Bangus Fry Resource Assessment in the Philippines

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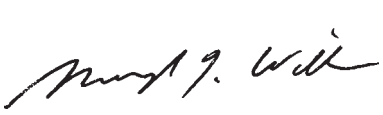
FOREWORD

Bangus or Milkfish is the Philippine 'national fish'. It is widely cultured and is generally favored by the Filipinos. The culture is traditionally based on fry collected from the wild. In the light of the growing demand for fry by the bangus industry and the implications of the decline of natural fry resources, the Philippines Bureau of Fisheries and Aquatic Resources (BFAR), the Philippine Council for Aquatic and Marine Research and Development (PCAMRD), the Southeast Asian Fisheries Development Center (SEAFDEC) and ICLARM – The World Fish Center embarked on an investigation of the conditions prevailing in the milkfish fry sector.

From 1996-1998 the staff of BFAR, SEAFDEC and ICLARM made a conscientious effort to understand not only the state of the natural fry resources in relation to the growing demand for fry by the bangus industry, but also the implications for the socioeconomic conditions of the poor people who rely, for their livelihood, on fry collection and sale.

We are confident that the findings of the Bangus Fry Resource Assessment project by the researchers from all institutions will benefit both the bangus aquaculture industry in general, and the bangus fry industry in particular, not to mention the poor people in the coastal areas of the country who rely on fry gathering for their source of income.

The project was made possible by the funding from PCAMRD and BFAR, which allowed ICLARM staff to work side by side with the SEAFDEC and BFAR staff. The collaboration between ICLARM and the other agencies serves as a successful example of partnership between national, regional, and international agencies concerned with optimizing the sustainable utilization of aquatic resources for the benefit of the poorer people in a developing country. We look forward to tapping more opportunities to work collectively on developing and managing a sustainable bangus industry in the Philippines and improving the well-being of those who depend on this resource for their livelihoods.



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PREFACE

During a tripartite meeting held in October 1995 involving ICLARM Director General, Dr. Meryl Williams; SEAFDEC-AQD Chief, Dr. Efren Ed. Flores; and Mr. Rolando Edra representing the Executive Director of PCAMRD, Dr. Rafael Guerrero, concern was raised about the scarcity of milkfish (bangus, *Chanos chanos*) fry, the increasing demand for fry and the resulting increase in the price in the Philippines. Though research agencies and private sector interests are working on the establishment of hatcheries to develop additional sources of supply, it was considered necessary to assess the availability of natural fry and the impact of a decline in the availability and other related developments on the coastal people who are dependent on the gathering and trading of milkfish fry on a small scale.

It was suggested by PCAMRD that a study be made of the *sabalo* (adult milkfish broodstock) fishery to assess the condition of the fry resources. However, it was not considered feasible to collect data on the *sabalo* population as fishing of broodstock is banned. The best alternative was to make an assessment of the natural fry industry itself. This led to the project on the Bangus Fry Resource Assessment.

In December 1995 PCAMRD and BFAR committed funds for the project. ICLARM and SEAFDEC committed staff time and travel funds for a collaborative study. Five sites were selected for the study, one each in Regions I (Currimao, Ilocos Norte), IV (Palawan), VI (Antique), VII (Bohol), and XI (General Santos City) of the Philippines.

Project field activities officially started in mid-March 1996. Data collection took twelve months and was completed in mid-May 1997. The designated regional field coordinators of BFAR assisted at the five study sites. The ICLARM, BFAR and SEAFDEC staff were responsible for the monitoring and supervision of all field sites during the field data gathering.

A project workshop was held in February 1997. The workshop was attended by the regional coordinators from the five Regions and project staff from BFAR, SEAFDEC, and ICLARM. The role of the regional coordinators was reviewed during the workshop. An assessment was made of the possibility of gathering time-series data on catch and effort for fry production from the major producing regions in addition to a survey on fry trading and gathering activities in the field sites. A preliminary attempt was made to identify coastal environmental parameters and human development factors affecting the productivity of spawning/nursery grounds in the project sites. The baseline information already collected was reviewed. The regional coordinators were requested to gather additional information to support this data.

Although most of the primary data collection was completed within the planned twelve-month period, the transmission of the data from the field and verification and analysis were delayed. This was due to the change of project staff assigned by ICLARM. The former Director of BFAR, Dr. Arsenio Camacho, made an additional allocation of funds for the collection of data for production and input used from different types of milkfish production systems in order to estimate the fry requirements of the milkfish aquaculture industry. This final round of data collection strengthened the analysis of this report.

Many colleagues from ICLARM, SEAFDEC and BFAR took part in the planning and execution of field data gathering for the project. Their invaluable contributions are as gratefully acknowledged below. Three former staff of the project namely Ms. Annabelle Trinidad, Mr. John Marie Gacutan and Ms. Marites Tiongco provided substantial technical inputs to the project. The conception of the project as well as its implementation would not have been possible without the support of Mr. Dennis Araullo and Dr. Arsenio Camacho, former Directors of BFAR; and Mr. Malcolm Sarmiento Jr, current Director of BFAR; Dr. Rafael D. Guerrero, Executive Director of PCAMRD; Dr. Efren Ed Flores (former Chief) and Dr. Rolando Platon, current Chief of SEAFDEC-AQD; Dr. Meryl J. Williams (Director General) and Dr. Peter Gardiner (Deputy Director General) of ICLARM. The team would also like to acknowledge the assistance of the following individuals who have, in one way

or another, been part of this project: Mrs. Simeona Aypa, Mr. Nemencio Arevalo, Mr. Francisco Santos and Mr. Isidro Velayo, Jr., all from BFAR; Mr. Jose Razon, Jr. and Ms. Rosalie Joven, both from SEAFDEC; Mr. Len Garces, Mr. Maximin O. Luna and Ms. Florabelle Gagalac of ICLARM; and the following regional coordinators for field coordination: Dr. Julita Ungson, MMSU, Batac, Ilocos Norte; Ms. Tutu Almonte, Office of the City Agriculturist, Puerto Princesa, Palawan; Ms. Mary Lou Estomata (deceased), DA-LGU, Antique; Mr. Jose Belga, DA-PAFCO, Bohol and Mr. George Campeon, DA-General Santos City.

The Authors

EXECUTIVE SUMMARY

During 1996-1998, BFAR, SEAFDEC, PCAMRD, and ICLARM collaborated in a project entitled *Bangus Fry Resource Assessment in the Philippines* to investigate the scarcity of milkfish fry in the Philippines and to explain the reasons for this. Specifically the project aimed to:

- monitor fry production in selected sites in the Philippines for a period of one year;
- assess the current demand for milkfish fry; and
- provide on-the-job training on data collection and recommend a system for continuous collection of data on fry production.

Sites were selected in five important fry producing regions of the country for the investigation of fry gathering activities over a twelve-month period during 1996-97. The sites were:

(i) Currimao, Ilocos Norte;
(ii) Puerto Princesa, Palawan;
(iii) Dauis, Guindulman, Jagna, Loay, and Tagbilaran in Bohol;
(iv) Pandan, Antique; and
(v) Kiamba, Sarangani.

A total of 194 fry gatherers were selected for interview based on the criterion of having at least 5 years experience in fry gathering. In addition, 13 fry traders and 44 milkfish producers were interviewed. BFAR's and SEAFDEC's own records and observations by their staff during field visits were used to supplement the data and analysis. Structured interviews, using a questionnaire, were conducted on all three groups (i.e., fry gatherers, fry traders and milkfish producers) covered by the study.

Survey results show a strong perception among the fry gatherers that milkfish fry production from natural stocks is declining. The reasons given for the decline are: pollution, loss or degradation of coastal habitats, overexploitation of fishery resources and a decline in the *sabalo* population. Ninety-five percent of the fry gatherers believe that the primary reason for the decrease in fry production is the decline in the *sabalo* population. Data generated by the study based on a one-year catch monitoring record show a declining trend in catch during both peak and lean months when compared to the historic data for the same site.

On the other hand, there are indications of a growing demand for fry in recent years. This is attributable to two factors. The first is a shift from traditional or extensive culture systems to semi-intensive and intensive or high-density culture systems. The second is the shift from prawn farming to milkfish farming. This shift is due to the collapse of the prawn farming industry. Because of the lack of reliable data on the size of land and water area under milkfish aquaculture and the rate of stocking, a preliminary estimate of the total demand for milkfish fry was made from a survey on production technology and stocking rates of milkfish producers. The estimate indicates a current annual demand for milkfish fry of 1.65 billion nationally. It is not possible to make a more definite estimate of fry scarcity or the level of deficit in supply because of incomplete information on alternative sources of supply such as imports. A definite conclusion is that fry availability from the wild is highly seasonal and its abundance fluctuates over time and space. The natural supply is unable to cope with the year round demand for fry for grow-out operations, even though the producers use various mechanisms (e.g., stunting the fry in nurseries or staggering the production cycle) to even out the gaps in the supply of fry.

This points to a need to develop a framework for monitoring natural fry resources and to develop a greater local participation over the management of fry gathering activities.

Hatcheries are seen as an increasingly important source of supply of fry for milkfish aquaculture. While the supply from the wild is decreasing, hatcheries are improving their technology for fry and fingerling production. This could mean competition for fry gatherers. Most milkfish producers place a higher value on wild-caught fry relative to hatchery-bred, so there is still a good market for the fry from the wild. However, this may change once the hatchery industry gets well established.

To ensure a stable and sustainable supply of fry to meet the growing demand of the milkfish industry it is necessary to develop: sources of fry supply, including hatcheries; a greater acceptability of hatchery produced fry by fish farmers; a reliable and efficient fry distribution system; and information on price and quality.

Based on the findings of this study and from the National Bangus Forum 99 (held in Mactan City, Cebu on 14 June 1999), the following recommendations are made for follow-up research and extension activities that will further help sustain the milkfish fry industry, including fry gathering and fry trading:

- Monitor fry gathering activities in the selected sites for a clearer understanding of production trends and management impacts;
- Devise a simple system for monitoring and data gathering;
- Understand and analyze the role of middlepersons and the private sector in the production and distribution of hatchery produced fry;
- Develop institutional mechanisms for the implementation and enforcement of fishery rules and regulations relating to catching *sabalo*, destructive fishing, fry gathering and fry smuggling; and
- Provide information campaigns, and financial and moral support for enforcement of regulations, to complement institutional devolution (e.g., community-based management) and legal enforcement of rules and regulations.

1. Introduction

Milkfish (bangus: *Chanos chanos*) fry for stocking can be collected in almost all coastal waters of the Philippines. It is most abundant in areas with narrow littoral regions but scarce in places with extensive tidal flats or in shallow inland bays with relatively low water salinity. The fry gathering grounds are generally administered by the contiguous towns or municipalities, with limited technical supervision by the national government through the field offices of the Department of Agriculture (Rabanal and Delmendo 1993).

1.1 Milkfish Production

Production data show a decline in milkfish production as well as a decreasing share of milkfish in total aquaculture and fish production. The production of milkfish declined from 225 026 t in 1981 to 150 151 t in 1996. The share of milkfish production in total aquaculture production declined from 88% in 1981 to 45% in 1996. It should be noted that total aquaculture production increased substantially during the period 1980-1996 as a result of a widespread adoption of the culture of tilapia and shrimp (Fig. 1).

A shortage in the supply of milkfish fry is said to be the main factor responsible for the decline in milkfish production. Although there are no firm estimates of the extent of milkfish fry shortage, data from the Department of Agriculture (DA) indicate that the milkfish fry deficit in 1995 was about 1.6 billion. This is based on the DA's estimate of a fry requirement of 1 726 million pieces less local fry production of 160.7 million. Disaggregated data by regions show that the biggest gaps between demand and supply of fry are observed in Region I and Region VI accounting for 65% of the total fry deficit in the country (Table 1). There are no details of how fry production has been estimated. The source of supply of the fry required for the production of over 150 000 t of milkfish is not well documented. The general understanding is that it is imported from neighboring countries.

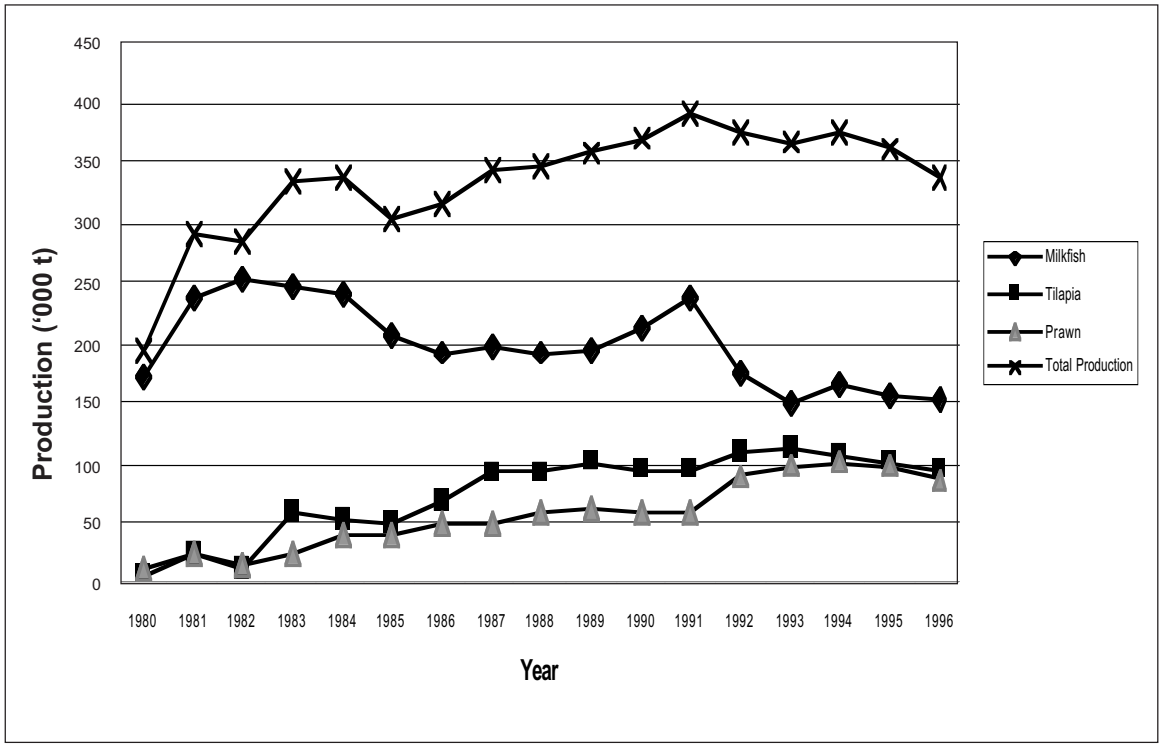


Figure 1. Production of milkfish, shrimp/prawn and tilapia in the Philippines, 1980-1996.
Source: FishBase 1998.

Table 1. Wild fry production and estimated requirement by region, 1995.

Region	Fry production	Fry requirement	Estimated deficit
I	15 000 000	629 760 000	614 760 000
II	9 000 000	12 477 742	3 477 742
III	9 000 000	137 826 000	128 826 000
IV	19 771 000	189 000 000	169 229 000
V	100 000	153 030	53 030
VI	35 288 172	439 246 800	403 958 628
VII	30 703 648	85 000 000	54 296 352
VIII	2 000 000	13 200 000	11 200 000
IX	20 000 000	54 495 267	34 495 267
X	9 000 000	27 000 000	18 000 000
XI	3 600 000	57 000 000	53 400 000
XII	6 000 000	76 000 000	70 000 000
ARMM	1 200 000	5 000 000	3 800 000
Total	**160 662 820**	**1 726 158 839**	**1 565 496 019**

Source: DA–RFU in Aqua Farm News 1995.

The availability of seed from the wild and limited access to alternative sources of supply of milkfish fry are major constraints to the expansion of milkfish production in the Philippines. Natural fry come from natural spawning grounds in coastal waters that are greatly affected by seasonal conditions. Currently this source is deteriorating due to overexploitation, environmental pollution, illegal fishing, open access fishing and conflicts in use rights. Fry gatherers from various parts of the country report that the appearance of large numbers of fish predators, particularly anchovy (*Stolephorus spp.*), greatly reduces their catch (Villaluz et al. 1982). Furthermore, post harvest activities expose the fry to undue stress that results in poor survival rates (Villaluz et al. 1982). All these factors reduce the supply of local wild fry. Coupled with increasing demand for fry, they create a shortage of fry.

1.2 Fry Production in Hatcheries

Reports indicate persistent fluctuation in the supply of milkfish fry. Experienced pond operators observe that the shortage in the mid-1980s was due to illegal exports. This situation has since been controlled by government regulations. On the other hand, the shortage of fry is relieved by the import of fry from Taiwan.

To regulate the supply of fry, the Philippine government has banned exports and is implementing programs that would supplement fry supply through hatchery production. Success in induced breeding of wild adults (Liao et al. 1979; Juario et al. 1984), spontaneous maturation and spawning of captive stock (Marte and Lacanilao 1986; Emata and Marte 1990), and development of seed collection techniques from broodstock cages (Marte et al. 1988; Garcia et al. 1988) have paved the way for hatcheries to produce milkfish fry.

Reseach on hatchery production of milkfish fry was carried out in four institutions, one each in the Philippines, Taiwan, Indonesia, and Hawaii. Successful spawning in marine cages and subsequent hatching and larval rearing in tanks was achieved in the late 1970s and early 1980s in the Philippines (Juario et al. 1984; Liao et al. 1979; Marte and Lacanilao 1986). Spawning in marine earth ponds, egg hatching and rearing of larvae in land based hatcheries is done in Taiwan. In Hawaii, spawning is carried out in concrete tanks located near the facilities for egg-hatching and larval rearing.

Availability of fertilized milkfish eggs paved the way for the development of mass production techniques for seed. Milkfish fry can be produced outdoors in semi-intensive conditions, as practiced in Taiwan (Chang et al. 1993), or intensively indoors (Gapasin and Marte 1990), as is more commonly practiced in Hawaii, Indonesia, Philippines, and Taiwan. Larval rearing tanks used in intensive production vary from 3 - 5 t with initial stocking densities of 10 - 30 larvae/liter. Semi-intensive production involves the use of 200 - 300 m^2 tanks with the bottom covered with 20 cm clay overlaid with about 30 cm of sand. Initial density varies from 200 000 - 600 000 larvae/pond. There is no bottom siphoning of debris and uneaten food in the semi-intensive system, as is routinely done in intensive system. Survival at harvest in indoor tanks is higher than 30% (M.N. Duray, personal communication) while 200 000 - 600 000 fry/pond may be produced outdoors

depending on the weather, availability of food organisms, and quality of pond management (Chang et al. 1993). Recent developments in larval rearing include the use of formulated larval diets as partial or total replacement of expensive brine shrimp (*Artemia naupli*) (SEAFDEC 1995).

Since 1991, commercial hatchery techniques have been made available by Southeast Asian Fisheries Development Center – Aquaculture Department (SEAFDEC-AQD). In 1992, five milkfish hatcheries in the Philippines reported a total production of 3.3 million fry (Garcia et al. 1999). The long and expensive rearing period for broodstock used for spawning, however, made it unattractive for private operators to invest in the industry initially. However, hatchery techniques for fry production have developed rapidly over the last few years, especially, for larval rearing. Milkfish broodstock technology has been integrated with larval-rearing technology (SEAFDEC 1995).

2. Rationale and Objectives

2.1 Rationale

The alleged shortage of bangus fry in the Philippines led to a collaborative effort by BFAR, ICLARM, SEAFDEC-AQD, and the PCAMRD to verify this claim and provide inferences as to the likely causes. A Memorandum of Agreement was signed on 1 April, 1996 to undertake a project entitled *Bangus Fry Resource Assessment in the Philippines.*

The milkfish fry industry is very important to the culture and production of milkfish in the Philippines. The cost of fry is the most important cost item for the culture of milkfish (Lopez 1991). The fry industry is a well-established and highly commercialized venture.

The shortage in the supply of bangus fry can be traced to:

- resource exploitation and management, and
- degradation of the ecosystems in which fry is spawned.

Although catching of the *sabalo* is prohibited, some people in the industry claim that it occurs as incidental catch, e.g., in fish corrals and *otoshi-amis*[1] (Bagarinao et al. 1986). There are instances in which the *sabalo* is actually targeted. The deterioration of coastal waters due to land conversion and pollution increases the natural mortality of fry or decreases the productivity of spawners. Critical environmental parameters, such as temperature, level of dissolved oxygen and salinity, are factors that influence natural fry production (Lin 1969; Duenas and Young 1993). Hence, any change in environmental parameters will affect the availability of natural fry.

This study attempts to verify the issue of the scarcity of fry. An earlier study by Smith (1981) identified the existence of an artificial scarcity in the supply due to technical and pricing inefficiencies in the bangus fry industry. In recent years, imported fry and locally produced hatchery reared fry may have resulted in a better supply.

2.2 Objectives

The main objective of the project was to verify the alleged scarcity in milkfish fry and to provide inferences as to the likely causes. The specific objectives were to:

(i) Monitor fry production in selected sites in the Philippines for a period of one year;
(ii) Assess the current demand for milkfish fry; and
(iii) Provide on-the-job training on data collection and recommend a system for continuous collection of data on fry production.

[1] Stationary trap nets.

3. Research Design

3.1 Study Area

The traditional milkfish fry grounds are located:

(i) in Luzon along Cagayan in the north, extending southward along the western side except in the inner portions of Lingayen Gulf and Manila Bay, to the coastal waters of Batangas, Albay in eastern Bicol and Mindoro Island;
(ii) in Central Philippines, around Panay Island particularly Iloilo and Antique provinces, Negros, and Cebu; and
(iii) in Mindanao, along the shores of Zamboanga, Cotabato and Davao.

Study sites were selected in five regions - Region I (Currimao in Ilocos Norte); Region IV (Puerto Princesa, Palawan); Region VI (Pandan in Antique); Region VII (Guindulman, Jagna, Dauis, Loay and Tagbilaran in Bohol); and Region XI (Kiamba in Sarangani)(Fig. 2). These sites were selected based on:

(i) a significant contribution to national fry production;
(ii) the existence of previous studies/data on bangus fry; and
(iii) the feasibility of project administration.

3.2. Sample and Data Collection

For data collection, regional coordinators (RCs) for each of the five regions were identified by BFAR. Two were from the Department of Agriculture (DA) Regional Coordinating Offices (Regions VII and XI), two from the Local Government Units (LGUs) of Palawan and Antique (Regions IV and VI), and one from academe (Region I). The RCs selected 24-46 respondents for each study site (Table 2). The respondents selected had been gathering fry for at least five years. This procedure was convenient and relatively inexpensive since respondents were readily available and willing to participate.

Table 2. Number of respondents by study area, 1996 - 1997.

Region	Province	Municipality	Number of respondents	Number of fry gatherers
I	Ilocos Norte	Currimao	40	203
IV	Palawan	Puerto Princesa	42	220
VI	Antique	Pandan	42	440
VII	Bohol	Guindulman	9	321
		Jagna	11	
		Dauis	6	
		Loay	14	
		Tagbilaran	6	
XI	Sarangani	Kiamba	24	227
Total			**194**	**1 411**

Monitoring sheets were distributed to fry gatherers and fry buyers to note the fry catch from March 1996 to February 1997. Monitoring activities did not start at the same time in all the five regions. Activities in Ilocos Norte started in March; Palawan, Bohol, and Sarangani in April; and Antique in May. A socioeconomic survey of the producers of bangus was also conducted.

3.3 Limitations

This study has limitations arising from:

- logistics;
- absence of historical data from fry gatherers and traders;
- problems in accessing existing records of fry production and distribution due to bureaucratic complexities and poor data storage and retrieval systems; and
- inadequate field supervision.

Given the above limitations, access to secondary data as well as re-tracking computational records would require a considerable amount of time and effort that is not realistic within the budget and timelines of the project.

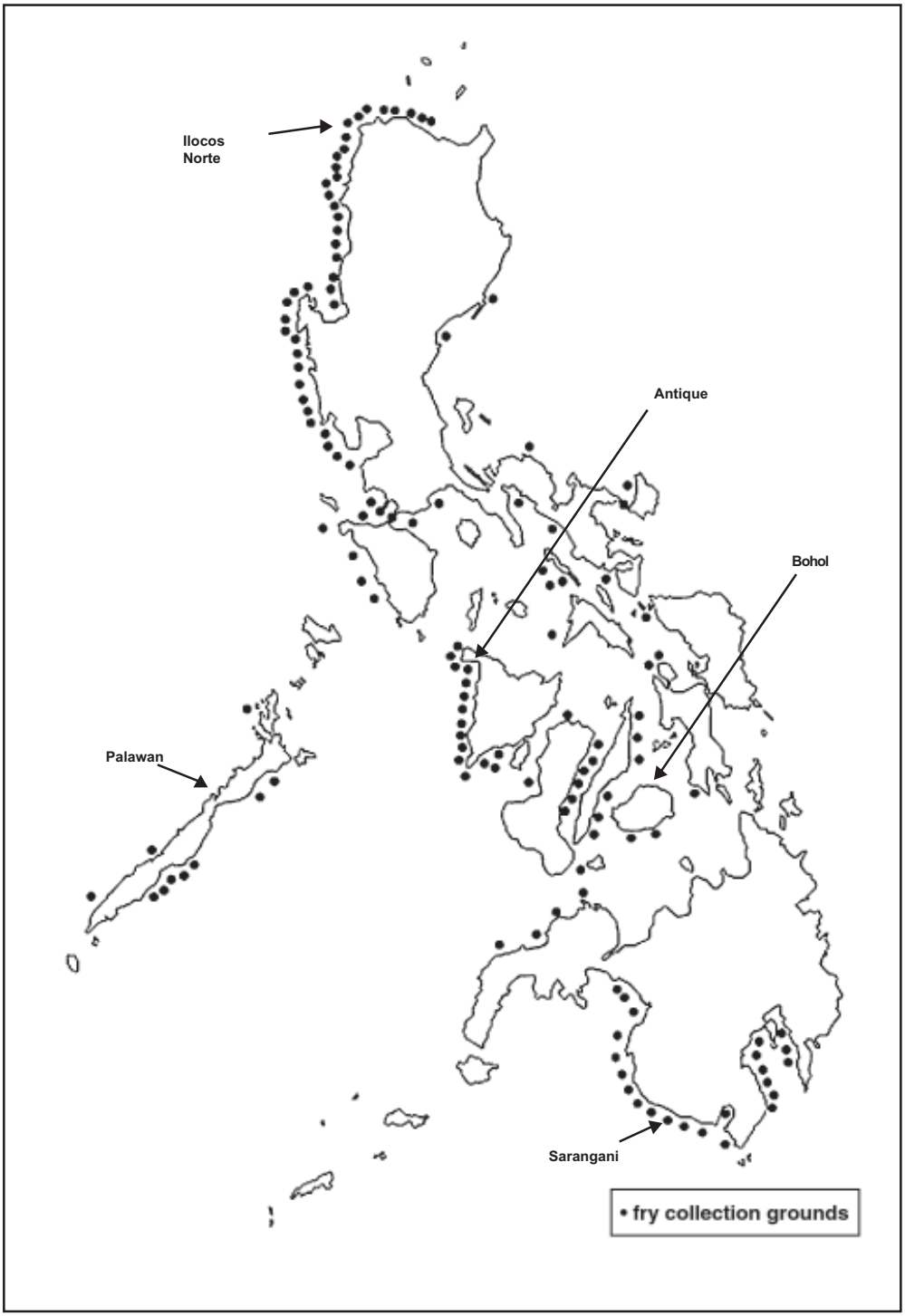


Figure 2. Collection grounds of milkfish fry in the Philippines.
Source: Ohsima 1973.

4. Results and Discussion

4.1 The Gatherers

4.1.1 Socioeconomic Characteristics

A total of 194 fry gatherers were selected in the five provinces. A minimum of 40 gatherers were targeted for each study area but only 24 respondents were available in Sarangani.

Eighty percent of the respondents in the study areas were male with ages ranging between 16 and 65 years. Respondents from Ilocos Norte, Sarangani, and Antique were within the 41-50 age group while the majority of the respondents from Bohol and Palawan were in the 21-30 age bracket.

All the respondents had some formal education: 46% had attained high school level and 1.5% had vocational education (Table 3). As fry gathering gives a steady source of supplementary income, working people with post secondary education are also attracted to this activity.

The average family size across all respondents was six, varying from five in Currimao, Ilocos Norte, and Puerto Princesa, Palawan to eight in Sarangani (Table 4) and 95% of the respondents have been involved in the activity for at least five years.

Table 3. Educational attainment of respondents, 1996 - 1997.

Province	Municipality	Elementary school		High		College		Vocational		Total	
		N	%	N	%	N	%	N	%	N	%
Ilocos Norte	Currimao	13	32.5	20	50.0	6	15.0	1	2.5	40	100.0
Palawan	Puerto Princesa	12	28.6	21	50.0	8	19.0	1	2.4	42	100.0
Antique	Pandan	26	61.9	14	33.3	1	2.4	1	2.4	42	100.0
Bohol	Dauis, Guindulman, Jagna, Loay, Tagbilaran	23	50.0	16	34.8	7	15.2	0	0	46	100.0
Sarangani	Kiamba	4	16.7	19	79.2	1	4.2	0	0	24	100.0
		78	**40.2**	**90**	**46.4**	**23**	**11.9**	**3**	**1.5**	**194**	**100.0**

During the peak season, the average monthly income from gathering fry was PhP[2] 2,709, with half of the sample earning PhP1 000 to PhP2 500 per month. During lean months, the monthly average income was PhP384, with every earning under Php1 000 (Table 4).

Fry gathering has been a traditional family activity for 58% of the respondents. They joined the fry gathering business through the influence of their neighbors and friends. They saw fry gathering as a lucrative addtional source of income to supplement their income from other sources (i.e., fishing).

In addition to fry gathering, respondents were also engaged in fishing, fish vending, daily labor, *nipa*-making, and farming. About 65% are involved in fishing (Table 6). In Kiamba, respondents were working for daily wages at the industrial establishments in Sarangani and South Catabato.

[2] US$1 = PhP27.87, 1996 - 1997

Table 4. Average family size, average number of years in fry gathering and income from fry gathering, 1996 - 1997.

Province	Municipality	*Barangay*	N	Average family size	Average no. of yrs. of fry gathering	Average income (PhP)	
						Peak	Lean
Ilocos Norte	Currimao	Gaang	20	5	18	2 738.00	940.00
		Victoria	20	5	13	1 721.00	606.00
	Subtotal/Average		*40*	*5*	*16*	*2 229.50*	*773.00*
Palawan	Puerto Princesa	Manalo	17	3	8	2 844.00	12.00
		Marayugon	25	6	11	3 284.00	50.00
	Subtotal/Average		*42*	*5*	*10*	*3 064.00*	*31.00*
Antique	Pandan	Jinalinan	6	8	10	5 083.00	500.00
		Mag-aba	10	7	13	3 850.00	275.00
		Nauring	16	7	16	3 275.00	243.00
		Patria	1	6	11	1 000.00	-
		Zaldivar	9	5	7	2 833.00	377.00
	Subtotal/Average		*42*	*7*	*11*	*3 208.20*	*279.00*
Bohol	Dauis	Mayacabac	1	3	1	800.00	280.00
		Poblacion	5	3	7	1 520.00	232.00
	Guindulman	Tabajan	9	6	19	1 555.00	222.00
	Jagna	Bunga Mar	1	7	20	1 000.00	150.00
		Can-upao	3	5	13	767.00	150.00
		Looc	5	3	14	1 120.00	220.00
		Pagina	1	8	23	5 000.00	400.00
		Poblacion	1	4	19	3 000.00	500.00
	Loay	Alegrea Sur	14	6	11	1 745.00	167.00
	Tagbilaran	Bool Junction	6	6	11	1 450.00	385.00
	Subtotal/Average		*46*	*5*	*14*	*1 795.70*	*270.60*
Sarangani	Kiamba	Kayupo	2	9	9	1 800.00	275.00
		Kling	14	9	9	1 800.00	275.00
		Lagundi	8	6	4	4 175.00	825.00
	Subtotal/Average		*24*	*8*	*7*	*2 591.67*	*458.33*
			194	**6**	**12**	**2 577.81**	**362.39**

Table 5. Reasons for engaging in the fry gathering business, 1996 - 1997.

Province	Municipality	*Barangay*	Reasons for engaging in fry gathering					
			Family tradition		Other *		Total	
			N	%	N	%	N	%
Ilocos Norte	Currimao	Gaang	18	45.0	2	5.0	20	50.0
		Victoria	7	17.5	13	32.5	20	50.0
	Subtotal		*25*	*62.5*	*15*	*37.5*	*40*	*100.0*
Palawan	Puerto Princesa	Manalo	*15*	*35.7*	*2*	*4.8*	*17*	*40.5*
		Marayugon	24	57.1	1	2.4	25	59.5
	Subtotal		*39*	*92.9*	*3*	*7.1*	*42*	*100.0*
Antique	Pandan	Jinalinan	2	4.8	4	9.5	6	14.3
		Mag-aba	6	14.3	4	9.5	10	23.8
		Nauring	1	2.4	15	35.7	16	38.1
		Patria	0	0.0	1	2.4	1	2.4
		Zaldivar	2	4.8	7	16.7	9	21.4
	Subtotal		*11*	*26.2*	*31*	*73.8*	*42*	*100.0*
Bohol	Dauis	Mayacabac	0	0.0	1	2.2	1	2.2
		Poblacion	3	6.5	2	4.3	5	10.9
	Guindulman	Tabajan	4	8.7	5	10.9	9	19.6
	Jagna	Bunga Mar	0	0.0	1	2.2	1	2.2
		Can-upao	2	4.3	1	2.2	3	6.5
		Looc	3	6.5	2	4.3	5	10.9
		Pagina	0	0.0	1	2.2	1	2.2
		Poblacion	1	2.2	0	0.0	1	2.2
	Loay	Alegrea Sur	10	21.7	4	8.7	14	30.4
	Tagbilaran	Bool Junction	6	13.0	0	0.0	6	13.0
	Subtotal		*29*	*63.0*	*17*	*37.0*	*46*	*100.0*
Sarangani	Kiamba	Kayupo	2	8.3	0	0.0	2	8.3
		Kling	3	12.5	11	45.8	14	58.3
		Lagundi	3	12.5	5	20.8	8	33.3
	Subtotal		*8*	*33.3*	*16*	*66.7*	*24*	*100.0*
			112	**57.7**	**82**	**42.3**	**194**	**100.0**

* Includes influence of neighbors and friends

Table 6. Other sources of income for fry gatherers, 1996 - 1997.

Province	Municipality	*Barangay*	OTHER SOURCES OF INCOME																	
			Fishing		Fish vending		Nipa making		Farming		Daily labor		Jeepney driving		Private service		Others *		Total	
			N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Ilocos Norte	Currimao	Gaang	18	45.0	-	-	-	-	-	-	1	2.5	-	-	1	2.5	-	-	20	50.0
		Victoria	16	40.0	-	-	-	-	2	5.0	-	-	1	2.5	1	2.5	-	-	20	50.0
	Subtotal		*34*	*85.0*	*-*	*-*	*-*	*-*	*2*	*5.0*	*1*	*2.5*	*1*	*2.5*	*2*	*5.0*	*-*	*-*	*40*	*100.0*
Palawan	Puerto Prinsesa	Manalo	6	15.4	2	5.1	4	10.3	-	-	-	-	-	-	1	2.6	1	2.6	14	35.9
		Marayugon	10	25.6	2	5.1	8	20.5	2	5.1	1	2.6	-	-	2	5.1	-	-	25	64.1
	Sub-total		*16*	*41.0*	*4*	*10.3*	*12*	*30.8*	*2*	*5.1*	*1*	*2.6*	*-*	*-*	*3*	*7.7*	*1*	*2.6*	*39*	*100.0*
Antique	Pandan	Jinalinan	4	8.7	-	-	-	-	1	2.2	1	2.2	-	-	-	-	-	-	6	13.0
		Mag-aba	5	10.9	1	2.2	-	-	3	6.5	1	2.2	-	-	-	-	-	-	10	21.7
		Nauring	16	34.8	2	4.3	-	-	-	-	-	-	-	-	-	-	-	-	18	39.1
		Patria	2	4.3	-	-	-	-	1	2.2	-	-	-	-	-	-	-	-	3	6.5
		Zaldivar	7	15.2	1	2.2	-	-	1	2.2	-	-	-	-	-	-	-	-	9	19.6
	Sub-total		*34*	*73.9*	*4*	*8.7*	*-*	*-*	*6*	*13.0*	*2*	*4.3*	*-*	*-*	*-*	*-*	*-*	*-*	*46*	*100.0*
Bohol	Dauis	Mayacabac	3	6.4	-	-	-	-	-	-	1	2.1	-	-	-	-	-	-	3	8.5
		Poblacion	2	4.3	-	-	-	-	-	-	1	2.1	-	-	-	-	-	-	3	6.4
	Guindulman	Tabajan	7	14.9	1	2.1	-	-	-	-	-	-	-	-	-	-	-	-	9	17.0
	Jagna	Bunga Mar	3	6.4	-	-	-	-	-	-	1	2.1	-	-	-	-	-	-	3	8.5
		Can-upao	1	2.1	-	-	-	-	-	-	-	-	-	-	-	-	1	2.1	3	4.3
		Looc	3	6.4	2	4.3	-	-	-	-	-	-	-	-	-	-	-	-	5	10.6
		Pagina	1	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2.1
		Poblacion	1	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2.1
	Loay	Alegrea Sur	8	7.0	2	4.3	-	-	-	-	3	6.4	-	-	-	-	-	-	13	27.7
	Tagbilaran	Bool Junction	5	10.6	1	2.1	-	-	-	-	-	-	-	-	-	-	-	-	6	12.8
	Subtotal		*34*	*72.3*	*6*	*12.8*	*-*	*-*	*-*	*-*	*6*	*12.8*	*-*	*-*	*-*	*-*	*1*	*2.1*	*47*	*100.0*
Sarangani	Kiamba	Kayupo		-	-	-	-	-	2	9.1	-	-	-	-	-	-	-	-	2	9.1
		Kling	8	36.4	-	-	-	-	-	-	7	31.8	-	-	3	13.6	1	4.5	19	86.4
		Lagundi		-	-	-	-	-	-	-	1	4.5	-	-	-	-	-	-	1.	4.5
	Subtotal		*8*	*36.4*	*-*	*-*	*-*	*-*	*2*	*9.1*	*8*	*36.4*	*-*	*-*	*3*	*13.6*	*1*	*4.5*	*22*	*100.0*
			126	**64.9**	**14**	**7.2**	**12**	**6.2**	**12**	**6.2**	**18**	**9.3**	**1**	**0.5**	**8**	**4.1**	**3**	**1.5**	**194**	**100.0**

***** Includes selling of vegetables, *balut*, and *sari-sari* store.

Despite the alleged scarcity of fry in the wild, 97% of the respondents did not plan to stop their involvement in fry gathering (Table 7). This is probably because the activity gives them an income with little requirement of capital. Only 3% of the respondents from the study areas in Bohol, Sarangani, Ilocos Norte, and Antique indicated that they would look for employment in big cities because fry gathering did not provide them a stable income for long-term family needs.

Table 7. Decision of respondents to abandon fry gathering activities, 1996 - 1997.

Province	Municipality	*Barangay*	Plan to cease fry gathering					
			Yes		No		Total	
			N	%	N	%	N	%
Ilocos Norte	Currimao	Gaang	1	2.5	19	47.5	20	50.0
		Victoria	-	-	20	50.0	20	50.0
	Sub-total		*1*	*2.5*	*39*	*97.5*	*40*	*100.0*
Palawan	Puerto Princesa	Manalo	-	-	17	40.5	17	40.5
		Marayugon	-	-	25	59.5	25	59.5
	Subtotal		*-*	*-*	*42*	*100.0*	*42*	*100.0*
Antique	Pandan	Jinalinan	1	2.4	5	11.9	6	14.3
		Mag-aba	-	-	10	23.8	10	23.8
		Nauring	-	-	16	38.1	16	38.1
		Patria	-	-	1	2.4	1	2.4
		Zaldivar	-	-	9	21.4	9	21.4
	Subtotal		*1*	*2.4*	*41*	*97.6*	*42*	*100.0*
Bohol	Dauis	Mayacabac	-	-	1	2.2	1	2.2
		Poblacion	-	-	5	10.9	5	10.9
	Guindulman	Tabajan	-	-	9	19.6	9	19.6
	Jagna	Bunga Mar	-	-	1	2.2	1	2.2
		Can-upao	-	-	3	6.5	3	6.5
		Looc	-	-	5	10.9	5	10.9
		Pagina	-	-	1	2.2	1	2.2
		Poblacion	-	-	1	2.2	1	2.2
	Loay	Alegrea Sur	2	4.3	12	26.1	14	30.4
	Tagbilaran	Bool Junction	-	-	6	13.0	6	13.0
	Subtotal		*2*	*4.3*	*44*	*95.7*	*46*	*100.0*
Sarangani	Kiamba	Kayupo	1	4.2	1	4.2	2	8.3
		Kling	1	4.2	13	54.2	14	58.3
		Lagundi	-	-	8	33.3	8	33.3
	Subtotal		*2*	*8.3*	*22*	*91.7*	*24*	*100.0*
			6	**3.1**	**188**	**96.9**	**194**	**100.0**

4. 1. 2 Gear Used

There are four types of gear used in the five study areas, namely: i) fry dozer or fry sweeper, ii) stationary gear, iii) *sayod/sadyap*[3] and iv) *sahid/salap*[4]. Fry dozer or sweeper is similar to *saplad*[5] but is mobile. This gear is operated by pushing it along the coastline. *Sayod/sadyap* is a collapsible net made of *sinamay* or nylon netting with a triangular frame of bamboo, usually operated by one man. *Sahid/salap* is a two-man drag seine made of *sinamay*. Stationary gear is a net mounted on bamboo frames set at the mouth of the river against the current.

Fry dozer or sweeper is used by 53% of the respondents, 100% in Pandan, 95% in Puerto Princesa, (Table 8). About 5% of the gatherers in Puerto Princesa use stationary gear to catch milkfish fry. About 54% of the fry gatherers from Bohol use *sahid/salap* and *sadyap* and the remaining 46% use fry dozers. *Sayod/sadyap* is the gear used exclusively by the gatherers in Currimao and Kiamba.

[3] fry seine, [4] drag seine, [5] set fry trap

Table 8. Type of gear used by fry gatherers, 1996 - 1997.

Province	Municipality	*Barangay*	Types of Gears									
			Fry dozer		Stationary gear		*Sayod/sadyap*		*Sahid/salap*		Total	
			N	%	N	%	N	%	N	%	N	%
Ilocos Norte	Currimao	Gaang	-	-	-	-	20	50.0	-	-	20	50.0
		Victoria	-	-	-	-	20	50.0	-	-	20	50.0
	Subtotal		-	-	-	-	*40*	*100.0*	-	-	*40*	*100.0*
Palawan	Puerto Princesa	Manalo	16	38.1	1	2.4	-	-	-	-	17	40.5
		Marayugon	24	57.1	1	2.4	-	-	-	-	25	59.5
	Subtotal		*40*	*95.2*	*2*	*4.8*	-	-	-	-	*42*	*100.0*
Antique	Pandan	Jinalinan	6	14.3	-	-	-	-	-	-	6	14.3
		Mag-aba	10	23.8	-	-	-	-	-	-	10	23.8
		Nauring	16	38.1	-	-	-	-	-	-	16	38.1
		Patria	1	2.4	-	-	-	-	-	-	1	2.4
		Zaldivar	9	21.4	-	-	-	-	-	-	9	21.4
	Subtotal		*42*	*100.0*	-	-	-	-	-	-	*42*	*100.0*
Bohol	Dauis	Mayacabac	-	-	-	-	1	2.2	-	-	1	2.2
		Poblacion	-	-	-	-	5	10.9	-	-	5	10.9
	Guindulman	Tabajan	9	19.6	-	-	-	-	-	-	9	19.6
	Jagna	Bunga Mar	1	2.2	-	-	-	-	-	-	1	2.2
		Can-upao	3	6.5	-	-	-	-	-	-	3	6.5
		Looc	5	10.9	-	-	-	-	-	-	5	10.9
		Pagina	1	2.2	-	-	-	-	-	-	1	2.2
		Poblacion	1	2.2	-	-	-	-	-	-	1	2.2
	Loay	Alegrea Sur	1	2.2	-	-	-	-	13	28.3	14	30.4
	Tagbilaran	Bool Junction	-	-	-	-	2	4.3	4	8.7	6	13.0
	Subtotal		*21*	*45.7*	-	-	*8*	*17.4*	*17*	*37.0*	*46*	*100.0*
Sarangani	Kiamba	Kayupo	-	-	-	-	2	8.3	-	-	2	8.3
		Kling	-	-	-	-	14	58.3	-	-	14	58.3
		Lagundi	-	-	-	-	8	33.3	-	-	8	33.3
	Subtotal		-	-	-	-	*24*	*100.0*	-	-	*24*	*100.0*
			103	**53.1**	**2**	**1.0**	**72**	**37.1**	**17**	**8.8**	**194**	**100.0**

4.1.3 Production Trends

Fry gatherers were asked about their observations on the environmental changes that have occurred in the fry catching grounds. Eighty-four per cent of the respondents said that there has been a tremendous increase in fishing activities other than fry gathering (Table 9). All the 24 gatherers from Kiamba indicated that the growth in population and industrial development has resulted in changes in fry catching grounds. Deterioration of water quality has been mainly caused by pollution, as in Bohol and Antique. Siltation and turbidity have also caused water quality to deteriorate.

The occurrence of bangus fry is seasonal in most of the coastal areas of the Philippines. The peak months are April, May, and June. In Ilocos Norte and Palawan, the bangus fry season is from April to August, with peak occurrence from April to June (Fig.3). In Antique and Bohol, the bangus fry season lasts for five to six months, with a peak in May and June. Fry collection decreases from July to September because of the Southwest monsoon, but continues in October if the weather is favorable. Bangus fry is available throughout the year in varying degrees of abundance in Kiamba. These seasonal trends are consistent with the findings of Ganaden et al. (1984).

Average daily catch per gatherer ranged from 840 pieces in Currimao to 1 633 pieces in Kiamba (Table 10). The quantity of fry caught depended on the amount of time spent on the activity by the gatherers and their families. However, the responses of the fry gatherers indicate that the time spent in gathering fry is not directly correlated with average daily catch. For example, fry gatherers in Puerto Princesa spent seven hours, the highest among the five sites, in collecting fry but the average daily production was only 796 pieces, which is the lowest among the five study areas (Fig. 4).

The perception of the fry gatherers was that milkfish fry production is decreasing due to pollution, degradation of coastal habitats, overexploitation of fishery resources, and decline in *sabalo* population. All these are difficult to quantify. The fry gatherers said that the main reason for the decrease in fry production was the decline in *sabalo* population (Table 11). Fry population decline, which implies reduction in catch per unit effort, is generally attributed to environmental causes. The shortage is exacerbated by competition among the increasing number of fry gatherers.

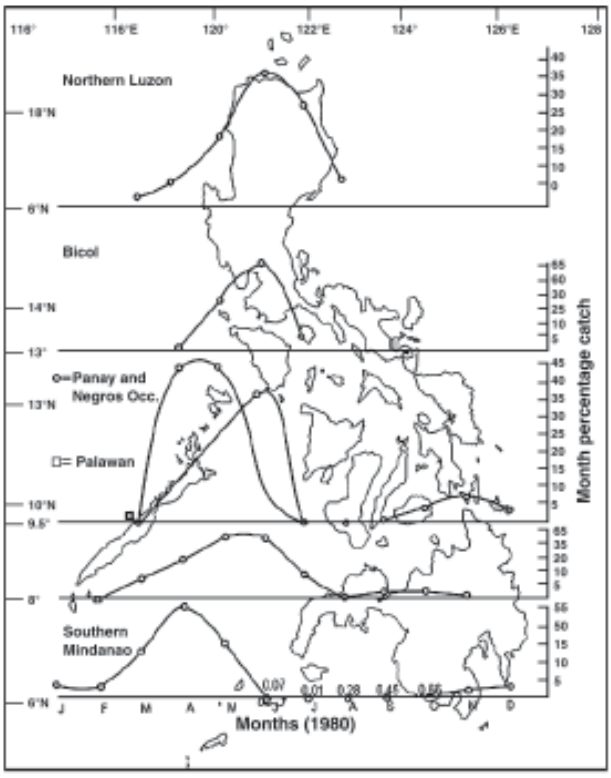


Figure 3. Percentage distribution of monthly milkfish fry catch in the different parts of the Philippines, 1980.
Adapted from Villaluz et al. 1982.

Table 9. Perceived changes affecting fry catches, 1996 - 1997.

Province	Municipality	*Barangay*	Perceived changes: Deteriorating water quality – Pollution N	Pollution %	More turbid N	More turbid %	Human/Industrial – Siltation N	Siltation %	Development N	Development %	Increase in fishing activities N	Increase in fishing activities %
Ilocos Norte	Currimao	Gaang	1	2.5	4	10.0	-	-	8	20.0	20	50.0
		Victoria	-	-	5	12.5	-	-	-	-	20	50.0
	Subtotal		*1*	*2.5*	*9*	*22.5*	-	-	*8*	*20.0*	*40*	*100.0*
Palawan	Puerto Princesa	Manalo	-	-	-	-	1	2.4	-	-	17	40.5
		Marayugon	-	-	1	2.4	1	2.4	-	-	24	57.1
	Sub-total		-	-	*1*	*2.4*	*2*	*4.9*	-	-	*41*	*97.6*
Antique	Pandan	Jinalinan	7	16.7	4	9.5	4	9.5	5	11.9	6	14.3
		Mag-aba	2	4.8	1	2.4	1	2.4	1	2.4	9	21.4
		Nauring	10	23.8	5	11.9	10	23.8	15	35.7	15	35.7
		Patria	1	2.4	-	-	-	-	1	2.4	1	2.4
		Zaldivar	3	7.1	-	-	-	-	1	2.4	9	21.4
	Subtotal		*23*	*54.8*	*10*	*23.8*	*15*	*35.7*	*23*	*54.8*	*40*	*95.2*
Bohol	Dauis	Mayacabac	1	2.2	-	-	1	2.2	-	-	1	2.2
		Poblacion	5	10.9	-	-	3	6.5	2	4.3	1	2.2
	Guindulman	Tabajan	9	19.6	-	-	-	-	9	19.6	-	-
	Jagna	Bunga Mar	1	2.2	-	-	-	-	1	2.2	-	-
		Can-upao	3	6.5	-	-	-	-	3	6.5	-	-
		Looc	5	10.9	-	-	-	-	5	10.9	-	-
		Pagina	1	2.2	-	-	-	-	1	2.2	-	-
		Poblacion	1	2.2	-	-	-	-	1	2.2	-	-
	Loay	Alegrea Sur	4	8.7	-	-	12	26.1	2	4.3	12	26.1
	Tagbilaran	Bool Junction	2	4.3	-	-	4	8.7	3	6.5	6	13.0
	Subtotal		*32*	*69.6*	-	-	*20*	*43.5*	*27*	*58.7*	*20*	*43.5*
Sarangani	Kiamba	Kayupo	2	8.3	-	-	-	-	2	8.3	-	-
		Kling	2	8.3	-	-	-	-	14	58.3	14	58.3
		Lagundi	4	16.7	-	-	-	-	8	33.3	8	33.3
	Subtotal		*8*	*33.3*	-	-	-	-	*24*	*100.0*	*22*	*91.7*
			64	**33.0**	**20**	**10.3**	**37**	**19.1**	**82**	**42.3**	**163**	**84.0**

Table 10. Time spent in gathering fry, 1996 - 1997.

Province	Municipality	*Barangay*	N	*Peak Months*			*Lean Months*		
				Operation period (no. of hours/day)	Average daily production (no. of fry/day)	Average survival rate (%)	Operation period(no. of hours/day)	Average daily production (no. of fry/day)	Average survival rate (%)
Ilocos Norte	Currimao	Gaang	20	7.4	860	95	2.6	190	98
		Victoria	20	6.7	820	95	3.0	215	96
		Subtotal	*40*	*7.1*	*840*	*95*	*2.8*	*203*	*97*
Palawan	Puerto Princesa	Manalo	17	7.2	747	96	2.6	56	98
		Marayugon	25	7.1	844	98	2.9	66	99
		Subtotal	*42*	*7.2*	*796*	*97*	*2.8*	*61*	*99*
Antique	Pandan	Jinalinan	6	6.8	950	94	1.2	68	99
		Mag-aba	10	5.5	960	98	1.2	67	99
		Nauring	16	5.5	1 136	96	1.0	109	98
		Patria	1	3.0	150	95	0.0	0	98
		Zaldivar	9	6.3	1 744	98	1.0	90	99
		Subtotal	*42*	*5.4*	*988*	*96*	*0.9*	*67*	*99*
Bohol	Dauis	Mayacabac	1	4.0	285	90	2.0	100	95
		Poblacion	5	4.0	300	90	2.0	100	95
	Guindulman	Tabajan	9	5.0	850	90	1.2	150	95
	Jagna	Bunga Mar	1	5.5	1 000	90	1.0	200	95
		Can-upao	3	4.7	867	90	1.0	54	95
		Looc	5	5.0	1 080	90	1.2	130	95
		Pagina	1	5.0	2 000	90	2.0	300	95
		Poblacion	1	5.0	1 500	90	2.0	300	95
	Loay	Alegrea Sur	14	5.0	870	94	1.1	75	98
	Tagbilaran	Bool Junction	6	6.7	1 000	96	3.0	115	98
		Subtotal	*46*	*5.0*	*975*	*91*	*1.7*	*152*	*96*
Sarangani	Kiamba	Kayupo	2	6.5	1 750	95	4.0	150	98
		Kling	14	6.0	1 500	94	3.5	100	95
		Lagundi	8	6.3	1 650	96	3.7	162	96
		Subtotal	*24*	*6.3*	*1 633*	*95*	*3.7*	*137*	*96*
			194	**6.2**	**1 046**	**95**	**2.4**	**124**	**97**

Table 11. Perceived causes of the decline in fry production, 1996 - 1997.

Province	Municipality	Decline in *sabalo* population		Exploitation of fishery resources		Degradation of coastal habitats		Climate change		Pollution	
		N	***%***	***N***	***%***	***N***	***%***	***N***	***%***	***N***	***%***
Ilocos Norte	Currimao	40	100.0	32	80.0	16	40.0	10	25.0		
Palawan	Puerto Princesa	39	93.0	33	79.0	3	7.0	4	10.0		
Antique	Pandan	42	100.0	3	7.0			26	62.0	1	2.0
Bohol	Dauis, Guindulman, Jagna, Loay, Tagbilaran	46	100.0			6	13.0	1	2.0	2	4.0
Sarangani	Kiamba	17	71.0	3	13.0	5	21.0	1	4.0	1	4.0
		184	***94.8***	***71***	***36.6***	***30***	***15.5***	***42***	***21.6***	***4***	***2.1***

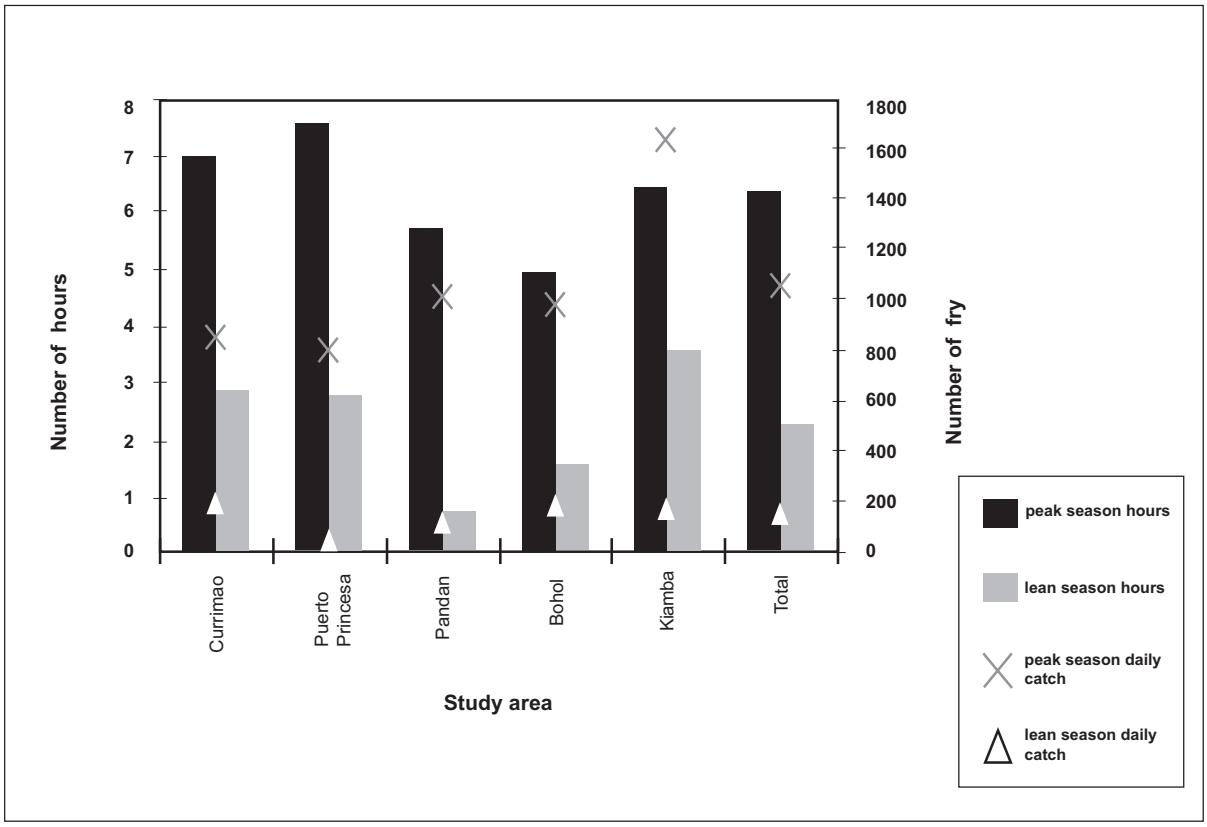


Figure 4. Average daily fry catch during peak and lean months, 1996 - 1997.

4.1.4 Marketing Aspects

In Sarangani and Antique, the fry catch was all purchased by the concessionaires. In Palawan, 88% of the catch was bought by concessionaires, while in Ilocos Norte and Bohol, gatherers could choose to sell to others (Fig. 5). The pricing system varies, ranging from buyers dictating the price to sellers setting the price for their catch. In some cases, open bidding takes place (Fig. 6). Fry is either picked up by the buyer, as in the case of Ilocos, Bohol, Antique, and Palawan, or delivered by the gatherers, as is the practice for Sarangani. In most cases, cash is paid on delivery (Fig. 7).

In general, fry price during lean months is higher than in the peak months. Price is relatively lower in Puerto Princesa at PhP320 per thousand pieces, and highest in Pandan at PhP600 per thousand pieces, during peak months. Gatherers received the lowest price from concessionaires and the highest from dealers/ brokers and runners. Gatherers in Puerto Princesa are members of the cooperative and thus received a low price while gatherers from Pandan enjoy an open access to their shoreline and could choose where to sell their catch. In Currimao, for example, the price of fry during peak months is low at PhP530 per thousand pieces as compared to PhP700 per thousand pieces during the lean months (Table 12). Fluctuations in prices are mostly attributed to the quantity of fry available in the market.

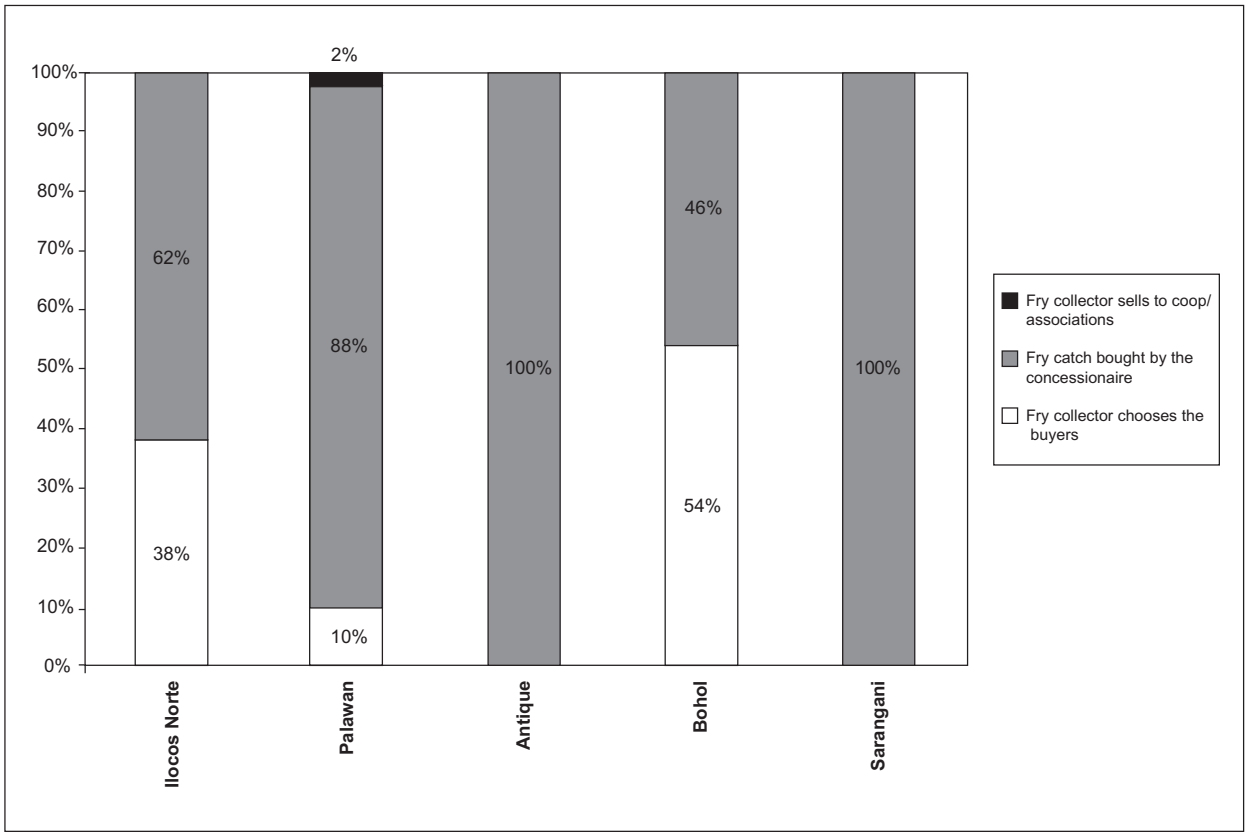


Figure 5. Fry marketing arrangements, 1996 - 1997.

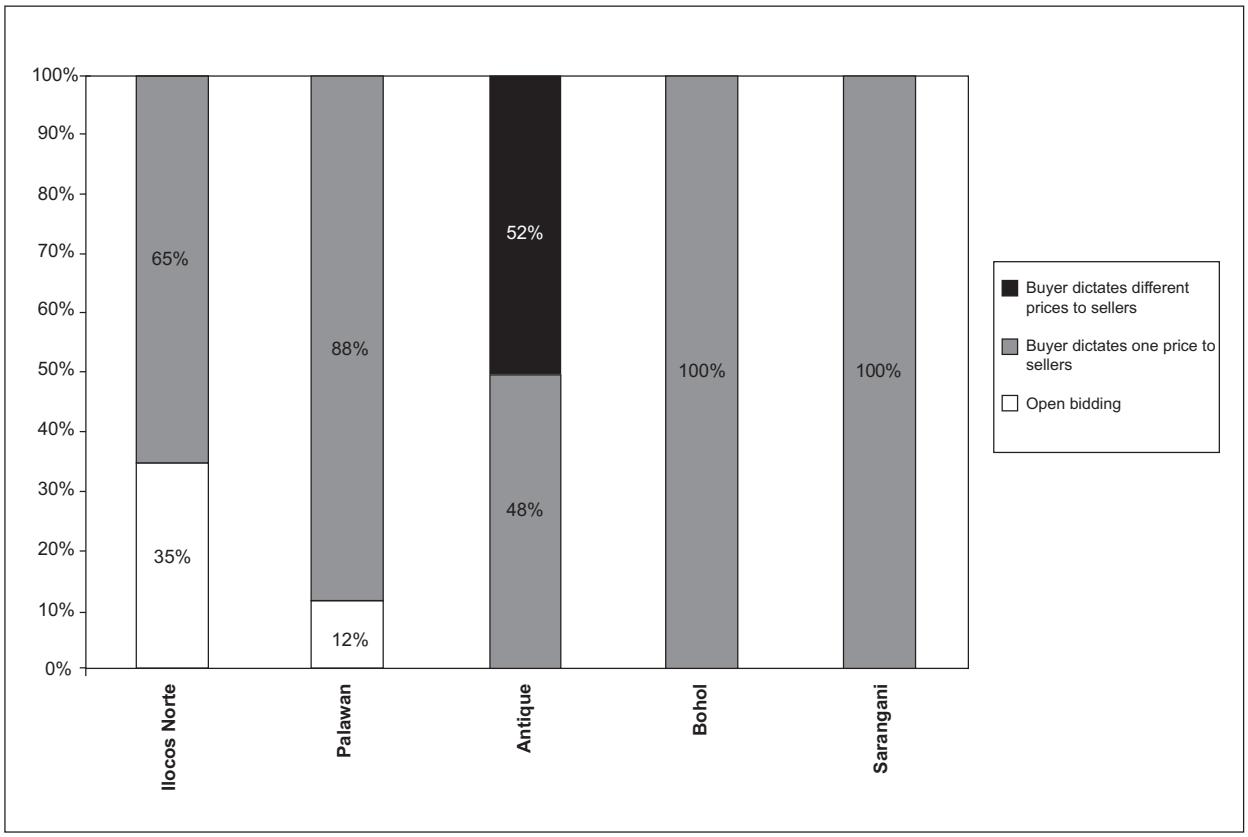


Figure 6. Method of price determination, 1996-1997

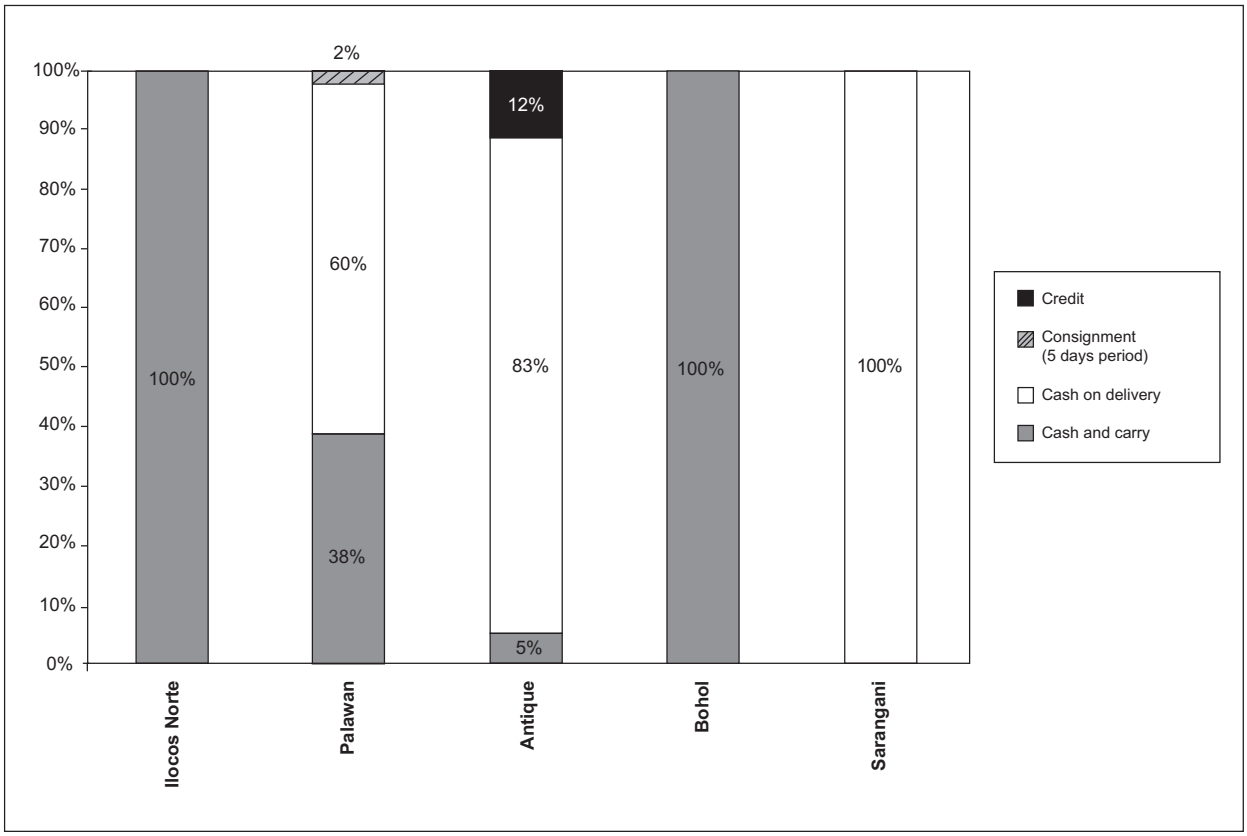


Figure 7. Terms of sale of milkfish fry, 1996-1997

Table 12. Average price of milkfish fry during peak and lean seasons, 1996 - 1997.

Province	Municipality	Average price per piece (PhP)	
		Peak collecting season	Lean collecting season
Ilocos Norte	Currimao	0.53	0.70
Palawan	Puerto Princesa	0.32	0.40
Antique	Pandan	0.60	0.70
Bohol	Dauis, Guindulman, Jagna, Loay, Tagbilaran	0.38	0.45
Sarangani	Kiamba	0.53	0.60
Average		**0.47**	**0.57**

4.2 Management of Fry Gathering Grounds

4.2.1. Ilocos Norte (Gaang and Victoria in Currimao)

Presidential Decree 704 (The Fisheries Decree of 1975) empowers the municipality to "grant the highest qualified bidder the exclusive privilege of gathering milkfish fry or the fry of other species". This process is done by sealed bids on a date designated by the municipality (usually the first quarter of the year). The concession fee represents a significant proportion of the annual municipal income of all coastal towns in which no license fee for a fishing vessel is charged (Ungson et al. 1989).

The concessionaires have two options in fry gathering:

(i) to employ fry gatherers on a daily wage of PhP400 per month to PhP600 per month, or
(ii) to allow the fry gatherers to use the fry grounds on the condition that 2/3 of the total catch will go to the concessionaire and the remaining 1/3 to the fry gatherers. Some concessionaires require fry gatherers to sell their share to them at a price lower than the prevailing market price.

4.2.2 Palawan (Manalo and Marayugon in Puerto Princesa)

Milkfish fry gathering has been a source of livelihood in the coastal *barangays* of Puerto Princesa. In the 1960s, gatherers enjoyed the freedom of selling their catch to the highest bidder.

In the early 70s, big businessmen, seeing the potential of large-scale trading, began concessioning/leasing milkfish fry gathering areas. They focused on areas with high annual production. Fry gathering areas were divided into zones with the city's major rivers serving as boundaries. Puerto Princesa City has three major milkfish fry gathering zones. The first zone is located at Inawagan facing Sulu Sea while the second and third zones divide the coastlines of Honda Bay. Each zone includes five to eight *barangays.*

Concessions are awarded by the City government through public bidding and concessionaires are granted the first and exclusive rights to purchase fry from the gatherers and the right to determine the price within their zones. The system places the fry gatherers at a disadvantage because the price paid by the concessionaires is lower than what they would have received under an open-access system. In this situation, fry gatherers sell fry to smugglers who act as dealers or as middlemen financed by another buyer (Chong et al. 1984). Prices paid by illegal buyers are up to 100% higher than concessionaires' prices. Smuggling usually takes place at night and the size of the zones make it hard to check the illegal activities. Each concessionaire requires a number of people to monitor fry gathering activities within their relatively large zones.

Smuggling was not controlled until the early 1990s. In 1994, an ordinance was enacted by the city council of Puerto Princesa declaring each coastal *barangay* an independent fry-gathering zone. The ordinance also provided that registered local cooperatives be given priority in bidding for concessions. At present, local cooperatives manage the concessions in each zone.

4.2.3 Antique (Jinalinan, Mag-aba, Nauring, Patria, Zaldivar in Pandan)

Municipal Ordinance No. 01-92 declared Pandan municipal waters an open zone for bangus fry gathering. Fry gatherers in the municipality have access to any part of the coastal zone. Almost all fry gatherers operate a fry sweeper/dozer, a fishing gear recommended by SEAFDEC-AQD. Some members of the Mag-aba Multi-Purpose Cooperative also operate stationary gears called *tangab* which are anchored at the mouth of the Bugang River. These stationary gears are pulled out in the event of a typhoon to give way to fishing boats that anchor in the river.

There are two stationary trap nets (*otoshi-ami*) operating in Patria. Seven licensed fishing boats with a capacity of three or more gross tons (GT) operating in the municipal waters of Pandan use drift gill net (*panting kalabaw*) and twelve operators use beach seine.

4.2.4 Bohol (Dauis, Guindulman, Jagna, Loay, and Tagbilaran)

Bangus fry gathering in Bohol is open to the residents of the locality. In Guindulman, fry gathering is managed by the association that gets 10% of the total fry gathered and pays taxes to the local government.

4.2.5 Sarangani (Kiamba)

Studies by Ganaden et al. (1984) noted that Kiamba is among the six richest fry grounds in the Cotabato area. In the early 1960, the coastal waters of Kiamba were placed under a zoning scheme assigning the fry gathering areas to its composite *barangays.* Fifteen fry gathering zones of varying size and production levels were formed in 1996. This zoning scheme is still being followed for the award of concessions. Except for Zone VI, all fry gathering zones are under concession.

The Municipal Council of Kiamba, under the supervision of the Vice Mayor, manages the screening of applications for the concessions. Priority is given to accredited fishermen's cooperatives and associations. The Council requires that a cooperative or association be duly registered with the Securities and Exchange Commission (SEC) and has been in existence for a minimum of three years. Furthermore, the cooperative or association must be of good standing in terms of its income-generating activities and finances. The Council requires the cooperative or association to present financial statements upon application for the concessions.

The minimum bid varies according to the area and productivity of the fry gathering zone. A large area with higher production calls for a higher minimum bid. However, a large zone with relatively low production requires a lower amount. The final determinant of the minimum bid is the zone's annual production per unit area. Table 13 lists the minimum bids for the fry gathering zones in Kiamba in 1996.

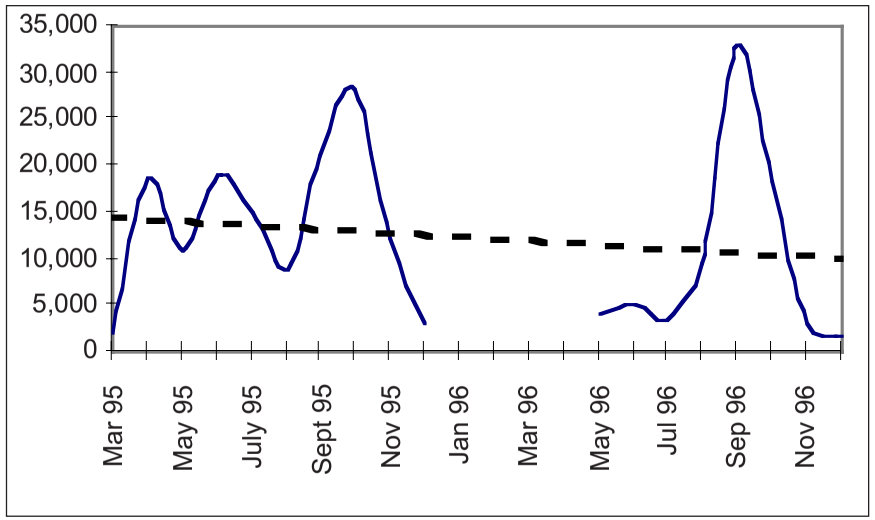
Table 13. Minimum bids for fry gathering zones in Kiamba, Sarangani, 1996.

Zone	Amount of Bid (PhP)
I	40 000.00
II	25 000.00
III	25 000.00
IV	70 000.00
V	15 000.00
VI	Reserved Zone
VII	7 500.00
VIII	75 000.00
IX	45 000.00
X	20 000.00
XI	26 500.00
XII	11 000.00
XIII	70 000.00
XIV	25 000.00
XV	75 000.00

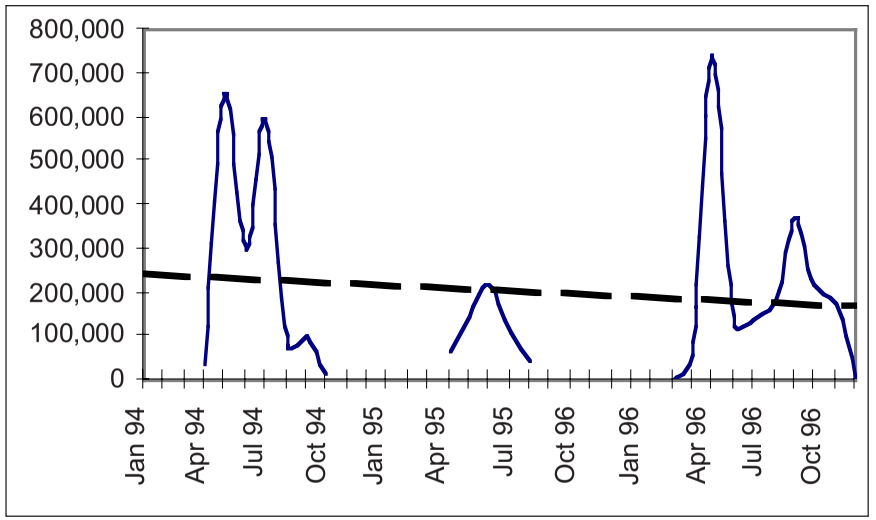
It normally takes two to three weeks for the Council to screen the applications and award the concessions. The awardees enjoy a long tenure conditional upon their ability to administer sustainable economic activities . The Council can strip the cooperative or association of its privileges if it fails to meet the conditions and declares the zone open for bidding. Annual renewal fees equal to the initial bid are paid in December for the following year.

4.3. Fry Supply

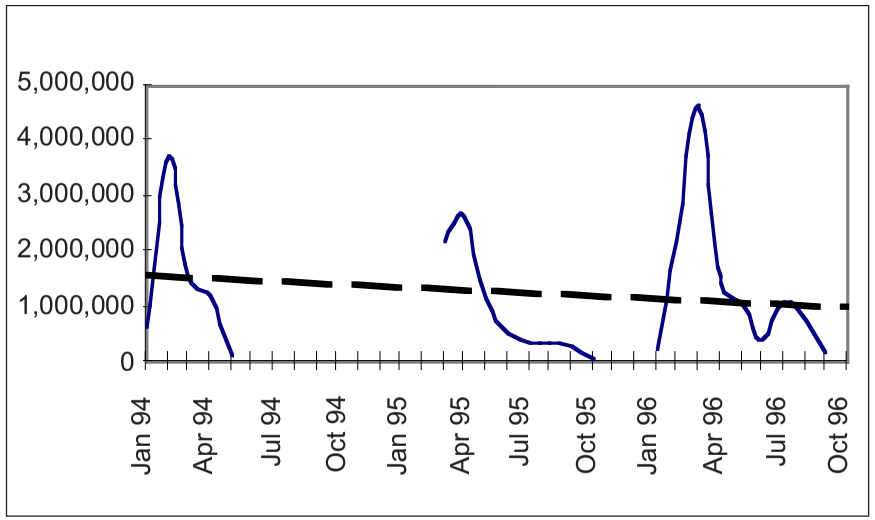
It was mentioned earlier that fry gatherers believe that milkfish fry catches are generally declining. Table 14 shows that catches declined from 1996 to 1997. Sarangani province had the biggest bangus fry catch in 1996 but has the greatest decrease in its catch for 1997. The decline in total catch in Sarangani from 1996 to 1997 is equivalent to 3 768 200 fry in a year or 1 383 fry per gatherer per month, an average loss of PhP691.50 per gatherer per month (at PhP0.50 per fry). The data generated by the study for Sarangani also reveals a decline in wild-caught fry (Fig. 8). This information is from the records of dealers and buyers, auxiliary invoices, and annual municipal records.



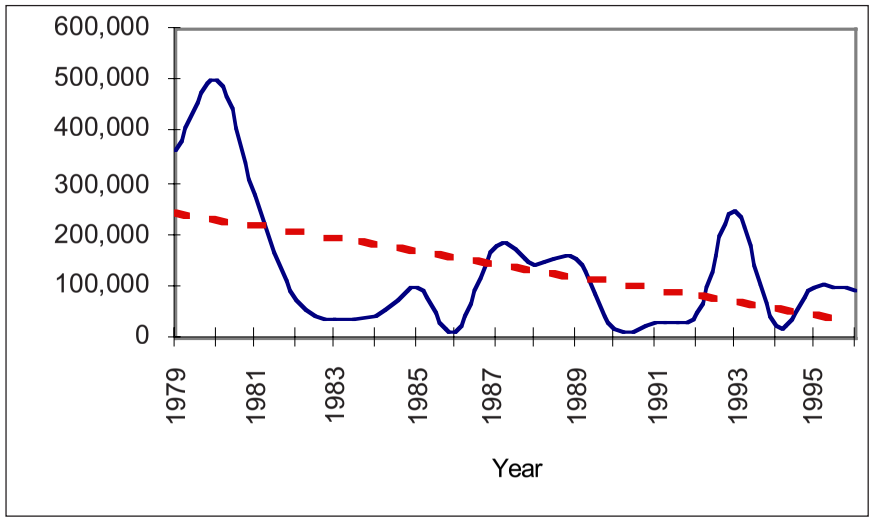
Bohol



Antique



Palawan



Sarangani

Figure 8. Estimated fry production in four study areas.

Note: No data for Ilocos Norte.

Table 14. Total bangus fry catch, 1996 and 1997.

Province	Number of fry gatherers	Total catch (no. of fry/year)*		Percentage change (%)
		1996	1997	
Ilocos Norte	203	5 916 050	5 122 340	-13.42
Palawan	220	5 712 200	4 975 150	-12.90
Antique	440	6 786 800	6 512 600	-4.04
Bohol	321	4 035 816	3 694 592	-8.45
Sarangani	227	18 727 500	14 959 300	-20.12
Average		**8 235 673**	**7 052 796**	**-11.79**

* Data from *barangay* and municipal records, 1996 and 1997.

Hatcheries, an alternative source of fry, are making a lot of progress. For example, in Sarangani, Aquasur Resources Corporation has a 2-hectare fingerling production farm consisting of 10 ponds with an average of 2 000 m^2 per pond. Stocking density is at 500 000 fry per hectare. At this level of stocking a potential output is 700 000 pieces at 1.0 million fry per cycle with 70% survival rate.They have also developed at least 2 500 broodstock for the hatchery. For the year 1998, they aimed to produce at least 250 to 500 million bangus fry. Since it started operations in March 1997, Aquasur's Finfish Hatchery has already sold over 300 million high quality bangus fry (Aquasur's personal communication 1998). Pond, pen, and cage operators as far as Pangasinan are buying fry and fingerling from this hatchery.

4.4 The Buyers

4.4.1 Characteristics

Thirteen buyers from the five provinces were interviewed. Of the 13, six were traders from Currimao, one each from Puerto Princesa and Pandan, two from Bohol, and three from Sarangani. These traders have been in the business for an average of seven years and have established a long-term relationship with the gatherers and concessionaires.

They started the business for various reasons, ranging from family tradition to influence of friends. They say that fry trading is a very profitable business. The monitoring sheets show an average monthly income of PhP11 541 (Table 15). Only one out of the 13 buyers reported that the high prices demanded by fry gatherers prompted him to shift to another business.

Table 15. Years in business and income from trading fry, 1996 - 1997.

Province	N	Average no. of years in the business	Average monthly income from trading (PhP)
Ilocos Norte	6	4	2 913
Palawan	1	20	10 298
Antique	1	9	20 042
Bohol	2	14	28 609
Sarangani	3	3	15 000
Total/Average	**13**	**18**	**11 541**

4.4.2 Handling and Storage

Bangus fry are stored in water containers with oxygen tanks to prolong the life of the fry. The commonly used containers include plastic or metal basins, pails and bowls while packing materials range from plastic bags and cardboard boxes to *bayong* for handling convenience. The capital investment varies depending on volume of fry traded. For example, a buyer from Sarangani invested PhP28 500 for storage and marketing implements, while a buyer in Palawan said his investment was PhP250 000 (Table 16).

Table 16. Average capital investment of fry buyers, 1996 - 1997.

	Average Investment (Ph P)				
Item	**Ilocos Norte**	**Antique**	**Bohol**	**Palawan ***	**Sarangani**
Basin	2 700	7 500	10 258		12 000
Net	0	0	83		0
Small bowl	58	0	104		0
Oxygen tank (rental)	0	3 500	2 300		0
Plastic bags	0	450	0		0
Carton boxes	0	120	0		0
Warehouse	0	0	0		16 500
Rubberband	0	0	0		0
Straw	0	0	0		0
Pail	60	60	60		0
Containers	140	300	350		0
Total	**2 958**	**11 930**	**13 155**	**250 000**	**28 500**

*no details.

The role of the family members is very important in small volume trading. They are involved in counting, recounting, stocking, assembling, storing, feeding, changing the water in the holding containers, packing and collecting payment. Big traders hire labor for these activities. A buyer from Puerto Princesa employed 1 160 catchers, 150 collectors and 30 managers. Labor is paid at PhP200 per thousand pieces plus a 15% commission on sales. Buyers in Bohol employ their family members and hire labor that is paid fixed monthly wages. Buyers in Sarangani hire helpers on a commission basis while the buyers in Antique hire labor at PhP3.00 per thousand pieces.

Buyers reduce fry mortality through regular changing of water. However, water salinity and temperature are not regularly monitored and the feeds used by buyers are not always of the required formulation. These handling practices expose fry to high mortality risks during the period between stocking and fry collection.

4.4.3 Production

The buyers attribute the decrease in fry gathering to the decline in *sabalo* population, overexploitation of resources, degradation of coastal habitats, pollution, prolonged dry seasons, illegal/dynamite fishing and smuggling of bangus fry. Buyers say the development of fry hatcheries can supplement supply from the wild and lower fry prices. However, some buyers prefer wild-caught fry to hatchery-bred fry. Buyers do not see imports as an alternative because this avenue is open only to big businesses.

4.4.4 Marketing

Fry are counted one by one and then grouped by hundreds. The buyers usually get a trade allowance (*pasobra*) ranging from 1% to 13% of the total purchase. Buyers in both Sarangani and Pandan dictate the price to the sellers, though Sarangani is a concession and Pandan has open access. While open bidding is prevalent in Currimao, buyers from Bohol and Puerto Princesa dictate different prices to the sellers.

Terms of sale can be cash and carry, cash on delivery, or consignment. Pandan, Bohol, and Sarangani buyers practice cash and carry. Puerto Princesa buyers prefer cash on delivery, while Currimao buyers use all systems with consignment allowed for 3-5 days. Pandan buyers sometimes make advance payments for up to 14 days to the fry gatherers. This gives them more control over the disposal of their harvest. A buyer from Bohol gives advances for up to 120 days.

Dealers sell the fry to rearing/nursery pond operators, fishpen operators, brokers, concessionaires and other dealers. Buyers in Sarangani sell their fry to the brokers who come from Dadiangas, Manila, and Iloilo. Buyers of fry from Pandan sell to fishpond operators located in the neighboring towns. The final buyers of the fry from Currimao are the fishpond operators in Dagupan City, Pangasinan and Bulacan. The buyers from Bohol sell to fishpond operators in Bohol, Cebu, and Manila. The biggest buyer from Puerto Princesa supplies fry to fishpond, fishpen, and fish cage operators located in Central Luzon and Iloilo. Traders act as middlepersons between gatherers and buyers outside their locality.

4.5 Grow-out Operations

Forty-four milkfish producers from Aklan, Capiz, Davao del Sur, Iloilo, Negros Occidental, Pangasinan, Quezon, and Rizal were included in the study. These provinces were selected because they are the major bangus producing provinces of the country and represent different farming technologies.

Thirty-six farmers work with ponds, four use pens and four operate cages. The farming technology or system of operations depends on:

(i) environment: fresh, brackish, or marine;
(ii) farming system: pond, cage, or pen;
(iii) management system: extensive, semi-intensive, or intensive;
(iv) culture system: monoculture, polyculture, or alternate; and
(v) culture practice - straight or modular.

Based on combinations of these five factors, 18 systems were identified.

The most common combination is brackish-pond-extensive-monoculture-modular which is being used by 11 (25%) of the farmers. It is followed by brackish-pond-extensive-monoculture-straight, which is being used by eight (18%) of the farmers. Both practices use natural food. The stocking density is 1 500 to 3 000 fry/ha. The former (modular system ponds) is divided into nursery, transition and rearing or grow-out ponds while the latter (straight ponds) does not differentiate the rearing stages. One to four farmers (Table 17) are using the other combinations identified.

Smith (1981) identified two farming systems, ponds and pens, during the period of his study. Of the two, ponds are more commonly used by farmers. It was not until the early 1970s that farmers discovered fishpens as an alternative method of rearing milkfish. The absence of secondary data made it difficult for Smith to describe further how ponds and pens were managed at that time. Pens were stocked at an average of 35 560 fingerlings/m^3 and annual yield averaged 3 798 kg/ha.

Bangus fry farming technology has made tremendous progress since the 1970s. Coastal cages and offshore cages of different models (Norwegian, US, local) have now been introduced to the farmers. Average stocking densities for pond, pen, coastal cages, US, and Norwegian cages have now been modified, depending on the type of farming technology adopted by a particular farmer. Ponds, pens, coastal cages and Norwegian cages are stocked at an average of 5 909 fry/ha, 22 000 fry/ha, 13 fingerling/m^3 and 42 fingerling/m^3, respectively. Average annual yield is 1 457 kg/ha, 4 193 kg/ha, 4 kg/m^3, and 18 kg/m^3, respectively (Table 18).

Table 17. Farming systems.

Regions	Environment	Type	Management system	Culture system	Practice	Number of respondents (N)
1	Brackish	Pond	Extensive	Monoculture	Straight	8
2	Brackish	Pond	Extensive	Monoculture	Modular	11
3	Brackish	Pond	Extensive	Polyculture	Straight	3
4	Brackish	Pond	Extensive	Polyculture	Modular	1
5	Brackish	Pond	Extensive	Alternate	Straight	2
6	Brackish	Pond	Extensive	Alternate	Modular	1
7	Brackish	Pond	Semi-Intensive	Monoculture	Straight	2
8	Brackish	Pond	Semi-Intensive	Monoculture	Modular	4
9	Brackish	Pond	Semi-Intensive	Polyculture	Straight	1
10	Brackish	Pond	Semi-Intensive	Polyculture	Modular	1
11	Brackish	Pond	Intensive	Monoculture	Straight	1
12	Brackish	Pond	Intensive	Polyculture	Modular	1
13	Brackish	Pen	Semi-Intensive	Monoculture	Straight	1
14	Brackish	Pen	Intensive	Monoculture	Modular	1
15	Fresh	Pen	Intensive	Monoculture	Straight	1
16	Fresh	Pen	Intensive	Monoculture	Modular	1
17	Marine	Coastal Cage				2
18	Marine	Norwegian				2
Total						**44**

Table 18. Mean stocking density and yield for ponds, pens, and cages.

Farming system	Stocking density		Yield	
	N	Mean	N	Mean
Pond[1]	36	5 909.03	36	1 457.18
Pen[1]	4	22 000.00	4	4 193.45
Coastal Cage[2]	2	13.13	2	4.38
Norwegian Cage[2]	2	42.45	2	18.28

[1] - stocking density = no. of fry/ha; yield = kg/ha.
[2] - stocking density = fingerling/m^3; yield = kg/$m.^{3.}$

4.6 Fry Demand

4.6.1.Factors affecting fry demand

The shift from a traditional (extensive) culture system to an intensive or high-density culture system resulted in an increase in the production of farmed bangus. As presented in Table 17, there are 26 farmers (59%) who are still practicing the traditional system. Of the 44 farmers surveyed, 26 practice a traditional system and 18 operate improved systems. These farmers mentioned that there are many other farmers in their area who have adopted intensive culture systems. This change is an indication of an increase in the demand for fry. Bangus farming in marine pens and cages has also been successful.

Another factor contributing to the increase in demand for fry is the shift from prawn farming to milkfish farming. This was due to the decline of the prawn farming industry that started in 1994. In the province of Negros Occidental alone, 90% of the 3 000 hectares of prawn culture ponds have shifted to the culture of other species, the majority of which is bangus.

Based on the data from the interviews of 44 bangus farmers, Table 19 shows the mean stocking density and mean number of crops per year for each farming technology. If the farm area under operation is known, annual fry requirement for a given farm can be computed using the following formula:

Annual fry requirement = (farm size) x (mean stocking density) x (mean number of crops) ***(1)***

4.6.2. Estimated annual national fry demand

In 1995, the DA Regional Offices released data on the total area per region (Area) devoted to fishpond operations. Likewise, each farming system is reported as a percentage (% Operation) of total aquaculture operations. These are estimates provided by the BFAR regional offices based on the systems in operation as of April 1999 (Appendix Table 1). Using this information the area devoted to each farming system (Farming System Area) in the region is estimated by the formula:

Farm Size = Farming System Area = Area x % Operation ***(2)***

Equations (1) and (2) above used in conjunction with data in Appendix Table 1, permit computation of annual regional fry requirements for each farming system (Appendix Table 2). Summing up the fry requirement across all farming systems and regions gives an estimate of the annual fry requirement nationally.

Appendix Table 2 shows an example of the annual national fry requirement computation. Using the stocking density obtained from the survey, an annual national fry requirement of 1.65 billion is estimated. This is consistent with the findings of Bagarinao (1998a). Using Bagarinao's correction factors for mortality of 6.6% for fry transport and 8.7% for storage, this implies that a fry catch of 1.94 billion is required to meet the demand. Bagarinao estimated that fry catch should be in the range of 1 to 2.45 billion a year, which again puts the current study's estimate within the range reported by Bagarinao.

Table 19. Stocking density and mean number of crops of milkfish for different farming systems in the Philippines.

	FARMING TECHNOLOGY					Number of respondents (N)	Stocking density fry/ha	Mean no. of crops per year
	Environment	Farming system	Management system	Culture system	Practice			
1	Brackish	Pond	Extensive	Monoculture	Straight	8	3 152.78	2.25
2	Brackish	Pond	Extensive	Monoculture	Modular	11	3 296.54	2.64
3	Brackish	Pond	Extensive	Polyculture	Straight	3	2 884.62	2.00
4	Brackish	Pond	Extensive	Polyculture	Modular	1	1 333.33	3.00
5	Brackish	Pond	Extensive	Alternate	Straight	2	1 576.92	2.50
6	Brackish	Pond	Extensive	Alternate	Modular	1	2 000.00	2.00
7	Brackish	Pond	Semi-Intensive	Monoculture	Straight	2	8 800.00	3.00
8	Brackish	Pond	Semi-Intensive	Monoculture	Modular	4	8 625.00	2.50
9	Brackish	Pond	Semi-Intensive	Polyculture	Straight	1	12 000.00	2.00
10	Brackish	Pond	Semi-Intensive	Polyculture	Modular	1	8 000.00	3.00
11	Brackish	Pond	Intensive	Monoculture	Straight	1	40 000.00	2.00
12	Brackish	Pond	Intensive	Polyculture	Modular	1	24 000.00	3.00
13	Brackish	Pen	Semi-Intensive	Monoculture	Straight	1	8 000.00	2.00
14	Brackish	Pen	Intensive	Monoculture	Modular	1	30 000.00	3.00
15	Fresh	Pen	Intensive	Monoculture	Straight	1	20 000.00	2.00
16	Fresh	Pen	Intensive	Monoculture	Modular	1	30 000.00	1.00
17	Marine	Coastal Cage				2	13.13*	2.00
18	Marine	Norwegian				2	42.45*	2.00

* *fingerlings per cubic meter.*

Taking this result a step further gives an estimate of the annual milkfish production (Table 20). In Bagarinao's 1998a study, she reported a fry to market size grow-out survival rate of 46% and an estimated weight of 250 g per milkfish. Using this survival rate and weight per milkfish gives an annual production of 190 000 t of milkfish. Another study by Bagarinao (1998b) shows a nursery (fry to fingerling) survival rate of 80–93% and an even higher fingerling to market size grow-out survival rate. Based on the same stocking density and fry requirement of 1.65 billion, estimates of milkfish production can range from 190 000 t to 384 157 t depending on the survival rates used.

Table 20. Estimated annual national milkfish production using 1998 fry stocking density survey.

Source of survival rate	Documented survival rate	Survival rate			Milkfish production (t)
		Fry to fingerling	Fingerling to market size	Fry to market size	
Bagarinao 1998a	46%			46%	190 013.00
Bagarinao 1998b	80-93%	80%	80%		264 365.91
	80-93%	80%	93%		307 325.37
	80-93%			80%	330 457.39
	80-93%	93%	93%		357 265.75
	80-93%			93%	384 156.72

4.7. Policy Management

The fry management schemes described in the preceding section are practiced all over the Philippines. Smith (1981) noted that even before the enactment of Presidential Decree of 1975 (PD 704, BFAR 1995), municipalities were engaged in bidding fry grounds to concessionaires by virtue of Act 4003 (1932). He further mentioned that the practice has proven to be a monopsonistic exploitation of fry gatherers by concessionaires, but it assures municipalities of a fixed and continuous revenue from the industry.

The latest inventory of fry grounds in 1989 -1990 showed 487 potential milkfish fry grounds throughout the country (Table 21) (Signey et al. 1996). Of these fry grounds, approximately 66% were classified as open access and 34% were declared as concession areas. However, about 5.3% of the known existing fry grounds may be classified both as open access and as concession areas on a changing basis as declared by ordinance, depending on the fry season or the prevailing buying price.

Signey et al. (1996) indicated that milkfish fry grounds may exist without being classified as either concession or free access zones by virtue of municipal ordinances. Concessions may be awarded as leases, bids (open or contract), reserves, exclusive rights to fry dealer, individual licenses, or exclusive municipal permits. These are all not well defined in any existing national policy but are locally sanctioned by way of municipal ordinances.

Aside from the inefficiencies and imperfections cited by Smith (1981), the milkfish fry industry in the Philippines suffers from complexities in fry ground management requiring more defined policy interventions. Over the years, laws embodying fry management regulations have been promulgated. Management aspects now include both resource exploitation and marketing. But among the critical legislative issues are the so-called integration, interpretation, and implementation of the current and future applicable laws, taking into consideration RA 7160, the approval of the 1998 Fisheries Code[6], and the Agricultural and Fisheries Modernization Act (RAs 8550 and 8435).

[6] Effectivity date: 23 March 1998

Table 21. Classification of bangus fry grounds, 1996 - 1997.

Region	Fry ground	Concession	Free access	Free access/Concession
I	42	35	19	12
II	8	4	5	1
III	10	5	6	1
IV	73	36	37	0
V	56	16	39	1 unclassified
VI	65	29	46	10
VII	74	22	48	4 unclassified
VIII	49	5	40	4 unclassified
IX	20	10	12	2
X	51	16	40	5
XI	28	6	25	3
XII	11	8	4	1
Total	**487**	**192**	**321**	**35**

Source: Signey et al. 1996.

Note: The same fry ground can be classified as free access or under concession depending on season and current price.

As for the Local Government Code (LGC) of 1991, for example, jurisdiction over management, conservation, development, protection, utilization and disposition of all fishery and aquatic resources in municipal waters has been devolved to local goverment units (LGUs) since 1975 (PD 704, Sec. 4, BFAR 1995). On the other hand, Section 149 (RA7160, BFAR 1998) granted authority to the LGUs to:

(i) classify fry grounds in the municipal waters;
(ii) establish zones to be awarded to organized fisherfolks or cooperatives through public bidding; and
(iii) grant privileges to marginal fishers to gather fry free of charge.

Section 29 of PD 704 also imposed similar provisions for the Municipal Council (Sangguniang Bayan) to grant concessions to bidders for a period no longer than five years. In addition, 1/5 of the total fry grounds are to be set aside as “fry reservations”. This is not being followed in the present LGC. Moreover, in awards of concessions, priority is not given to the established fishers’ cooperatives or associations in the locality but to the highest individual bidder (insider or outsider). Marginal fishers are, therefore, deprived of their privilege of open access to fry gathering in the locality.

Smith (1981) mentioned the benefits of the Fisheries Administrative Order (FAO) 115 in 1975 restricting free trade in fry as implied in Section 16 of PD 704, however, because of the imbalance in local demand and supply of fry the law was lifted in 1978. Similarly, PD 704 (Sec. 18) strictly requires a permit for the import/export of fry. Exports of milkfish fry and fingerlings are totally banned (Sec. 36 and FAO 173, BFAR 1995). In November 1995, the tariff on imports of milkfish fry and breeders was lowered from 30% to 3% in recognition of the seriousness of the shortage of milkfish fry in the country (D.B. Araullo’s personal communication 1995). In the following years, free import of hatchery-bred fry and milkfish breeders from Taiwan and wild caught fry from Indonesia and Malaysia was allowed for private entrepreneurs.

Smith (1981) recommended lifting the ban on export of fry outside the local area during periods of low fry price. This would balance the regional shortages and surpluses of fry and help determine whether there is an overall scarcity in the country.

The emerging hatchery-based fry industry should be considered in planning for the development of bangus farming. One solution to the perennial scarcity of fry is to fast-track the development of milkfish fry hatcheries. This way, the wild fry resources could be used as a buffer stock, as was done in Taiwan over the last decade.

5. Conclusions and Recommendations

Fry gatherers strongly claim that there is a shortage of wild fry. However, given the lack of documented information, firm conclusions are difficult to make. They indicate that the reasons for such a situation are:

(i) decline in the *sabalo* population;
(ii) overexploitation of fishery resources;
(iii) pollution; and
(iv) loss or degradation of coastal habitats.

Ninety-five percent believe that the major reason is the declining number of *sabalo*. It is difficult to quantify the decline in the supply of fry given the information available. This points to a need for government agencies to have a regular and systematic collection of data.

The supply of fry from the wild may be declining, but hatcheries are becoming a very promising source of fry and fingerlings. The development of hatcheries is a threat to the small fry gatherers, primarily because of the favorable response of bangus producers to hatchery-produced fry.

Looking at the demand side, the intensification of milkfish farming, the adoption of imported fish cages with a volume of about 3 000 m^3 (European and US) capable of handling 200 000 fingerlings per cage, and the shift from prawn farming to milkfish farming have all led to the increase in the demand for fry and fingerlings.

There will be a decreasing supply of wild-caught fry until the *sabalo* population and environmental conditions recover. Only an increasing supply from hatcheries can support the increasing demand for fry in the long run. In the meantime, sporadic scarcity will persist due to the seasonal gathering of wild fry.

The study has unearthed some very important issues that need to be addressed. Proper implementation and enforcement of fishery rules and regulations would alleviate the problems concerning catching *sabalo*, illegal fishing, and fry smuggling. Furthermore, information campaigns, financial and moral support to fishery law enforcers, as well as the modernization of their equipment will be complementary to legal enforcement of rules and regulations.

Institutional efforts have yet to focus on the proper and regular monitoring of supply from the wild. It is equally important to monitor the fry demand by the milkfish producers.

The preconditions for a stable and sustainable supply of fry to meet the growing demand of the milkfish industry are: alternative and supplementary sources of fry supply including hatchery sources; greater acceptability of hatchery produced fry by fish farmers; and reliable and efficient fry distribution system including information on price and fry quality.

Efforts must be made to investigate these issues. The scarcity of wild fry can be established by reviewing historical records. Inferences could then be made on whether the scarcity is due to decreasing supply or increasing demand or both. Changes in critical environmental parameters that are known to have adverse impacts on wild fry should be documented. The causes of natural scarcity need to be identified to see whether the scarcity is localized (caused by a specific intervention) or generalized (caused by a decline in the broodstock population). A study of demand patterns and market organization would also shed light on the causes of the scarcity.

Based on the findings of the present research and inputs provided during the National Bangus Forum '99 held in Mactan City, Cebu on 14 June 1999, the following recommendations are made for follow-up research and extension activities that will further help sustain the milkfish fry industry and the people who depend on fry gathering and fry trading:

- Monitor fry gathering activities in the selected sites for greater understanding of production trends and management impacts.
- Devise simple instruments for monitoring and data gathering.
- Understand and analyze the role of middlepersons and the private sector in the production and distribution of hatchery-based fry supply.
- Experiment with institutional mechanisms for proper implementation and enforcement of

fishery rules and regulations dealing with catching *sabalo*, destructive fishing and fry gathering activities and fry smuggling.

- Provide information, modern equipment, and financial and moral support to fishery law enforcers, to complement institutional devolution (e.g. community-based management) and efforts to enforce rules and regulations.

Milkfish farming in the Philippines has become increasingly linked to the international markets. The majority of the Southeast Asian aquaculture production of milkfish comes from Indonesia, the Philippines and Taiwan. Milkfish aquaculture has been extensively adopted in all three countries. Indonesia and the Philippines lag behind Taiwan in terms of breeding and hatchery technology. In the light of the expanding domestic market for milkfish in the Philippines and the growing links to the international market, the future growth of the country's milkfish production will depend on the increased and steady supply of hatchery-bred fry and adoption of multiple and high-input production systems. However, despite the availability of hatchery technology locally, the Philippines remains primarily dependent on the supply of wild fry for the majority of grow-out operations. Furthermore, fishpond tenure and lease policies lead to inefficient allocation of resources and stiff competition for the limited land and water in the brackish water areas. This requires the expansion of culture systems into freshwater lakes and offshore cages, and the intensification of current production systems.

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Appendix

Table 1. Farming technologies for milkfish culture used in brackishwater by region in the Philippines.

Region	Area (ha)[1]	Farming system	Management system	Culture system	Practice	% of operation[2]
I	11 910.00	Pond	Extensive	Monoculture	Modular	15.0
	11 910.00	Pond	Extensive	Polyculture	Modular	10.0
	11 910.00	Pond	Semi-intensive	Monoculture	Modular	20.0
	11 910.00	Pond	Semi-intensive	Polyculture	Modular	10.0
	11 910.00	Pond	Intensive	Polyculture	Modular	44.0
II	1 235.42	Pond	Extensive	Monoculture	Straight	12.0
	1 235.42	Pond	Extensive	Polyculture	Straight	10.0
	1 235.42	Pond	Semi-intensive	Monoculture	Straight	18.0
	1 235.42	Pond	Semi-intensive	Monoculture	Modular	20.0
	1 235.42	Pond	Semi-intensive	Polyculture	Modular	10.0
III	20 150.00	Pond	Extensive	Monoculture	Modular	10.0
	20 150.00	Pond	Extensive	Polyculture	Modular	30.0
	20 150.00	Pond	Semi-intensive	Monoculture	Modular	40.0
	20 150.00	Pond	Semi-intensive	Polyculture	Modular	10.0
	20 150.00	Pond	Intensive	Polyculture	Modular	10.0
IV	12 316.50	Pond	Extensive	Monoculture	Straight	10.0
	12 316.50	Pond	Extensive	Monoculture	Modular	15.0
	12 316.50	Pond	Semi-intensive	Monoculture	Modular	50.0
	12 316.50	Pond	Semi-intensive	Polyculture	Modular	20.0
V	5 101.00	Pond	Extensive	Monoculture	Straight	5.0
	5 101.00	Pond	Extensive	Monoculture	Modular	9.0
	5 101.00	Pond	Extensive	Polyculture	Straight	30.0
	5 101.00	Pond	Extensive	Polyculture	Modular	10.0
	5 101.00	Pond	Extensive	Alternate	Straight	20.0
	5 101.00	Pond	Extensive	Alternate	Modular	20.0
	5 101.00	Pond	Extensive	Monoculture	Straight	5.0
	5 101.00	Pond	Extensive	Monoculture	Straight	1.0
VI	30 503.25	Pond	Extensive	Monoculture	Straight	29.0
	30 503.25	Pond	Extensive	Monoculture	Modular	44.0
	30 503.25	Pond	Extensive	Polyculture	Straight	5.0
	30 503.25	Pond	Extensive	Polyculture	Modular	3.0
	30 503.25	Pond	Extensive	Alternate	Straight	4.0
	30 503.25	Pond	Extensive	Alternate	Modular	6.0
	30 503.25	Pond	Semi-intensive	Monoculture	Straight	4.0
	30 503.25	Pond	Semi-intensive	Polyculture	Straight	0.6
	30 503.25	Pond	Intensive	Monoculture	Straight	4.0
	30 503.25	Pond	Intensive	Monoculture	Modular	0.2
VII	2 615.00	Pond	Semi-intensive	Monoculture	Straight	15.4
	2 615.00	Pond	Semi-intensive	Monoculture	Modular	78.0
	2 615.00	Pond	Semi-intensive	Polyculture	Straight	4.0
VIII	3 306.00	Pond	Semi-intensive	Monoculture	Straight	15.0
	3 306.00	Pond	Semi-intensive	Monoculture	Modular	80.0
	3 306.00	Pen	Semi-intensive	Monoculture	Straight	5.0
IX	10 899.05	Pond	Extensive	Monoculture	Straight	30.0
	10 899.05	Pond	Extensive	Monoculture	Modular	40.0
	10 899.05	Pond	Semi-intensive	Monoculture	Straight	10.0
	10 899.05	Pond	Semi-intensive	Monoculture	Modular	20.0
X	268.00	Pond	Extensive	Monoculture	Straight	35.0
	268.00	Pond	Extensive	Polyculture	Straight	10.0
	268.00	Pond	Extensive	Alternate	Straight	5.0
	268.00	Pond	Semi-intensive	Monoculture	Straight	25.0
	268.00	Pond	Semi-intensive	Polyculture	Straight	25.0
XI	5 704.00	Pond	Extensive	Monoculture	Modular	10.0
	5 704.00	Pond	Extensive	Polyculture	Modular	5.0
	5 704.00	Pond	Extensive	Alternate	Modular	5.0
	5 704.00	Pond	Semi-intensive	Monoculture	Modular	50.0
	5 704.00	Pond	Semi-intensive	Polyculture	Modular	20.0
	5 704.00	Pond	Intensive	Polyculture	Modular	5.0

Region	Area (ha)[1]	Farming system	Management system	Culture system	Practice	% of operation[2]
XII	7 556.00	Pond	Extensive	Monoculture	Modular	70.0
	7 556.00	Pond	Extensive	Polyculture	Modular	27.0
	7 556.00	Pond	Extensive	Monoculture	Modular	2.0
Caraga	2 732.00	Pond	Extensive	Monoculture	Straight	90.0
	2 732.00	Pond	Extensive	Polyculture	Straight	5.0
	2 732.00	Pond	Extensive	Alternate	Straight	2.0
	2 732.00	Pond	Semi-intensive	Monoculture	Straight	3.0
ARMM	500.00	Pond	Extensive	Monoculture	Straight	10.0
	500.00	Pond	Extensive	Monoculture	Modular	20.0
	500.00	Pond	Semi-intensive	Monoculture	Modular	60.0
	500.00	Pond	Semi-intensive	Polyculture	Modular	10.0

1 Source: DA Regional Offices, September 1,1995.
2 Source: BFAR Regional Offices, April 1,1999.

Table 2. Annual national fry requirement.

Farming system	Stocking density[1] (pcs/ha)	% of operation[2]	Area[2] (ha)	Farming system Area (ha)	Mean # crops[1] per year	Fry requirement (pcs)	Milkfish production (mt)
REGION I							
Po/E/M/M	3 296.54	0.15	11 910.00	1 786.50	2.64	15 547 669.39	1 787.98
Po/E/P/M	1 333.33	0.10	11 910.00	1 191.00	3	4 763 988.09	547.86
Po/S/M/M	8 625.00	0.20	11 910.00	2 382.00	2.5	51 361 875.00	5 906.62
Po/S/P/M	8 000.00	0.10	11 910.00	1 191.00	3	28 584 000.00	3 287.16
Po/I/P/M[3] Coastal Cage	6 911.00	0.44	11 910.00	5 240.40	3	108 649 213.20	12 494.66
Subtotal				*11 790.90*		*208 906 745.68*	*24 024.28*
REGION II							
Po/E/M/S	3 152.78	0.12	1 235.42	148.25	2.25	1 051 652.02	120.94
Po/E/P/S	2 884.62	0.10	1 235.42	123.54	2	712 743.45	81.97
Po/S/M/S	8 800.00	0.18	1 235.42	222.38	3	5 870 715.84	675.13
Po/S/M/M	8 625.00	0.20	1 235.42	247.08	2.5	5 327 748.75	612.69
Po/S/P/M Coastal Cage	8 000.00	0.10	1 235.42	123.54	3	2 965 008.00	340.98
Subtotal				*864.79*		*15 927 868.05*	*1 831.70*
REGION III							
Po/E/M/M	3 296.54	0.10	20 150.00	2 015.00	2.64	17 536 274.18	2 016.67
Po/E/P/M	1 333.33	0.30	20 150.00	6 045.00	3	24 179 939.55	2 780.69
Po/S/M/M	8 625.00	0.40	20 150.00	8 060.00	2.5	173 793 750.00	19 986.28
Po/S/P/M	8 000.00	0.10	20 150.00	2 015.00	3	48 360 000.00	5 561.40
Po/I/P/M[3]	19 200.00	0.10	20 150.00	2 015.00	3	116 064 000.00	13 347.36
Subtotal				*20 150.00*		*379 933 963.73*	*43 692.41*
REGION IV							
Po/E/M/S	3 152.78	0.10	12 316.50	1 231.65	2.25	8 737 023.35	1 004.76
Po/E/M/M	3 296.54	0.15	12 316.50	1 847.48	2.64	16 078 326.62	1 849.01
Po/S/M/M	8 625.00	0.50	12 316.50	6 158.25	2.5	132 787 265.63	15 270.54
Po/S/P/M Coastal Cage	8 000.00	0.20	12 316.50	2 463.30	3	59 119 200.00	6 798.71
Subtotal		*0.95*		*11 700.68*		*216 721 815.60*	*24 923.01*
REGION V							
Po/E/M/S	3 152.78	0.05	5 101.00	255.05	2.25	1 809 262.21	208.07
Po/E/M/M	3 296.54	0.09	5 101.00	459.09	2.64	3 995 398.57	459.47
Po/E/P/S	2 884.62	0.30	5 101.00	1 530.30	2	8 828 667.97	1 015.30
Po/E/P/M	1 333.33	0.10	5 101.00	510.10	3	2 040 394.90	234.65
Po/E/A/S	1 576.92	0.20	5 101.00	1 020.20	2.5	4 021 934.46	462.52
Po/E/A/M	2 000.00	0.20	5 101.00	1 020.20	2	4 080 800.00	469.29
Po/S/M/S	8 800.00	0.05	5 101.00	255.05	3	6 733 320.00	774.33
Po/I/M/S[4]	1 126.00	0.01	5 101.00	51.01	2	114 874.52	13.21
Subtotal				*5 101.00*		*31 624 652.63*	*3 636.84*
REGION VI							
Po/E/M/S	3 152.78	0.29	30 503.25	8 845.94	2.25	62 750 948.84	7 216.36
Po/E/M/M	3 296.54	0.44	30 503.25	13 421.43	2.64	116 804 901.45	13 432.56
Po/E/P/S	2 884.62	0.05	30 503.25	1 525.16	2	8 799 028.50	1 011.89

Farming system	Stocking density[1] (pcs/ha)	% of operation[2]	Area[2] (ha)	Farming system Area (ha)	Mean # crops[1] per year	Fry requirement (pcs)	Milkfish production (mt)
Po/E/P/M	1 333.33	0.03	30 503.25	915.10	3	3 660 380.85	420.94
Po/E/A/S	1 576.92	0.04	30 503.25	1 220.13	2.5	4 810 118.50	553.16
Po/E/A/M	2 000.00	0.06	30 503.25	1 830.20	2	7 320 780.00	841.89
Po/S/M/S	8 800.00	0.04	30 503.25	1 220.13	3	32 211 432.00	3 704.31
Po/S/P/S	12 000.00	0.00	30 503.25	183.02	2	4 392 468.00	505.13
Po/I/M/S	40 000.00	0.04	30 503.25	1 220.13	2	97 610 400.00	11 225.20
Pe/I/M/M Coastal Cage	30 000.00	0.002	30 503.25	61.01	3	5 490 585.00	631.42
Subtotal				*30 442.24*		*343 851 043.14*	*39 542.87*
REGION VII							
Po/S/M/S	8 800.00	0.154	2 615.00	402.71	3	10 631 544.00	1 222.63
Po/S/M/M	8 625.00	0.780	2 615.00	2 039.70	2.5	43 981 031.25	5 057.82
Po/S/P/S[5] Coastal Cage Norwegian	1 909.00	0.040	2 615.00	104.60	1	199 681.40	22.96
Subtotal				*2 547.01*		*54 812 256.65*	*6 303.41*
REGION VIII							
Po/S/M/S	8 800.00	0.15	3 306.00	495.90	3	13 091 760.00	1 505.55
Po/S/M/M	8 625.00	0.80	3 306.00	2 644.80	2.5	57 028 500.00	6 558.28
Pe/S/M/S	8 000.00	0.05	3 306.00	165.30	2	2 644 800.00	304.15
Subtotal				*3 306.00*		*72 765 060.00*	*8 367.98*
REGION IX							
Po/E/M/S	3 152.78	0.30	10 899.05	3 269.72	2.25	23 194 563.51	2 667.37
Po/E/M/M	3 296.54	0.40	10 899.05	4 359.62	2.65	38 084 914.03	4 379.77
Po/S/M/S	8 800.00	0.10	10 899.05	1 089.91	3	28 773 499.92	3 308.95
Po/S/M/M	8 625.00	0.20	10 899.05	2 179.81	2.5	47 002 166.06	5 405.25
Subtotal				*10 899.05*		*137 055 143.52*	*15 761.34*
REGION X[6]							
Po/E/M/S	3 152.78	0.30	268.00	93.80	2.25	665 394.22	76.52
Po/E/P/S	2 884.62	0.10	268.00	26.80	2	154 615.63	17.78
Po/E/A/S	1 576.92	0.05	268.00	13.40	2.5	52 826.82	6.08
Po/S/M/S	8 800.00	0.25	268.00	67.00	3	1 768 800.00	203.41
Po/S/P/S[5]	93.00	0.25	268.00	67.00	2	12 462.00	1.43
Subtotal				*268.00*		*2 654 098.67*	*305.22*
REGION XI							
Po/E/M/M	3 296.54	0.10	5 704.00	570.40	2.64	4 964 114.54	570.87
Po/E/P/M	1 333.33	0.05	5 704.00	285.20	3	1 140 797.15	131.19
Po/E/A/M	2 000.00	0.05	5 704.00	285.20	2	1 140 800.00	131.19
Po/S/M/M	8 625.00	0.50	5 704.00	2 852.00	2.5	61 496 250.00	7 072.07
Po/S/P/M	8 000.00	0.20	5 704.00	1 140.80	3	27 379 200.00	3 148.61
Po/I/P/M[3] Coastal Cage	5 797.00	0.05	5 704.00	285.20	3	4 959 913.20	570.39
Subtotal				*5 418.80*		*101 081 074.89*	*11 624.32*

Farming system	Stocking density[1] (pcs/ha)	% of operation[2]	Area[2] (ha)	Farming system Area (ha)	Mean # crops[1] per year	Fry requirement (pcs)	Milkfish production (mt)
REGION XII							
Po/E/M/M	3 296.54	0.70	7 556.00	5 289.20	2.64	46 031 196.73	5 293.59
Po/E/P/M	1 333.33	0.27	7 556.00	2 040.12	3	8 160 459.60	938.45
Po/S/M/M Fresh-Cage	8 625.00	0.02	7 556.00	151.12	2.5	3 258 525.00	374.73
Subtotal				*7 480.44*		*57 450 181.33*	*6 606.77*
CARAGA							
Po/E/M/S	3 152.78	0.90	2 732.00	2 458.80	2.25	17 442 124.79	2 005.84
Po/E/P/S	2 884.62	0.05	2 732.00	136.60	2	788 078.18	90.63
Po/E/A/S	1 576.92	0.02	2 732.00	54.64	2.5	215 407.27	24.77
Po/S/M/S	8 800.00	0.03	2 732.00	81.96	3	2 163 744.00	248.83
Subtotal				*2 732.00*		*20 609 354.25*	*2 370.08*
ARMM							
Po/E/M/S	3 152.78	0.10	500.00	50.00	2.25	354 687.75	40.79
Po/E/M/M	3 296.54	0.20	500.00	100.00	2.64	870 286.56	100.08
Po/S/M/M	8 625.00	0.60	500.00	300.00	2.5	6 468 750.00	743.91
Po/S/P/M	8 000.00	0.10	500.00	50.00	3	1 200 000.00	138.00
Subtotal				*500.00*		*8 893 724.31*	*1 022.78*
Total national values						**1 652 286 982**	**190 013.00**
Before 8.7% storage mortality						**1 809 733 825**	
Before 6.6% transport mortality = fry catch to meet national fry requirement						**1 937 616 515**	

[1] - From Table 19.
[2] - From Appendix Table 1.
[3] - Stocking density of 24 000 fry per hectare is done only in Region VI.
Corresponding stocking density computed based on production ratio between the two regions.
[4] - Stocking density of 40 000 fry per hectare is done only in Region VI.
Corresponding stocking density computed based on production ratio between the two regions.
[5] - Stocking density of 12 000 fry per hectare is done only in Region VI.
Corresponding stocking density computed based on production ratio between the two regions.
[6] - Area for 1995 lumps Region X and CARAGA in one.
Area split up between Region X and CARAGA based on production ratio between the two regions.