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Twelve years of co-operative research on milkfish to increase aquaculture production for local markets in the Philippines

Ulfert Focken[1]*, Clarissa Marte[2], Relicardo Coloso[2] and Klaus Becker[1]

[1]Department of Animal Nutrition and Aquaculture
Institute for Animal Production in the Tropics and Subtropics
University of Hohenheim, Stuttgart, Germany
[2]Southeast Asian Fisheries Development Centre, Aquaculture Department
Tigbauan, Iloilo 5021, Philippines
*Email: focken@uni-hohenheim.de, Fax +49 711 459 3702

Abstract

In Southeast Asia, fish is the most important source of animal protein for the majority of the population. For centuries, aquaculture has contributed significantly to the supply with fish. In the Philippines, milkfish (*Chanos chanos* Forsskal) is the predominant fish species for brackish water aquaculture, it has been cultivated there at least for 400 years. In addition to the production of valuable protein-rich food, milkfish culture provides (partly seasonal) employment and income. However, milkfish culture has not been static over the centuries, but has been influenced by technical progress and economic developments, as can be clearly demonstrated by the changes in the last decades. Milkfish culture has to be economically competitive compared to shrimp and other fish culture which do not contribute to local food supply. Joined research projects have been undertaken between SEAFDEC AQD and Hohenheim University to develop a scientific base for improved management practices for milkfish culture.

Keywords: Aquaculture, Philippines, Milkfish (Chanos chanos)

Introduction

The milkfish is one of the top 20 aquaculture species in the world (FAO 1998). Although the species is distributed all over the tropical Indopacific Ocean, it is cultured only in 8 nations at all, and from these, only three (Indonesia, Philippines and Taiwan) make up more than 99 % culture (Table 1).

Table 1: World milkfish production 1985 – 1997 (metric tons)

Year	Indonesia	Philippines	Taiwan	Others *	Total
1985	93508	193743	31677	29	318957
1990	132432	210872	90716	93	434123
1995	151256	150858	63254	76	365443
1996	162127	140150	58453	76	370806
1997	167900	161426	62143	1051	392520

* Cook Islands, Guam, Kiribati, Micronesia, Singapore
Source: FAO 1998

Up to 1990, the Philippines used to be the biggest producer of milkfish, but in 1995, it has been overtaken by Indonesia, which has almost doubled the production in the past 12 years.

Table 2: Development of Milkfish Aquaculture in the Philippines

	Total	Brackish Water Aquaculture			Freshwater Aquaculture
Year	Production (t)	Production (t)	Pond Area (ha)	Yield ($kg*ha^{-1}*a^{-1}$)	Production (t)
1955	36734	36734	104952	350	minimal
1960	60119	60119	123252	488	minimal
1965	63198	63198	137251	461	minimal
1970	96461	96461	168118	574	minimal
1975	142000	106461	176032	605	35000
1980	211586	135951	176230	771	56299
1981	236331	168727	193874	870	56299
1985	209017	155344	160394	969	38000
1990	213215	191886	150000	1279	19005
1991	236456	213674	n.a.	n.a.	20449
1992	173411	145554	n.a.	n.a.	25562
1993	151117	124510	n.a.	n.a.	24455
1994	157025	135682	121000	1121	21343
1995	150858	137796	112500	1225	13062
1996	150151	139372	n.a.	n.a.	10779
1997	164126	147251	n.a.	n.a.	14175

Source: Combined and calculated from Bagarinao 1998, BAS 1991, BFAR 1994, FAO 1994, FAO 1995, FAO 1998, Lee 1995, Smith & Chong 1984, Samson 1984
n.a. = no data available

Table 2 gives a summary of the total production of milkfish in the Philippines from 1955 to 1997, the share of brackish-water and freshwater culture, pond area and average production per hectare for brackish-water pond culture. Minor differences between Tables 1 and 2 are due to different data sources.

Although milkfish farming has a history of several centuries, it is obvious from these data that milkfish culture has been undergoing significant changes in the past 4 decades. Total production has been increasing steadily from 36 734 t in 1955 to 236 331 t in 1981. A similar production has been achieved in 1991 (236 456 t), but yields have decreased to 150 000 t to 160 000 t since that year. Up to 1970, almost the entire milkfish production originated from brackish-water aquaculture. Freshwater aquaculture in Laguna de Bay started in the seventies, peaked with more that 55 000 t is 1981 but has been fluctuating between 10 000 t and 20 000 t in the past few years. The increase in milkfish production from brackish-water culture from 1955 to 1981 was due partly to an extension of pond area. Up to 1980, milkfish was almost the only species for brackish-water aquaculture in the Philippines. Later on, fish farmers partly shifted to the production of shrimp, causing a significant reduction in pond area dedicated to milkfish culture. After the collapse of the shrimp industry in the Philippines in 1994/1995, there are reports about shrimp farmers moving back to milkfish, but no quantitative data are available on this right now.

The yield per hectare and year has been efficiently increased from 350 kg in 1955 to almost 1279 kg in 1990. This increase was achieved by the introduction of pond fertilization and feeding. The drop in productivity after that may be caused by the fact that especially well qualified fish farmers with productive farms moved into the shrimp business. An increase may be expected now, as they shift back to milkfish culture, bringing with them the higher technological standards and experience in intensive aquaculture.

In the Philippines, milkfish culture deserves special attention compared to other aquaculture activities for various reasons:

- Milkfish culture provides (partly seasonal and/or part time) employment and income at various stages of the culture process from collection of fry in coastal waters to harvest and marketing and processing of the food fish. It is estimated that about 1 million people in the Philippines are engaged in this business.

- In contrast to other brackish water aquaculture activities like shrimp or sea bass farming, in which the product is mostly sold on urban and international markets, milkfish production is almost entirely for the national market in the Philippines and contributes to the supply with animal protein for a large fraction of the Philippine society.

- Milkfish production is mostly carried out semi-intensively, which means that a significant fraction of fish growth originates from the natural productivity of the pond (enhanced by liming and fertilisation), feeds are given in much lower quantity and typically also in lower quality compared to other aquaculture systems. This implies that milkfish culture is causing less eutrophication of adjacent waters and has less competition with other sectors of animal production for high quality feeds than e.g. shrimp culture.

However, the decision of fish farmers on the species to culture is not based on the social or environmental benefits of their activities but on economic profitability, making best use on their physical and human resources, as can be seen from the reduction of pond area dedicated to milkfish production in the last decade (Table 2). Therefore, the only way to enhance milkfish production is the development of improved farming techniques which increase productivity or reduce resource use and therefore make milkfish culture more profitable compared to other aquaculture activities. The drastic changes in farming practices and fish yield during the last decades have nourished the hope that the optimal

farming practices have not yet developed and that there is scope for technical and economical improvement.

The Co-operation between SEAFDEC and Hohenheim University

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional international organisation which was established in the late 60's in response to the food crisis. The Aquaculture Department (AQD) of SEAFDEC is based in the Philippines. Its tasks are research, dissemination of information, training and other activities in support to the aquaculture sector in the SEAFDEC member countries.

Following contacts between scientists from SEAFDEC AQD and Hohenheim University at the 1st Asian Fisheries Forum held at Manila in 1986, a co-operation between both institutions was started. Most of the joined projects started since have been dedicated to milkfish in order to create the scientific base for improved aquaculture techniques to increase the profitability of milkfish culture compared to other aquaculture activities and thereby help to maintain this aquaculture for local markets. Although a lot of research had been carried out on milkfish in various laboratories around the Pacific, knowledge on certain aspects of milkfish nutrition was found to be patchy. The amino-acid requirements of and optimal protein-energy ratios for milkfish had been investigated in several laboratory studies (e.g. Borlongan & Coloso 1993), but little was known about the absolute energy metabolism of milkfish of different body mass and at different temperature and salinity conditions. The first project, funded under the programme for scientific co-operation with developing countries of the "Deutsche Forschungsgemeinschaft" (German Science Foundation) dealt therefore with basics of energy requirement of milkfish (Becker *et al*. 1995, Schroeder 1997). Information on the energy metabolism of a species is essential for any systematic improvement of feeding strategies. In milkfish, this gains additional importance as this species is cultured the year round, while the natural supply of fry is seasonal. Controlled feeding of fingerlings at maintenance level allows to maintain fingerlings for those parts of the year when there is no natural supply. Tables with

recommended feeding levels for fingerlings, depending on size, temperature and salinity, have been developed from these data. Simultaneously, an M.Sc. project on the effect of salinity on the digestibility of different protein sources in milkfish was carried out (Da Costa Reis 1991, unpubl. M.Sc. thesis), which was supported by the Eiselen-Stiftung, Ulm, Germany.

In 1994, the joined research on milkfish in pond culture was started, funded by a DAAD grant. Several studies had been undertaken previously by other authors to investigate feeding strategies for milkfish in pond culture. Feeding compound diets of rather low protein and high fibre content at rates of 4 % body mass equivalent has been recommended base on these studies (Sumagaysay & Borlongan 1995). However, in these studies, the ponds had been treated as “Black Box”, feed inputs and fish output of the pond system had been monitored, but not the processes within the pond, which finally cause fish growth.

A first study to evaluate the feeding behaviour of milkfish in pond culture was started using ponds of the Brackishwater Aquaculture Center of the University of the Philippines in the Visayas. For both dry and wet seasons, 4 ponds were managed according to common milkfish culture practices. Once a month, fish were sampled for quantitative analysis of their gut content in the course of the day. From these data, the daily intake of natural food and supplemental feed was calculated. The results revealed that not all of the feed given was directly ingested by the fish, a large fraction of the feed contributed to fish growth probably only by acting as fertiliser, moreover, the combination of natural food and supplemental feed in the ratios determined from the gut content did not meet the requirements in amino acid composition and protein/energy ratio for optimal growth which had been determined in laboratory studies (Focken *et al*. 1997, Kühlmann *et al*. 1997, Kühlmann 1998). The relative constant contribution of natural food to fish growth in this experiment was confirmed by stable isotope analysis of feeds and fish by Focken (1998).

As we had doubts if the wastage of compound feed might be an artefact to working “On Station”, in 1996 a project was started to evaluate the use of feed and the intake of natural food and supplemental feeds in commercial milkfish farms on Panay island. First results from this study are reported separately (Lückstädt et al., this volume).

Based on these results, the use of feeds should be restricted, while fertilisation should be increased, especially continued throughout the culture period, in order to enhance the production of natural food for milkfish (Sumagaysay *et al*. 1998). Although a final test of such modified pond management scheme including economic analysis has not yet been done, we expect that this strategy of reduced feeding will increase the economic performance of milkfish culture compared to other aquaculture activities and thereby contribute to food production for the local market in the Philippines.

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