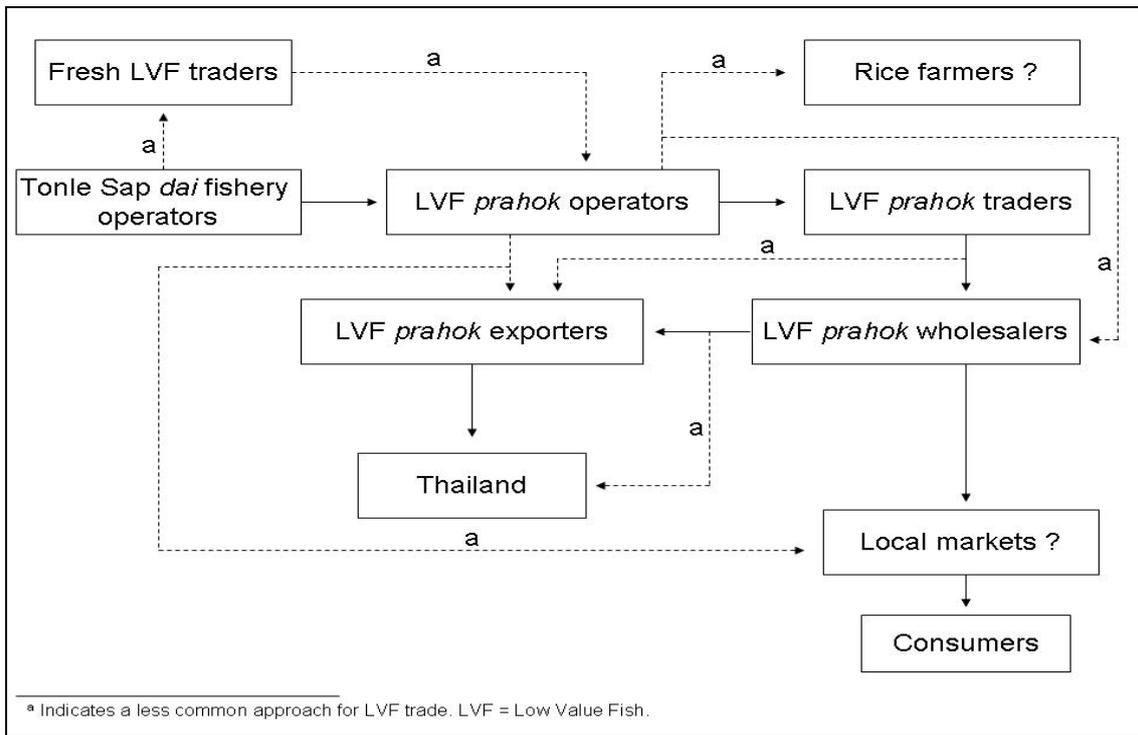
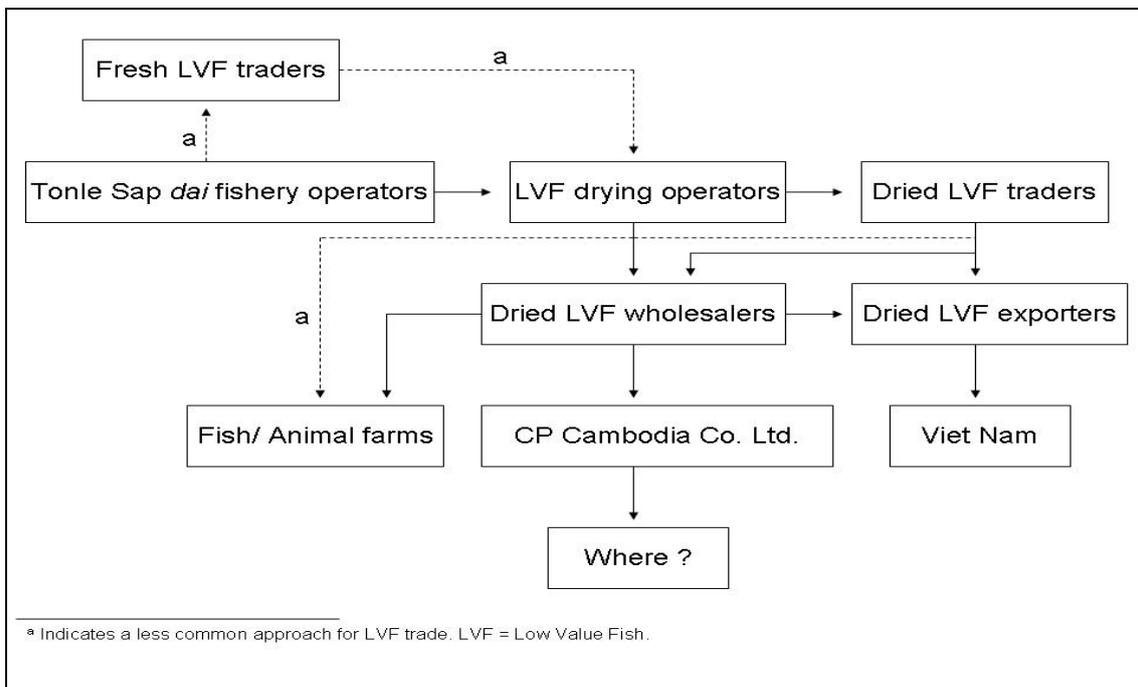


Figure 10 Market chain for Tonle Sap dai dried LVF trade (March 2007).



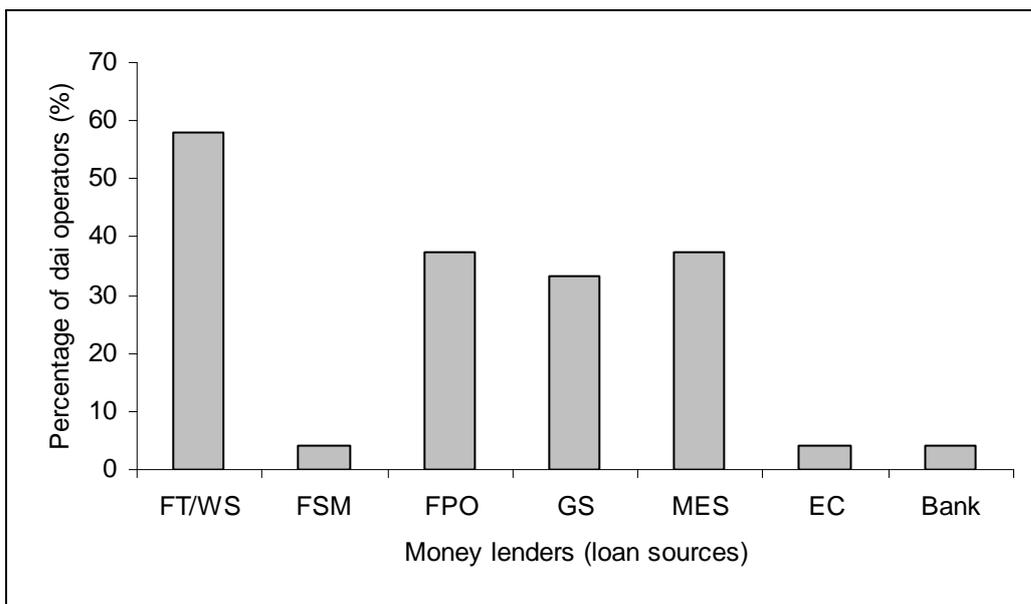
6.1 Dai fishing operators

Dai fishing operators were defined here to include commercial scale fishers harvesting fish by using bagnet 'dai' along Tonle Sap River in Kandal province and Phnom Penh municipality. They seasonally operate their dais, starting in October and ending in March each year. These fishers have to pay official annual fees to Kandal and Phnom Penh treasuries of the Ministry of Economics and Finance mostly through provincial/municipal Fisheries Offices to operate their dais. In addition, they also paid unofficial fees to fisheries officers, local authorities, economic police, and military police. The amount of official and unofficial fees paid by each dai operators was recorded in Table 4. Dai operators control fish catch and function as fish suppliers to various actors, including traders/middlepersons/fish collectors, wholesalers, exporters, fish sauce manufacturers, small- (rice farmers), medium- and large scale *prahok* operators, fish drying operators, and retailers at Kandal and Phnom Penh markets. Dai operators never export fish to Vietnam, but sold low value fish to Vietnamese traders, who crossed the border by big boats (with loading capacities varying from 30 to 70 tones) to buy and ferment LVF to a half fermented form, the so called, *mum* in Vietnamese. Last LVF season (2006-2007), the numbers of Vietnamese traders drastically decreased because (1) Cambodia's government had strong measures not allowing them to cross the border to buy LVF in Tonle Sap River due to high local demands of LVF; and (2) most Vietnamese traders had to pay lots to many checkpoints from Phnom Penh to the border. Most of the Tonle Sap dai operators had another occupation which was cage fish culture, mainly snakehead fish (before the ban, 2004/2005) as they can have sufficient amount of low value fish to feed their snakehead to generate additional incomes and high profits. They never keep harvested low value fish in cage or pen for selling later on (or in lean fishing periods) as these fish will be dead in a short time. Therefore all harvested low value fish have to be sold immediately after removing them from dais to the above actors in the supply market chain. When catches are big (more than a few tones per dai per lifting or harvesting time), the bulk of fish have to be released back to the River to prevent dai damages. In such case, some dai operators also sun-dried low value fish for selling to fish and animal farms, while some fermented them to *prahok* form for selling to internal or external markets, if those have sufficient amount of labors, land and facilities. Prices are set through negotiation, with buyers relying on knowledge of the previous day's fish price and catch, and 'word-of-mouth' information on prices from other dai operators (for details see Section 6.13)

All Tonle Sap dai operators selected for this study were in debt to private and institutional money lenders (Fig. 11). Most of the dai operators (58%) borrowed money from traders/wholesalers (who themselves have been financed by private, e.g. money exchange store/ Gold seller and institutional, e.g. banks, lenders), followed by 38% from large-scale LVF *prahok* operators (who themselves have been financed by private, e.g. money exchange store/ Gold seller, and institutional, e.g. banks, lenders), 38% from money exchange stores/gold sellers, and 33% from grocery sellers. A minority of dai operators borrowed money from banks, estate companies, and LVF sauce manufacturers. On average, the amount of money borrowed by each dai operator was Riel 33,140,330 (US\$ 8,083), varying from Riel 12,300,000 (US\$ 3,000) to Riel

82,000,000 (US\$ 20,000). Dai operators borrowed to support boat and gear purchases and repairs, labor hires, daily food and fuel purchases, fee payment and other operation cost payments. Most of the interviewed traders/wholesalers, large-scale LVF *prahok* operators, and fish sauce manufacturers did not charge dai operators an interest rate on loans, but require that dai operators sold low value fish to them at a discount price of 20

Figure 11 Loan sources of Tonle Sap dai operators (March, 2007). FT = LVF trader; WS = Wholesaler; FSM = Fish Sauce Manufacturers; FPO = Fish paste (*prahok*) operator; MES = Money exchange store/gold seller; EC = Estate company.



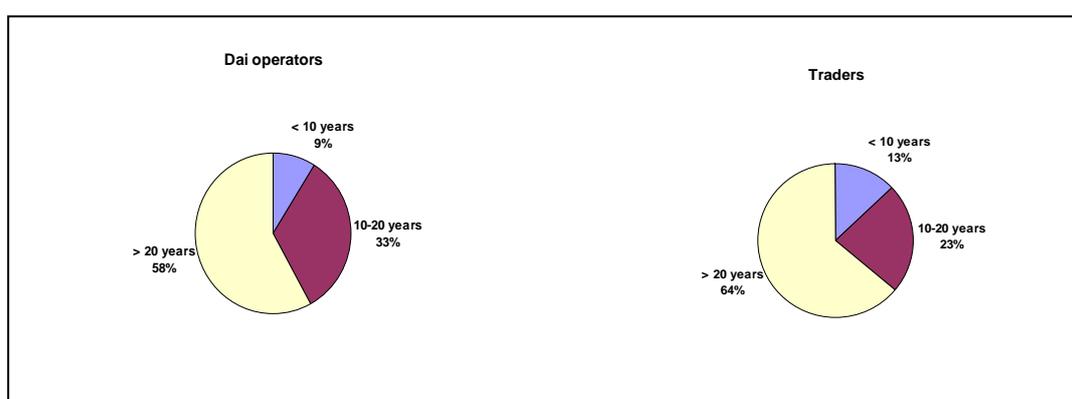
percent (an implicit interest rate). Other money lenders charged dai operators an interest rate of 2 to 5% per months. Normally dai operator borrowed for at least 5-6 months, most starting from when they register to bid for dai fishing operations as they have to pay 50% of dai fees when they register. Approx. 46% of the interviewed dai operators paid back the loan through cash, followed by 37% through cash and fish and 17% through only fish. There were two loan structures: (1) without contract (i.e. from friends and relatives, 58%) and with contract (i.e. requiring witness from local authorities and value things pawned or pawns, 42%). Most dai operators had extensive experience and were very skillful in harvesting fish in Tonle Sap River. Around 60% of the interviewed dai operators have been in this business for more than 20 years (Fig. 12).

6.2 LVF traders/middlepersons/LVF collectors

Traders were defined here as middlepersons or LVF collectors who collected or bought low value fish from dai operators (Fig. 8), LVF *prahok* operators (Fig. 9), and dried LVF (Fig. 10) to sell to wholesalers, rice farmers (small-scale *prahok* operator), Phnom

Penh and Kandal market retailers, fish and animal raisers, fish sauce manufacturers, and exporters (Fig. 8, 9 & 10). Most of the interviewed LVF traders are living on the Tonle Sap River banks or in floating houses in Tonle Sap River of Kandal province and Phnom Penh municipality. Generally they have one or several boats (Fig. 8) or pick-up car(s) or motorbike(s) (Fig. 9 & 10). Most LVF traders operated on a small-scale, working for 3-4 months each year (Fig. 8, 9 & 10) and were in this business for more than 20 years (Fig. 12).

Figure 12 Number of years Tonle Sap dai operators and traders involving in the business (March, 2007).



All traders of fresh LVF bought LVF from dai operators and brought these to landing sites to usually sell to rice farmers (small-scale *prahok* operators), wholesalers, Kandal and Phnom Penh market retailers and fish and animal (i.e. duck, chicken and pig) farmers (Fig. 8). Some trader bought LVF from dai operators and sold them to LVF sauce manufacturers. Each trader, on average, bought 41 tones of LVF per year, varying from 11 to 100 tones. They set prices by direct negotiation with buyers, contacts with dai operators and other traders, as well as based on local market LVF prices and times (day or night) of LVF sales.

Traders of LVF *prahok* bought *prahok* from medium and large scale *prahok* operators and usually sold them to *prahok* wholesalers (Fig. 9). Some traders directly sold *prahok* to exporters, who have lent money to them.

Traders of dried LVF bought dried LVF from LVF drying operators and sold them to dried LVF wholesalers and exporters. Some traders sold dried LVF to fish and animal farmers.

Most traders were in debt to grocery sellers (42% of traders), money exchange/gold sellers (8%), banks (17%), wholesalers (17%), and medium/large scale *prahok* operators

(17%). They borrow, on average, Riel 4,419,800 (US\$ 1,078, range: US\$ 500-2,000) to support labor fee and food payments, LVF and LVF processed product purchases, and to lend to dai operators. Approx. 5% of interviewed traders lent money (US\$ 500 – 1,000) to dai operators who exclusively sold LVF to them at a reduction price of 20%. Similarly, private and institutional money lenders charged traders an interest rate of 3 to 5%, and others (wholesalers and *prahok* operators) did not charge, but require that traders sold LVF to them at a discount price of 20%.

6.3 LVF wholesalers

Wholesalers were defined here as traders who channel major quantities of low value fish and represent a vital part of supply and market chain. They were comparable to distributors who have a permanent LVF stall at a landing site along Tonle Sap River. They usually did not have a boat, but had pick-up car(s). Most wholesalers most often bought LVF from traders/middlepersons/collectors, but some bought LVF from dai operators who brought these by boats to them and some hired boats to brought LVF from dai operators. They usually supplied approx. 225 tones of LVF (brought by pick-up car) to Phnom Penh municipality, and Kandal, Kampong Speu, Takeo, Prey Veng, Svay Rieng, Kampot and Kampong Chhnang provinces; LVF sauce manufacturers, particularly in Phnom Penh, Kandal and Takeo; fish and animal raising farmers in Kandal and Phnom Penh; exporters who exported fish to Vietnam by trucks or pick-up cars. Some wholesalers also exported LVF to Vietnam (Fig. 8).

Most LVF *prahok* wholesalers usually bought *prahok* from traders and occasionally from medium and large scale *prahok* operators. They supplied *prahok* to provincial and municipal markets over the country, and exporters who channels *prahok* to Thailand by roads. A few wholesalers also acted as exporters to export *prahok* to Thailand too. For dried LVF wholesalers, they bought dried LVF from LVF drying operators and channeled dried LVF to fish and animal raising farmers, CP Cambodia Co. Ltd. Company, and exporters who exported these to Vietnam.

Most wholesalers were in debt to LVF sauce manufacturers, exporters and banks. They borrowed, on average, Riel 14,350,000 (US\$ 3,500), ranging from US\$ 2,000 to US\$ 7,000 to support labor and food payments and LVF purchase, and to lend some (i.e. US\$ 1,000 - 4,000) to dai operators. The above lenders charged an interest rate of 3-5% per month if the payback was in cash, or reduced 20% of selling fish price if the return was in fish.

6.4 Medium/large scale LVF prahok operators

LVF *prahok* operators were generally businesspersons who have a permanent stall at a landing site along Tonle Sap River. The LVF *prahok* operators, who bought, on average 29 tones, ranging from 7 to 50 tones, of LVF mainly from dai operators and/or occasionally from traders/middlepersons/collectors, produced fermented fish paste (*prahok*). The operators supplied *prahok* mainly to traders, and occasionally to wholesalers, exporters (to Thailand), municipal and provincial markets (Phnom Penh,

Kandal, Prey Veng, Kampong Speu, Takeo, Svay Rieng and Kampong Chhnang), rice farmers (small-scale *prahok* operators), and NGOs, who supplied *prahok* to the rural poor. The medium scale operators produce, on average, about 5 - 10 tones of *prahok*, and large scale approx. 20 - 50 tones.

LVF *prahok* operators were in debt to grocery sellers and banks. They borrowed approx. US\$ 500 – 1000 to support their business and to lend some (US\$ 100-500) to dai operators or traders.

6.5 Small-scale LVF *prahok* operators

Small-scale LVF *prahok* operators were defined here as mostly rice farmers who came from fish deficit areas over the country to Tonle Sap River in Kandal and Phnom Penh in around December-January every year to produce LVF *prahok* for household subsistence. As mentioned in the previous sections, *prahok* is a crucial ingredient and protein source for the rural poor, particularly during closed fishing season (June-September) and at the end of the dry season (April-May). In the past, thousands of rice farmers have come to the Tonle Sap landing sites by cow or house carts, but recently (a few years ago) they took mini buses or pick-up cars to approach the sites. Most rice farmers usually bought LVF from traders/middlepersons/collectors, and some from dai operators to get cheaper price. Interestingly, all research dais of IFReDI considered the recommendations of the Minister of MAFF and always supplied LVF to rice farmers first before selling their LVF to other actors in the market chain. Most rice farmers came from Kandal, Kampong Speu, Takeo, Prey Veng, Savy Rieng, Kampong Chhnang, Kampot, Kampong Cham and Battambang provinces, and Phnom Penh municipality. On average, they bought approx. 116 kg of LVF per household, varying from 80 kg to 200 kg. Although the numbers of traders and wholesalers gradually increased in the past few years, numbers of rice farmers decreased because most of the national and rural roads have been renovated by the government and available new/modern fish processing equipment (i.e. LVF head cutting machine), previously LVF head removed by rice farmers one by one. Therefore traders/wholesalers could supply LVF to many provinces to meet the demands of rice farmers in rural areas. As a result, those rice farmers did not spend time, money and efforts to come to Tonle Sap landing sites to produce *prahok*. In past years, they have exchanged LVF with rice which they just harvested in the same year, but recently such exchanges have been rarely detected.

6.6 LVF drying operators

LVF drying operators are generally fishers and/or fish farmers who are living along the National Road # 5 in Kandal province and Phnom Penh municipality. Most operators rent piece(s) of land or rice-field located along the Tonle Sap River bank to dry LVF under the sun. They bought cheaper LVF mainly from dai operators at night time, and occasionally from traders at day time when the latter could sell their fish at the end of the day. Each operator bought about 150 tones of LVF for sun drying. They sold dried LVF to traders, wholesalers, and fish and animal raising farmers, particularly all from Phnom Penh and Kandal. They were also in debt to private and institutional money lenders. The same as previous actors, they also lend some borrowed money (US\$ 500 –

1000) to dai operators. In other words, dai operators were in debt to all the above actors of the LVF market chain.

6.7 LVF retailers

LVF retailers were those who sell LVF in Kandal and Phnom Penh markets directly to consumers. They usually bought LVF from traders/middleperson/collectors at Tonle Sap landing sites. Some retailers also bought fish from dai operators as they wanted to have high quality or specific fish species. They came to Tonle Sap to buy fish and went back to markets to sell fish every day.

6.8 LVF sauce manufacturers

LVF sauce manufacturers were defined as businesspersons who had a fish sauce production facility/plant. LVF were brought by wholesalers, traders and dai operators and sold to them at the plants. Most LVF sauce manufacturing plants were located along Tonle Sap River in Kandal and Phnom Penh, and in Takeo province, but some in other provinces. Some plants have been closed as their land values have drastically increased in the past few years.

6.9 Fish and animal raising farmers

Defined as fish (mainly *Pangasiid* and *Clariid* catfish species) and other animal (mainly duck, chicken and pig) raising farmers, who mostly owned farm(s) in Kandal province and Phnom Penh municipality. Fresh (Fig. 8) or/and dried (Fig. 10) LVF were usually brought by wholesalers by cars and sold them at the farm gate. Some farmers went to LVF landing sites to buy fresh LVF from traders (Fig. 8) or dried LVF from traders or drying operators (Fig. 10).

6.10 LVF exporters

LVF exporters exported LVF and LVF products to neighboring countries (Fig. 8, 9 & 10). They generally purchased LVF from wholesalers and/or traders, and some times from dai operators. For fresh LVF, they stored them with ice and exported them by land to Vietnam. They also exported dried and fermented LVF by land to Vietnam and Thailand, respectively.

6.11 CP Cambodia Co. Ltd.

Is the largest fish/animal meal Company, located in Phnom Penh, in Cambodia, whose owner is Thai. The Company bought dried LVF from wholesalers (Fig. 10) for producing fish meal to supply fish/animal farming industries.

6.12 Other actors in the market chain

Many other actors and beneficiaries who are involved to a lesser extent in the market chain for low value fish trade along Tonle Sap River included the following:

- LVF transporters,
- Fishing gear and equipment producers and sellers,
- Renting place (for drying fish under the sun) owners,
- Fish landing place owners,
- Fish handler and workers at landing sites, dais, and markets
- Boat makers ,
- Boat, motor-taxi, and other vehicle drivers,
- Ice and salt suppliers,
- Fisheries officers,
- Fish and fisheries researchers, and
- Economic and military police, and local authorities, and

6.13 Prices of low value fish

The prices of fresh low value fish varied according to five major factors: (1) dai LVF production, (2) level of LVF demands, (3) LVF fish species caught, (4) time of LVF sale, and (5) numbers of LVF buyers (Fig. 13). All respondents reported that dai LVF catch was the most important factor to change LVF prices. Interestingly, different types of buyers bought LVF with different prices (Fig. 14). LVF drying operators usually bought LVF with the cheapest price, from dai operators at night time. Rice farmers (i.e. small-scale *prahok* operators) often bought LVF with the most expensive price, from traders at day time. There was a difference price of 20 – 100 Riel per kilo of fresh low value fish from one transaction to the other at landing sites (Fig. 14 & 15). For example, the different price per kilo of LVF from traders to rice farmers was 48 Riel (Fig. 14).

Figure 13 Major factors affecting low value fish price (March, 2007)

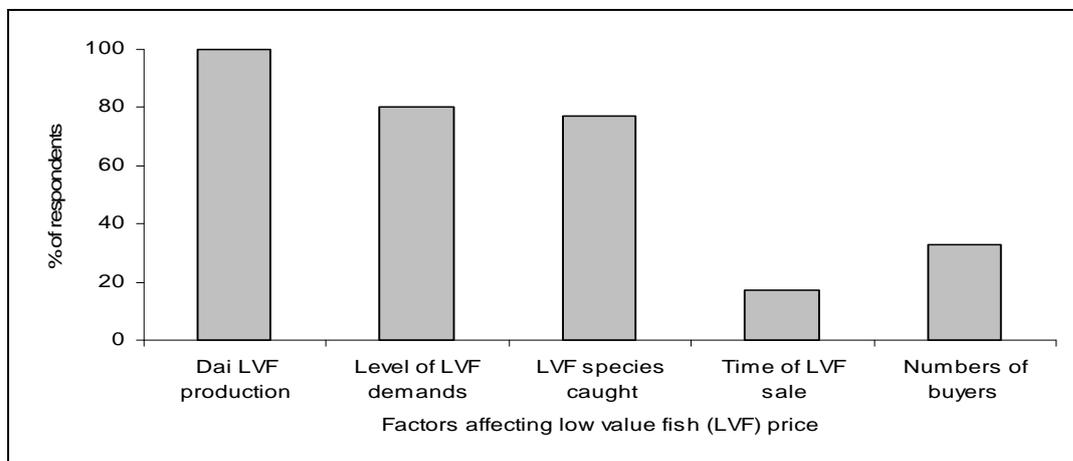
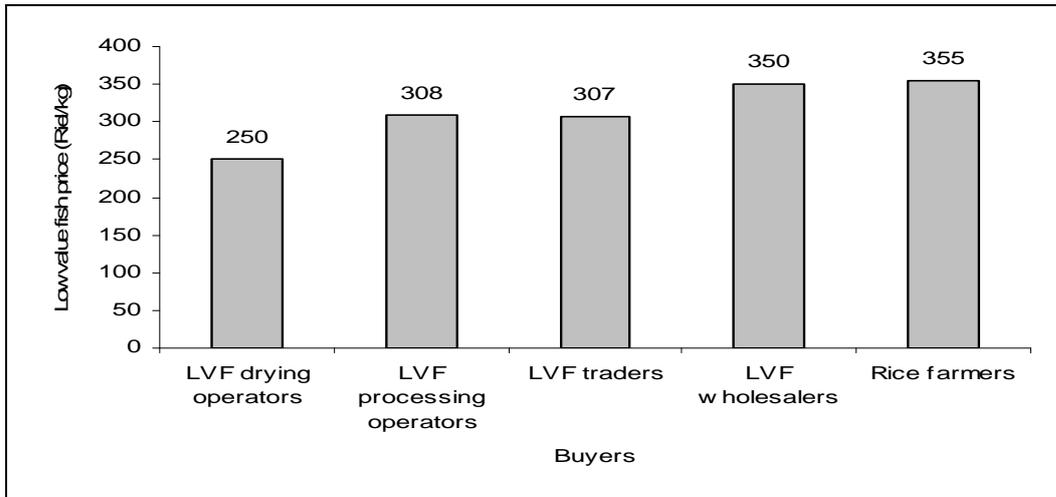


Figure 14 Prices of fresh low value fish at landing sites in 2006-2007 (March, 2007)



The prices fresh low value fish (Fig. 15), *prahok* (Fig. 16) and dried fish gradually increased for the past ten year at Tonle Sap landing sites due to several combined factors: (1) changes in LVF catches, (2) increases in local and external market demands, (3) higher dai operating costs, particularly labor, and dai and other related fishing gear/equipment costs), and (4) population growth. Both dai operators' and traders' selling prices of fresh low value were shown in Figure 15. As mentioned in the above paragraph, the different selling prices varied from around 20 to 100 Riel/kg. Fresh LVF price, on average, increased from 65 Riel/kg in 1997-98 to 308 Riel/kg in 2006-07; *prahok* from 395 Riel/kg in 1997-98 to 1,817 Riel/kg in 2006-07; and dried LVF increased from 215 Riel/kg in 1997-98 to 1,150 Riel/kg in 2006-07. Unfortunately, the price of *prahok* has decreased for the past two seasons (2005-06 & 2006-07) mainly due to the hygienic and quality problems.

Figure 15 Trends of fresh low value fish price at Tonle Sap landing sites (March, 2007)

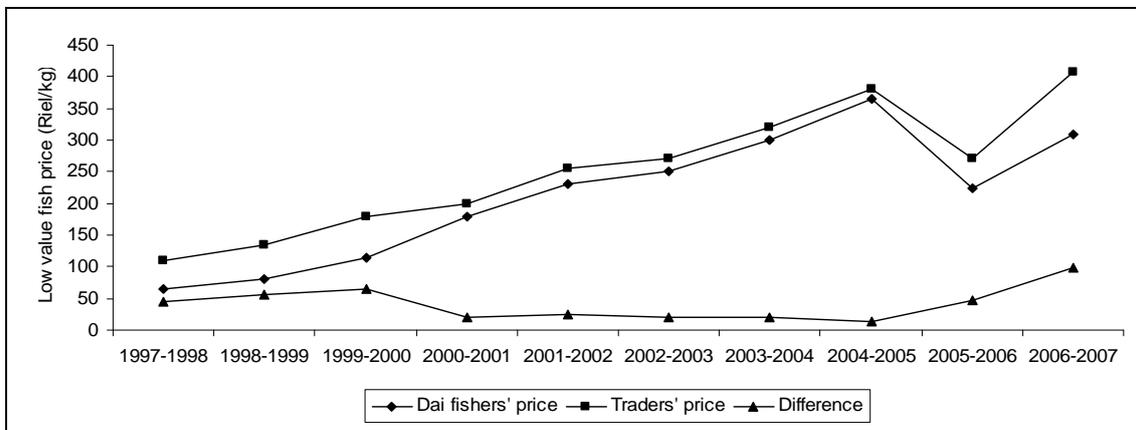


Figure 16 Trends of low value fish *prahok* price at Tonle Sap landing sites (March, 2007)

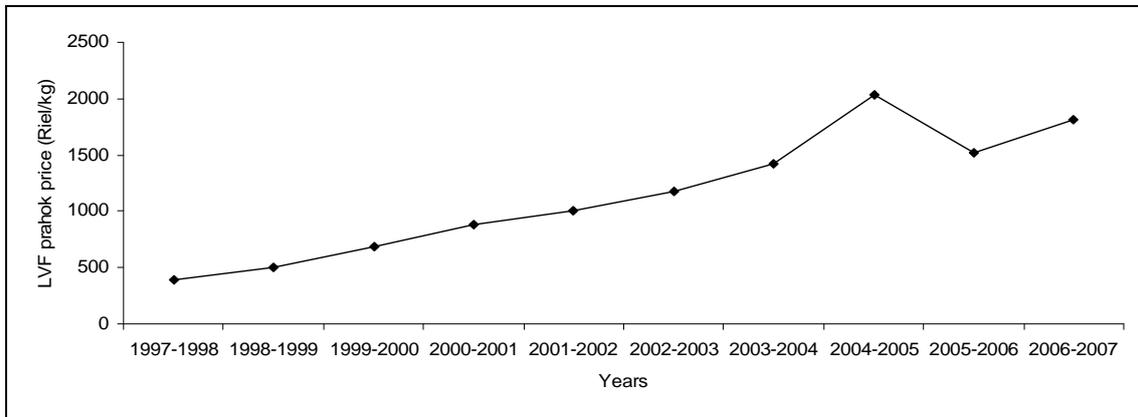
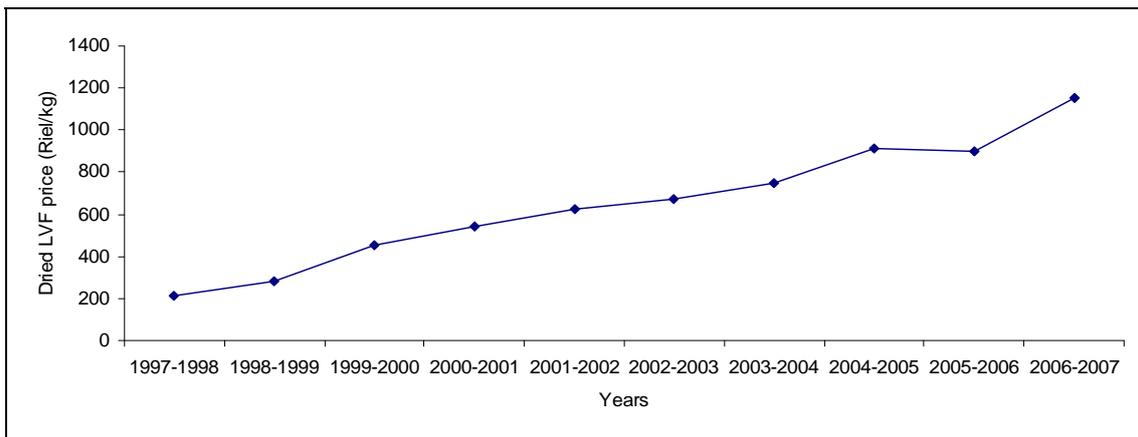


Figure 17 Trends of dried low value fish price at Tonle Sap landing sites (March, 2007)



7. Economic analysis of *dai* fishery

Dai fishery operation business along Tonle Sap River is generally profitable. All surveyed dai operators made profits from selling low value fish to many stakeholders described in the above market chain (Table 4). On average, each dai operator earned a profit rate of Riel 31,097,558 (US\$ 7,678) in 2006-07 fishing season. The highest (max.) profit was Riel 78,845,000 (US\$ 19,468) made by the operator of dai # 14A, while the lowest (min.) one was Riel 1,050,000 (US\$ 259) made by the operator of dai # 11C. The total expenditure per dai was averaged at Riel 60,397,680 (US\$ 14,913), varying from Riel 39,385,000 (US\$ 9,725) to Riel 106,070,000 (US\$ 26,190). The highest cost was due to equipment, contributing 31% to the total costs, followed by

labor cost (23%), official fees (23%), food cost (16%), and fuel cost (5%), while the lowest cost was for unofficial fee payment (2%). The profit margin of the dai operation business was averaged at around 51%, ranging from 3% to 74%.

Table 4 Financial balance and profits of dai fishery operation in 2006-2007 in Tonle Sap River (March, 2007)

| Dai ID # | Expenditure (Riel) | | | | | Official fee | Un-official fee | Total expenditure (Riel) | LVF production (kg) | LVF price (Riel/kg) | Total income (Riel) | Profit (Riel) |
|----------|--------------------|-----------|------------|------------|------------|--------------|-----------------|--------------------------|---------------------|---------------------|---------------------|---------------|
| | Equipment | Fuel | Labor | Food | | | | | | | | |
| 12B | 18,225,000 | 5,000,000 | 21,750,000 | 12,000,000 | 7,000,000 | 1,860,000 | 65,835,000 | 302,610 | 290 | 87,756,900 | 21,921,900 | |
| 11C | 20,250,000 | 3,750,000 | 16,000,000 | 10,500,000 | 36,800,000 | 1,650,000 | 88,950,000 | 300,000 | 300 | 90,000,000 | 1,050,000 | |
| 15C | 20,250,000 | 5,000,000 | 17,500,000 | 2,250,000 | 21,000,000 | 120,000 | 66,120,000 | 361,560 | 300 | 108,468,000 | 42,348,000 | |
| 11A | 20,250,000 | 4,000,000 | 10,800,000 | 3,000,000 | 42,600,000 | 2,610,000 | 83,260,000 | 455,225 | 300 | 136,567,500 | 53,307,500 | |
| 12C | 20,250,000 | 5,000,000 | 21,150,000 | 12,000,000 | 6,500,000 | 1,910,000 | 66,810,000 | 341,910 | 270 | 92,315,700 | 25,505,700 | |
| 8H | 18,225,000 | 4,000,000 | 16,700,000 | 12,000,000 | 18,000,000 | 1,560,000 | 70,485,000 | 317,020 | 300 | 95,106,000 | 24,621,000 | |
| 10C | 18,225,000 | 3,040,000 | 17,700,000 | 10,800,000 | 34,125,000 | 1,690,000 | 85,580,000 | 357,630 | 320 | 114,441,600 | 28,861,600 | |
| 8F | 20,250,000 | 2,000,000 | 5,000,000 | 15,000,000 | 15,000,000 | 1,580,000 | 58,830,000 | 309,160 | 350 | 108,206,000 | 49,376,000 | |
| 14A | 20,250,000 | 3,500,000 | 6,500,000 | 7,500,000 | 9,500,000 | 1,630,000 | 48,880,000 | 510,900 | 250 | 127,725,000 | 78,845,000 | |
| 10B | 20,250,000 | 2,250,000 | 8,600,000 | 7,500,000 | 18,375,000 | 1,740,000 | 58,715,000 | 361,560 | 250 | 90,390,000 | 31,675,000 | |
| 7C | 18,225,000 | 3,000,000 | 5,500,000 | 7,000,000 | 4,600,000 | 1,060,000 | 39,385,000 | 212,875 | 350 | 74,506,250 | 35,121,250 | |
| 10D | 18,250,000 | 1,400,000 | 19,000,000 | 12,000,000 | 18,700,000 | 1,390,000 | 70,740,000 | 351,735 | 300 | 105,520,500 | 34,780,500 | |
| 14C | 18,250,000 | 5,000,000 | 18,675,000 | 15,000,000 | 5,500,000 | 1,060,000 | 63,485,000 | 448,020 | 250 | 112,005,000 | 48,520,000 | |
| 3D | 15,000,000 | 1,620,000 | 10,000,000 | 3,000,000 | 10,200,000 | 400,000 | 40,220,000 | 235,800 | 300 | 70,740,000 | 30,520,000 | |
| 6C | 18,225,000 | 2,175,000 | 18,000,000 | 10,500,000 | 9,000,000 | 720,000 | 58,620,000 | 195,000 | 310 | 60,450,000 | 1,830,000 | |
| 4D | 14,175,000 | 3,000,000 | 13,000,000 | 12,000,000 | 10,000,000 | 400,000 | 42,575,000 | 235,800 | 300 | 70,740,000 | 28,165,000 | |
| 4B | 16,200,000 | 1,250,000 | 15,000,000 | 12,000,000 | 14,000,000 | 730,000 | 59,180,000 | 189,950 | 350 | 66,482,500 | 7,302,500 | |
| 3A | 16,200,000 | 1,500,000 | 10,030,000 | 15,000,000 | 5,100,000 | 430,000 | 48,260,000 | 235,800 | 300 | 70,740,000 | 22,480,000 | |
| 3B | 14,175,000 | 3,750,000 | 10,600,000 | 9,000,000 | 7,200,000 | 400,000 | 45,125,000 | 281,650 | 320 | 90,128,000 | 45,003,000 | |
| 6E | 14,175,000 | 2,800,000 | 12,750,000 | 15,000,000 | 2,250,000 | 700,000 | 47,675,000 | 157,200 | 400 | 62,880,000 | 15,205,000 | |
| 5B | 20,250,000 | 3,000,000 | 10,800,000 | 10,500,000 | 132,000 | 400,000 | 45,082,000 | 242,350 | 320 | 77,552,000 | 32,470,000 | |
| 5D | 20,250,000 | 3,750,000 | 10,500,000 | 10,000,000 | 14,000,000 | 400,000 | 44,900,000 | 209,600 | 450 | 94,320,000 | 49,420,000 | |
| 9B | 16,200,000 | 2,500,000 | 18,225,000 | 8,500,000 | 10,000,000 | 150,000 | 55,575,000 | 302,610 | 250 | 75,652,500 | 20,077,500 | |
| 2B | 18,225,000 | 1,160,000 | 9,000,000 | 7,500,000 | 13,000,000 | 700,000 | 49,585,000 | 235,800 | 250 | 58,950,000 | 9,365,000 | |
| 13A | 32,400,000 | 5,000,000 | 36,450,000 | 17,000,000 | 15,000,000 | 220,000 | 106,070,000 | 582,950 | 250 | 145,737,500 | 39,667,500 | |
| Average | 18,665,000 | 3,137,800 | 14,369,200 | 10,262,000 | 13,903,280 | 1,020,400 | 60,397,680 | 309,389 | 305 | 91,495,238 | 31,097,558 | |
| Maximum | 32,400,000 | 5,000,000 | 36,450,000 | 17,000,000 | 42,600,000 | 2,610,000 | 106,070,000 | 582,950 | 450 | 145,737,500 | 78,845,000 | |
| Minimum | 14,175,000 | 1,160,000 | 5,000,000 | 2,250,000 | 132,000 | 120,000 | 39,385,000 | 157,200 | 250 | 58,950,000 | 1,050,000 | |

Riel 4050 = US\$ 1 in March 2007

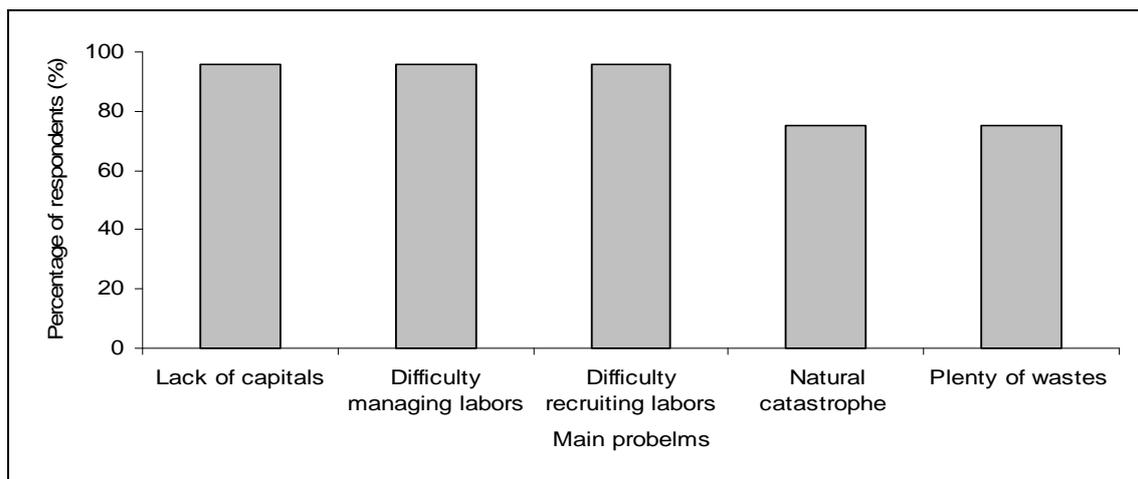
8. Major problems, future plans and suggestions

Despite dai operators made profits, they encountered several main problems (Fig. 18). Most dai operators have encountered similar problems for the past years; they included (1) lack of capitals to operate the business, (2) difficulty managing laborers, (3) difficulty recruiting laborers, (4) natural catastrophe (i.e. strong river water flows/currents and waves, and strong winds) leading to detach their dais, and (5) plenty of wastes trapped in their dais (i.e. plastic bags and tree stumps). Traders and wholesalers have also faced with the problems of (1), (2), (3) and (4), while LVF drying operators have faced with the problem of limited spaces/places for drying their fish under the sun, and medium/large-scale LVF *prahok* operators have encountered with the problem of gangs and poaching.

All dai operators in Tonle Sap River provided very quick response that they will continue their business with the same scale in the next years due to a profitable business (Table 4) and their extensive experience (Fig. 12). Similarly all traders wholesalers would like to continue the trade with the same scale due to the above encountered problems, while fish drying operators will expand their business by instructing their children to be involved in making more income to improve livelihoods as the demands

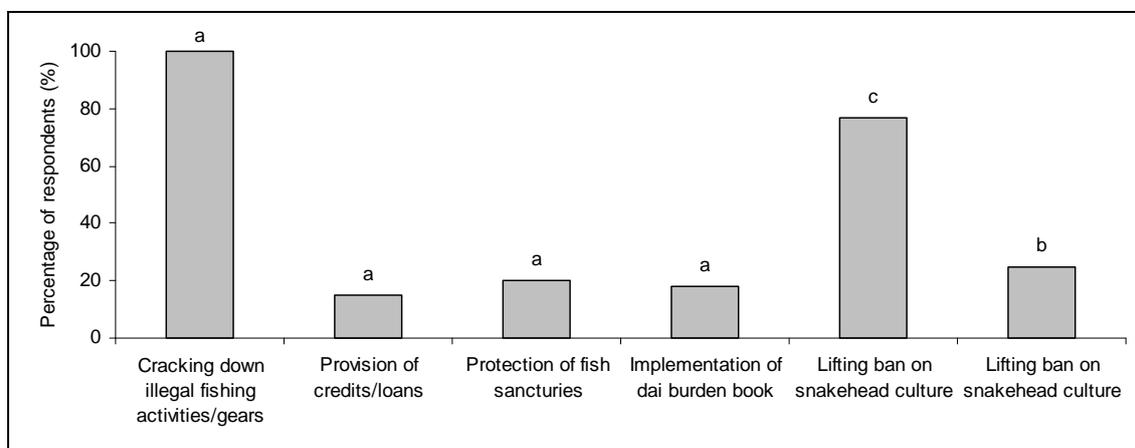
of dried fish have been increased locally and internationally in the past years. Most LVF *prahok* operators will continue their business with the same scale due to the above encountered problems, while some will expand it by involving their children and purchasing new fish head cutting machine due to increased demands of *prahok* in internal and external markets.

Figure 18 Major problems encountered by Tonle Sap dai operators and traders/wholesalers (March, 2007)



The question was asked that what suggestions you would like to proposal to make your business even more profitable and stable. All respondents provided suggestions that all illegal fishing activities/gears, including fishing in the closing season, using electro fishing gear and fine mesh-sized nets, clearing flooded forests and other activities of land encroachments (e.g. filling natural lakes/reservoirs, and ponds/pools) in Tonle Sap floodplains should be cracked down (Fig. 19). Other suggestions included provision of loans with a low interest rate, protection of fish sanctuaries in Tonle Sap Lake, and implementation of dai burden book. Interestingly, most dai operators suggested that the ban on snakehead culture by the government in September 2004 should be lifted due to several good reasons: (1) lots of snakehead farmers, including most of dai operators (See section 6.1), have lost lots of income earned by selling cultured snakeheads to local markets, but the income was not calculated here; (2) some proportions of low value fish were exported to neighboring country (Fig. 6, 7, 8 & 10) to supply its fish/animal industries; and (3) fish (including snakehead fish) and other animals (e.g. ducks, chickens and pigs) have been imported from the neighboring country to supply the increasing demands in the country, but those imported amounts could not be quantified in this study. In contrast, most of the other respondents (including traders, wholesalers, and LVF drying and *prahok* operators) had good perceptions of the ban on snakehead culture (Fig. 19).

Figure 19 Major suggestions recommended by respondents in the study (March, 2007). Note: ^a referring to all types of respondents/interviewees; ^b referring to the respondents of traders, wholesalers, and low value fish drying and *prahok* operators; ^c referring the respondent of dai operators.



9. Further research needs

Further applicable research needs and activities include the following.

- Map the flow of low value fish in the whole Cambodian Mekong River basin, including mapping the consumption patterns and their nutritional and economic values.
- Quantify the proportions of Tonle Sap dai low value fish supplied to: (1) LVF drying operators who will then supply these to fish and animal farms and CP Cambodia Co. Ltd.; (2) directly fish and animal farms as feed; (3) small, medium and large scale *prahok* operators to produce *prahok*; (4) low value fish sauce manufacture plants to produce fish sauce; and (5) Vietnamese market as human food and Vietnamese fish and animal farms as feed.
- Estimate number of actors (e.g. traders, wholesalers, small (rice farmers), medium and large scale *prahok* operators, fish drying operators, exporters, number of Vietnamese boats, and fish sauce manufacture plants) involved in low value fish trade at Tonle Sap landing sites.
- Carry out additional research on the market structure of processed low value fish (dried fish, fish sauce, and fermented fish paste, called *prahok*) in Tonle Sap River as well as other rivers of the Mekong basin in Cambodia.
- Evaluate low value fish processing practices for human consumption, and to compare the traditional processing practices with the modern ones;
- Assess key low value fish marketing fees, costs and constraints from Tonle Sap River to other provinces and municipalities in Cambodia, Vietnam and to Thailand.
- Study the role of low value fish in Phnom Penh and Kandal markets.

- Carry out additional research on the role of private and public microfinance institutions in low value fish dai fishery and marketing and trade along Tonle Sap River.
- Monitor and evaluate prices of low value fish at Tonle Sap landing sites and make them accessible to all stakeholders in the market structure.
- Examine how the aquaculture sectors need for fish resources affects fish protein availability for poor people.
- Assess the effectiveness and impact of the ban on snakehead culture in Cambodia.
- Assess diversity, composition and bio-ecological characteristics of low value fish species in Cambodia.
- Research into the ecological impacts of the use of low value fish as direct feed on wild fish populations and freshwater environments in order to provide measures for mitigation.
- Assess the catchability and fishing efforts of Tonle Sap dais in Kandal province and Phnom Penh municipality, comparing with different river flows/currents (velocity).
- Analyze the response of Tonle Sap dai low value fish catch to changes in river hydrological regime and fishing effort/catchability of dais.
- Assess stocks of low value fish species in Cambodia.

10. Conclusions

The methodology developed through extensive literature reviews and consultations with all relevant stakeholders at different levels in the market chain for low value fish trade, followed by testing in the field is very useful and applicable for this study, and will hopefully be beneficial for future studies, which are identified in Section 9 of this study.

The dai fishery of Tonle Sap River is a commercial or large-scale fishery, which operates during receding floodwaters between October and March each year in Tonle Sap River to filter migratory fish species, particularly small cyprinids of the genus *Henicorhynchus* (i.e. *trey riel* in Khmer), migrating from the Tonle Sap Great Lake floodplains, via Tonle Sap River, to the Mekong River. The total catches of all 61 dais is around 18,000 tones in the 2006-07 season, while the average catch of each dai is around 300 tones, varying from 59 tones to 603 tones. More than 95 percent of total dai fish catch is low value or small-sized fish. Of which, the most dominant species is *trey riel* (*Henicorhynchus spp.*, 52%), followed by *trey slak russey* (*Paralaubuca typus*, 20%), *trey khnorng veng* (*Dangila spp.*, 12%), and *trey bandol ampeou* (*Corica laciniata*, 5%). The size of low value fish species is declining, over the past six years, a decreasing rate of 5% per year.

Tonle Sap dai low value fish is supplied to both internal (nearly 85%) and external (around 15%) markets to use as human food (84%), and fish and other animal feed (16%).

The market chain for low value fish trade is complicated, involving tens of thousands of actors/stakeholders, many different trade routes and methods (e.g. by road and waterway), and many intermediaries (e.g. dai operators, traders, wholesalers, exporters,

processing operators, and many others). Most of these intermediaries are in debt to formal or/and informal existing financial/credit systems to support their business.

Prices are set at Tonle Sap landing sites through negotiation between dai operators and buyers relying on knowledge of the previous day's fish price and catch, and 'word-of-mouth' information on prices from other dai operators. Different types of buyers bought low value fish with different prices. The different prices per kilo of low value fish from one buyer to the other vary from Riel 20 to Riel 100. Over the past ten years, the prices of low value fish and fish products at Tonle Sap land sites increase due to several combined factors: (1) changes in LVF catches, (2) increases in local and external market demands, (3) higher dai operating costs, particularly labor, and dai and other related fishing gear/equipment costs), and (4) population growth.

Tonle Sap dai fishery operation business is generally profitable. The average amount of profit earned by each dai operator is Riel 31,097,558 (US\$ 7,678) in 2006-07 fishing season.

In the supply and market chain of Tonle Sap dai low value fish, the intermediaries encounter several major problems: (1) lack of capitals to operate the business, (2) difficulty managing laborers, (3) difficulty recruiting laborers, (4) natural catastrophe (i.e. strong river water flows/currents and waves, and strong winds) leading to detach their dais, (5) plenty of wastes trapped in their dais (i.e. plastic bags and tree stumps); (6) limited spaces for drying fish under the sun, and (7) gangs and poaching. Despite the above encountered problems, all interviewed actors will continue their business in the next years.

There are several suggestions/recommendations proposed by the above intermediaries in order to improve as well as stabilize their businesses. Those suggestions include (1) cracking down illegal fishing activities/gears, (2) provision of loans with a low interest rate, (3) protection of fish sanctuaries in Tonle Sap Lake, (4) implementation of dai burden book, and (5) lifting the ban on snakehead culture.

As this is a preliminary or exploratory study, at the end of this research, many applicable research needs and activities are proposed to in-depth analyze marketing structure, fees, costs and constraints, importance and flow, utilization and its impacts, diversity, stocks and dai catching efforts/catchability of low value fish species in Tonle Sap River as well as other rivers and their floodplains in Cambodia. The detailed primary information and data will be used to develop policy and business decisions concerning the use and management of low value fish species, including trade-offs between aquaculture/animals and human consumption.

References

- ARTHUR Robert, Eric BARAN, SO Nam, LENG Sy Vann, PRUM Sitha, PUM Sok Hourt and Yumiko KURA (2007). Influence of built structures on Fisheries in Tonle Sap basin. CNMC & WorldFish Center, Phnom Penh. 55p.
- Baran E (2005). Cambodian Inland Fisheries- Facts, Figures and Context. WorldFish Center and Inland Fisheries Research and Development Institute, Department of Fisheries, Phnom Penh. 49p.
- Baran E, van Zalinge NP & Ngor PB (2001). Analysis of the Cambodia Bagnet (dai) fishery data. ICLARM, Penang, Malaysia, Mekong River Commission Secretariat and Department of Fisheries, Phnom Penh. 50p.
- Bush SR & Le Nguyet M (2005). Fish trade, food and income security: An overview of the constraints and barriers by small-scale fishers, farmers and traders in the Lower Mekong Basin. Oxfam America, Phnom Penh. 15p.
- Bush SR (2002). Review of fish marketing in the Lao PDR. Mekong River Commission, Vientiane. 34p.
- Deap Loeung (1998). Report on fish market surveys in eleven provinces. Department of Fisheries, Phnom Penh. 19p.
- Edwards P, Le Anh T, Allan GL (2004). A survey of marine trash fish and fish meal as aquaculture feed ingredients in Vietnam. ACIAR Working Paper No. 57, Canberra. 56p.
- FiA (2007). Fisheries Statistics. Fisheries Administration, Phnom Penh.
- Halls AS, Lieng S & Ngor P (2007). Landings from Tonle Sap dai fishery in 2006-2007 above the 12-year average. *Catch and Culture* **13** (1), 7-11.
- Hap Navy & So Nam (2001). Trade, Marketing and Processing of Fisheries and Fisheries Product Review. DoF/APIP Technical Paper No. 6. Agricultural Productivity Improvement Project, Department of Fisheries, Phnom Penh. 22 pages.
- Hortle KG & Bush SR (2006). Consumption of fish and other aquatic animals in the Lower Mekong River Basin. Inland Fisheries Research and Development Institute, Department of Fisheries, Phnom Penh. 69p.
- Hortle KG, Ngor P, Hem R & Lieng S (2004). Trends in Cambodia dai fishery: floods and fishing pressure. *Catch and Culture* **10** (1): 7-9.
- Hortle KG, Ngor P, Hem R & Lieng S (2005). Tonle Sap yields record haul. *Catch and Culture* **11** (1): 3-7.
- Kaewnern M & Wangvoralak S (2003). Overview of the status and trend of trash fish from marine capture fisheries and their utilization, with special reference to aquaculture. Faculty of Fisheries, Kasetsart University, Bangkok. 12p.
- Le Xuan S, Nguyen AT, Pomeroy RS, Genio E, Garces A & Agbayani RF (1997). Marketing freshwater tbale fish in the central area of the Mekong River Delta. College of Agriculture, Cantho University, Cantho. 41p.
- Leng S (2006). Dai fish catches in 2005-2006 along Tonle Sap River. *Cambodia Fisheries Magazine* **8**, 19-25. Khmer.
- Lieng S, Yim C, & van Zalinge NP (1995). Freshwater Fisheries in Cambodia, I: The bagnet fisheries in the Tonle Sap River. *Asian Fisheries Science* **8**: 985-1000.
- Mattson NS Ngor PB, Sam A, Lieng S, Cans G, Ngor P & Hortle KG (2006). Tonle Sap dai fishery almost doubles to reach new record. *Catch and Culture* **12**: 9-12.

- Nao Thuok, So Nam, and Thor Sen Sereyvath 2001. Cambodia's Fish Processing and Marketing and Distribution of Fish and Fishery Products, focusing on Market Opportunities and Export Potentials. Paper prepared for presentation at the Conference on Export Potentials for Cambodian Fishery Products in the International Market, 6 Feb. 2001, Hotel Sofitel Cambodiana, Phnom Penh, Organized by DoF/MAFF/INFOFISH, sponsored by UN-ESCAP).
- Ngor P and Hom C (2000). Analysis of the dai catches in Phnom Penh and Kandal. In Ed Matics, KI) Proceedings of the 3rd Technical Symposim on Mekong Fisheries, 8-9 December 2000, Phnom Penh. Pp 105-113.
- Ngor P and van Zalinge NP (2001). Dai Bagenet Fisheries: 1994/95-2001. Catch Assessment Methodology and Results. Mekong River Commission, April 2001. 47p.
- Phonvisay A (2000). Fish marketing study in Vientiane, Laos. Living Aquatic Resources Research Center, Vientiane. 87p.
- Rab Mohammed A, Hap Navy, Seng Leang, Mahfuzuddin Ahmed & Katherine Viner (2005). Marketing Infrastructure, Distribution Channels and Trade Pattern of Inland Fisheries Resources Cambodia: An Exploratory Study. The WorldFish Center, Penang, Malaysia. 50p.
- Ros Kunthy & Guttman H (1997). Survey of fish marketing in Svay Rieng province, Cambodia. AIT AQUA OUTREACH, Department of Fisheries, Phnom Penh. 14p.
- So N & Nao T (1999). National Aquaculture Development Review (1984-1999) and Aquaculture Development Plan (2000-2020), Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh.
- So N, 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 Fisheries Program, Department of Fisheries, Phnom Penh.
- So N, Leng SV, Bara E & Arthur R (2006). An evaluation of fish species and genetic diversity of the Tonle Sap Great Lake, Cambodia. In "Proceedings of the International Workshop and Training on Fish Species Diversity of the Mekong River", 17-20 November 2006, Tohoku University, Sendai, Japan.
- Sung Sokunthea (1999). Fish marketing study: A case study of a fish dealing entrepreneur in Chhnouk Tru, Kampong Chhnang province, Department of Fisheries, Phnom Penh. 26p.
- Touch Seang Tana & Todd BH (2002). The inland and marine fisheries trade of Cambodia. Oxfam America, Phnom Penh. 147p.
- van Zalinge NP, Lieng S, Ngor PB, Heng K, Valbo-Jørgensen J (2002). *Status of the Mekong Pangasianodon hypophthalmus recourses, with special reference to the stocks shared between Cambodia and Vietnam. MRC Technical Paper No. 1.* Mekong River Commission, Phnom Penh.
- Vanna Sok (2005). Fish Markets in Phnom Penh, Siem Reap and Sihanouk Ville. Working paper No. 1, Department of Fisheries, Phnom Penh.

Annex A Dai operator survey form

Date: (DD, MM, YY):.....

Interviewer's Name:.....

Code No.:.....

1. Background

1.1 Name:.....Age:.....years; Sex:.....

1.2 Address (commune, district, city/province):.....

1.3 Type of fisher: Dai fisher (dai row #.....; dai ID #.....); Others:.....

1.4 Telephone:.....

1.5 Main Occupation:.....

1.6 How long have you been in this business?.....years or since:.....

1.7 Do you do this business year round, seasonal, open/closed fishing season?

.....

2. Fishing

2.1 How many months do you fish per year?.....

2.2 Where do you fish?.....

2.3 What is the total catch per year?.....Low value fish catch:.....%

2.4 How many low value fish (LVF) species do you catch per year?

| Common LVF species | During peak periods (% of total catch) | Outside peak periods (% of total catch) |
|--------------------|---|--|
| Species 1 | | |
| Species 2 | | |
| Species 3 | | |
| Species 4 | | |
| Others | | |

2.5 What are the trends of annual catch of low value fish for the past ten years?

| Year | LVF catch (tone) | Size of LVF (cm) | | | |
|-----------|---------------------|------------------|-----------|-----------|-----------|
| | | Species 1 | Species 2 | Species 3 | Species 4 |
| 2006-2007 | | | | | |
| 2005-2006 | | | | | |
| 2004-2005 | | | | | |
| 2003-2004 | | | | | |
| 2002-2003 | | | | | |
| 2001-2002 | | | | | |
| 2000-2001 | | | | | |
| 1999-2000 | | | | | |
| 1998-1999 | | | | | |
| 1997-1998 | | | | | |

2.6 How do you know about total fee per year to fish?.....

2.7 Based on what criteria do you decide or not to pay the total annual fee to fish?.....

2.8 What institution(s) charge fees?

Formal fees:

- License (from what institution? For what (fishing, trade, transport, others).....
- Provincial Fisheries Office
- Sangkat Nesaat (District Fisheries Section)
- Landing site
- Other (please specify).....

Informal fees

- Fisheries Administration
- Provincial/Municipal Fisheries Office
- Sangkat Nesaat (District Fisheries Section)
- Landing site
- Local authority
- Checkpoint
- PM (military police)
- Economic police
- Other (please specify).....

3. *Selling fish*

3.1 Whom do you sell low value fish to?

| No. | Selling fish to | Amount of LVF | | Riel/kg | Night or day time | Num. of persons |
|-----|--|---------------|--------|---------|-------------------|-----------------|
| | | Tone/year | %/year | | | |
| 1 | Wholesalers | | | | | |
| 2 | Vietnam traders | | | | | |
| 3 | Khmer traders | | | | | |
| 4 | Large and medium scale <i>prahok</i> operators | | | | | |
| 5 | Small-scale <i>prahok</i> operators (rice farmers) | | | | | |
| 6 | Fish sauce manufacturers | | | | | |
| 7 | LVF drying operators | | | | | |
| 8 | LVF landing sites | | | | | |
| 9 | Fish farms | | | | | |
| 10 | Crocodile farms | | | | | |
| 11 | Animal farms (e.g. chicken, duck,....) | | | | | |

| | | | | | | |
|----|------------------|--|--|--|--|--|
| 12 | CP company | | | | | |
| 13 | Others (specify) | | | | | |

3.2 Why the other buyers do not buy your low value fish?

| No. | Buyer | Why not buying your LVF? |
|-----|--|--------------------------|
| 1 | Wholesalers | |
| 2 | Vietnam traders | |
| 3 | Khmer traders | |
| 4 | Large and medium scale <i>prahok</i> operators | |
| 5 | Small-scale <i>prahok</i> operators (rice farmers) | |
| 6 | Fish sauce manufacturers | |
| 7 | LVF drying operators | |
| 8 | LVF landing sites | |
| 9 | Fish farms | |
| 10 | Crocodile farms | |
| 11 | Animal farms (e.g. chicken, duck, pig,...) | |
| 12 | CP company | |
| 13 | Others (specify) | |

3.3 Please draw marketing chain flow chart (Sell fish to whom and to where?). See the attached map for viewing provinces/municipalities and neighboring countries.

| No. | Seller | 2005-2007 (after ban on snakehead culture) | | Before 2005 (before ban on snakehead culture) | |
|-----|--|--|------------|---|------------|
| | | Sell to whom | From where | Sell to whom | From where |
| 1 | Wholesalers | | | | |
| 2 | Vietnam traders | | | | |
| 3 | Khmer traders | | | | |
| 4 | Large and medium scale <i>prahok</i> operators | | | | |
| 5 | Small-scale <i>prahok</i> operators (rice farmers) | | | | |
| 6 | Fish sauce manufacturers | | | | |
| 7 | LVF drying operators | | | | |
| 8 | LVF landing sites | | | | |
| 9 | Fish farms | | | | |

| | | | | | |
|----|--|--|--|--|--|
| 10 | Crocodile farms | | | | |
| 11 | Animal farms (e.g. chicken, duck, pig,...) | | | | |
| 12 | CP company | | | | |
| 13 | Others (specify) | | | | |

3.4 How much fish do you sell to the below utilization sources?

| No. | Utilization source | Amount of LVF sold | |
|-----|--|---|---|
| | | Tone/year | %/year |
| 1 | Animal feed (fish, crocodile and chicken, duck and pig) in the country | - Fish..... - Crocodile..... - Other animals... | - Fish..... - Crocodile..... - Other animal |
| 2 | Animal feed in the other countries (e.g. Vietnam, Thailand,...) | - Vietnam..... - Thailand..... | - Vietnam..... - Thailand..... |
| 3 | Human food in the country | | |
| 4 | Human food in the other countries (e.g. Vietnam, Thailand,...) | - Vietnam..... - Thailand..... | - Vietnam..... - Thailand..... |
| 5 | Others (specify) | | |

3.5 What will you decide to do with too many low value fish that cannot be sold out during the peak periods, especially at night time?.....

Are there any suggestions to solve this problem?.....

3.6 What are the main factors that affect low value fish price?.....

3.7 How do you set price with your buyers? Do you set different prices with different types of buyers?.....

3.8 How do you get price information? Do you face constraints in getting price information?.....

3.9 What is the average price per kg of low value fish over the past ten years?

| No. | Year | LVF price (Riel/kg) |
|-----|-----------|---------------------|
| 1 | 2006-2007 | |
| 2 | 2005-2006 | |
| 3 | 2004-2005 | |
| 4 | 2003-2004 | |

| | | |
|----|-----------|--|
| 5 | 2002-2003 | |
| 6 | 2001-2002 | |
| 7 | 2000-2001 | |
| 8 | 1999-2000 | |
| 9 | 1998-1999 | |
| 10 | 1997-1998 | |

- 3.10 What is the trend of low value fish trade over the past ten years?.....
.....
- 3.10.1 Are there a dai fisher (other fisher) catch more fish?.....
Why?
- 3.10.2 Are there more or less dai fishers or other fishers?.....
Why?
- 3.10.3 Are there more or less local traders in fish trade?.....
Why?
- 3.10.4 Are there are more or less foreign traders in fish trade?.....
Why?
- 3.10.5 Are there more or less large and medium scale *prahok* operators in fish trade?.....
Why?
- 3.10.6 Are there more or less small scale *prahok* operators (rice farmers) to process
fish?.....
Why?
- 3.10.7 Is the low value fish price generally lower or higher?.....
Why?
- 3.11 What is the trend of demand and supply?
- Demand increase or decrease? Why?.....
- Supply increase or decrease? Why?.....

4. Loans or credits

- 4.1 Do you (dai fisher) offer loan to trader or others? (Yes or No)
Yes (go to a, b, c) and 4.2-4.4 and 4.8
No (go to 4.5)
a. Number of traders or others who you have lent cash to:.....persons
b. Loan per trader range from.....to.....
c. Common loan per trader.....
- 4.2 Do traders or others who borrow money from you buy fish from you exclusively? If
yes, why?.....
- 4.3 Are there any traders who are not borrowers that buy fish from you?.....
.....
- 4.4 How many traders who borrow money from you and run away with loans in your
business experience? Can you take any action?.....
.....
- 4.5 Do you (dai fisher or other fisher) typically borrow money from wholesaler/trader or
others?.....
- 4.6 How much do you typically need to borrow to support your business?.....
- 4.7 What is the typical structure of these loan arrangements?.....

- 4.8 When and why do you typically get loan? (Need money to buy/repair fishing gears, ceremonies, health costs, labor costs, other expenses.....).
- 4.9 Do you sell fish at a different price to lenders compared to non-lenders?.....
- 4.10 Do you sell fish to your lender exclusively? If yes, why?.....
- 4.11 When do you have to pay back the loan (with cash, fish)?.....
- 4.12 What is the interest rate (IR)?.....

5. Economic aspects

| Item | Variable | Amount |
|----------------|--|--------|
| Fish catch | Low value fish caught per year (ton) | |
| Gear costs | Fishing gears and boats | |
| | Annual repairing costs for gears | |
| | Annual repairing costs for boats | |
| | Other expenses..... | |
| Operation cost | Gasoline/diesel used for operating dai fishery | |
| | Labor | |
| | Daily food | |
| | Other expenses..... | |
| Formal fee | Annual fee- fishing license | |
| Informal fees | Fisheries Administration | |
| | Provincial/Municipal Fisheries Office | |
| | Sangkart Nesart | |
| | Economic police | |
| | Military police | |
| | Local authority | |
| | Others (Please specify)..... | |
| Selling price | Price at which fish are sold | |

6. Problems encountered

6.1 Of the various problems you face, which are the biggest constraints/challenges you face in running your business and how do you manage/overcome with them?

.....

.....

.....

7. Future plan

7.1 In the next two years, do you plan to:

- Maintain current scale of your business
- Reduce business
- Expand business
- Close business

Explain if possible:.....
.....

8. Suggestion

8.1 What types of change would you like to see in your business in the future?

.....
.....
.....

Thank you very much for your kind cooperation

Annex B Trader/Middleperson/Collector survey form

Date: (DD, MM, YY):.....

Interviewer's Name:.....

Code No.:.....

1. Background

1.1 Name:.....Age:.....years; Sex:.....

1.2 Address (commune, district, city/province):.....

1.3 Telephone:.....

1.4 Main Occupation:.....

1.5 How long have you been in this business?.....years or since:.....

1.6 Do you do this business year round, seasonal, open/closed fishing season?.....

.....

2. Buying and selling low value fish

2.1 Who do you usually buy fish from at different times of the year? How many kilos of fish do you buy? What is the price? When do you buy fish?

| Seller | During peak migration periods | | | | During not peak migration periods | | | |
|---------------|-------------------------------|--------|---------|-----------------------|-----------------------------------|--------|---------|-----------------------|
| | Ton/year | %/year | Riel/kg | Night and/or day time | Ton/year | %/year | Riel/kg | Night and/or day time |
| Dai fishers | | | | | | | | |
| Other fishers | | | | | | | | |

2.2 What low value fish species do you buy?

| Common LVF species | During peak periods (% of total catch) | Outside peak periods (% of total catch) |
|--------------------|--|---|
| Species 1 | | |
| Species 2 | | |
| Species 3 | | |
| Species 4 | | |
| Others | | |

2.3 Please draw marketing chain flow chart of low value fish trade (buy fish from where and whom and sell fish to where and whom)

During peak migration periods

a. Year 2005-2007 (after ban on snakehead culture)

- Buy fish from whom?.....
-
- Buy fish from where?.....
-
- Number of sellers.....
- Buying price (Riel/kg).....
- Sell fish to whom?.....
-
- Buyers from where?.....
-
- Number of buyers.....
- Selling price (Riel/kg).....

b. Before Year 2005 (before ban on snakehead culture)

- Buy fish from whom?.....
-
- Buy fish from where?.....
-
- Number of sellers.....
- Buying price (Riel/kg).....
- Sell fish to whom?.....
-
- Buyers from where?.....
-
- Number of buyers.....
- Selling price (Riel/kg).....

Outside peak migration periods

a. Year 2005-2007 (after ban on snakehead culture)

- Buy fish from whom?.....
-
- Buy fish from where?.....
-
- Number of sellers.....
- Buying price (Riel/kg).....
- Sell fish to whom?.....
-
- Buyers from where?.....
-
- Number of buyers.....
- Selling price (Riel/kg).....

b. Before Year 2005 (before ban on snakehead culture)

- Buy fish from whom?.....
-

- Buy fish from where?.....
-
- Number of sellers.....
- Buying price (Riel/kg).....
- Sell fish to whom?.....
-
- Buyers from where?.....
-
- Number of buyers.....
- Selling price (Riel/kg).....

During closed fishing season

a. Year 2005-2007 (after ban on snakehead culture)

- Buy fish from whom?.....
-
- Buy fish from where?.....
-
- Number of sellers.....
- Buying price (Riel/kg).....
- Sell fish to whom?.....
-
- Buyers from where?.....
-
- Number of buyers.....
- Selling price (Riel/kg).....

b. Before Year 2005 (before ban on snakehead culture)

- Buy fish from whom?.....
-
- Buy fish from where?.....
-
- Number of sellers.....
- Buying price (Riel/kg).....
- Sell fish to whom?.....
-
- Buyers from where?.....
-
- Number of buyers.....
- Selling price (Riel/kg).....

2.4. How do you find the government ban on snakehead culture? Do you support or not supporting the ban? Why?.....

.....

.....

.....

2.5 How much fish do you sell to the below utilization sources?

| No. | Utilization source | Amount of LVF sold | |
|-----|--|---|---|
| | | Tone/year | %/year |
| 1 | Animal feed (fish, crocodile and chicken, duck and pig) in the country | - Fish..... - Crocodile..... - Other animals... | - Fish..... - Crocodile..... - Other animal |
| 2 | Animal feed in the other countries (e.g. Vietnam, Thailand,...) | - Vietnam..... - Thailand..... | - Vietnam..... - Thailand..... |
| 3 | Human food in the country | | |
| 4 | Human food in the other countries (e.g. Vietnam, Thailand,...) | - Vietnam..... - Thailand..... | - Vietnam..... - Thailand..... |
| 5 | Others (specify) | | |

2.6 Why the other buyers do not buy your low value fish?

| No. | Buyer | Why not buying your LVF? |
|-----|--|--------------------------|
| 1 | Wholesalers | |
| 2 | Vietnam traders | |
| 3 | Khmer traders | |
| 4 | Large and medium scale <i>prahok</i> operators | |
| 5 | Small-scale <i>prahok</i> operators (rice farmers) | |
| 6 | Fish sauce manufacturers | |
| 7 | LVF drying operators | |
| 8 | LVF landing sites | |
| 9 | Fish farms | |
| 10 | Crocodile farms | |
| 11 | Animal farms (e.g. chicken, duck, pig,...) | |
| 12 | CP company | |
| 13 | Others (specify) | |

2.7 What are the main factors that affect low value fish price?.....

.....

2.8 How do you set price with your buyers?.....

.....

Do you set different prices with different types of buyers?.....

.....

2.9 How do you get price information? Do you face constraints in getting price information?.....

2.10 What is the selling price of low value fish for the past ten years?

| No. | Year | LVF price (Riel/kg) |
|-----|-----------|---------------------|
| 1 | 2006-2007 | |
| 2 | 2005-2006 | |
| 3 | 2004-2005 | |
| 4 | 2003-2004 | |
| 5 | 2002-2003 | |
| 6 | 2001-2002 | |
| 7 | 2000-2001 | |
| 8 | 1999-2000 | |
| 9 | 1998-1999 | |
| 10 | 1997-1998 | |

2.11 What is the trend of low value fish trade over the past ten years?.....

2.11.1 Are there more or less local traders in fish trade?.....

Why?

2.11.2 Are there are more or less foreign traders in fish trade?.....

Why?

2.11.3 Is the low value fish price generally lower or higher?.....

Why?

2.12 What is the trend of demand and supply?

- Demand increase or decrease? Why?.....

- Supply increase or decrease? Why?.....

3 *Loan or credits associated with low value fish trade*

3.1 Do you offer loan to fishers or others (specify.....) as part of your business? (Yes or No)

Yes (go to a, b, c, 3.2, 3.3, 3.4, 3.7)

No (go to 3.5, 3.6, 3.7)

d. Number of fish dai fishers who you have lent cash to:.....persons

e. Loan per dai fisher range from.....to.....

f. Common loan per dai fisher.....

3.2 Do dai fishers who borrow money from you sell fish to you exclusively? If yes or no, why?.....

3.3 Are there any dai fisher who are not your borrowers that sell fish to you?.....

3.4 How many fishers who borrowed money from you and run away with loans in your business experience? Can you take any action?.....

3.5 Do you or other traders typically borrow money from whom (specify.....) to support your business?

- 3.6 How much do you or other traders typically need to borrow to support your/their business per year?.....
- 3.7 What is the typical structure of these loan arrangements?.....
 - When and why do you typically get loan? (Need money to buy fish, ceremonies, health costs, labor costs, other expenses.....)
- 3.8 Do you sell fish at a different price to lenders compared to non-lenders?.....
- 3.9 Do you sell fish to your lenders exclusively? If yes, why?.....
- 3.10 When do you have to pay back the loan (with cash, fish)?.....
- 3.11 What is the interest rate (IR)?.....

4 Fee associated with low value fish trade

- 4.1 Formal fees:
 4.2 Informal fees

| |
|--|
| a. Fisheries Administration |
| b. Provincial/Municipal Fisheries Office |
| c. Sangkat Nesart |
| d. Landing site |
| e. Local authority |
| f. Checkpoint |
| g. Military police |
| h. Economic police |
| i. Others (specify.....) |

5 Problems encountered

- 5.1 Of the various problems you face, which are the biggest constraints/challenges you face in running your business and how do you manage/overcome with them?

6 Future plans

- 6.1 In the next two years, do you plan to:
 - Maintain the same scale of your current business - Expand business
 - Reduce business - Close business
 Explain if possible:.....

7 Suggestions

- 7.1 What types of change would you like to see in your business in the future?

Thank you very much for your kind cooperation

Annex C Wholesaler/Distributor survey form

Date: (DD, MM, YY):.....

Interviewer's Name:.....

Code No.:.....

1. Background

1.1 Name:.....Age:.....years; Sex:.....

1.2 Address (commune, district, city/province):.....

1.3 Telephone:.....

1.4 Main Occupation:.....

1.5 How long have you been in this business?.....years or since:.....

1.6 Do you do this business year round, seasonal, open/closed fishing season?.....

2. Market chain for low value fish trade

2.1 What export companies are you affiliated with? Please specify.....

2.2 Do you sell low value fish to an export company exclusively, many exporters, traders, market retailers or/and others (specify.....)?

Where do you sell fish to? Please draw marketing chain flow chart for low value fish trade (Sell fish to whom and to where?)

c. Year 2005-2007 (after banning on snakehead culture)

Sell fish to whom and to where?.....

.....
.....
.....
.....

d. Before year 2005 (before banning on snakehead culture)

Sell fish to whom and to where?.....

.....
.....
.....
.....

2.3 How much fish do you sell to the below buyers and where do they come from or where do you sell you fish to (See attached Cambodia Map)?

▪ Fish farms:.....ton/year or%/year

Where?:.....

▪ Crocodile farm:.....ton/year or%/year

Where?:.....

▪ Chicken/duck/pig farm:.....ton/year or%/year

Where?:.....

▪ Animal meal factory/company (e.g. CP):.....ton/year or%/year

Where?:.....

▪ Large and medium scale *prahok* operatorston/year or%/year

Where?:.....

Small-scale *prahok* operators:ton/year or%/year

- Where?:.....
- Fish sauce manufacturers:ton/year or%/year
- Where?:.....
- Local markets for human food consumption:ton/year or%/year
- Where?:.....
- Local markets for animal feed (fish and other animals):ton/year or%/year
- Where?:.....
- Foreign markets for human food consumption:ton/year or%/year
- Where?:.....
- Foreign markets for animal feed (fish or other animals):ton/year or%/year
- Where?:.....

3. Buying and selling low value fish

3.1 Where and who do you usually buy fish from at different time of the year? How many traders/dai fishers/other fishers do you buy fish from?

During peak seasons:

- Where?.....
- Who?.....
- How many?.....

Out of peak periods:

- Where?.....
- Who?.....
- How many?.....

Closed fishing season

- Where?.....
- Who?.....
- How many?.....

3.2 What are typical fish species bought during different times of the year?

- Common ones: 1..... (.....%); 2..... (%.....)
- Common ones: 3..... (.....%); 4..... (%.....)
- Other species.....

3.3 How do you decide which fish to buy from fishers/traders?

- What ever is available, I buy them.
- Focus on specific fish species
- Knowledge of internal/external market demand compared to what I have to pay fishers/traders.
- Knowledge of prices at the internal/external markets compared to what I have to pay fishers/traders?
- Others (specify).....

3.4 How many tons of fish do you buy per year? When

- During peak periods:
- Dai fishers.....ton/year or%; At night or day time
- Price: R/kg fish.....
- Other fishers.....ton/year or%; Night or day time
- Price: R/kg fish.....

Traders.....ton/year or%; Night or day time
 Price: R/kg fish.....
 - Outside peak seasons:
 Dai fishers.....ton/year or%; Night or day time
 Price: R/kg fish.....
 Other fishers.....ton/year or%; Night or day time
 Price: R/kg fish.....
 Traders.....ton/year or%; Night or day time
 Price: R/kg fish.....
 - Closed fishing season:
 Dai fishers.....ton/year or%; Night or day time
 Price: R/kg fish.....
 Other fishers.....ton/year or%; Night or day time
 Price: R/kg fish.....
 Traders.....ton/year or%; Night or day time
 Price: R/kg fish.....
 Others (specify.....)
ton/year or%; Night or day time
 Price: R/kg fish.....

3.5 Who do you sell your fish to? How long does it take to buy enough fish to fill your truck (other transports)?.....

3.6 What are the main factors that affect fish price?.....

3.7 How do you set price with your buyers? Do you set different prices with different types of buyers?.....

3.8 How do you get price information? Do you face constraints in getting price information?.....

3.9 What is the average selling price per kg of fish over the past ten years?

| No. | Year | LVF price (Riel/kg) |
|-----|-----------|---------------------|
| 1 | 2006-2007 | |
| 2 | 2005-2006 | |
| 3 | 2004-2005 | |
| 4 | 2003-2004 | |
| 5 | 2002-2003 | |
| 6 | 2001-2002 | |
| 7 | 2000-2001 | |
| 8 | 1999-2000 | |
| 9 | 1998-1999 | |
| 10 | 1997-1998 | |

3.10 What is the trend of fish trade over the past ten years?

- Are there dai fishers/producers providing more or less fish?.....

Why?

- Are there more or less dai fishers/producers?.....

Why?

- Are there more or less local traders in fish trade?.....
Why?
- Are there are more or less foreign traders in fish trade?.....
Why?
- Are there more or less wholesalers/agents like you?.....
Why?
- Is the fish price generally lower or higher?.....
Why?
- 3.11 What is the trend of demand and supply?
- Demand increase or decrease? Why?.....
- Supply increase or decrease? Why?.....

4. Loan or credits associated with low value fish trade

- 4.1 Do you offer loan to fishers, traders or others (specify.....)
as part of your wholesale business? (Yes or No)
Yes (go to a, b, c, 4.2, 4.3, 4.4, 4.7) or
No (go to 4.5, 4.6, 4.7)
 - g. Number of fishers/traders who you have lent cash to:.....persons
 - h. Loan per fisher/trader range from.....to.....
 - i. Common loan per fisher/trader.....
- 4.2 Do fisher/traders who borrow money from you sell fish to you exclusively? If yes,
why?.....
- 4.3 Are there any fisher/traders who are not your borrowers that sell fish to you?.....
.....
- 4.4 How many fishers/traders who borrowed money from you and run away with loans
in your business experience? Can you take any action?.....
.....
- 4.5 Do you or other wholesalers/agents typically borrow money from export company
or others (specify.....)?
- 4.6 How much do you or others typically need to borrow to support your/their business?
.....
- 4.7 What is the typical structure of these loan arrangements?
- When and why do you typically get loan? (Need money to buy fish, ceremonies,
health costs, labor costs, other expenses.....)
.....
- Do you sell fish at a different price to export company/any difference in prices for
lenders compared to non-lenders?.....
.....
- Do you sell fish to your lender exclusively? If yes, why?.....
.....
- When do you have to pay back the loan (with cash, fish)?.....
- What is the interest rate (IR)?.....

5. Problems encountered

- 5.1 Of the various problems you face, which are the biggest constraints/challenges you
face in running your business and how do you manage/overcome with them?

.....
.....
.....

6. Future plan

6.1 In the next two years, do you plan to:

- Maintain your current business sclale
- Reduce business
- Expand business
- Close business

Explain if possible:.....
.....

7. Suggestion

7.1 What types of change would you like to see in your business in the future?

.....
.....
.....

Thank you very much for your kind cooperation