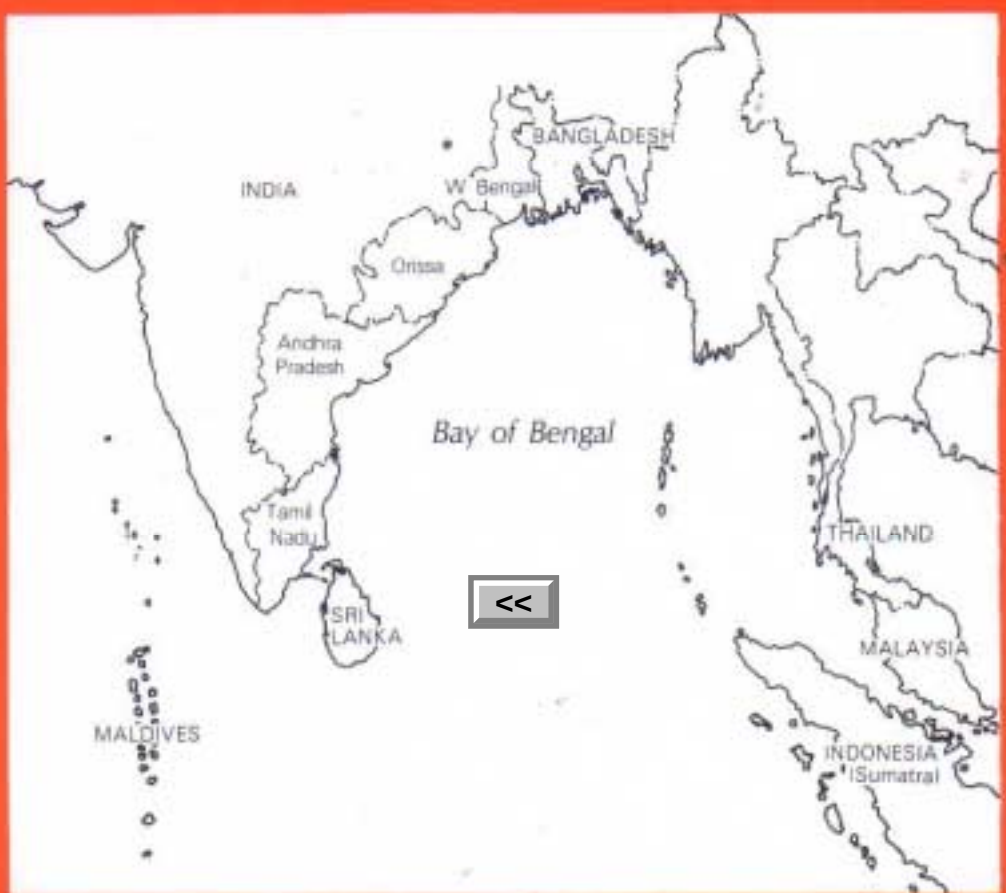
BAY OF BENGAL PROGRAMME
BOBP/REP/28
Development of Small-Scale Fisheries
GCP/RAS/040/SWE

Small-Scale Aquaculture Development Project in South Thailand : Results and Impact



SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

BAY OF BENGAL PROGRAMME BOBP/REP/28

Development of Small-Scale Fisheries GCP/RAS/040/SWE

SMALL-SCALE AQUACULTURE DEVELOPMENT PROJECT IN SOUTH THAILAND: RESULTS AND IMPACT

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This report discusses the results and the impact of a (i-year BOBP-assisted project (March 1979-July 1985) for small-scale aquaculture development on the south-west coast of Thailand. An earlier report (BOBP/REP/14) discussed the outcome of the project's first phase, from March 1979 to September 1981.

The project work encompassed several components in three main areas-aquaculture, community development and activities for women. The project began 1979 in a single province: Phang Nga. At the time of termination, it covered six provinces in south Thailand.

This report critically assesses the project's performance and the impact generated by each component. It is based on a review of project documents such as progress reports, project preparation and assessment reports, as well as on interviews with fisheries officers, small-scale fisherfolk and large-scale fish farmers in eight selected villages in Satun, Trang and Phang Nga provinces, carried out over a period of two weeks in October 1985.

BOBP would like to record its appreciation of all officers who helped in the successful implementation of the project and of those who contributed actively to preparing this report. The report was prepared by Ms. E. Drewes, BOBP Socio-economist, with inputs on aquaculture techniques description from J.A.J. Jannsen, BOBP Aquaculturist (Associate Professional Officer) and with assistance from several others:

— Mr. Kachornsak Wetchagarun, Chief of the Fishery Economics Section, who participated in the discussion of the draft report;

Mr. Manu Potaros, former Chief of the Satun Brackishwater Fisheries Station, who prepared and led the two-week project evaluation mission and participated in the preparation and discussion of the draft report;

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The Thailand project, and this paper which reports on it, are activities of the small-scale fisheries project of the Bay of Bengal Programme. This project began in 1979 and covers five countries bordering the Bay of Bengal — Bangladesh, India, Malaysia, Sri Lanka and Thailand. Funded by SIDA (Swedish International Development Authority) and executed by the FAO (Food and Agriculture Organization of the United Nations), the project seeks to develop, demonstrate and promote appropriate technologies and methodologies to improve the conditions of small-scale fisherfolk in member countries.

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1. SUMMARY

The BOBP-assisted small-scale aquaculture development project of South Thailand began 1979 in Phang Nga province. It was later extended to some other provinces, and terminated in 1985.

The project aimed at developing coastal aquaculture as a viable occupation for small-scale fisher-folk in the region, who had been affected over the years by decreased catches and at improving the living standard of small-scale fisherfolk through improved fish processing, handicrafts, family care, education and village infrastructure building with voluntary labour.

The project's performance and the impact it generated are summarized below:

- ***Finfish cage culture,* the project's main component, generated good impact. Beginning with only 28 fish cage demonstration farms in 1979, the project gained wide acceptance, and expanded to cover 3600 cages operated by more than 1000 fishermen in 1985. Apart from generating higher incomes, new income-earning opportunities were created in subsidiary activities such as capture of fish fry and fish supply. One negative result of cage culture, however, was the fact that it attracted absentee owners who hired small-scale fisher-folk as labourers for feed preparation, night-watch, cage maintenance and seed supply. There was no system built into the project to prevent this.**

- **Of the project's shellfish culture components (cockle, mussel and oyster), *cockle culture* produced limited impact. Though cockle culture was demonstrated in only one farm (of 0.3 ha area) for a year, a number of private farms were rapidly established in the project area. By November 1985, a total water area of 280.3 ha was under culture. However, cockle farming has almost wholly attracted only businessmen and large entrepreneurs, mainly because it depends on illegally imported seed in the project area. Only businessmen with sufficient capital and connections can incur the risk of procurement. Small-scale fisher-folk benefited only marginally as labourers on these large-scale cockle farms.**

- **The results from oyster demonstration farms were not encouraging enough to attract people to invest in *oyster culture.* Yields were low, as were prices, and marketing channels could not be developed because of insufficient production.**

- ***Mussel culture* met the same fate as oyster culture, because of the high cost of spats and low production.**

- **Of the project components directed at fisherwomen *(fish processing, handicrafts training and education),* the first two had little or no impact. Women trained in techniques to produce higher quality shrimp paste did not apply them, as consumers in the area preferred cheaper ordinary paste. As for the education component (on health, family planning, nutrition and hygiene), it is too early to judge, since it was introduced only during the project's second phase in 1984.**

- **The community development approach to infrastructure building -with the project providing the funds and the community some voluntary labour-enjoyed only limited success. It seemed easier to get the fisher-folk to contribute money than voluntary labour. Jetties, a shallow well, a windmill-driven water pump, a small water tank, a large rainwater tank, repair of a walkway-these were the facilities provided. Voluntary labour was forthcoming only for a few of these facilities.**

Generally, the project's aquaculture components achieved better results than the other components. Apart from the reasons already cited, this could be because of the detailed preparation and planning that went into the aquaculture components.

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2. INTRODUCTION

The rapid development of demersal trawling in Thailand from the mid-1960s resulted in the over-exploitation of demersal resources in the Gulf of Thailand. Within a short time, the inshore resources off the Andaman Sea coast were also over-exploited. The proportion of high value species in the catch declined drastically and there was drop in both the total catch and the catch per unit effort. This development significantly reduced the earnings of small-scale fishermen. The small-scale fisherfolk communities in remote villages, where opportunities for alternative employment were limited, were the most seriously affected.

To help the small-scale fisherfolk, the Government of Thailand, through its Department of Fisheries, decided to promote coastal (brackishwater) aquaculture as a viable alternative or supplementary source of income.

In 1978, the Thai Department of Fisheries, in collaboration with the FAO/SI DA project "Development of Small-Scale Fisheries of the Bay of Bengal" and the FAO/UNDP South China Sea Fisheries Development and Coordinating Programme identified a suitable area in the Phang Nga province for a pilot project to test and demonstrate appropriate technologies for brackishwater aquaculture. The area selected is characterized by dense mangrove vegetation with many stream systems flowing into the bay; it seemed a suitable environment for coastal aquaculture. It contains a number of remote villages in which the majority of the population are small-scale fisher-folk hit by reduced earnings from fishing.

Apart from coastal aquaculture demonstration, the pilot project incorporated components on fish processing, handicrafts training and infrastructure development and — during the last phase- education of fisherwomen in health care and family planning.

Preparatory activities were undertaken before and immediately after the commencement of the project in March 1979. They were:

- three site surveys undertaken in November 1978, May 1979 and April 1980 by the professional staff of the Brackishwater Fisheries Division of the Department of Fisheries. These surveys related to the finfish and shellfish species suitable for culture, the hydrological parameters and the suitability of aquaculture demonstration sites;
- a benchmark survey on the socio-economic conditions in six project villages, undertaken between April and July 1979 by a consultant;
- a survey of the suitability of two aquaculture demonstration sites, undertaken in August 1979 by a consultant.

Details of these surveys are contained in an earlier report (BDBP/REP/14) on the first phase of the project.

The ultimate objective of the project was to improve the living standard of small-scale fisherfolk in depressed coastal fishing communities.

The immediate objectives were:

- to provide a viable alternative source of income or a supplementary source of income for small-scale fisher-folk;
- to develop a model for an expanded development effort in the rural fishing sector.

To achieve these objectives, the following operational targets were identified. They were:

"(a) the establishment of appropriate aquafarming, cage, raft or pilot units in the project area complete with all necessary facilities to rear finfish fry or fingerlings and/or other suitable commercial organisms to marketable sizes;

(b) the practical demonstration of aquafarming techniques at the village level;

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(c) the provision of assistance to strengthen and expand the activities of village cooperatives as a means to manage and operate the aquafarms, initiate collective marketing and provide other essential common services to the villages;

(d) the demonstration of improved village-level fish processing techniques;

(e) the training of villagers in the technology involved in all the project components; and

(f) assistance in the acquisition of loans and/or grants to expand operations and provide basic facilities for improving local living standards.[1]

The project was implemented in six selected villages in the Phang Nga province during the initial phase, from March 1979 to September 1981. On the basis of the experiences gained during the first phase (reported in BOBP/REP/14), project activities were continued for three more phases : the second from 1981 to 1982, the third from 1982 to 1983 and the fourth from 1983 to 1985. They were also extended to cover more villages in the Phang Nga province and villages in the Satun, Trang, Krabi, Phuket and Ranong provinces. Prior to expansion in the new provinces, surveys of potential aquaculture project sites were undertaken by the professional staff of the Brackishwater Fisheries Division.

Thus, at the termination of the project in September 1985, activities were spread over all six coastal provinces bordering the Andaman Sea (see map in Appendix 1 and Tables 1a-1d).

The project was executed throughout its lifetime by the Department of Fisheries, Thailand. BOBP provided financial support and assistance in planning and monitoring the project. More details about the organizational structure of the project are given in Appendix 2.

[1]Letter of Understanding between the Fisheries Department of Thailand and South China Fisheries Development and Coordinating Programme (SCSP), Manila, Bangkok, 1979 (unpublished).

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3. SUMMARY RECORD OF PROJECT ACTIVITIES

Project Components	*Sub-Components*	*Method of introduction*	*Target group*
1. Finfish culture	Cage culture – sea bass – grouper Village nursery cages – seabass – grouper	Demonstration, training, finance	Initially only small-scale fishermen, later also women.
2. Shellfish culture	Mussels Oyster Cockles	Demonstration, training, finance	Small-scale fishermen
3. Fish processing	Shrimp paste, fish crackers, sauce	Training	Women in coastal villages
4. Handicrafts	Macrame articles, paper umbrellas, natural fibre baskets, tailoring	Training, study tour	Women in coastal villages
5. Family care	Family planning and health care	Nonformal education	Women in coastal villages
6. Village infrastructure	Wells, water tanks, jetties, walkways, community halls	Partly finance for materials only, partly finance for materials and labour	Coastal village communities

3.1 Aquaculture demonstration and training

Throughout the life of the project, finfish cage culture (of seabass and grouper) was the project's main component in all the provinces. Shellfish culture of cockle, mussel and oyster ranked next in importance.

Mussel and oyster culture demonstration were also undertaken throughout the life of the project, though not in all provinces. As for cockle culture, its demonstration was confined during the first phase to Phang Nga province. On the basis of results here, commercial expansion of cockle culture was supported by the provincial government and no further demonstration work by the project was considered necessary. During the second phase, cockle culture demonstration was attempted in a small way with negative results in Satun province.

Aquaculture techniques had to be adapted to the needs of the species under culture. It was necessary to check whether hydrological conditions were favourable; whether the water was deep enough to place rafts for fish cages; whether it was deep enough for rafts from which ropes or trays had to be suspended for oyster and mussel culture; whether the water was polluted ; and whether the sites were easily accessible to the fishermen. The principles used in cage, mussel, oyster and cockle culture demonstrations and major technical issues are described in Appendix 3.

Since it was believed that the success of the project would depend very much upon the participation of villagers in the demonstration of the technology and upon group action, seven groups

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of fishermen and three groups of schoolchildren were formed with the help of the Provincial Fisheries Officer and through close consultation with the village leaders.

Each group of fishermen comprised of between two and 10 members; most had six. One member from each group was elected by the others to take on the role of leader. Each school group was headed by a school master. The group leaders assumed the responsibility of maintaining contact with the project staff and also served the project by supervising the day-to-day work undertaken by their members at the aquaculture demonstration sites. Appropriate training was provided throughout the period to enable these groups to acquire basic and essential skills. At the same time, the work undertaken by these groups was directly supervised by the project staff.

After cockle culture was taken over in Phang Nga by the Provincial Government, another five groups, similar to the ones above, were formed in October 1980 to work on cockle culture.

From the second phase of the project, less emphasis was laid on group action in cage culture, and individuals were given cages instead.

The project team leaders and technical extension officers (biologists), together with the provincial fisheries officers, selected the villages and persons to participate in the demonstration units. The technical extension officers then provided technical training and advice on the spot.

The material for the demonstration units, as well as the seeds (fish and shellfish), were initially provided free of cost. During the later phases of the project, when the economic viability of fish cage culture had already been proved, the fisherfolk were provided seeds against loans.

To encourage further expansion of the individual demonstration cage units, the operators were offered seeds either against grants or bank loans, on the condition that they would construct additional cages on their own. This method proved to be most successful in villages where feed was easily available. It is worth noting that it resulted in the construction of less capital-intensive rafts than those demonstrated by the project, as fisherfolk utilized second hand floats, locally available wood and thinner ropes.

During the third project phase, women were included in the demonstration of cage culture. They were selected particularly to demonstrate the nursing of seabass fry which was provided by the hatchery.

3.2 Fish processing and handicraft training for fisherwomen

During the first phase, the main activity undertaken under this component was the demonstration of improved shrimp processing in order to produce higher value fermented shrimp paste with a longer shelf life. (For details of shrimp paste production, see Appendix 4).

Training of small groups of women in the making of fish cakes, fish biscuits and fish sauce was also carried out on a minor scale.

During the third and fourth phases, more emphasis was given to this component than during the second phase. Groups of women were trained in the third and fourth phases in Satun and Trang provinces to produce fish sauce, fish crisps, fish powder etc. both for consumption at home and sale in the local village markets.

Women in Phang Nga province were trained to produce handicrafts, mainly macrame products, during the first phase. The handicraft items intended for the tourist market remained virtually unsold and the activity was discontinued. During the second phase, a small group of women were trained in Phang Nga province in making souvenirs, such as miniature paper umbrellas and fish scale brooches for sale in local village markets.[1] During the fourth phase, a group of women were trained in basket-weaving in Satun province. However, marketing the product proved to be a major problem in this case too.

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[1] E. O. Oswald, Report of the regional study on the implementation and objectives of an operational small-scale fisheries development project. FAO/SCSP Working Paper 9, Manila 1980, P. 4.

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During the third phase, women in Satun and Trang provinces were trained in tailoring garments in order to sell them in the village or for use at home.

3.3 Family planning and health care

Activities with respect to family care were confined to one village in Satun province, where the project had obtained the assistance of the health department. The assistance was for nonformal education to women in health care (hygiene and nutrition) and family planning.

3.4 Village infrastructure

Under this component, the project assisted in providing certain basic amenities and facilities essential for improving living conditions in the project villages. These activities incorporated an element of community development by emphasizing the need for self-help and collective action and promoted the participation of the villagers in project activities. The villagers provided the labour for some of the activities. The capital input was provided by the project and the Government. The design, costing and supervision were provided by consultants and contractors engaged by the project.

During the first phase, the infrastructure facilities provided in Phang Nga province consisted of two jetties, a shallow well, a windmill-driven pump, a small water tank and piping system, a large rainwater holding tank, water supply to two villages, repair of a walkway and a multi-purpose service boat for transport of water and construction materials. A community hall was set up in Satun province during the second phase and a community hall and a jetty provided in Trang province during the fourth phase. An attempt was also made to develop a small village-level solar still for distilling fresh water out of brackishwater during the second phase, but with negative results.

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Project Activities in Pictures

Left: These motorized pushnetters are used to catch small fish required as feed for finfish cage culture.

Right: Cages under culture and a night guard hut against the distinctive Phang Nga backdrop.

Left: Family operated cage culture farm.

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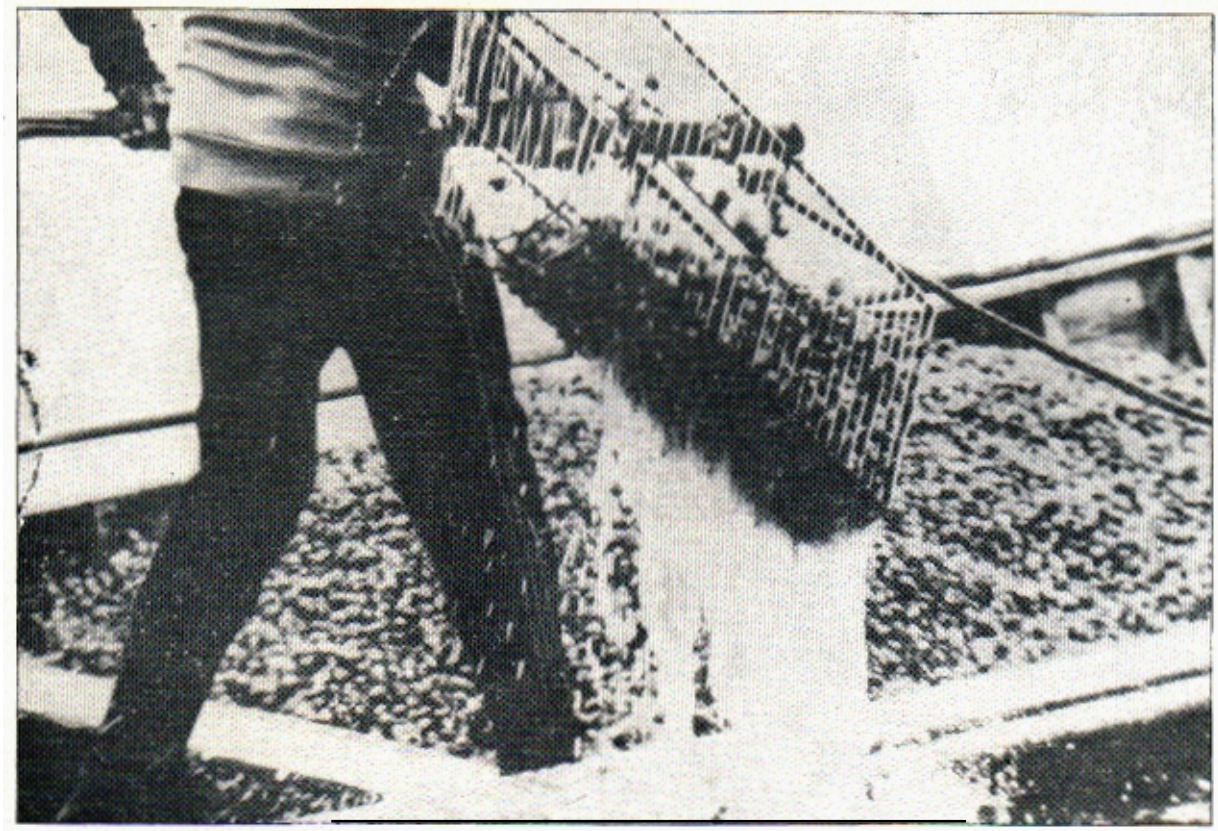
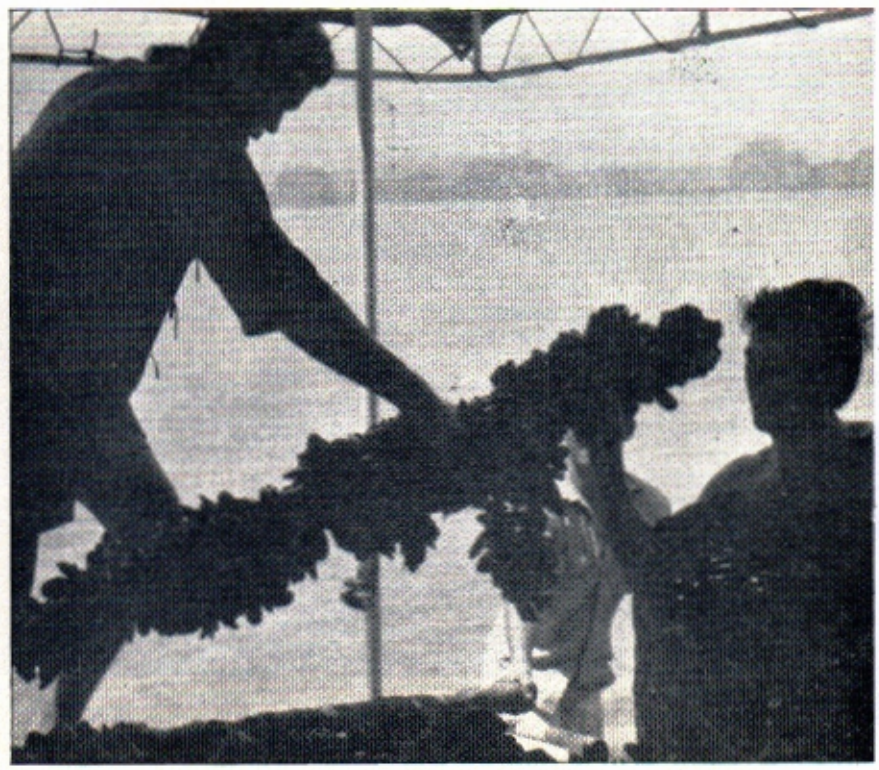


Above: Cockle harvest.

Oysters on rope (left) and mussels on pole (below).



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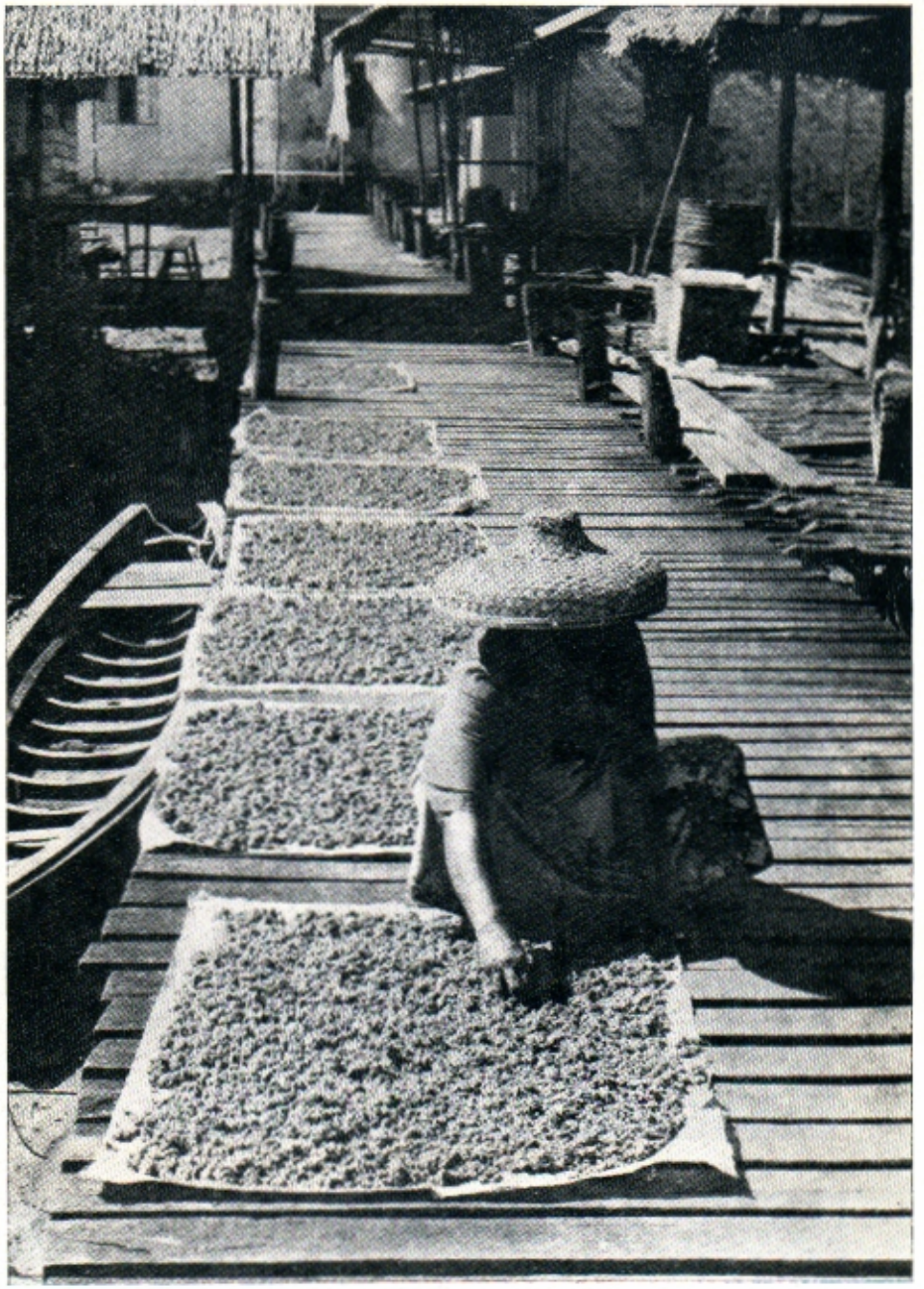
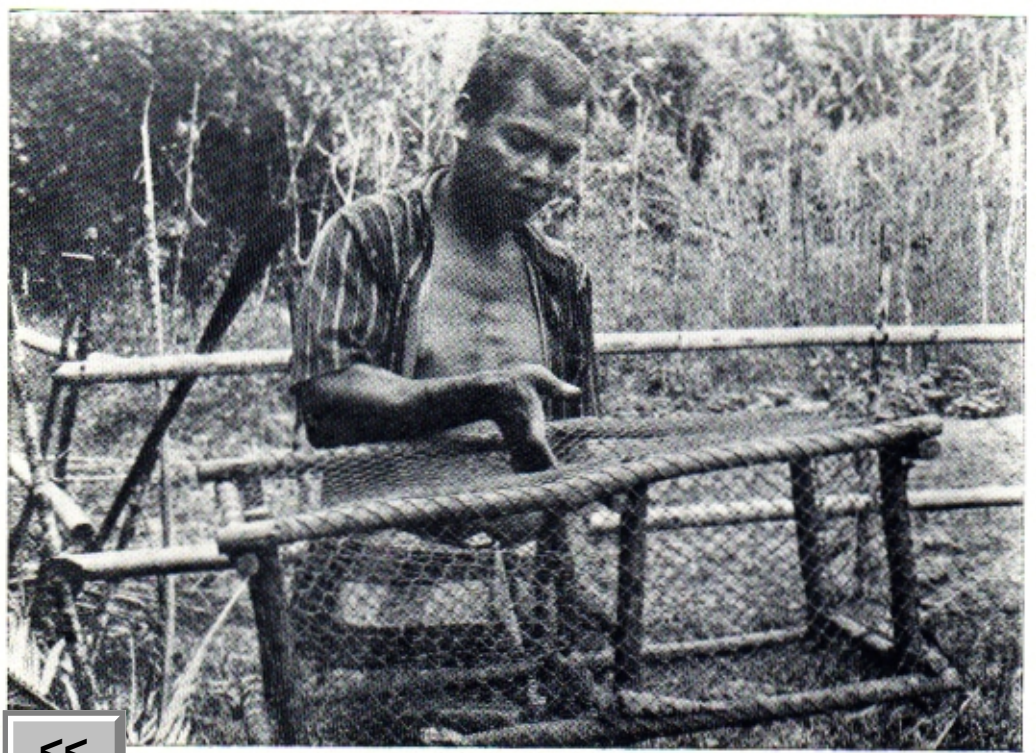


Right: Traditional shrimp paste preparation.

Below: Grouper/seabass collection trap.



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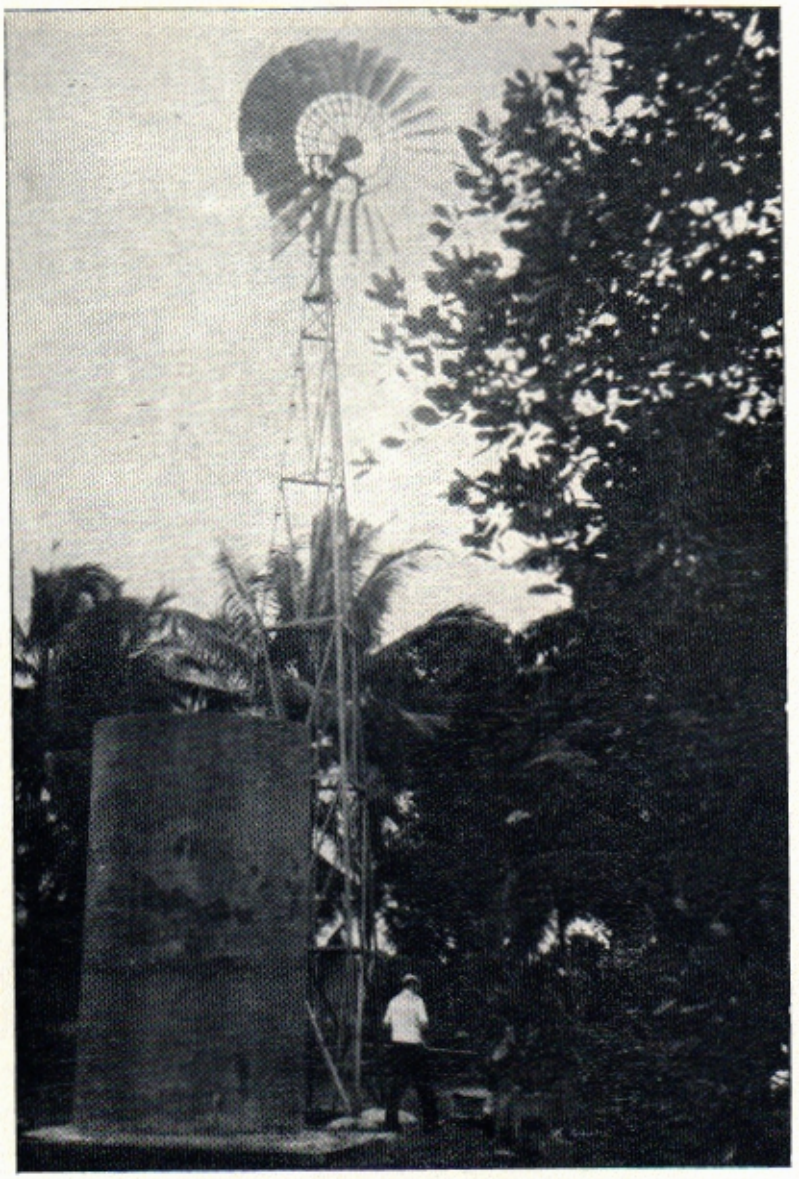

Left: Water tank and windmill-driven pump for supply of drinking water.

Below: Community hail built by the project.

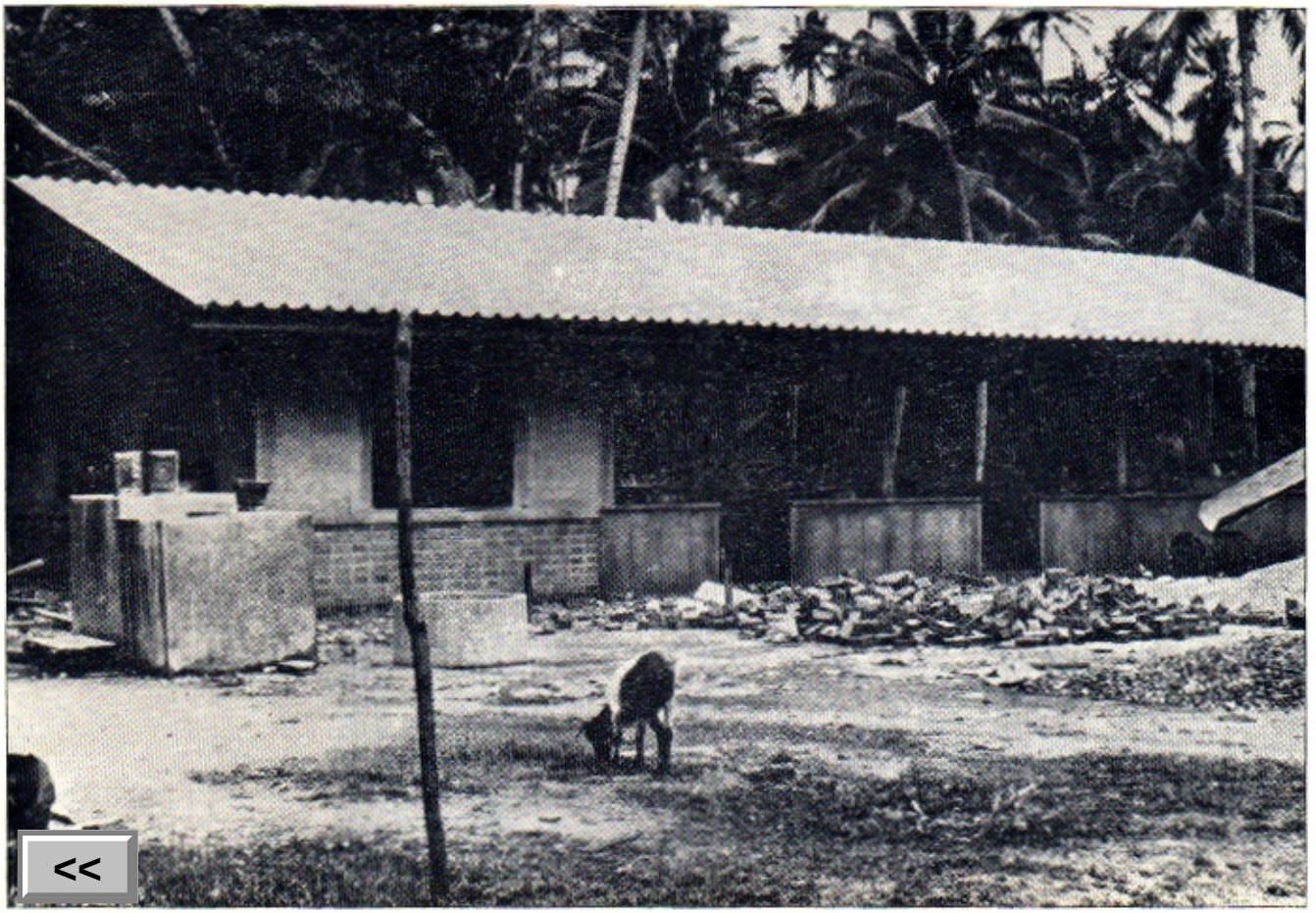

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Table 1a
Project Activities — Aquaculture

Province	Village	Finfish cage culture including cages in ponds after mining			Shellfish culture										
					Cockle			Oyster				Green Mussel			
		Year	Owners (no.)	Cages (no.)	Year	Owners (no.)	Area (1 ha)	Year	Owners (no.)	Poles (no.)	Trays (no.)	Year	Owners (no.)	Seed (tonnes)	
Phang Nga	Ban Ko Panyee	1979	12	18	—	—	—	1979	1 school		15	1983	30	32.0	
	Ban Ko Khiam	1980	6	6	—	—	—	1982	2	200	—	—	—	—	
	Ban Sam Chong Nua	1980	2	4	—	—	—	**1982**	2	200	—	—	—	—	
	Ban Kok Krai	1981	**1**	4	—	—	—	**1982**	2	200	—	1983	7	6.3	
	Ban Ko Maipai	—	—	—	1979	10	0.3	—	—	—	—	—	—	—	
	Ban Ko Mak Nai	—	—	—	—	—	—	1979	1 school		10	1979	6	1.2	
	Ban Bordan	1985	5	10	—	—	—	—	—	—	—	—	16	1.2	
	Ban Tha Jude	1985	5	10	—	—	—	—	—	—	—	—	—	—	
	Ban Thai Mai	1985	5	10	—	—	—	—	—	—	—	—	—	—	
	Ban Sam Chong Tai	—	—	—	—	—	—	—	—	—	—	1983	25	22.8	
Satun	Ban Ba Kan Koei	1982	60	60	1983	10	3.2	—	—	—	—				
	Ban Pu Yu	1982	13	13	—	—		- -	-	—	—	1985	5	8	
	Ban Tha Pha Yom	1984	5	20	—	—	—	—	—	—	—	- -	—	—	
	Ban Boh Jed Look	1984	5	20 nurseries	—	—	—	—	—	—	—	—	—	—	

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Table 1a
Project Activities — Aquaculture (contd,)

Province	Village	Finfish cage culture including cages in ponds after mining			Shellfish culture								
					Cockle			Oyster				Green Mussel		
		Year	Owners (no.)	Cages (no.)	Year	Owners (no.)	Area (1 ha)	Year	Owners (no.)	Poles (no.)	Trays (no.)	Year	Owners (no.)	Seed (tonnes)
Trang	Ban Ko Khiam	1982	14	14										
	Ban Pak Pron	1982	16	16										
	Ban Tu Ban	1984	10	40										
Krabi	Ban Tha Maprao	1982	5	10										
	Ban Kuan Tor	1982	5	10										
	Ban Bakan	1982	5	10										
	Ban Laem Kruad	-	-	-				1985	5	1000				
Phuket	Ban Ko Mapraow	-	-	-								1984	2	3
	Ban Ao Por	-	-	-								1985	5	3
	Ban Bang Rag Mai	1985	5	10										
Ranong	Ban Hard Prapas	1985	3	6										
	Ban Klong Kluay	1985	2	4										
	Ban Ko Lao	1985	5	10				1985	2	200				

Table 1 b

Project Activities — Aquaculture Training

Province	Village	Fish cage culture		General aquaculture		Seabass nursing		Diseases and feeding	
		Year	Trainees	Year	Trainees	Year	Trainees	Year	Trainees
Phang Nga	6 villages	1979	10	1979	40	1980	34	1985	40
	(Ko Pan Yee, Ko Khiam,	1984	60	1980	34	1984	10		
	Sam Chong Nua & Ko Mak Noi			1981	94				
Satun	4 villages	1984	22	1985	16			1985	45
	(Bakan Koei, Pu Yu, Bo Jed Look & Thapayom)								
Trang	3 villages	1984	15	1985	8			1985	40
	(Ko Khiam, Pak Pron & Tuban (Sikao)								
Krabi	3 villages	1983	45	1983	30			1985	40
	(Tha Mapraow, Kuan Tor & Ban Bakan)								
Ranong	3 villages			1984	40				
	(Ko Lao, Haad Prapass & Klong Kluay)								

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Table Ic

Project Activities -Training and Education for Women

Province	Village	Fish processing		Handicrafts			Education in family care	
		Year	Trainees	Year	Trainees		Year	Trainees
					Course	Study tour		
Phang Nga	6 villages (Ko Pan Yee, Ko Khiam Samchong Nua & Ko Mak Noi)	1980	135	1979 1980 1981 1981 1981	43 30 30	 1 (Japan) 1 (Philippines)		Activity implemented. No details available
Satul	4 villages (Bakan Koei, Pu Yu, Bo Jed Look & Thapayom)	1984 1985	10 group leaders 120				1984 1984	42 10 group leaders
Trang	3 villages (Ko Khiam, Pak Pron & Tuban (Sikao)	**1984**	4 group leaders				1984	4 group leaders
Krabi	3 villages (Tha Mapraow, Kuan Tor and Ban Bakan)	**1985**	80					
Ranong	3 villages (Ko Lao, Haad Prapass and Klong Kluay)							

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Table 1d

Project Activities – Infrastructure

Province	Village	Windmill, Water Pump		Jetty		Water storage		Community hall		Solar still	
		Year	No. of units	Year	No. of units	Year	No. of Units/Capacity	Year	No. of units	Year	No. of units
Phang Nga	Ban Bang Patana	–	–	1981	1	1979	1 500 m^3	–	–	1981	2
	Ban Ko Khiam	1979	1	1981	1	–	1 20 m^3	–	–	–	–
	Ko Pan Yee	–	–	–	–	–		–	–	1981	2
Satun	Ba Kan Koei	–	–	–	–	1985	48 1-1.5m^3	1981	1	–	–
	Pu Yu	–	–	–	–	1985	33 1-1.5m^3				
Trang	Ko Khiam	–	–	1985	1	–		1985	1	–	–

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4. RESULTS AND IMPACT

The impact of a project is determined, apart from social factors, by the technical feasibility and economic viability of the technology chosen for trials and demonstration. Generally, a feasible and viable technology is adopted quickly by people. However, unless certain provisions are made, a rather profitable technology is not adopted by the needy in most cases. Therefore, while this project did have a great impact on production (fish, shellfish) and total profits — it still remains to be discussed whether it achieved its main objective: improved incomes for small-scale fisherfolk[1]. This question will be addressed in this chapter.

4.1 Finfish cage culture

Considering the fact that finfish cage culture was an entirely unknown technology in the project area and that only experimental trials had been carried out in Thailand (by the National Institute of Coastal Aquaculture in Songkhla) at the time of commencement of the project, finfish cage culture demonstration has had a very significant impact.

Many small-scale fisherfolk have benefited through higher incomes and have become owners of fish culture cages. New income earning opportunities in subsidiary activities such as capture of fish fry and feed supply have also been generated. This was achieved due to the following : small-scale fishermen in the project area adapted to the new working patterns (except for night-watch) and put in increased effort; the market demand for the product increased steadily; the prices of the product increased as demand could not be sufficiently met despite higher production; investment costs were low; operating capital was made available by banks; and technical advice and extension services were provided by the project staff and the Department of Fisheries for a sufficient period of time.'

The expansion of cage culture has resulted in substantial production of high-value fish species and increased foreign exchange earnings.

Some negative impact from this expansion is seen in the concentration of farm ownership among a few non-fishermen in some villages and the increased pressure on inshore resources due to efforts to obtain low-value fish species as feed.

Dissemination of cage culture — and its beneficiaries

Finfish cage culture, which started with only 28 fish cage demonstration farms has, due to its economic viability and wide acceptance, spread quickly and widely in the area around the demonstration project. More than 1000 people have become fish cage farmers. They operate some 3600 cages in a total area of 32,400 m^2 (see Table 2).

One needs however to take a closer look at the distribution of cage ownership and the figures for production, costs and net earnings of a fish cage, in order to draw conclusions on whether and how much the incomes of small-scale fisher-folk have improved.

It was found that the 3600 fish cages were not equally distributed among the 1000 owners. The three kinds of cage farms set up can be categorized as follows:

-family farms without hired labour (2-4 cages)

— owner-managed farms with hired labour (5-30 cages)

— absentee owner farms with hired managers and labour (31-100 cages).

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[1] L. 0. Engvall, "Anatomy of a success- BOBP's aquaculture project in Thailand" in Bay of Bengal News No. 19, September 1985, page 3.

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Table 2
Demonstration and private fish cages in the project area

Province/District[1] or/and village	Demonstration		Year started	No. of cages per owner	Private (Nov. '85)		No. og cages per owner	Total[2] -(November '85) Demonstration & private	
	Cages	Owners			Cages	Owners		Cages	Owners
PHANG NGA									
1. Pan Yee	18	4 groups of 2-6 members	1979	0.9	163	25	6.5	181	56
2. Ko Khiam	6	6	1979	1	24	4	6	28	6
3. Samchong Nua	4	2	1979	2	245	45	5.4	251	51
4. Koke Krai	—				237	75	3.2	237	75
5. Ta Sanuk	—				28	9	3.1	28	9
6. Koh Mai Pai	—				40	25	1.6	40	25
7. Sam Do	—				8	2	4	8	2
8. Sam Laem	—				4	1	4	4	1
9. Bo Saen	—				83	35	2.4	83	35
10. Ka Song[3]	—				20	2	10	20	2
11. Koh Mak Noi	—								
12. Samchong Tai	—								
13. Bang Patana	—								
14. Kao Dueng	—								
Sub-Total	28							880	262

[1] As no common data monitoring system was followed, data for certain provinces are lacking, and the information can only be provided for an entire district instead of for each village.

[2] This total is not the sum of demonstration and private cages and of demonstration and private owners: some demonstration farmers stopped operations because they were reluctant to invest their own money. This happened mainly in Satun district, where the incomes and living conditions of demonstration farmers are poorer than elsewhere. They also belong to a different ethnic group and speak another language (Malay).

[3] Some private cages were discontinued after a year, in the villages numbered 10 to 14, because of inadequate protection from the wind.

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Table 2 (continued)

Province/District or/and village	Demonstration		Year started	No. of cages per owner	Private (Nov. '85)		No. of cages per owner	Total (November 1985) Demonstration & private	
	Cages	Owners			Cages	Owners		Cages	Owners
SATUN									
1. Ba Kan Koei	60	60	1982	1	212	53	4	241	63
2. Pu Yu	13	13	1982	1					
3. Tamalung	—	—	—	—					
4. Jae Bee Lung	10	10	1982	1	100	9	5	148	10
5. Tha Pha Yoam	20	5	1984	4					
6. Boh Jed Loog	20	5	1984	4	—	—	—	—	—
7. La Nga District (excl. 5 & 6)	—	—	—	—	375	102	3.7	415	142
8. Tungwa district	—	—	—	—	172	100	1.7	162	100
Sub-Total	123	93						966	315
TRANG									
1. Kan Tang district	58	14	1982	4	378	136	2.8	436	150
2. Pa Lian district	28	14	1982	2	363	109	3.3	391	123
3. Si Kao district	40	10	1984	4	67	32	2.1	107	42
Sub-Total	126	38						934	315
KRABI									
1, Klongtom district	—	—	—	—	500	180	2.8	500	180
2. Muang district	10	5	1982	2	200	40	5	210	45
3. Ao Luk district	10	5	1982	2	140	10	14	150	15
4. Koh Lanta sub-district	10	5	1982	2	30	20	1.5	40	25
Sub-Total	30	15						900	265
Total 4 provinces	307	174						3680	1157

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Table 3

Development trends in private fish cage culture and in cage ownership patterns: Phang Nga province

Villages	October 1982		September 1983		1984		1985	
	Cages	Owners	Cages	Owners	Cages	Owners	Cages	Owners
1. Koh Pan Yee	255	87	244	64	219	37	163	25
2. Koh Khiam	9	3	12	3	29	4	24	4
3. Sam Chong Nua	101	24	197	41	304	37	245	45
4. Koke Krai	85	37	306	68	239	64	237	75
5. Ta Sanuk	10	6	68	17	70	8	28	9
6. Ko Mai Pai	72	36	48	17	11	23	40	25
7. Sam Do	—	—	6	2	9	2	8	2
8. Som Laem	—	—	6	3	4	1	4	1
9. Bo Saen	2	1	48	12	102	34	83	35
10. Ka Song	—	—	—	—	20	2	20	2
11. Koh Mak Noi	—	—	4	2	—	—	—	—
12. Sam Chong Tai								
13. Bang Patana	8	4	—	—	—	—	—	—
14. Kao Daeng	—	—	2	1	—	—	—	—
Total	542	198	941	230	1007	212	852	223

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Most of the cage farms fall under the first two categories.

Tables 2 and 3 reveal that the ownership pattern of the cages, and thereby the distribution of benefits, differs between villages. In some locations a person owns up to 100 fish cages, whereas in other villages 100 cages are owned by 25-50 persons (2-4 cages per farmer). In the latter case, profits are lower per unit area but spread far wider, and small-scale fisherfolk have thereby benefited more.

Farms with 5-30 cages are generally owned by fishermen. These owners look after farm management themselves and employ hired labour to perform various tasks in the farms.

Cage farms with more than 30 cages are generally owned by non-fishermen. Many of them are non-residents of fishing villages with sources of income from agricultural land (rubber), tin mines, charcoal factories, fish trade and school teaching. They do not look after the farm management themselves. They engage managers who look after marketing and the purchase of seed and feed. The managers also supervise the labourers who are engaged for feed preparation, feeding, cage maintenance and security. The small-scale fisherfolk who are employed as labourers in these large-scale farms benefit less than those who operate family farms.

The prevalence of large cage farms (5-100 cages) in certain villages can be attributed to the following favourable conditions: easy availability of by-catch from nearby trawler landing centres, accessibility to such centres by road, natural availability of fingerlings in the vicinity of the cage farm area and the availability of electricity to enable effective safeguarding. Wherever these conditions do not obtain, the profits are insufficient to attract anyone other than small-scale fishermen.

Cage operators in villages too far away from the trawler landing centres (in Tai Muang, Phuket, Krabi, Trang, Kan Tang and Satun -see Appendix 1) depend on the feed that they can catch in the bay with their own gear, such as set bag nets and gill nets. lnspite of increased fishing effort, the bay fish resources accessible to fishermen with small craft (long tail engine boats) are insufficient to meet the feed requirements for even the existing number of small cage farms (see Table 2 which shows a reduction in cages and an increase in farmers). Even small cage farmers with two to four cages could not catch enough fish for feed. This resulted in comparatively low yields and profits. Some enterprising fishermen tried to overcome the problem of feed shortage through more intensive fishing units (motorized push netters) which were banned by the Government to avoid further exploitation of bay fish resources. However, these fishing units are not very cost effective due to the fact that the bay fish resources are highly exploited. Those who invested in them were able to catch fish feed sufficient for only a maximum of 10 cages.

Therefore, most of the small cage farmers did not expand their farms due to the problems of obtaining feed. As the cost of cages is only a small fraction of the total investment required in fish culture (Appendix 5), and since the water area can be used free of cost, small farmers tended to understock their cages or underfeed their fish, leading in both cases to low yields. The provision of grants and loans at subsidized interest rates for cage construction materials in areas without access to trawler landing centres also aggravated the under-utilization of cages and under-feeding of fish.

Though most family farms face problems of feed shortage, they can still improve their incomes substantially through cage culture. The average annual yield per cage (one crop) of small farmers (4 cages) was 96 kg — consisting of 160 groupers of 600 g body weight. Groupers of this size fetch a market price of 85 Baht per kg (800 g groupers fetch upto 120 Baht per kg). In spite of the rather low yield, these small farmers made a net profit of Baht 5776 per 4 cages plus an additional Baht 24000 earned on fry and feed collection (see Appendix 5). This makes an annual family income of Baht 29000 which is about double the family income earned from capture fisheries in 1983[1].

[1]According to a survey carried out by C. Tiantong, the average annual income from fishing for a household with three working members was Baht 14,624 in 1983.

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Though sufficient field records are not available on labour requirements and seed and feed collection, the information obtained through interviews suggest that a two-to-four cage farm can be operated by a family of three working members.

As fish culture does not provide daily incomes but at best — if selected harvesting is done — only income at quarterly intervals, it is difficult for small-scale fishing families to take up cage culture as an exclusive occupation. They have to continue with capture fisheries and fish processing to meet the basic daily needs of the family. This means that a family has to sell a part of its captured fish and that the entire catch cannot be used for fish feed. Small-scale fishing families have therefore taken up fish cage culture only as an additional occupation.

Fish cage culture, whether family-based or large-scale, depends to a great extent on the contribution of female labour. Though initially the technical training and demonstration was directed only towards men, women picked up the required techniques on their own by observation.

The labour required for seed and feed collection in fish cage culture is provided mainly by men. However, women also contribute towards this work. Feed preparation (chopping of feed) and feeding on the other hand are mainly carried out by women. Checking and cleaning of the cages is generally undertaken by men. Women generally contribute towards the stocking of fry. Harvesting is done by both men and women. One task carried out exclusively by men is that of safeguarding the cage farm during the night.

Although women were not excluded from access to the new technology, they should have been included in the technical training on cage management and nursery rearing of fries provided by the fisheries extension officers in all demonstration villages. This might possibly have improved cage maintenance and management, and thereby reduced the mortality rate of fish, and increased profits.

Until early 1984, Government hatcheries at Phuket and Satun provided seabass fry to many farmers free of cost (Appendix 8). The Government also allotted subsidized cage construction materials and offered bank loans at subsidized interest rates (which are not being adequately repaid) for purchase of feed (Appendix 9). This led to a large expansion of cage culture and an increase in cage farms.

From the second half of 1984, however, the Government cut down on cage culture subsidies. Result: fewer fish cages under farming. However, whereas the area under culture (number of cages) has declined, the number of owners has increased (Table 3). This indicates that fairly substantial subsidies must have been given to cage farmers operating in areas where fry and feed are not adequately available. Also that rather good profits were achieved in many areas only due to subsidized investment and production costs. After the withdrawal of Government subsidies in villages without favourable production conditions, it is mainly small family farms that continue to function.

Foreign exchange earnings through finfish production

The project has had a remarkable impact on finfish production. The 28 demonstration fish cages started in 1979 in three villages of Phang Nga province (Table 2) had a very good demonstration effect, Cage culture expanded to more than 800 cages within a few years. According to a survey carried out in Phang Nga in 1983,[1] the average annual yield per cage (for small and large farms) was 112 kg for seabass and 93 kg for grouper. As 26% of the cages were stocked with seabass and 74% with grouper, this amounts to an estimated annual production of nearly 80 tons. Seabass was sold at an average producer's price of 63 Baht per kg and grouper at 85 Baht per kg. Assuming that the same yields and prices were achieved in the other three provinces (Table 2), this means a total annual production of 350 tons of finfish valued at Baht 27.7 million (one million US $).

[1]Chao Tiantong, survey report on small-scale fisheries development in Phang Nga province. Economic Project 8 Programme Evaluation Division of the Ministry of Agriculture Co-operatives, Bangkok (Unpublished).

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Neither increased fish production nor higher foreign exchange earnings was an objective of the project. Both were unintended effects of finfish cage culture. It is estimated that a good portion of cultured seabass and a major portion of cultured grouper is exported to Malaysia and Singapore.[1] As the estimated total production value of Baht 27.7 million is a rather conservative figure, it can be safely estimated that at least Baht 20 million worth of cultured finfish is being exported annually. Considering that the officially recorded export value of marine products from all the southern provinces was Baht 722 million in 1984[2], it can be inferred that cage culture has contributed remarkably to foreign exchange earnings.

However, it has also to be noted that cage culture in Thailand has led to a reduction in the export of grouper fry collected from the estuaries. This is because the fry are in great demand in the local market. The export value of fry was nominal (Baht 10 per grouper of 7 cm size) in comparison with the export value of grown-out groupers.

Fishing gear development and alternative use of cages

Some small-scale fishermen have begun to specialize in collecting seeds from the estuaries. The most effective method is the use of traps. A new fish trap has been developed by fishermen. This is used only for trapping small size groupers between 100 and 400 g. This new gear — unlike the traditional bamboo fish traps with a wider and expandable opening -is placed in grouper nursery grounds. As grouper seeds are generally available throughout the year, seed collection is a regular occupation except in the monthly neap tide phases.

The few families who have specialized in grouper fry collection own medium-sized long tail engine boats and therefore operate over a wide range. In most cases, the fry collectors fabricate their own traps. In areas where large cage farms exist, some fishermen have specialized in fabricating traps which they sell to fry collectors. The latter provide them with the materials and pay them for their labour on a piece rate basis (Baht 150 per trap).

In certain villages (Pan Yee, Ko Mai Pai), fishermen have found an alternative use for fish cages as they faced both feed and seed shortages. They utilize some of their cages to store high priced fish species that are captured daily, such as blue crabs and lobsters. These are stored for a few days until the quantity is sufficient to be taken to the market at Phang Nga or Phuket. This has led to an increase in incomes.

Problems and constraints of cage culture

To some extent, cage culture has had a negative impact on brackishwater and inshore fisheries resources. This is due to the introduction of the motorized push netter to catch small and low cost fish to feed the fish under cage culture. These push netters, which were common in certain areas at one time, were banned from operating within 3 kilometres inshore by the Government a few years ago. However, a few of them have reappeared as a result of the expansion of cage culture. Those who have recently invested in push netters find that it is not a cost efficient unit. This is probably due to the fact that resources have been over-exploited because of the large increase in trawlers in the recent past[3].

Medium and large cage farmers obtain most of their fish feed from harbours (trawler and purse seine landings). They use trawler by-catch, which consists of non-edible fresh fish as well as edible low cost species. They also use small sardines, which otherwise are ***to*** a large extent turned into fish meal. About 20% of the feed used by large farmers consists of small mackerels which are usually canned for local consumption. If cage culture is to spread further or intensify (through fattening programmes), there will be a strong competition for mackerels between local consumers and producers of the high priced seabass and groupers (which are mainly exported).

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[1] No data is available.

[2] Phuket Marine Fisheries Station, Fisheries Development in Southern Thailand, report published in Thai, Phuket 1984, page 24.

[3] Phuket Marine Fisheries Station, Twatcha Chantawong and others. Report on trawling and status of demersal fisheries in the Andaman Sea, Phuket 1984.

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Estimated annual feed requirements for about 3,600 cages:

1. **Estimated production of groupers : 360,000 kg**
   (3600 cages x 100 kg cultured fish)
2. **Assumed conversion ratio : 6kg :1 kg**
3. **Required fish feed : 2,160 tons (20% mackerels)**

It can be calculated from these figures that 432 tons of edible mackerels are used every year to grow the groupers.

In the event of further expansion of cage culture, the competition between local fish consumers and cage culturists should be reduced by carrying out feeding trials with a mixture of vegetable and fish feed and then producing such feed mixtures. As fish nutrition is still in a nascent stage, more applied research remains to be carried out.[1]

The production of storable low cost formulated feed, whether a mixture of vegetable and animal products or a 100% animal product, is an absolute necessity if cage culture is io be expanded further. This is true particularly in areas which are extremely suitable from the hydrological point of view but have no access to large fish landing centres for fresh feed supply.

It can be concluded that the availability and accessibility of feed has determined the profitability of cage culture and the patterns of investment and cage farm ownership to a large extent. The amount of feed available is inadequate in many locations which are hydrologically suitable for fish cage culture. The cage farms in these locations are small in size and owned by the operators themselves. These operators have taken up cage culture as a family "enterprise" and collect fry and most of the feed instead of buying it. Consequently, the feed constraint, though it lowered profits, appeared to be a control mechanism for cage farm sizes.

Limited seed availability (from nature and hatcheries) was another constraint for the greater expansion of fish cage culture. This was probably the greatest constraint for large-scale farmers who generally set up their cage farms in the vicinity of large fish landing centres used by purse seiners and trawlers.

Capital for investment costs and operating costs (seeds) was not a constraint as banks were prepared to provide credit. This applied mainly to those cage investors who had either collateral or sureties to guarantee the loans. In some provinces, however, the Government had made special provisions for providing credit to people without assets (subsidy scheme). More small-scale fishing families might have benefited if long or medium term credit had been provided to meet daily family expenses until the first harvest in addition to seed and feed costs; and if intensive technical advice and training had been provided during the nursing and grow-out phases of seabass to keep the mortality rate low and also to ensure adequate profits so that loans could be repaid more easily.

4.2 Cockle Culture

Like finfish cage culture, cockle culture technology was also unknown in all the four provinces at the inception of the project. However, it was well established in the Gulf of Thailand and in the Malaysian part of the Andaman Sea that is close to the Thai border. In these areas, seeds occur in nature-this is not so in the project area.

Cockle culture was demonstrated in only one farm for only one year in an area of 0.3 ha. While the demonstration farm was discontinued, four persons started their own private farms in the immediate vicinity of the demonstration farm. Another eight private farms were established between 1981 and 1985 in the same province, but in locations a little further away from the demonstration farms. In November 1985, a water area of 280.3 ha was reported to be under cockle culture in the Phang Nga province (Table 4).

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[1] **Cho/Cowey/Watanabe, Finfish nutrition in Asia. Methodological approaches to research and development. IDRC-233e, Ottawa 1983.**

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Table 4

Cockle farms and ownership structure in Phang Nga province

Location of farm	Demonstration farm		Private farms			
	Area (ha)	No. of farmers	Area per farm (ha)	Owners per farm	Residence of owners*	No. of local "partners"
Off Ko Pan Yee			8	Group of Pan Yee 16		—
			48	1	Haadyai	12
			8	1	Phang Nga	9
			0.3	1	Pan Yee	1
Off Ko Mai Pai	0.3	Group of 10	—	—	—	—
			24	1	Haadyai	15
			24	1	Haadyai	15
			24	1	Kra bi	30
			8	1	Mai Pai	4
Off Sam Chong Tai			56	1	Ka Some	28
			40	1	Phang Nga	20
and Sam Chong Nua			32	1	Ban Nua	16
			8	1	Ka Some	4
Total	0.3ha	10	280.3 ha	11+ 16		155

* Ka Some and Ban Nua are villages in Phang Nga province. For location of the other places see map in Appendix 1.

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The expansion of the technology proves that it is economically viable. The sizes of farms and type of investors indicate that the profits are high. Unfortunately, the production costs and earnings were not continuously monitored. Information obtained from interviews with a cockle farm manager and members of a cockle cooperative indicate that although cockle culture depends on costly illegally imported seed, the earnings after deduction of the seed costs were around 75,000 Baht per ha per crop (11-18 months). Cockle farmers reported that yields had decreased by more than 10%, in spite of prolonged culture cycles (up to 21 months), after the third crop in the same location. They intended to overcome this problem by shifting their farms to new areas with unexploited natural feed.

As Table 4 reveals, all cockle farms -except one-are much larger than the demonstration farm. The high profitability of cockle farming has attracted businessmen and large entrepreneurs who have sufficient capital and connections with seed suppliers to invest in cockle farming. The lack of legal access to seed as well as access to bank credit for seed seem to have prevented fishermen from investing in cockle farms.

Small-scale fishermen have taken up cockle farming only in one village (Pan Yee). Eight people without their own capital have formed a cockle farming cooperative. The government helped them in obtaining financial assistance from a local bank.

The cockle farming cooperative consists of 16 members among whom the shares are equally divided. Profits are distributed in relation to the shares owned. One of the members has been appointed by the others as a part-time manager, to arrange for seed procurement, harvesting and marketing, for which he receives a fixed salary. His other occupation is to manage a 24 ha privately owned farm off Ko Mai Pai (map in Appendix 1). The owner of this farm resides close to the southern border and has well-established links with seed sellers abroad. Without this connection, the cockle cooperative would not have been able to function.

The owners of all the other farms are non-fishermen and most of them are not residents of fishing villages. They are engaged in various business activities. Due to the non-availability of seed in the project area[1] and export restrictions on cockle seed in the neighbouring countries, it is highly risky to procure the seed. This risk can only be taken by people with sufficient capital and connections-small-scale fishermen certainly do not belong to this group.

Large cockle farmers face another legal problem in Thailand. Since the water area accessible to individuals is restricted, farms must officially be registered with the Department of Fisheries, which cannot allot more than 2 ha (exceptions are 4 ha) to an individual. To overcome this constraint, large-scale cockle farmers find "partners" from the local fishing communities in whose names the water area is allotted. Small-scale fishermen generally welcome such "partnerships" as no financial or labour inputs are required. It is said they are paid 5% of net earnings. No protest from those who have not been chosen as "partners" have been reported so far. For harvesting work, the large-scale farmers generally engage local fishermen. Security guards are recruited from other areas.

It can be concluded that lack of seed has inhibited cockle culture expansion. Whereas cockle farming is very profitable, it has not been adequately accessible to the target group of small-scale fisherfolk, mainly because of lack of locally available seed. Because of low labour requirements, cockle culture can offer few employment opportunities to local people, particularly to women.

Even if seed can be grown locally in future, it is unlikely that small farms will be established, as safeguarding will be a problem. The lack of capital among small-scale fisher-folk can probably be overcome if banks finance the operating costs for seed and labour. Production cooperatives like the one in Yee Pan may be an appropriate solution if the target group is to benefit from cockle culture in the future.

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[1] Anuwat Ratanachote and others. Report on aquaculture demonstration, Phuket Brackishwater Fisheries Station, Phuket. Page 7.

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4.3 Oyster culture

Despite the fact that spats are found locally, production in the demonstration farms was apparently not high enough to attract fisherfolk and others to invest in oyster farming. Yields were much lower than those achieved by oyster farmers in the Gulf of Thailand.

In addition, farmers have found it difficult to obtain reasonable prices as the marketing channels were not developed due to the insufficient quantities of oysters produced. Marketing of oysters needs experienced merchants who have access to well-paying customers, like tourist hotels in the southern provinces or in Bangkok. These merchants, who are well established in the oyster-producing Gulf of Thailand, could not be attracted to the project area since the estimated profits here from oysters was too low. Further technical culture trials may have to be carried out before private farmers invest in oyster culture.

4.4 Mussel culture

Like oyster culture, mussel culture hardly attracted fisher-folk and other investors. Reasons seem to be the high cost of transporting spat from the Gulf of Thailand and the high cost of culture technology (rafts) in the demonstration farms. Finally, as in oyster culture, low yields kept away merchants with access to affluent customers (hotels, etc.).

4.5 Training and education for fisherwomen

The training of women in technical skills such as improved fish processing techniques, handicrafts, tailoring and basket weaving had a very limited impact in comparison with the aquaculture components. The main cause for this seems to be the problem of marketing the products.

Women trained in techniques to produce higher quality shrimp paste (Appendix 4) did not apply these techniques as they added to the production costs. No local shrimp paste merchant was prepared to pay for the value added since consumers in the area preferred low cost ordinary paste. This leads producers to stick to the low cost ingredients. Since the processing (fermenting) of improved shrimp paste takes a few more weeks than ordinary paste, it takes a longer time before the product can be sold. Moreover, the producers also required more storage facilities. All this should have been considered and carefully analyzed before it was decided to train women in new shrimp paste processing techniques. A ready market for higher quality and costlier shrimp paste might have been found in areas close to cities like Bangkok, but not in the project area.

Women continue to produce the ordinary shrimp paste which has a ready local market. It can therefore be concluded that the training had no impact.

Women shrimp paste makers in the project area are of the view that a possible way to improve their incomes would be by increasing production. To do this, working capital at reasonable interest rates would have to be provided by banks in order to purchase more raw material. Before one decides to provide bank credit, one must find out whether sufficient raw material shrimp (ascetes) is available. If the raw material is not readily available, bank credit will not help expand shrimp paste production.

Handicrafts training (in macrame products, paper umbrellas and articles made from fish scales) has also had very limited impact due to limited demand. Macrame products were almost out of fashion as early as 1980. Articles made from fish scales and small paper umbrellas, meant as souvenirs for local people, also did not find a market as they could not compete with other souvenirs made in a large production centre in Phuket.

Training in basket weaving and tailoring had some impact. A few young women who do not engage in fishing and fish processing have been able to make use of the skills imparted. Some have found customers for their baskets in border towns with the help of fish merchants. A few women get tailoring orders from people in their own village.

The impact of the project component on the education of women in family planning, health, hygiene and nutrition cannot be assessed at this stage, as this component was introduced only in 1984. As educational programmes are implemented by the Department of Public Health, the

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project staff's role was restricted to helping initiate these programmes and motivating the fisherwomen to participate. The one notable impact in some villages has been the construction of simple toilets which did not exist prior to the education programme. To identify the impact of subjects such as family planning and health education, further investigations at a later stage are called for.

4.6 Infrastructure for the fishing community

This project component aimed mainly at providing a model for community development. However it did not try to demonstrate new infrastructure techniques, except for the windmill-driven water pump. The fishing communities in pilot villages were to be motivated to contribute labour for facilities such as drinking water, jetties, village walkways, community buildings. Funds were to be provided by the project and the Government for procuring the materials required.

This community development approach, which has been tried out in various other countries in the Bay of Bengal area, had limited success. It proved easier to get fisher-folk to contribute money to village or community infrastructure development than labour. For example, in 1984/85, people in Sam Chong Nua in Phang Nga province collected a large sum of money to construct link road. Individuals contributed between Baht 2,000 and 15,000 (US $76-570) for this purpose. However, they were not willing to contribute their own labour; road construction was carried out by a professional construction firm. A similar thing happened with respect to the construction of a mosque at Pan Yee in Phang Nga province.

Besides the community/infrastructure facilities constructed with funds contributed by the village, various other public-funded infrastructure facilities have been built since the inception of the project in 1979. These are not a direct result of the project, though the project staff and fisheries field officers assisted the technical department officers in the provinces and districts to identify the specific infrastructure needs of the fisherfolk. The facilities included establishing a drinking water supply and constructing new school buildings. These proved to be of great benefit to the villagers.

The community development approach which the project demonstrated was not adopted outside the project village. Two factors seem to have influenced or prevented this. The Government did not have sufficient field extension personnel to organize and motivate fisher-folk to contribute their own labour; and the village leaders themselves found it more advisable to ask for voluntary cash contributions rather than solicit labour.

5. CONCLUSIONS

The project aimed at two immediate objectives. To provide a viable alternative or at least a supplementary source of income to small-scale fisherfolk and to develop a "model for expanded development effort in the rural fishing sector". The first immediate objective has been achieved-mainly through finfish cage culture. The other project components-shellfish culture, fish processing, handicrafts and tailoring-have not contributed much to achieving the objective. This was either because the technology was not adequately accessible to small-scale fisher-folk or because it proved to be techno-economically inappropriate in that particular area.

It is not possible to assess whether the second objective has been met since no operational targets had been formulated on how this objective should be achieved.

The preceding discussions on the project's impact show that the aquaculture project component has led to better results and impact than the other components. The various factors which contributed to this have been discussed. But one more factor could have been responsible: the thorough preparation and detailed planning of the aquaculture component in comparison with the other components. This is reflected in the operational targets. Much less preparatory work went into the fish processing, handicrafts and infrastructure project components, the operational targets were hardly outlined. A detailed project identification study-as undertaken for

finfish cage culture-could have resulted in a more specific formulation of the operational targets and should have led to more positive project results. This refers particularly to the handicrafts component, but also to fish processing.

It should have been taken into account that there is hardly any division of labour between men and women in small-scale fisheries. A recognition of this fact may have suggested that there was no need for a component directed specifically at women. Rather, women should have been given the same access as men to new technologies (e.g. cage culture) by providing training, credit and extension support.

Those components aimed at improving family life (nutrition, health, hygiene etc.) through education should have included men to obtain better results. However, it may be difficult to motivate men to participate in these components since they deal with problems that are mainly attended to by women. If may be more effective if these components were also directed towards young boys (and girls) by incorporating them in the school curriculum.

Whether components other than aquaculture should be considered for future development efforts can only be answered positively. However a thorough identification and planning exercise should be undertaken of such components. Moreover it has to be recognized that departments other than just the Brackishwater Aquaculture Division of the Department of Fisheries will have to be involved in the identification, planning and implementation of such activities.

Since finfish cage culture has proved its income-expanding potential for small-scale fisher-folk, it is anticipated that coastal aquaculture will play an important role in future development efforts in the southern provinces.

In recognition of the importance of credit for both finfish and shellfish culture, the Government of Thailand, through its Bank of Agriculture and Agricultural Cooperatives, has already allocated funds. However, the existing services need to be improved by increasing contact between credit officers and small-scale fishing families. A well coordinated extension plan will have to be designed in order to utilize the existing extension service facilities in a better way.

It needs to be realized that a massive technical and financial extension of cage culture will be meaningful only when sufficient fry and pelletized feed can be supplied to farmers. As both requirements cannot be sufficiently met at present, the technical development effort should concentrate on hatchery seed and pelletized fish feed production.

There are indications that fish cage culture may not expand further if hatchery seed and fish feed production are not promoted. Moreover, the number of cages is likely to decrease with the reduction in natural seed stock.

With respect to shellfish culture, only cockle culture has proved to be technically and economically viable in the project areas so far. Cockle culture will not, however, become a means of improving the incomes of small-scale fisherfolk in the area until the Government succeeds in taking stronger measures in support Of Small-Scale fisherfolk. These measures should include access to seeds, strict enforcement of territorial (water) use rights and motivational support through extension services to form cockle production cooperatives.

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14. Somporn Ithipongs. Report of a village-level post-harvest fisheries technology training/ demonstration course, FAO/South China Sea Programme Working Paper 5, Manila, 1980.

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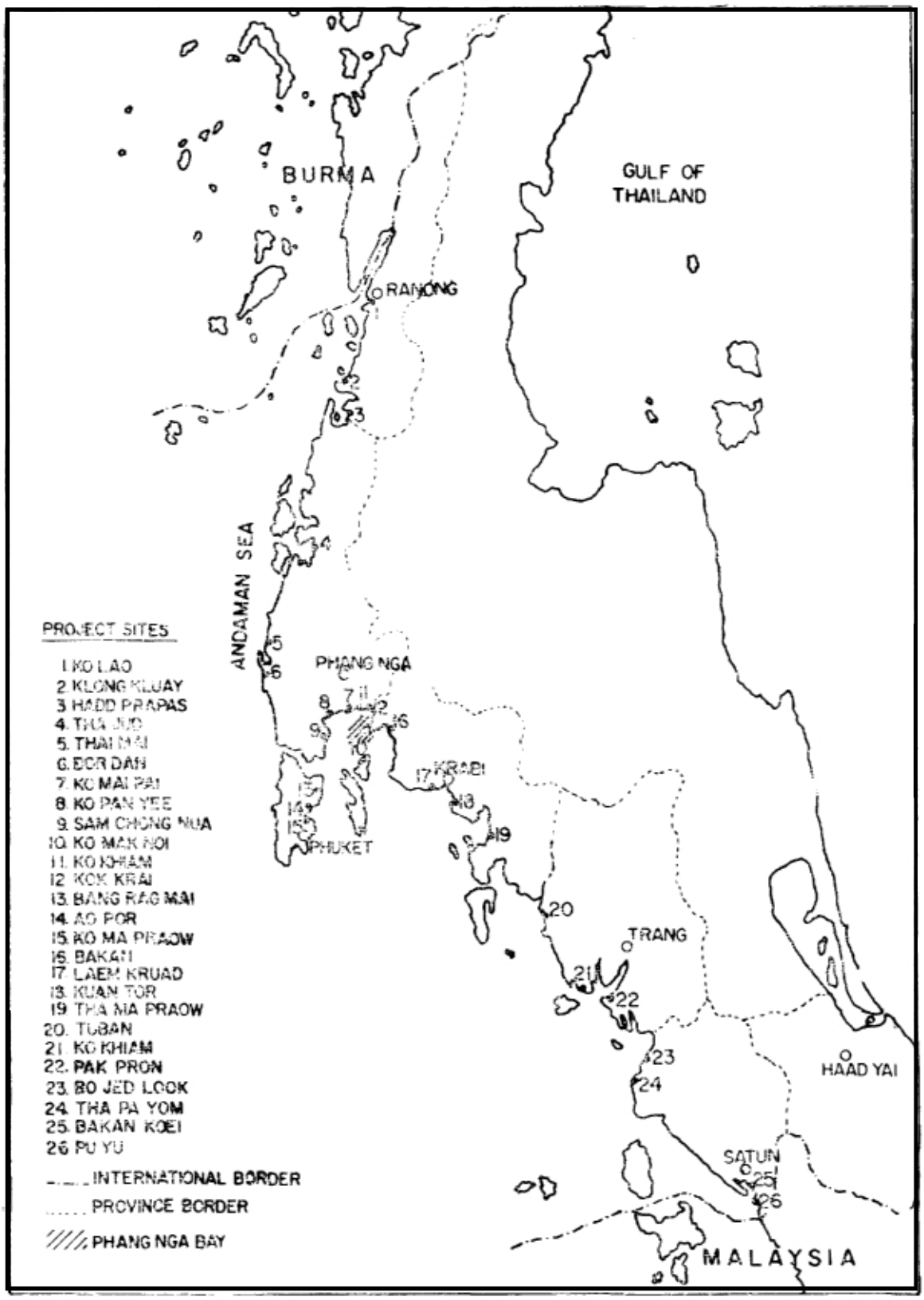
Appendix 1

LOCATION OF PROJECT SITES



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Appendix 2

ORGANIZATIONAL STRUCTURE OF THE PROJECT

During the first phase of the project, technical support was provided by the South China Sea Programme which also undertook responsibility for the disbursement of external funds provided by BOBP. During the next three phases, these arrangements were discontinued and local expenditure of externally provided funds for the project were handled directly by BOBP through a FAO sub-imprest maintained in Phuket. In addition to intermittent visits by BOBP headquarters staff to assist in planning and monitoring, BOBP also provided the services of a full-time Project Officer whose function was to assist the Project Director and the Team Leaders in the administrative aspects of the implementation of the project.

Throughout the life of the project, the Director of the Brackishwater Fisheries Division, Department of Fisheries, functioned as the Project Director.

A staff member of the Phuket Brackishwater Fisheries Station functioned as the Team Leader of the project during the first phase. The Phang Nga activities of the project were also under his charge during the second phase. The project activities in Satun during the second phase were placed under the part-time charge of the Chief of the Satun Brackishwater Fisheries Station.

During the third phase of the project, activities in Phang Nga and Krabi provinces were placed under the part-time charge of the Chief of the Phuket Brackishwater Fisheries Station and those in Satul and Trang provinces under the part-time charge of the Chief of the Satun Brackishwater Fisheries Station.

During the fourth phase of the project, activities in Satun, Trang and Krabi provinces were placed under the charge of the Chief, Satul Brackishwater Fisheries Station and the activities in Phang Nga, Phuket and Ranong provinces under the charge of the Chief, Phuket Brackishwater Fisheries Station.

The team leaders were assisted by biologists, technicians and administrative and support personnel assigned to the project on a full-time basis by the Department of Fisheries. In addition, the Department provided the services of professional specialists, when required, on a short-term basis. Liaison between the Department and BOBP, mainly in matters pertaining to policy, was provided by the Fishery Economics Section of the Department.

During the first and second phases, there was collaboration between the team leader of the Phang Nga unit and the Phang Nga provincial government through the Provincial Fisheries Officer, Phang Nga. In the third and fourth phases, the Provincial Fisheries Officers and District Fisheries Officers were actively involved in the implementation of project activities in their respective provinces.

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Appendix 3

MAJOR FEATURES OF DEMONSTRATED AQUACULTURE TECHNIQUES

1 Cage culture of finfish

A *floating cage* is one of many types of enclosures which can be used to contain fish. Several features make it attractive. The initial investment for small flexible cages is relatively limited. They make productive use of existing water bodies, in this case the rivers along which the villages are built. The cages are therefore readily accessible, and guarding against predators is not much of a problem. The fishing community can provide many of the inputs needed (labour, boats, feed and to a certain extent the seed) without disturbing its normal activities.

The *raft* from which the synthetic netting is suspended is usually made of locally cut mangrove poles or wooden planks, or in more exposed sites, of galvanized pipes. Polystyrene blocks or sometimes plastic containers ensure the buoyancy. The principal lay out of a raft is given in Fig. 1.

The poles or planks are usually nested in rows parallel to the shore. Collapsing of the netting material, which would result in crowding the fish, is prevented by weighting the corners with stones. A typical grow-out *cage* is 3 x3 x2.5 m (Fig. 2) with PE webbing of 40 mm mesh size. The largest cages used were 5 x 5 x 2 m. For nursing of fry the cages were 1 x 2 x 1 m with a mesh size of 4 mm. An intermediate cage of 1 x 2 x 1.5 m was used for nursing and rearing of fingerlings.

The fish *species selected* for culture were seabass *(Lates calcarifer)* and grouper *(Epinephelus tauvina),* both fetching high prices on the market. Grouper is the more valuable but seabass seed is more readily obtained because it is hatchery-produced at the Phuket and Satul Brackish-water Fisheries Stations and also at private hatcheries. Nursing of the seabass fry is done in cages by the fish culturist.

In general, the marketability during the nursing period was very high and efforts were made to train the farmers and to establish specialized nursery farmers. Grouper fingerlings are mostly caught from the wild in traps (60 x30 x30 cm) made of wood and chicken wire. The fish trapped weigh. 100 to 300 g. They are caught all around the year but March-April is the peak season. At that time 150 fishes can be caught per trap and month. Because of their size no nursing is required. They are immediately stocked in grow-out cages and the survival rate is very high (80 - 100%).

The stocking density for both seabass and grouper is about 300 fishes in a standard cage of 3 x 3 x 2 m.

The production can be expected to amount to about 150 kg per cage. Groupers of 100 - 300 g grow in 5 to 8 months to 500 - 800 g. Seabass requires about 12 months to grow from a 3 g fry to a marketable size of 600 - 800 g.

The table below summarizes the stocking and harvest ranges for grouper and sebass.

Species	Initial stocking		Rearing period (months)	Harvest (kg/m^3)	Size of fish	
	$fish/m^3$	kg/m^3			Initial (g)	Harvest (g)
Seabass	1.5-25.6	0.01-0.1	± 12	1.5-10.8	4-6	490-1670
Grouper	2.2-13.1	0.4 -3.6	5-8	**2.1- 8.1**	160-210	350-950

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Errta -- BOBP/REP/28

Please note the following corrections:

Page 32: Appendix 3, para 3 line 1 -- Please read 'cages' for 'poles or planks'... The first line shold read: The cages are usually nested in rows parallel to the shore.

Para 5, first line and second line: Please read 'mortality' for 'marketability' and nursery 'farms' for farmers. The lines should read : In general, the mortality during the nursing period was very high and efforts were made to train the farmers and to establish specialized nursery farm.

Page 36: Para 3, 2nd line. Please read 'sown' for 'grown'. The line should read: Cockle seed, 1000 - 3000 cockles/kg is sown at a rate of about 1 t/rai (6t/ha) .....

1.8.1986

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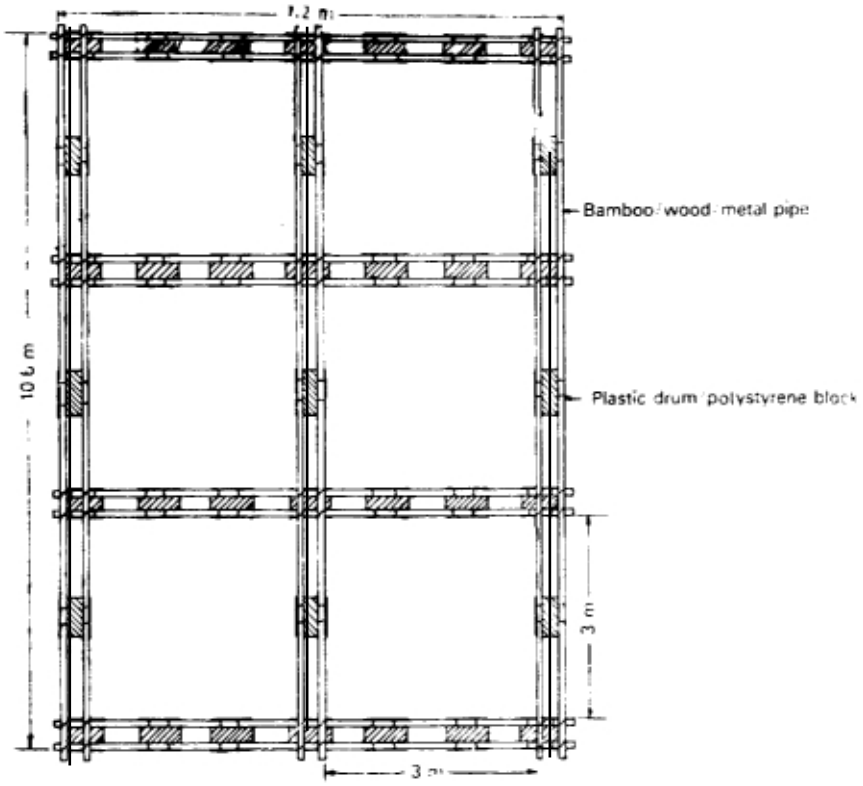

Fig. 1 GENERAL LAYOUT OF A RAFT FOR SIX CAGES

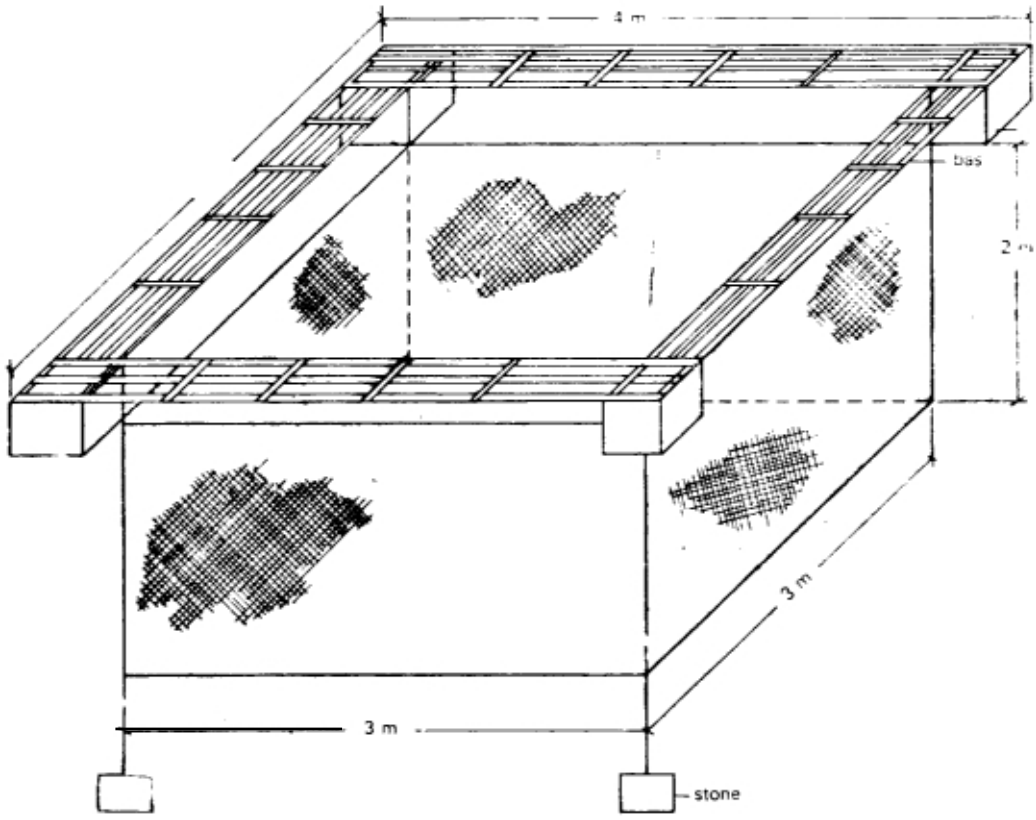

Fig. 2. CAGE OUTLAY (3 x 3 x 2 m) INSIDE RAFT OF 4 x 4m

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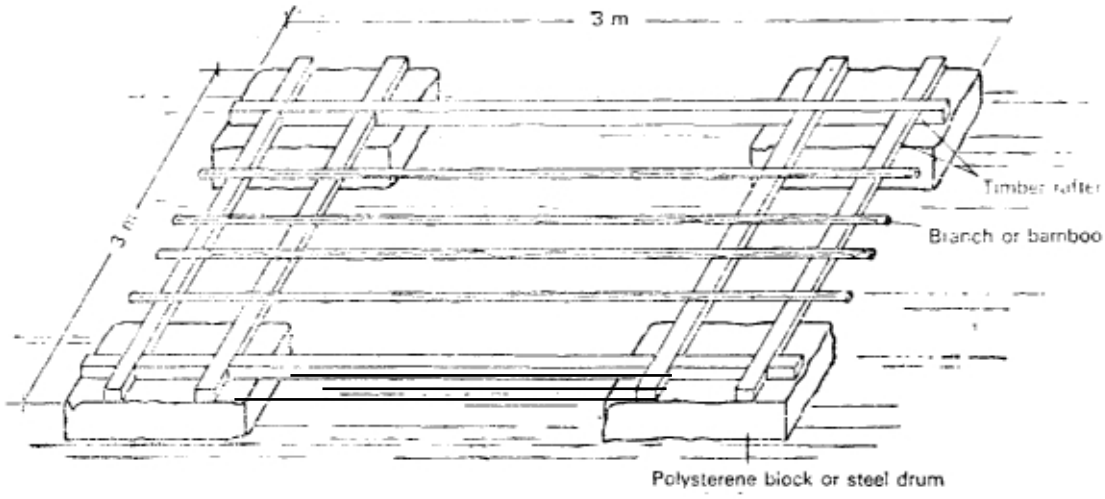
Appendix 3 *(contd.)*



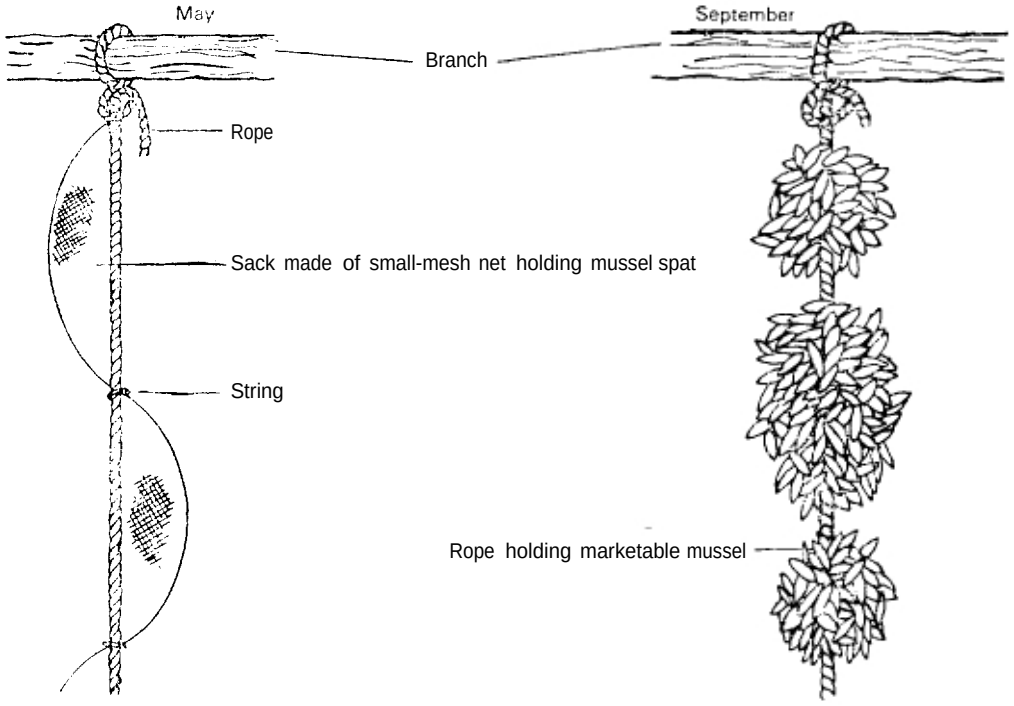


Fig. 3 RAFT METHOD OF CULTURING GREEN MUSSEL
Mytilus smaragdinus

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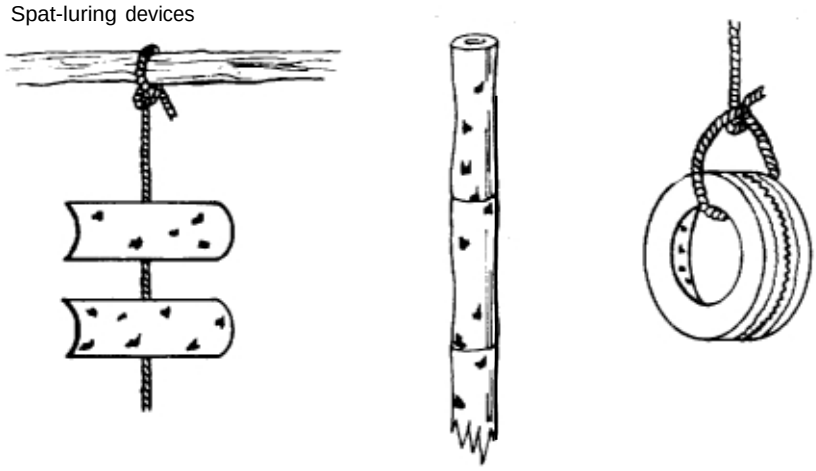
Spat-luring devices

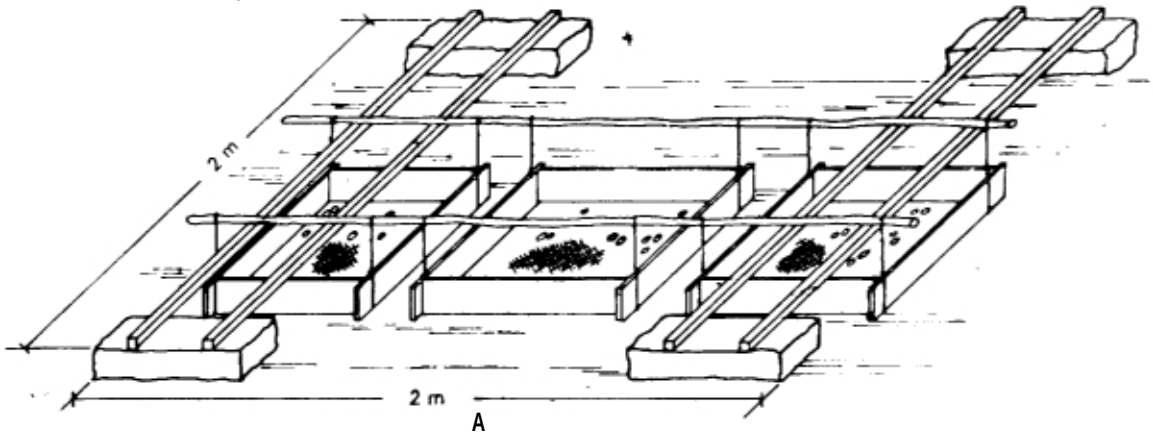


A
Corrugated asbestos

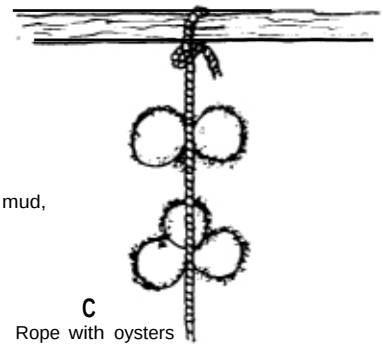
5
Pole or bamboo coated wrth cement

C
Car tyre

Grow-out systems



A
Tray hanging down from raft



Short poles stuck in mud,

Bamboo split

B
Bottom Tray

C
Rope with oysters

Fig. 4 SPAT-LURING DEVICES & GROW OUT SYSTEMS FOR OYSTERS

The fish are given supplementary feed daily during the entire culture period. It consists of chopped trash fish which at each time is given until satiation. The feed conversion ratio is in the range of 6-10 i.e., to produce 1 kg of fish, 6-10 kg of trash fish is required. The groupers are at the *lower* end of the range and the seabass at the upper end.

2 Shellfish culture

The culture of shellfish differs from fish culture mainly in one aspect, i.e. feeding. There's no feed administered by the aquaculturist. Mussel, oyster and cockles feed on algae filtered from the water. These algae are converted into high quality animal protein.

Cockle *culture*

Culture of cockles (mainly *Anadara* granosa) is carried out on leased mud flats. Cockle seed, 1000-3000 cockles/kg, is grown at a rate of about 1 t/rai (6t/ha). Harvest starts 12 months later. Production is up from 3-t/rai (18-t/ha) depending on the site, management and extent of poaching, Cockles are filter-feeders and therefore do not need to be fed during culture. Management is limited to predator control and thinning if too high densities are recorded.

A major limitation on the expansion of cockle culture is the seed supply. Anadara granosa is not native to Thailand. Seed had to be imported from Malaysia. The export of cockle spats from Malaysia has however recently been banned.

Raft culture of mussel and oysters

Rafts are floating structures from which ropes or collectors on which the shellfish grow, are hung (See Fig 3 and Fig. 4). Species cultured are the green mussel *(Perna viridis)* and oysters (mainly *Crassostra Lugubris).* Green mussel culture depends on spat supply from the east coast. A variety of collectors (old tyres, corrugated asbestos) are used to lure oyster spat.

Mussels are cultured to market size (8 - 10 cm) in 5 - 8 months. Oysters take a longer time (12 - 14 months) to reach 10 - 12 cm. Rafts are not the only method to culture these shellfish. Mussels can be reared on poles. Oysters can be cultured on the sea bottom, on platforms or in trays. A problem with these methods is that predators which crawl on the bottom, such as starfish, have access to the shellfish. This is avoided by the use of rafts.

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Appendix 4

FURTHER DETAILS OF FISH PROCESSING TECHNIQUES DEMONSTRATED BY THE PROJECT

1. Shrimp paste production

Shrimp paste production has been undertaken by fisher-folk in the project area for ages. Long ago, the paste used to be produced mainly for household consumption. The demand for shrimp paste in towns and cities has changed this situation. Shrimp paste production is controlled by fisherwomen. Some are professional shrimp paste makers, others make it only for use at home. The professional producers buy the raw material — Ascetes -from fishermen in their villages. As the Ascetes catch is seasonal and peaks during the rainy season, the producers often face problems in drying Ascetes.

The Ascetes is mixed in a jar with salt (for preservation) and sugar (for fermentation) and then sun-dried for one to two days. It is then pounded into a fine paste and dried for another five to 10 days depending on the weather. On rainy days the paste is kept to ferment overnight in bamboo baskets lined with plastic sheets. During sunny days the mixture is spread out on bamboo mats on the jetties or on the verandah floors (see photograph on page 9). It is finally packed into 50 kg bags and sold to merchants who get it repacked into one kg bags and labelled for sale in nearby towns.

The investment costs (for stone grinders/pounders, bamboo baskets, earthern jars, plastic bags) are negligible when compared to the gross profit.

The raw material cost for 1 kg of shrimp paste is about Baht 8.20 and the product is sold for Baht 25 per kg.

Some professional producers make about 500 kg of shrimp paste per month. The labour requirements for this can be met with female labour (two persons).

The project tried to introduce the following new production techniques:[1]

— the use of honey in addition to or instead of sugar

— better cleaning of the Ascetes

— replacement of stone grinders by manual hand grinders

— extended fermentation period from 12 days to four months

These techniques increased the production costs which could not be compensated by higher market prices. As a result, the new production techniques were not adopted by professional shrimp paste producers. However the trainees sold some paste in an annual local fair. The limited impact of the training course on new techniques of production may have also been due to the fact that only young girls and not professional paste makers were trained.

2. Processing of other new fish products

The demonstration/training course on "some simple methods of making fish sausages, smoked fish, shrimp biscuits and crackers and fish sauce"[2] was intended to provide the basis for diversified and improved income earning opportunities.

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[1] R. Pruthiarenum, Report of three workshops held to improve quality of locally produced shrimp paste. FAO/SCSP Working Paper 7, Manila, 1980.

[2] S. Ithipongs, Report of a village level post harvest fisheries technology training/ demonstration course, FAO/SCSP Working Paper 5, Manila, 1980.

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The training course was conducted by a group of officers from the Technology Development Division of the Department of Fisheries. Training equipment provided by the project, such as food grinders, mixers, slicers, smoke ovens etc., were left with the trainees for later use.

The trainees (young girls from several pilot villages) were expected to take up production and marketing of the products by themselves after the three-day training course. However this did not prove to be feasible. Although the trainees were able to sell certain products at annual fairs, they could not do so on a regular basis.

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Appendix 5

COSTS AND EARNINGS OF ONE FISH CAGE

	Baht
I. Investment costs	
8 kg netting materials	700
3 polystyrene floats -second hand	450
6 wooden poles	120
Ropes	250
Labour	160
Sub-total	1680
II. Operating costs	
(a) 200 fingerlings (groupers) at the rate of B 15 per seed	3000
(b) 1200 kg of feed at the rate of B 2.50/kg	3000
Sub-total	6000
III. Fixed costs	
(3-year lifespan of investment materials)	
(a) Depreciation	560
(b) Interest (equalized over 3 years) of 14% on investment capital	156
Sub-total	716
IV. Total annual costs (II+III)	6716
V. Total annual gross earnings : 160 fish x 0.6 kg x 85 Baht	8160
VI. Annual earnings of operator per cage	1444

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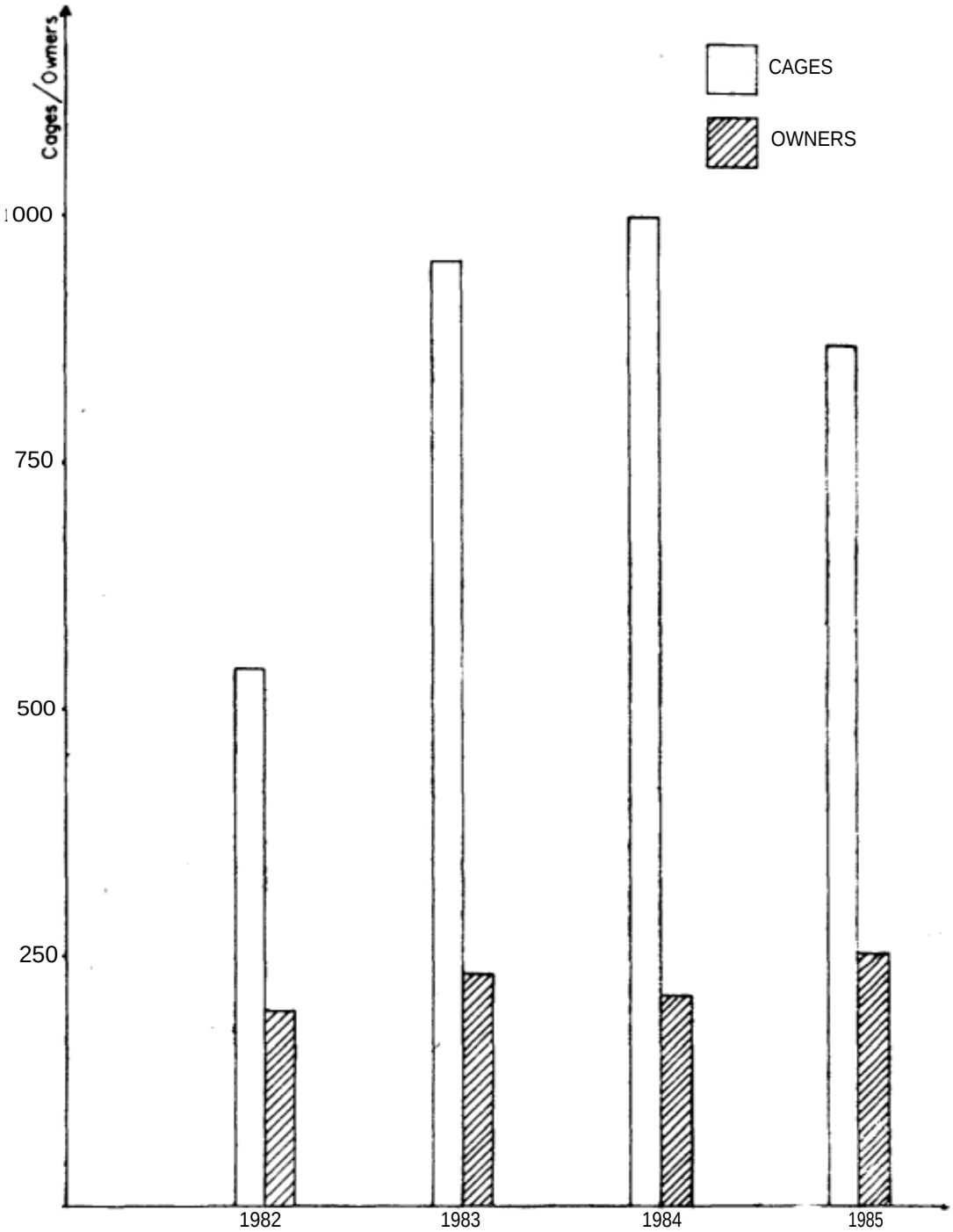
Appendix 6

NUMBER OF FISH CAGES AND OWNERS



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Appendix 7

OWNERSHIP DISTRIBUTION AND DEVELOPMENT TRENDS OF MUSSEL FARMS IN PHANG NGA PROVINCE

Village	Number of farms							Seeds under culture in tons						
	1979	1980	1981	1982	1983	1984	1985	1979	1980	1981	1982	1983	1984	1985
1. Koke Krai	–	–	–	–	12	–	1	–	–	–	–	6.3	–	3.0
2. Pan Yee	–	–	–	–	50	–	–	---	–	–	–	32.0	–	3
3. Sam Chong Tai	–	–	–		25	—	—	—	—	–	–	22.8	–	–
4. Koh Mak Noi	1	–	7	–	–	–	–	2	–	–	–	–	–	—
5. Bang Chan	–	–	–	–	–	–	16	–	–	–	–	–	–	12

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Appendix 8

SUPPLY OF SEEDS TO FISH CAGE FARMERS FROM THE GOVERNMENT HATCHERY AT PHUKET

Year of Supply	Seabass (no.)	Size (cm)	Grouper (no.)	Size (cm)	No. of operators supplied	Mode of seed supply		
						Free of cost (no.)	Against cash . payment (no.)	On credit (no.)
1979	37,142	2-4	—	—	8	1,142	36,000	—
1980	60,450	2-4	—	—	25	45,450	15,000	—
1981	249,500	2-4	—	—	34	62,200	187,300	—
1982	161,130	2-4	—	—	19	13,000	148,130	—
1983	115,160	2-4	—	—	38	22,800	92,360	—
1984	154,600	2-4	—	—	55	64,600	90,000	—
1985	228,100	2-4	127,940	3.0-7.0	184	285,040	71,000	—
TOTAL	1,006,082		127,940		363	494,232	639,790	—

Note:-No details available on the provinces/villages to which seeds were supplied.
No data available from the Satun hatchery.

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Appendix 9

BANK LOANS ISSUED FOR FISH CAGE CULTURE IN PHANG NGA PROVINCE, 1984 AND 1985

Village	Number of borrowers				Total loan amount				Remarks
	(a) for cage investment costs		(b) for operating costs (seed, feed)		for cage investment costs (in Baht)		for operating costs (in Baht)		
	1984	1985	1984	1985	1984	1985	**1984**	**1985**	
1, Koke Krai	5	12	76	16	41,000	88,000	803,000	218,000	Max. loan per individual: (a) for investment cost Baht 7,000 as medium-term loans for 3 years, repayment in 2 annual instalments (Sep.-Dec.) (b) for operating costs Baht 15,000 as short-term loan for 1 year, repayment in 3 instalments (June, Sept., Dec.)
2. Pan Yee	4	10	12	7	38,000	125,000	104,000	62,500	
3. Samchong Nua	2	1	84	43	17,000	8,000	1,031,000	463,000	-The interest rate was 14% for short-term loans and 16% for medium-term loans. -Various persons who applied for loans, did not however invest in cage culture themselves. They either handed over the loan amount to other cage operators or spent it for other purposes.
Total	11	23	172	66	96,000	221,000	1,938,550	743,500	

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Publications of the Bay of Bengal Programme (BOBP)

The BOBP brings out six types of publications:

Reports (BOBP/REP/. . . .) describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and projects in member-countries for which BOBP inputs have ended.

Working *Papers* (BOBP/WP/. . .) arc progress reports that discuss the findings of ongoing BOBP work.

Manuals *and Guides* (BOBP/MAG/. . .) arc instructional documents for specific audiences.

Miscellaneous *Papers* (BOBP/MIS/. . .) concern work not originated by BOBP staff or consultants but which is relevant to the Programme's objectives.

Information Documents (BOBP/INF. . .) arc bibliographies and descriptive documents on the fisheries of member-countries in the region.

Newsletters(Bay of Bengal News), issued quarterly, contain illustrated articles and features in non-technical style on BOBP work and related subjects.

A list of publications follows.

Reports (BOBP/REP/. . .)

1. Report of the First Meeting of the Advisory Committee. Colombo, Sri Lanka, 28-29 October 1976. (Published as Appendix 1 of IOFC/DEV/78/44.1, FAO, Rome, 1978)
2. Report of the Second Meeting of the Advisory Committee. Madras, India, 29-30 June 1977. (Published as Appendix 2 of IOFC/DEV/78/44.1, FAO, Rome, 1978)
3. Report of the Third Meeting of the Advisory Committee. Chittagong, Bangladesh, l-10 November 1978. Colombo, Sri Lanka, 1978. (Reissued Madras, India, September 1980)
4. Role of Women in Small-Scale Fisheries of the Bay of Bengal. Madras, India, October 1980.
5. Report of the Workshop on Social Feasibility in Small-Scale Fisheries Development. Madras, India, 3-8 September 1979. Madras, India, April 1980.
6. *Report of the Workshop on Extension Service Requirements in Small-Scale Fisheries* Colombo, Sri Lanka, 8-12 October 1979. Madras, India, June 1980.
7. Report of the Fourth Meeting of the Advisory Committee. Phukct, Thailand, 27-30 November 1979. Madras, India, February 1980.
8. Pre-Feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh. G. Eddie, M. T. Nathan. Madras, India, April 1980.
9. Report of the Training Course for Fish Marketing Personnel of Tamil Nadu. Madras, India, 3-14 December 1979. Madras, India, September 1980.

10.1 Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal. Chittagong, Bangladesh, 16-21 June 1980. Volume 1: Proceedings. Madras, India, September 1980.

10.2 Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal. Chittagong, Bangladesh, 16-21 June 1980. Volume 2: Papers. Madras, India, October 1980.

11. Report of the Fifth Meeting of the Advisory Committee. Penang, Malaysia, 4-7 November 1980. Madras, India, January 1981.
12. Report of the Training Course for Fish Marketing Personnel of Andhra Pradesh. Hyderabad, India, 11-26 November 1980. Madras, India, September 1981.
13. Report of the Sixth Meeting of the Advisory Committee. Colombo, Sri Lanka, 1-5 December 1981. Madras, India, February 1982.
14. Report of the First Phase of the "Aquaculture Demonstration for Small-Scale Fishcrics Development Project" in Phang Nga Province, Thailand. Madras, India, March 1982.
15. Report of the Consultation-cum-Workshop on Development of Activities for Improvement of Coastal Fishing Families. Dacca, Bangladesh, October 27-November 6, 1981. Madras, India, May 1982.
16. Report of the Seventh Meeting of the Advisory Committee. New Delhi, India, January 17-21, 1983. Madras, India, March 1983.
17. Report of Investigations to improve the Kattumaram of India's East Coast. Madras, India, July 1984.
18. Motorization of Country Craft, Bangladesh. Madras, India, July 1984.
19. Report of the Eighth Meeting of the Advisory Committee. Dhaka, Bangladesh, January 16-19, 1984. Madras, India, May 1984.
20. Coastal Aquaculture Project for Shrimp and Finfish in Ban Mcrbok, Kcdah, Malaysia. Madras, India, December 1984.
21. Income-Earning Activities for Women from Fishing Communities in Sri Lanka. Edeltraud Drewes. Madras, India, September 1985.

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