Bay of Bengal Programme

Development of Small-Scale Fisheries

PEN CULTURE OF SHRIMP IN THE BACKWATERS OF KILLAI, TAMILNADU
. A study of techno-economic and social feasibility

BOBP/WP/32

SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY

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PEN CULTURE OF SHRIMP IN THE BACKWATERS OF KILLAI, TAMIL NADU

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A study of techno-economic and social feasibility

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This report describes the findings and recommendation of a techno-economic and social feasibility study of shrimp pen culture in the backwaters of Killai, Tamil Nadu. It is based on field surveys in the communities of the region in the latter half of 1983 and on three culture trials at Killai undertaken during an earlier 21-month technical programme conducted by BOBP and the Department of Fisheries, Government of Tamil Nadu.

The 21-month programime showed promise of technical viability on pen culture of shrimp. This study was therefore undertaken to focus on problems relating to social and economic feasibility, and thus help plan future state policy on introducing shrimp pen culture to fisherfolk.

The study and the paper resulting from it are activities of the small-scale fisheries project of the Bay of Bengal Programme (BOBP). The project is funded by SIDA (Swedish International Development Authority) and executed by FAO (Food and Agriculture Organization of the United Nations), and covers five countries bordering the Bay of Bengal — Bangladesh, India, Malaysia, Sri Lanka and Thailand. The main goals of the project are to develop, demonstrate and promote appropriate technologies and methodologies to improve the conditions of small-scale fisherfolk and to boost supplies of fish from the small sector in member countries.

The author of the paper would like to thank Dr. Ian R. Smith (Deputy Director-General, ICLARM, Manila), Mr. I. Rajendran and Mr. V.C. Bose (Directorate of Fisheries, Government of Tamil Nadu), and Dr. M. Karim (BOBP) for their cooperation in the planning and execution of this study.

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1. INTRODUCTION

During the Fourth Advisory Committee Meeting of the BOBP (27-30 November 1979, in Thailand) India, along with the other participating countries, expressed interest in the BOBP's technical cooperation for aquaculture development in her coastal waters.[1]

Following the Advisory Committee Meeting, the state of Tamil Nadu made a specific request to the BOBP in 1980 for technical cooperation in aquaculture development in the state's coastal waters. The increased demand for fish both for local consumption and export, escalating fuel costs which constrained any substantial expansion of fuel-dependent capture fisheries, the socio-economic need for improving the lot of small fisherfolk by increasing and expanding their earning options and the availability of large stretches of coastal fallows and shallow backwaters had no doubt caused the government to actively consider the development possibility of hrackishwater aquaculture along the coast of Tamil Nadu.

Pursuant to the request of the Tamil Nadu Government, the BOBP made a preliminary review of the state's aquaculture status. This was followed by a 15-day long reconnaissance study by a consultant who along with the BOBP staff, visited 11 potential sites distributed in seven coastal districts.2 Further studies were made by a two-meniber Thai TCDC aquaculture mission organised and sponsored by the BOBP. The Mission visited the state for four weeks in September-October 1981 and submitted its findings and recommendations

The Mission, *inter* a/ia, recommended pen culture in the backwaters as the most promising technology for developing coastal aquaculture in the state. Low tidal amplitudes and the generally sandy nature of the soil in Tamil Nadu tends to limit the possibilities of pond culture, and the abundance of shallow and protected backwaters make pen culture and floating cage culture viable and preferred options. Further, the low capital costs of such systems when compared to pond culture makes the proposition even more attractive. In particular, the Mission identified the sandy mud flats near Pulicat Lake and the Killai backwaters as areas where pen culture of shrimp could be profitably developed.

Out of these recommendations emerged a 21-month project to test the technical feasibility fo shrimp pen culture in the Killai backwaters, to evolve and test culturing practices and to assist the Government of Tamil Nadu to formulate its aquaculture development strategy. The project, a collaborative effort of the Department of Fisheries, Government of Tamil Nadu and the BOBP, went on-line in May 1982.

A year and two harvests later, with a preliminary indication of technical feasibility in hand, the BOBP and the Tamil Nadu Government began considering the problems of economic and social feasibility which in turn would dictate the directions of state policy in extending the technology to its fisherfolk. Dr. Ian R. Smith, Deputy Director-General of the International Centre of Living Aquatic Resources Management, Manila and Mr. Rathindra Nath Roy, Director, the Catalyst Group, Madras, a consulting organization concentrating on development and environmental planning, were asked by the BOBP to visit Killai and suggest an activity to answer the concerns of the BOBP and the Tamil Nadu Government.

On the basis of a visit in May 1983, Roy and Smith recommended a two-phase activity. The first phase would address the outstanding technical 'questions such as feed and seed supply, conduct a socio-economic study, and if feasibility was demonstrated, develop a strategy and plan for a pilot extension phase of shrimp pen culture.

This report describes the findings and recommendations of the first phase of the activity.

2. OBJECTIVES

The objectives of the study were to.

carry out a field study in the Killai backwaters area and identify and describe

a. the target populations for extension

h. the occupation patterns aniong males and females

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c. the forms of economic and social dependency

d. the ownership and utilization patterns of the backwater area and potential allocation problems that may be faced during extension.

e. earnings, savings, investment patterns and indehtendness amongst the target population

f. the conflicts that may arise from competition among potential target populations.

g. the marketing patterns of fish and shrimp

h. the infrastructure facilities relevant to the new technology

i. the attitudes of male and female populations towards the new technology

j. the feasible size of family pen operation

k. the possible socio-economic impact of the new technology on the area's population.

-- incorporate the findings of the technical studies undertaken by the BOBP which give information on

a. the water area suitable for shrimp pen culture

b. the area's potential for feed supply

c. the area's potential for seed supply

d. the availability and cost of feed-mix and non-meat proteins

into the socio-economic data and undertake a financial analysis based on private costs/returns to test for economic feasibility.

develop a strategy and plan for the next step in extension, based on the results of the socio-economic study and the technical study.

3. TECHNO-ECONOMIC & SOCIAL FEASIBILITY OF SHRIMP PEN CULTURE

3.1 Technical Feasibility

3.1.1. *Shrimp pen culture — the technology in brief*[4]

There are two basic means of aquaculture. aquaculture in ponds constructed on coastal low lands or in backwaters enclosed in pens and cages. The Tamil Nadu coast is predominantly characterised by sandy soil and the tidal amplitude is very narrow, usually in the range of 150 — 300 mm. These two conditions make pond construction, maintenance and water management difficult and expensive. Erosion of pond dykes, water and natrient loss through seepage and a constant dependence on fuel-operated pumps are some of the problems which limit pond culture potential.

On the other hand the state has vast areas of backwaters offering opportunities for pen culture which does not depend on fuel-dependent pumps as it is naturally serviced by tidal rises and falls. Pen construction requires low capital investment, is easy, and requires very little by way of skills or manpower, and is ready for full-scale production as soon as it is installed, made pest-free and stocked with seed. For these reasons pen culture is likely to prove an appropriate and financially accessible technology for fisherfolk of limited means.

Pen culture involves segregating an area of water with nylon netting held in place by casuarina poles and ropes. Once the water body is penned in, predators and other undesirable organisms are removed by using various fishing gear and by hand picking. The pen is then stocked with juveniles of the preferred species and given supplementary feed until harvest. In the case of *shrimp, Penaeus monodon* and *P. indicus,* the feed consists of squid offal, trash fish, clams and mussel meat, cooked and supplemented with rice bran and groundnut cake and bound with tapioca.

The only serious problem encountered during culture is damage to the nets by crabs and other pests and their subsequent entry into the pen. The problem is overcome by systematic and regular inspection and repair of the pen and removal of pests at regular intervals.

In the technical trials the extrapolated production rate for a single crop was approximately 500 kg/ha and an annual production of 1500 kg/ha in three cycles of production. This was achieved with stocking rates of 45,000/ha on average and a feeding rate that varied from 10% of body weight initially to about five per cent of body weight per day as the cycle neared harvest in about three months.

3.1.2. *The area available for pen culture*[5]

The backwater system at Killai extends to about 1300 ha, as estimated from topographical

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maps of the Survey of India. The water body is intercepted by irregular land masses, and thick bushy mangroves are the characteristic vegetation. The backwater is connected to the Bay of Bengal by two perennially open bar mouths. Two other bar mouths which existed in the past are now closed due to silting/erosion. The tidal amplitude is low, ranging between 100 and 300 mm, the maximum being 400 mm during highest high tide.

The criteria used for selecting suitable areas were

- a minimum depth of 300 mm keeping in mind the minimum ecological habitat depth requirements of shrimp;
- a maximum depth of 800 mm keeping in view construction costs of pens and vulnerability to maintenance and management;
- shorelining of the area to enable shore-based management;
- areas selected to be neither ferry landing sites nor on the regular waterways used by fishermen:

By detailed depth sounding of the whole area over a two-month period and making appropriate seasonal corrections, 15 potential water sites satisfying the criteria were identified. The areas ranged from 1.3 ha to 13.3 ha in size and the total area available was estimated to be approximately 85 ha in size.

3.1.3. *The availability of seed*

The entire Killai backwaters were covered on foot and by boat and 30 probable sites identified as nursery grouonds, and sample collections were made using four types of gear. Each sampling took about 25 minutes. Physico-chemical parameters like dissolved oxygen, salinity, water and atmospheric temperature, and pH with reference to time and lunar phase were recorded simultaneously. The nature of the bottom was also studied.

The study was undertaken during June and July 1983. Naturally such a small and seasonally restricted sample cannot be expected to give a realistic picture of the seed resources. The sample, therefore, was augmented with the records of the BOBP shrimp project which has been functioning since May 1982 in the region. In the opinion of the technical staff of the Department of Fisheries, Government of Tamil Nadu, and of the BOBP, the seed resources are sufficient to meet the requirements of 85 ha of pen culture in the region.

The study estimated that a man using a push net and working four to five hours a day should be able to collect 3500 seeds. Assuming that each cycle of production will have to be preceded by about a month of seed collection, and a seed demand per year of 17.85 million seeds (85 ha x 3 production cycles X 70,000 seeds/ha/cycle), a total of 5100 man-days of effort will be needed to collect seed. This would require 5.7 men working for 90 days in a year, a labour demand which is within the region's capacity, especially considering the Veddar folk, who are particularly skilled in similar activity and are in need of regular employment. Each hectare of pen culture would require 60 man-days of effort to stock it with seed during the year.

Availability of seed is critical to the success of the technology. To ascertain the validity of the results of the study, a simple back-of-envelope type of exercise was performed.' From the socio-economic data collected, the approximate amount of shrimp now being captured in the backwaters was estimated at 107.47 tonnes/year. Such a catch would bring in about 50% juveniles and if one assumes a weight of 0.1 g/juvenile, then the number of juveniles caught each year is about 537.5 million. It is fair to estimate that a fishery that can sustain capture of 537.5 million juveniles can support a demand of 17.85 million live juveniles needed to stock the 85 ha of proposed pen culture even if the numbers are off by one order of magnitude.

Thus the seed resources survey, in spite of its small sample size, shows that the Killai backwaters can supply sufficient seed for the proposed 85 ha of shrimp pen culture using 5100 man-days of effort.

What remains to be studied is the detailed seasonwise availability of seed by species *and,* especially before going in for full scale extension, the ecological impact of seed collection on the capture fisheries in the backwaters and on the marine shrimp fishery that uses the backwaters as its nursery.

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3.1.4. *The availability of feed8*

The feed survey looked at the availability of squid offal, prawn heads, trash fish, squilla and crabs, clams, oysters and mussels in and around the Killai area. Non-meat sources like rice bran, groundnut cake and tapioca were also studied. In terms of quantity, the study indicates that there is sufficient feed in the region to supply the requirements of 85 ha of pen culture. In fact, clams and squid offal, and trash fish are two sources that can independently meet a very high proportion of the feed demand of the proposed pen culture fishery.

However, availability of feed either in terms of natural stock assessment or in terms of estimates of present landing cannot be considered real availability without looking into factors such as the effort needed to collect or capture the feed, the alternate demands for such products and the economics of the pen culture which will determine what can be paid for the feed while making a profit. Thus while there is an indication that sufficient feed resources exist, further studies are indicated to identify and measure the catch effort, alternate demand for the products and prices that the culture practice will be able to afford for feed. These studies are best done on-line, in real-scale situations.

For example,9 the survey estimated a clam population of 17,300/100 m2 in a 450 ha region which adds up to a virgin stock of 7.785×10^6 clams or, assuming a gram of meat per clam, a meat biomass of the virgin standing stock of 778.5 tonnes. Using Gulland's equation [10] with natural mortality set at unity, it can be shown that the potential sustainable yield of the clam bed is 389.25 tonnes per year, or 76% of the feed demand based on a 4:1 feed conversion ratio. Of course, this assumes non-destructive harvesting.

In considering catch effort, the study found that one man could collect enough clams in a day to provide for about 7.5 kg of clam meat. To supply 76% of the feed demand of 85 ha would thus require 51,900 man-days of effort, or 228 men working just on feed collection. It is doubtful whether the region would be able to generate such a vast manpower source just for feed collection. Also, clams are now being exported and clam pickers will have a more lucrative alternate market to feed. Thus what seems at first sight a possible source may not on closer examination turn out to be so.

Squid offal and trash fish, however, seem a fairly reliable source as they are already being landed and, more often than not, being thrown away as no alternate demand exists. In the BOBP experiments, squid offal and trash fish at 60% of the diet, with rest being made up of non-meat proteins, provided an excellent feed substitute for high conversion feeds like clams and mussels.

As in the case of seed availability, what remains to be ascertained is the detailed seasonwise availability of feed types, the effort that goes into their capture/collection, the alternate demands for these products and whether the economics of the culture practice can afford to pay for the feed in the desired combinations and quantities.

The very size of the pen culture fishery may well be constrained and decided by factors such as labour availability for feed collection, catch/collection effort, alternate demands for feed, and the costs that can be afforded given the culture practice economics.

Table 1

Investment costs & annual depreciation for a one ha shrimp pen

Items	1983 costs in Rs.	Estimate of useful life in years	Annual depreciation in Rs.
1. *Pen construction materials:*			
Nylon webbing 10 mm mesh	10,780	3	3,593.33
Nylon webbing/6 mm mesh	2,480	3	826.66
HDPE rope/5 mm	570	3	190.00

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Nylon twine	70	3	23.33
Casuarina posts	1,200	3	400.00
Casuarina crossbars	400	3	133.33
Coir rope	100	3	33.33
Cost of nursery pen at 10% of growing out pen	1,560	3	519.99
Sub-total for pen materials	17,160		5,719.97
2. *Equipment*			
Bottom furrower	50	10	5.00
Buckets, tubs	200	1	200.00
Knives, choppers	50	5	10.00
Meat grinders	350	5	70.00
Table for grinder	300	5	60.00
Weighing balance	100	5	20.00
Torch/hurricane lamp	60	2	30.00
Seed collection gear	200	3	66.66
Cast nets (2)	100	1	100.00
Feeding trays	100	1	100.00
Crab traps	100	1	100.00
Sub-total for equipment	2,310		1,061.66
3. Guard shed	500	3	166.66
Sub-total for shed	500		166.66
4. Labour for pen construction 30 m-d at Rs. 12/m-d	360		
Sub-total for labour	360		
5. Contingency	940		
Sub-total for contingency	940		
Total investment costs	21,270		6,948.29

Note: m.d = man day.

3.2 Economlc feasibility of shrimp pen culture

Financial analysis in this section is based on private costs/returns. Social cost-benefit analysis (sometimes called economic analysis by banks) would also take into consideration the true social costs and benefits of the operation, particularly as they affect employment. The data available at this stage of operation makes it difficult to go very much beyond financial analysis; however, it is recommended that a thorough economic analysis including social cost-benefit analysis be undertaken before full-scale extension. However, such an analysis will require hard operations data in commercial working conditions which would need some form of real-scale operations.

In the first table, investment costs and annual depreciation is calculated for a one ha operation using data and estimates from M Karim's report on shrimp pen culture in Killai.[4] The data was thoroughly checked and updated to 1983 prices. Expert estimates of the useful life of each item were used to calculate the annual depreciation. The total investment cost for a one ha pen is Rs.21 270 with an annual depreciation of Rs.6948.

Tables 2 to 5 are exercises in calculation of variable costs and revenues, leading up to Table 6 which brings together annual costs and returns and allows us to estimate returns on the owner's labour, unpaid family labour and opportunity cost of personal investment, if any. Table 2 estimates labour demand. The data were derived from the records maintained by the BOBP Shrimp Culture Project in Killai and from detailed discussions with its staff. Pen construction needs about 30 man-days of effort. The running of the farm needs 340 man-days of hired labour, almost all of it skilled in fishing practices and 180 man-days of labour contributed from the owner and his or her family. This labour demand listing does not

include every-day activities like security and conservancy, It also does not include the collection of feed as it is assumed that the fisherman-owner buys it. The labour demand for full scale extension would be about 31450 man-days and would provide full-time employment to about 105 small fisherfolk who have no gear of their own. The Killai region has enough manpower of this sort to answer the demand, should it arise.

Feed calculations for a one ha pen with a stocking density of 50000/ha are shown in Table 3. The feed amount as percentage of total body weight of the shrimps is a decreasing function with growth and, as shown, the feed required for the nursery and growing pens amount to 3102 kg/cycle. The recommended feed mix, cost of components and the cost per kg of the composite feed are shown. The expense for feed/ha/year is Rs.14,890.

The Killai-hased shrimp culture project has had three trials since its inception. Unfortunately, the results from the three cycles are not comparable because of differences in season, water area, stocking rates and the lengths of growth period. However, with weighted averages and extrapolated trends, a reasonable idea of the production characteristics may be obtained.

It is risky to extrapolate production trends from smaller pen sizes and aquaculturists prefer a minimum size of half an hectare. In trial 3 there were two half-ha pens and it is particularly reassuring that the overall extrapolated figures came close to figures extrapolated from the half-ha pen's production, thus giving credence to the numbers derived.

Table 2

Labour demand for **a one ha shrimp** pen

	Activity	Sk/ NSk	Int.	Ex.	m-ds	Rate/ m-d in Rs.	Year's total cost in in Rs.
1.	Pen construction	NSk		X	30	12	360
2.	Initial harvesting to remove pests: 30 m-d cast nets/ 20 m-d drag nets/ 10 m-d hand picking; 33% on subse-quent efforts	Sk		X	100	12	1,200
3.	Seed collection: 3500/m-d for 70000/ ha/cycle	Sk		X	60	12	720
4.	Pen maintenance	NSk		X	60	12	720
5.	Feed preparation	NSk		X	60	12	720
6.	Intermittent pest removal	Sk		X	60	12	720
7.	Harvesting as in No. 2	Sk		X	180	12	2,160
	Total				550 m-d		Rs 6,600

Classification of labour

1.	Labour in investment	30 m-d	@ Rs. 12/m-d	Rs. 360
2.	Hired labour	340 m-d	@ Rs. 12/m-d	Rs. 4,080
3.	Internal labour (Family contribution)	180 m-d	@ Rs. 12/m-d	Rs. 2,160

Sk: Skilled; NSk: Non-skilled; Irit: Internal; Ex: External: m-d: mani-day

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Table 3

Feed demand for one ha shrimp pen (Stocking: 50000/ha)

Time in days	Wt./ piece (g)	Total biomass (kg)	Feed as % of biomass	Feed/day (kg)	Cumulative feed (kg)
0	2	100	10	10	–
15	6	300	9	27	150
30	9	450	8	36	405
45	11	550	7	38.5	540
60	13	650	6	39	577.5
75	15	750	5	37.5	585
90	16	–	–	–	562.5
Total for 90 day growing period					2,820
Feedfor nursery pen at 10% of above					282
Total feed demand/cycle					3,102 kg

Recommended feed mix

Feed component	% in mix	Cost/kg	Cost contributed to 1 kg of composite
Clams/mussels	60	2.50	1.50
or			
Squid offal & trash fish	60	1.25	0.75
Rice bran	20	1.25	0.20
Groundnut cake	15	2.50	0.375
Tapioca	5	2.00	0.1
Total	100		1.425

Say approximately Rs. 1.60/kg

Per cycle cost of feed/ha = 3102 x 1.6 = Rs.4,963.20

Per year cost of feed/ha 3,102 X 1.6 X 3 = Rs. 14,890

Table: 4 ProductIon data **from BOBP Shrimp Culture Project**

Trial 1: 80 days (10 July – 28 September 1982)

2 ponds of 1500 m2 each and 2 ponds of 625 m2 each

Average stocking rate: 37870/ha; Recovery percentage: 73.97

Final average weight in (g): *P. monodon:* 19.42

P. indicus: 11.75

Production of (Pm + Pi) was 186.1 kg and was sold for Rs. 5,794.50, or at an average rate of Rs. 31.136/kg.

Production of other species was 57.4 kg and was sold for Rs. 175.75, or at an average rate of Rs. 3.06/kg.

Production/ha (weighted average; extrapolated)

(Pm + Pi) 437 kg

others 135 kg

Trial 2:117 days (15 October – 10 February 1983)

2 ponds of 1250 m2 each and 2 ponds of 625 m2 each

Average stocking rate : 44000/ha; Recovery percentage : 68.80

Final average weight in (g): *P. monodon:* 26.00

P. indicus: 16.00

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Production of (Pm + Pi) was 214.6 kg and was sold for Rs. 9,334.00, or at an average rate of Rs. 43.49/kg.

Production of others was 218.8 kg and was sold for Rs. 210.00, or at an average rate of Rs. 0.959/kg.

Production/ha (weighted average; extrapolated)
(Pm + Pi) 572 kg
others 583 kg

Earnings per ha: Rs. 25,669.89/cycle

Trial 3: 94 – 127 days

2 ponds of 1250 m2 each; 2 ponds of 625 m2 each; and, 2 ponds of 1500 m2 each.

Average stocking rate: 56600/ha; Recovery percentage: 53.50

Final average weight in (g) :*P. monodon* : N.A.
P. indicus : 10.7

Production of (Pm + Pi) was 511.4 kg and was sold for Rs. 9,347.00, or at an average rate of Rs. 18.27/kg.

Production of others was 375.5 kg and was sold for Rs. 925.00, or at an average rate of 2.46/kg.

Production/ha (weighted average; extrapolated)
(Pm + Pi) 372 kg
Others : 273 kg

Earnings per ha : Rs. 7,468.00/cycle

Average for 3 trials

Production/ha (weighted average; extrapolated)
(Pm + Pi) 460.33 kg/cycle
Others 330.33 kg/cycle

Average price received for (Pm + Pi) Rs. 31.04/kg
Average price received for others Rs. 2.15/kg

Earning per ha Rs. 14,998.85/cycle
Rs. 44,996.55/year

The project had to depend on the local market and agents who came by to pick up the production and this seems to have led to certain unfortunate situations. The prices received were lower than similar specie/size prices all along the market chain, except in the odd, rare situation. This was further aggravated by flucutations in the export price of shrimp which is felt all along the market chain. So while the fluctuations in extrapolated production are within acceptable limits, especially considering the drought conditions then prevailing, the fluctuations in prices received are dificult to explain. There are certain other peculiarities such as the price difference between *P. monodon* and *P. indicus* which is a mirror image inversion of the price structure upstream in the chain, and the sale of finfish and crabs at throw away prices when even in Chidambaram they receive reasonable prices.

it is important to note that finfish, crabs and auto-stocked shrimp though sold at low rates, form a generous portion of the harvest, and so while one should try to reduce pests when caught, there should be an attempt made to get the best price for them and thus add to revenues and get a better return on the feed which is, of course, shared.

The average weighted and extrapolated production of *P. monodon* and *P. indicus* over three trials was 460.33 kg/ha/cycle while the production of finfish, crabs and auto-stocked shrimp was 330.33 kg/ha/cycle. Using average procurement prices received of Rs. 31.04/kg for *P. monodon* + *P. indicus* and Rs. 2.15/kg for the rest, the per hectare earnings amount to Rs. 14,998/cycle or about Rs. 44,996/year.

The market determines the revenue and as such is perhaps the single most important variable controlling profits. To get an understanding of the market mechanisms that the Killai fishermen encounter, the socio-economic study collected price and organizational data all the way up the market chain beginning with shore sales and ending in export procurements.

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Table 5 gives the procurement prices of various varieties of shrimp for various counts/kg at different locations. The numbers begin to make sense when visually simplified as in Figure 1. In addition to the obvious fact that prices seem to increase upstream, it can also be seen that, unlike the situation in Killai, Chidambaram and in the BOBP project, *P. indicus* fetches a better price than either *P. monodon* or pink shrimp (Pp). This obviously benefits the middlemen as *P. monodon* and pink shrimp are relatively scarce species and with their seemingly logical higher prices, keep the price of the more abundant *P. indicus* depressed, in spite of the fact that it is preferred and fetches a better price in the export markets.

One would also expect that transportation costs would cause a sharp increase in prices as the shrimp covered the long distances to Madras. This does not really happen as Table 5a clarifies. Longer and larger hauls turn out to be ridiculously cheap. For example, shipping shrimp in bulk by refrigerated trucks from Killai to Madras would cost a one-ha farm about Rs. 103/year or a per kg cost increase of about Rs. 0.10. This is quite different from the local picture in Killai where the cost of transportation to Chidambaram is high and adds substantially to the nrice. This is the irony of scale.

Table 5

Procurement prices for **shrimp**

a.	*to Veddar community onshore*	
	assorted Pm, Pi, Pp 40-180 counts/kg	Rs.12-15/kg
b.	*at Killai market, offered by agents:*	
	Pm 60 count and larger, sorted	Rs.45/kg
	Pm + Pp below 60 count, unsorted	Rs.35/kg
	Pi 60 count and smaller, unsorted	Rs.10-15/kg
c.	*at Amman Kovil, Porto Novo, offered by agents:*	
	Pm 40-180 count, sorted	Rs. 15-45/kg
d.	*at Chidambaram retail market:*	
	Pm 60 count and larger, sorted	Rs. 20-30/kg
	Pm, Pp, Pi 60 count and smaller, sorted	Rs. 7-20/kg
e.	*at Cuddalore, offered by agents,* processors & exporters:	
	Pm 40-180 count, sorted	Rs. 18-62/kg
	Pp 40-180 count, sorted	Rs. 20-65/kg
	Pi 40-180 count, sorted	Rs. 25-70/kg
	Pi 40-180 count, unsorted	Rs. 45-50/kg
f.	*at Madras, offered by agents, processors, exporters:*	
	Pm 40-180 count, sorted	Rs. 15-70/kg
	Pp 40-180 count, sorted	Rs.18-72/kg
	Pi 40-180 count, sorted	Rs. 20-75/kg
	Pi 40-180 count, unsorted	Rs.45-50/kg
g.	*at BOBP Shrimp Farm, offered ny fishermen, agents:*	
	Pm 50-90 count, sorted	Rs.15-60/kg
	Pi 80-150, unsorted	Rs. 17-50/kg

.Note: Prices are quoted *head-on* for comparative study. The usual practice in the upper regions of the market chain is to quote head-off prices.

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Figure 1: Summary of shrimp procurement prices at different locations.

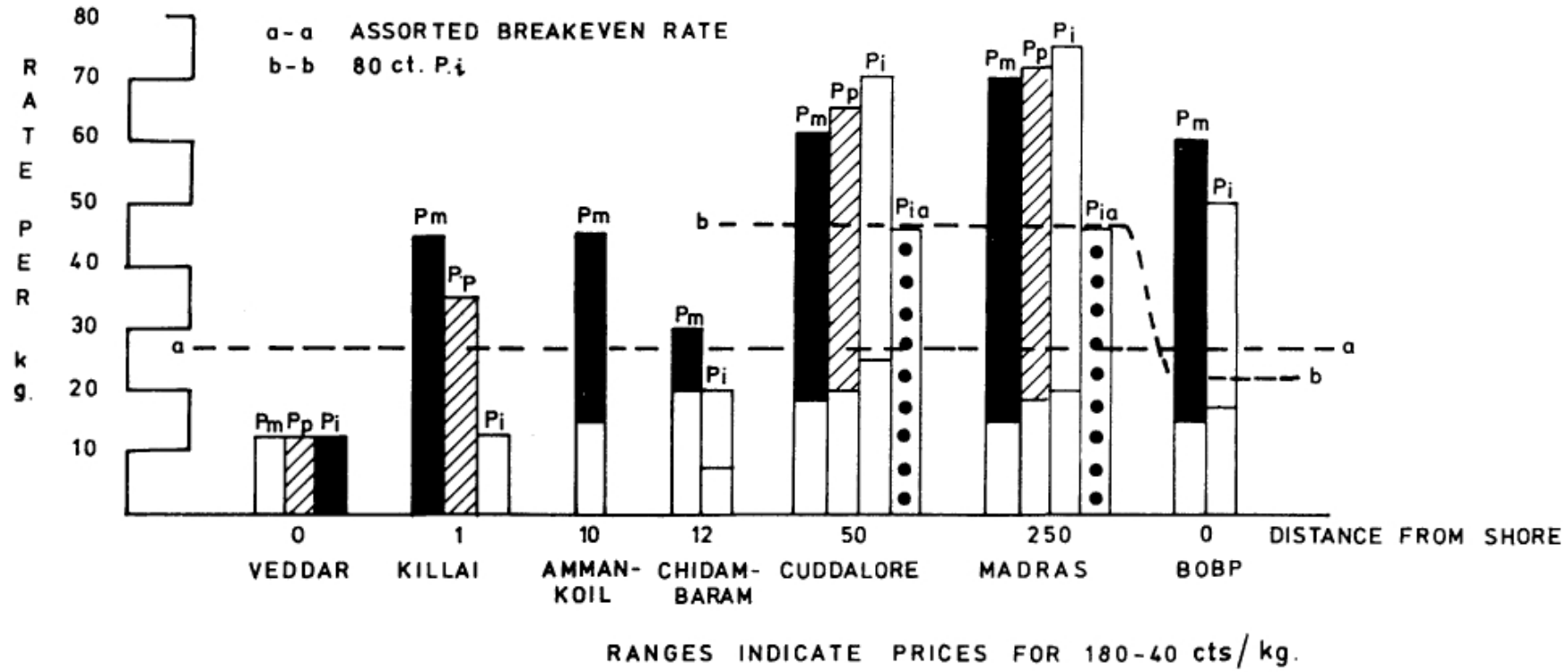

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Table 5a

Transportation costs by refrigerated trucks

Garage-to-garage rentals for 72-hour periods of 6 tonne refrigerated trucks from the Marine Products Export Development Authority, Madras.

Cost per tonne-km · Rs.0.28

Cost of transportation from Killai to Madras (250 km) of 1.5 tonnes (one ha's production per year)

= 1.5 X 250 X 2 X 0.28

Rs. 210.00

Cost added per kg due to transportation = Rs.0.14

Note: To optimally utilize the haulagc capacity of the 6 tonne truck, the harvest will have to be scheduled in 12 to 15 hectare lots.

This is an important factor to keep in mind as a small investment in transportation reaps substantial increases in procurement prices received and goes a long way towards ensuring the economic feasibility of the technology.

The prices received for 80 cts/kg *P. Indicus* are marked for Madras, Cuddalore and at the BOBP project site to give an idea of the differential. The break even rate of Rs. 26 is also plotted to suggest that economic feasibility may only be possible if the harvest is sold directly in Madras or Cuddalore.

The price data were collected over a two-month period which is a small sample for the widely fluctuating shrimp trade. However, relative positions along the market chain seem to remain stable and thus the figures are indicative. The gap between export-supported procurement prices and local consumption prices are so vast that even with violent fluctuations the production would be drawn towards exports, which is a rather serious developmental aspect to be considered. The question is whether one should encourage a dependence on export markets and thus increase the possibility of exploitation. And all this, in the name of developing small fishermen and small-scale fisheries!

Table 6 sums up the variable and fixed costs for a one ha pen and estimates the returns expected on the basis of rates received in Cuddalore and Madras. As calculated, the residual returns on the owner's labour, on his or her family's unpaid labour and capital invested if any, and management skill, amounts to Rs. 26,385 per year. With several variables going into generating profit (or loss), some obviously have a larger and, therefore, more consequental impact than others. The sensitivity calculations in Table 7 identify feed costs and market rates received as the only really important variables suggesting that these two aspects be carefully studied during the pilot phase.

More small enterprises have failed due to inadequate cash flow than for most other reasons put together. The cash flow analysis in Table 8 shows that with *a* loan to cover capital expenses and a working capital loan of Rs. 5,000, the projected one-ha shrimp pen should have no cash flow problems and actually generate sufficient surplus to ensure a generous profit and sufficient funds to provide for the initial working capital for the second year.

The financial analysis on the basis of private costs/returns in the existing environmental and commercial conditions seems to indicate that the technology is economically viable and will provide *a* good return on investment. The aspects that need to be carefully studied and dealt with are market procurement rates received and feed costs paid.

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Table 6

Annual costs and returns for a 1 ha shrimp farm

1.	*Capital Investment*			Rs.21 270.00
	For pen construction materials, equipment, a guard/tool/storage hut and on labour for construction pen (see Table 1)			
2.	*Variable Costs*			
	1. Seed	Rs.720.00	(60 m-d @ Rs.12/m-d)	
	2. Feed	Rs.14889.00	(9305 kg @ Rs.1.60/kg)	
	3. Firewood	Rs.600.00		
	4. Kerosene	Rs.300.00		
	5. Torch cells	Rs.150.00		
	6. Boat rental	Rs.600.00		
	7. Hired labour	Rs.4080.00	(340 m-d @ Rs.12/m-d)	
		Rs.21339.00		Rs.21339.00
3.	*Fixed Costs*			
	1. Depreciation	Rs.6948.00		
	2. Interest	Rs.3284.00	(Rs.21270 @ 12.5%	
		Rs.10232.00	+ Rs.5000 @ 12.5%)	Rs.10232.00
4.	*Returns*			
	P.monodon + P.indicus			
	460 kg X 3 cycles X Rs.45/kg Av. Price		= Rs.62100.00	
	Finfish + Crabs + Auto stock shrimp			
	330 kg X 3 cycles X Rs. 3/kg Av. Price		= Rs. 2970.00	
			= Rs.65iJ70.00	Rs.65070.00
5.	*Total Costs* (2+ 3)			Rs.31 571 .00
6.	*Residual Returns* (4 (2 +3))			Rs.33499.00

to cover
- own labour
- unpaid family labour
- opportunity cost of investment
- inputs of management/technical knowhow

Table 7
Sensitivity of annual costs and returns to inputs

Sensitivity of annual costs to;

Labour rate change; 430

Feed cost change; 9305

Sensitivity of returns to;

Market procurement price change; 1380

<<

Table 8

Cash flow anaiysls for first year of operations

Item	Pen construction	Cycle 1 m¹	m²	m³	m⁴
Seed		240.00			
Feed		451.00	1504.00	1504.00	1504.00
Hired labour	360.00	720.00			720.00
Materials	19970.00	137.50	137.50	137.50	137.50
Others:					
Int. + cap. rep.					3346.00
Total costs	20330.00	1548.50	1641.50	1641.50	5707.50
Revenue					21690.00
Cash flow	-20330.00	-1548.50	-1641.50	-1641.50	+ 15982.50
Balancing loans	20330.00	5000.00			
		Cycle 2 m⁵	m⁶	m⁷	m⁸
Seed		240.00			
Feed		451.00	1504.00	1504.00	1504.00
Hired labour		240.00			720.00
Materials		137.50	137.50	137.50	137.50
Others:					
Int. + cap. rep.					3346.00
Total costs		1068.50	1641.50	1641.50	5707.50
Revenue					21690.00
Cash flow		-1608.50	-1641.50	-1641.50	+ 15982.50
Balancing loans					
		Cycle 3 m⁹	m¹⁰	m¹¹	m¹²
Seed		240.00			
Feed		451.00	1504.00	1504.00	1504.00
Hired labour		240.00			720.00
Materials		137.50	137.50	137.50	137.50
Others:					
mt. + cap. rep.					3346.00
Total costs		1068.50	1641.50	1641.50	5707.50
Revenue					21690.00
Cash flow		-1068.50	-1641.50	– 1641.50	+ 15982.50
Balancing loans					

Cash surplus at the end of first year	:	Rs.39413
Less depreciation	:	Rs. 6948
Less residual returns		Rs.26385
Actual cash surplus for investment in 2nd year's working capital for 1st cycle	:	Rs. 6080

m = month

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While the restricted availability of data at this stage of operations makes if difficult to go beyond financial analysis it is worthwhile to do what might be described as a paper exercise to get a feel for the way the technology would affect employment in the Killai region.

A detailed month by month labour demand was worked out for a one-ha pen and extrapolated for the 85 ha scheme. An equivalent labour demand assuming full-time employment for at least a month at a time was derived, and this demand was allocated on the basis of a policy assumption: that the Veddars who have the lowest socio-economic status would get first preference in employment followed by Killai fishermen who own only nets and finally boat-owners and others.

The *present earnings* of the Veddars and net owners (who would be employed by the project) was estimated from the soclo-economic data. The *projected earnings* from the expansion scheme were estimated using a per-day labour rate of Rs. 12. Two options were then considered: the substitution option, wherein only those not employed by the project would continue to earn at present levels while those employed would earn only from the project; and the complementary option where labour would work in the project *and* continue their present occupations thus earning from both sources. The results of this exercise are shown in Table 9.

While the present earnings of 276 Veddars and net owners, who are now dependent on the backwaters is Rs. 1,097,628 per year, in the substitution option it is Rs. 1,217,189 and in the complementary option Rs. 1,450,788, an increase of 10.8% and 32.1 7%, respectively.

The increases in earnings due to the project do not seem very high, especially in the substitution option. So, while the pen culture scheme is extremely paying for the entrepreneur who owns the farm, it is not as attractive to the labourer who works the farm. For a 30% increase in labour earnings, he or she would have to continue in their present occupations and do the work on the farms.

One important aspect is that in computing present earnings, gross returns are being considered. If the opportunity cost of labour is deducted, the residual returns turn out to be far less and would make the increases in earning due to the project far more attractive (see Table 9a). However, it should be kept in mind that people generally do not set a cost to their own labour and as such the logic of deducting opportunity cost may not be a real exercise. This exercise seems to indicate that it may be necessary to contemplate some form of profit sharing with labour to attract labour to the extension scheme.

Table 9

Labour **demand and** return-on-labour data **for the one ha and 85 ha** pen **schemes**

Description		M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_{10}	M_{11}	M_{12}	Total
Labour demand for the pen (1 ha).														
Pen construct,on	men/day	10/3												30
Pest removal	men/day	10/5				4/5				4/5				100
Harvesting	men/day				10/b				10/b				10/b	180
Seed collection	men/day	10/2				4/5				4/5				hO
Total labour demand	men/day	10/11			10/b	4/10			10/b	4/10			10/6	
— in man-days	m—d	110			60	40			60	40			bO	370
Labour demand for 85 ha of pens	men/day	850/11			850/b	340/10			850/b	340/10			850/b	
— in man-days	m—d	9350			5100	3400			5100	3400			5100	31450
Equ,valen(labour demand for 85 ha assuming full employment														
During month	men	312			170	114			170	114			170	
Veddars	men	124			124	114			124	114			124	
Net owners	men	119			46				46				46	
Others	men	69												
Total income Rs 12/day and 30 days to a nett month (w,thout pen construction labour)	Rs	87,480			b,200	41,040			61,200	41,040			bI,2(*)	3.53,160
Labour now dependent on backwaters but not util,secj in Project														

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Total	men	33	276	276	1(8,	14,2	276	276	106	162	276	276	106	
Veddars	men		124	124		10	124	124		10	124	124		
Net owners	men	33	152	152	IOb	152	152	152	IOb	152	152	152	106	
Income earned at present levels														
Veddars S Rs 153 48/rn	Rs		19.032	19,032		1.535	19.032	19,032		1,535	19,032	19.032		
Net *ow,re, 4,* R', 476 56, iii	Rs	15.726	72,437	72,437	50515	72.437	72437	72437	50515	72437	*72437*	72437	50.515	
Total	Rs	15,726	91.469	9144,9	50,515	73.972	91.469	91.469	50,515	73.972	91,463	91.469	1,11,715	12,17,189
Proiected ,ncorne *(substrtution effect)*	Rs	1,03,206	91,469	91,469	1.11.715	1,15,012	91,469	91,469	1,11.715	1,15.012	91,469	91,469	1,11,715	12.17.189
Proiected income *(complemi'nta.v* effect)	Rs	1,78.949	91.469	91,469	1,52,669	1,32,509	91.469	91.469	1.52.669	1.32.509	91.469	91,469	1.52.669	14.50 788
Present income	Rs	91,469	91,469	91,469	9144,9	91.469	91,469	91,469	91,469	91.469	91.469	91.469	91.469	10.97.628

Table 9a

Returns and labour costs of extension scheme and of present occupation

Calculation for 85 ha of pens

Total projected return/year	65070 X 85	Rs.5,530,950
Total residual return/year	26385 *X* 85	Rs.2,242,752
Total expenditure on hired labour		Rs. 377,400
Total opportunity cost of self-labour		Rs. 153,000

Present return, opportunity cost of *labour and residual return:*

Fishing population	Families	Yearly return/family	Gross return	Opp. cost or labour @ 12/-	Residual return
		(Rs.)	(Rs.)	(Rs.)	(Rs.)
290	102 (B)	16,97,451	1,731,400	1,068,360	663,040
152	97 (N)	897,852	870,916	559,968	310,948
124	61 (V)	373,891	228,074	470,208	– 242,134
Total					
566	260		2,830,390	2,098,536	731,854

3.3. Soclo-economic aspects of the Klliai community

3.3.1. *Socio-economic data*

3.3.1.1. Community size and sample design

The Killai community is scattered in 10 hamlets and takes its name from the main village Killai. While the entire population in these 10 hamlets considers itself as 'belonging' to Killai, on closer examination, the people fall into distinct groups'. those who have permanently moved away and practise marine fishing, and return to Killai only for religious and social occasions; those who shuttle between Killai and one of the hamlets and spend at least one season in Killai fishing the backwaters; and, those who live in Killai and do not participate in the fishing activity directly. Since the focus of the study was to examine the feasibility of extending a new technology to the present users of the backwater, the study ignored the first category and considered the last category in lesser detail. The community was enumerated by physically checking a recently put-together voters' list and stratifying the families on the basis of ownership ot fishing assets. The family was considered as the unit of study because the new technology was considered as a family occupation and bacause the family is the existing commercial unit.

All the fishermen, and in fact the entire Kitlai community belong to one caste of Hindus, Parathevars. The other community in the backwater area who live off the backwaters is a tribal, semi-nomadic group, referred to as the Veddars, who in all probability are an offshoot of the wandering lrula tribes of south India. This community moved into the region a decade ago, with the hope that the government would allot them homesteads.

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Their hope has remained unfulfilled but they have remained, eking out a livelihood in various ways — working the local fields, engaging in construction, fishing the backwaters with their bare hands and basket nets.

Klliai

Families owning boats (and nets)	102 (32.07%)
Families owning only nets	97 (30.50%)
Families with no fishing assets	119 (37.42%)
Total families	318 (100.00%)

Veddars

Total families	61 (100.00%)

Samples drawn

Families owning boats	25/102 (24.50%)
Families owning nets	26/97 (26.80%)
Families with no fishing assets	11/119 (9.24%)
Total families	62/318 (19.49%)
Veddars	24/61 (39.34%)

The number of families in the backwater area dependent on the backwaters for a major part of their livelihood, is 219, or 57.51%.

Population characteristlcs, literacy and occupation

Characteristics	B	N	NA	V
Female/male ratio	00.67	01.09	01.78	01.00
Family size	5.68	4.19	3.54	3.41
Literate females %	14.03	15.78	28.00	4.76
Literate males%	54.11	61.53	57.14	9.52
Literate population %	38.02	37.61	38.46	7.31
Females in fishing %	42.10	28.07	16.00	76.19
Males in fishing %	56.47	48.07	7.00	40.47
Population in fishing %	50.07	37.61	12.82	59.75
Economicallydependent%	48.59	58.71	71.79	40.24

Note: The following abbreviations will be used to denote the various groups in this data pack: (B) for families owning boats; (N) for families owning nets only; (NA) for families with no fishing assets; and (V) for Veddars.

Keeping in mind communication and its importance in technology transfer and in evoking participation from the community, the exposure to influence was ranked by importance.

Exposure to influence by order of Importance

B	N	NA	V
Radio	Community	Community	Community
Community	Radio	Visits	Radio
Printed media	Visits	Radio	Printed media
Visits	School teacher	Printed media	Visits
School teacher	Printed media	Political cadre	Political cadre
Coop.official	Political cadre		
Political cadre			

For seasonal routines see Table 10, and for daily routines see Table 11.

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Tabie 10

Seasonal routines in marine and backwater fishing and agriculture, and festival days

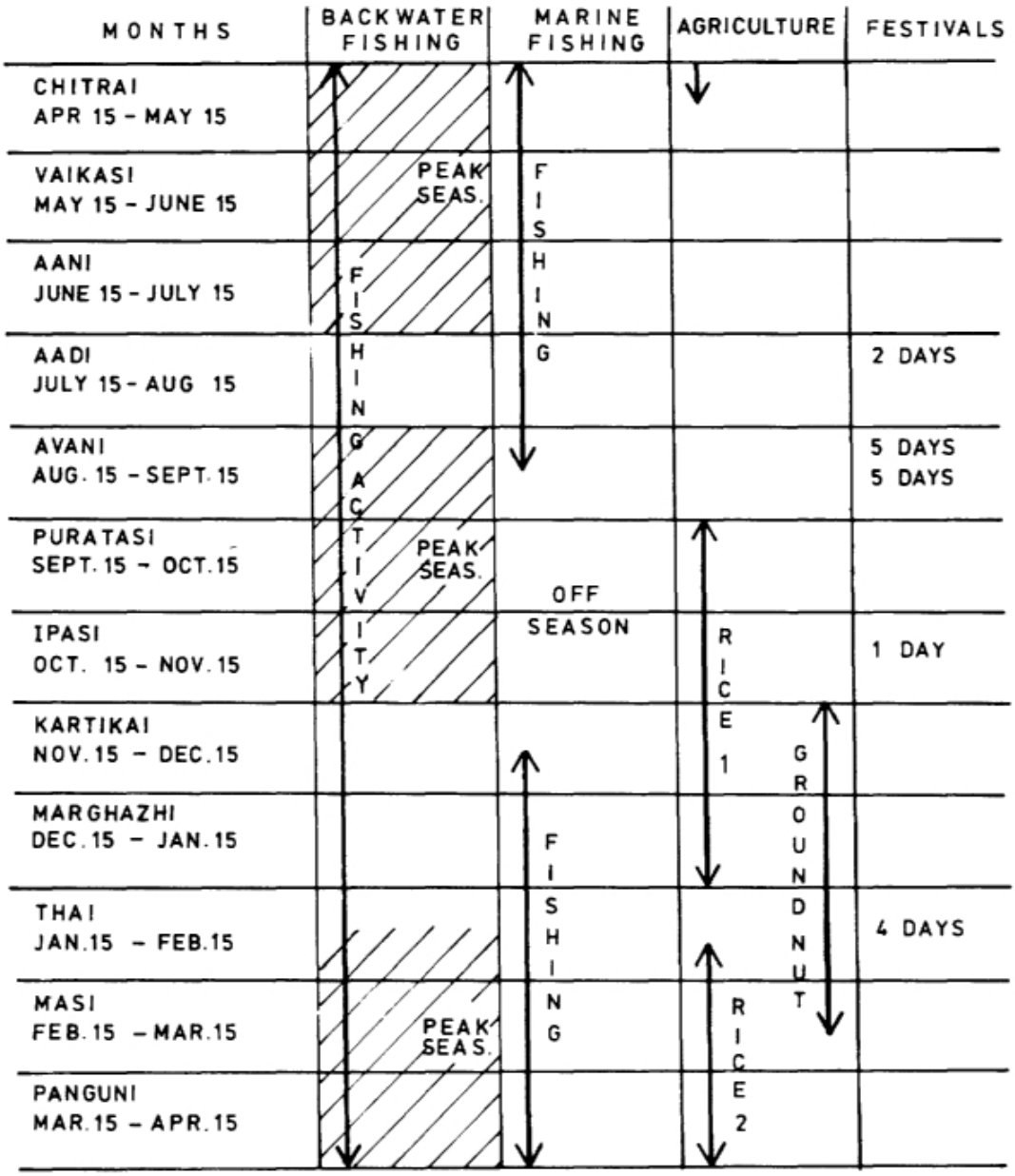

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Table 11
Dilly routine of various categories of people

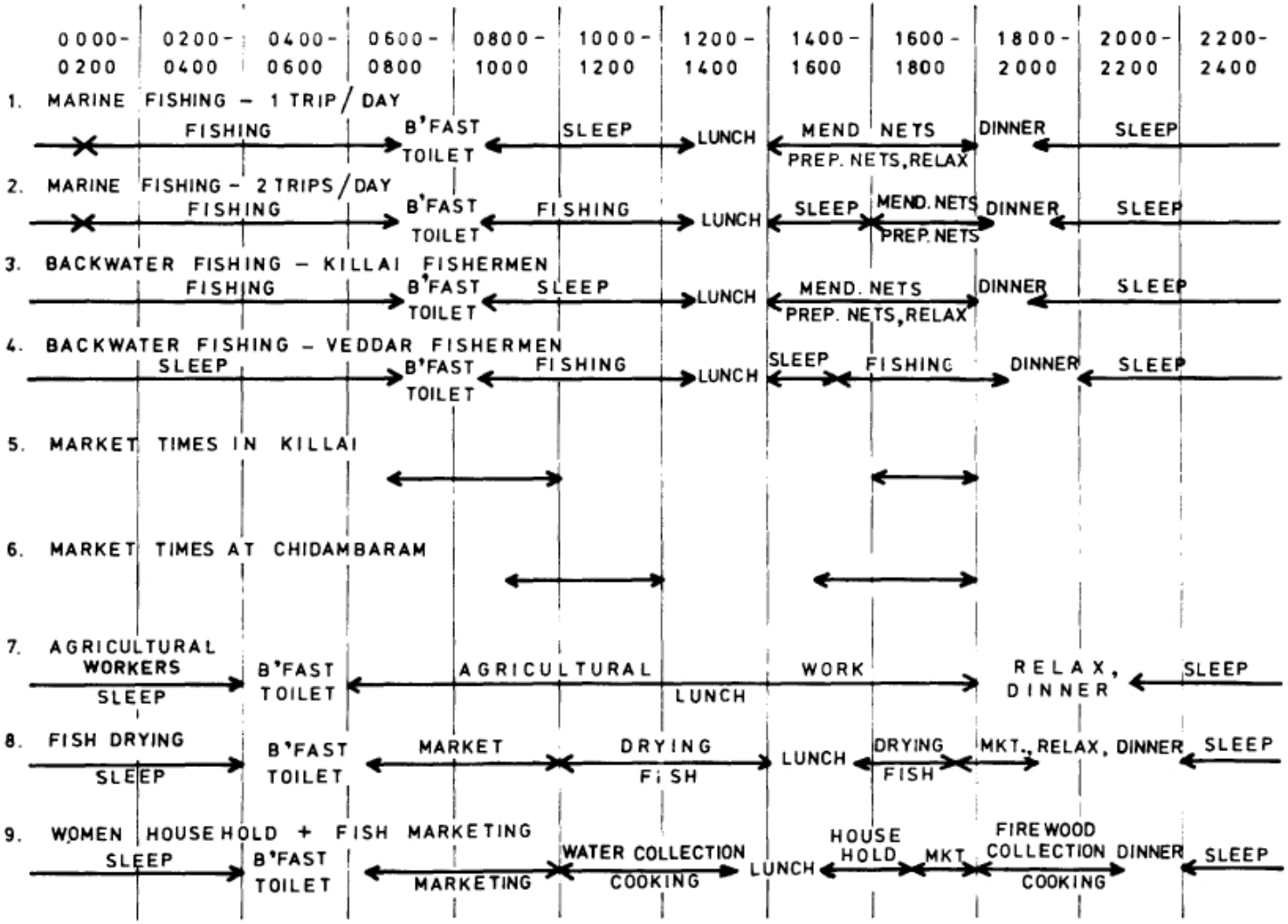

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Table 12

Asset holding by strata

	B	N	NA	V
Houses				
Per cent own houses	100	96	91	100
Per cent live in rented houses	0	4	9	0
Land				
Per cent own land (wet)	56 (43)	19.23(15.15)	18 (16)	4.16 (100)
(dry)	(57)	(84.55)	(84)	(0)
Averagefamilyholding	1.21a	1.15a	1.31a	0.5a
Per cent work themselves	14	40	0	100
Per cent hire cultivators	86	60	100	0
Livestock				
Per cent own livestock	36	19.23	9	16.66
Boats				
Per cent own boats	100			
Boats per family	1			
Per cent cash purchase	72			
Per cent credit-cum-cash purchase	20			
Per cent credit purchase	**8**			
Nets				
Per cent own nets	100	100		
Nets/family	4.92	2.19		
Per cent make nets themselves	96	96		
Per cent purchase nets	4	4		
Per cent credit purchase	8	26		
Per cent make net in instalments	92	96.92		

Note: B – Boat owners, N – Net owners, NA – No assets, V – Veddars

<<

Table 13

Present indebtedness, sources of credit, and interest rates

Sources of loans

		% those indebted	% Relative	% Bank	% Money lender	% Thread shop	% Coop. society	% Land owner	% Fish dealer	Total % indebted	Amount loaned per cap.	Interest rates
Boat owners	C	0								60	3514.28	120% 48% 36% 0%
	S	46.66	100									
	W	53.33	37.5	50	12.5						3093.75	200% 120% 36% 13% 12.5% 2%
Net owners	C	7.6	100							50	600	36%
	S	30.76	50	25	25						2125	25% 36% 13%
	W	61.53	12.5	25	12.5	12.5	12.5				712.50	36% 15% 13% 0%
No fishing assets	C	42.85	66.66		33.33					63.63	833.33	15% 30%
	S	14.28		100							2000	12.5%
	W	42.85		66.66	33.33						1020	30% 15% 18%
Veddars	C	83.33						80	20	50	410	0 Bonded Lab. 0 Excl. Buy Rts.
	S	8.33							100		800	0 Exclusive Buy Rts.
	W	8.33			100						300	0 50% of harvest

Note: C = Consumption loans; S = Special loans for festival and family rituals; W = Work-related loans

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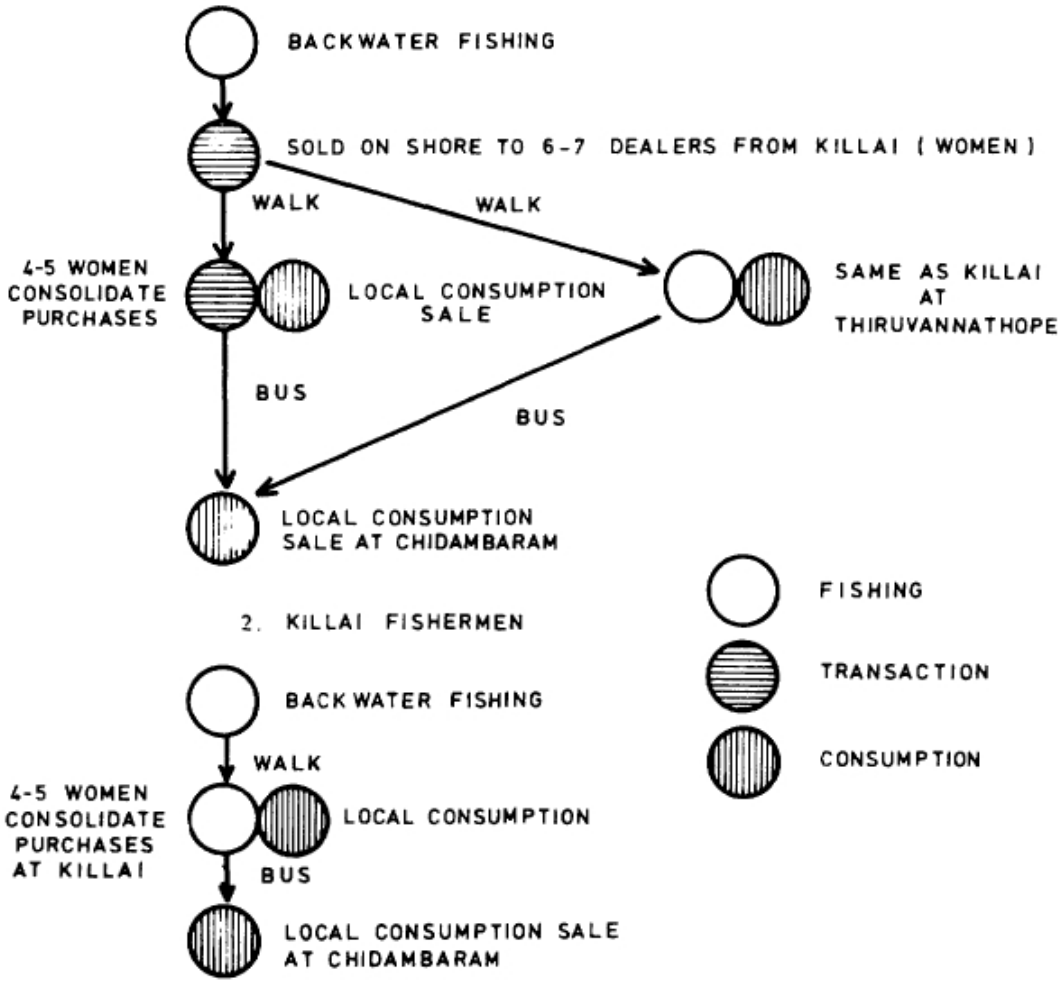
3.3.1.2 Marketing of fish

Marketing schematics of fresh **finlish from the** backwaters

1. VEDDAR FISHERMEN



The marketing of fish is controlled by less than a dozen women in Killai who also lend money.

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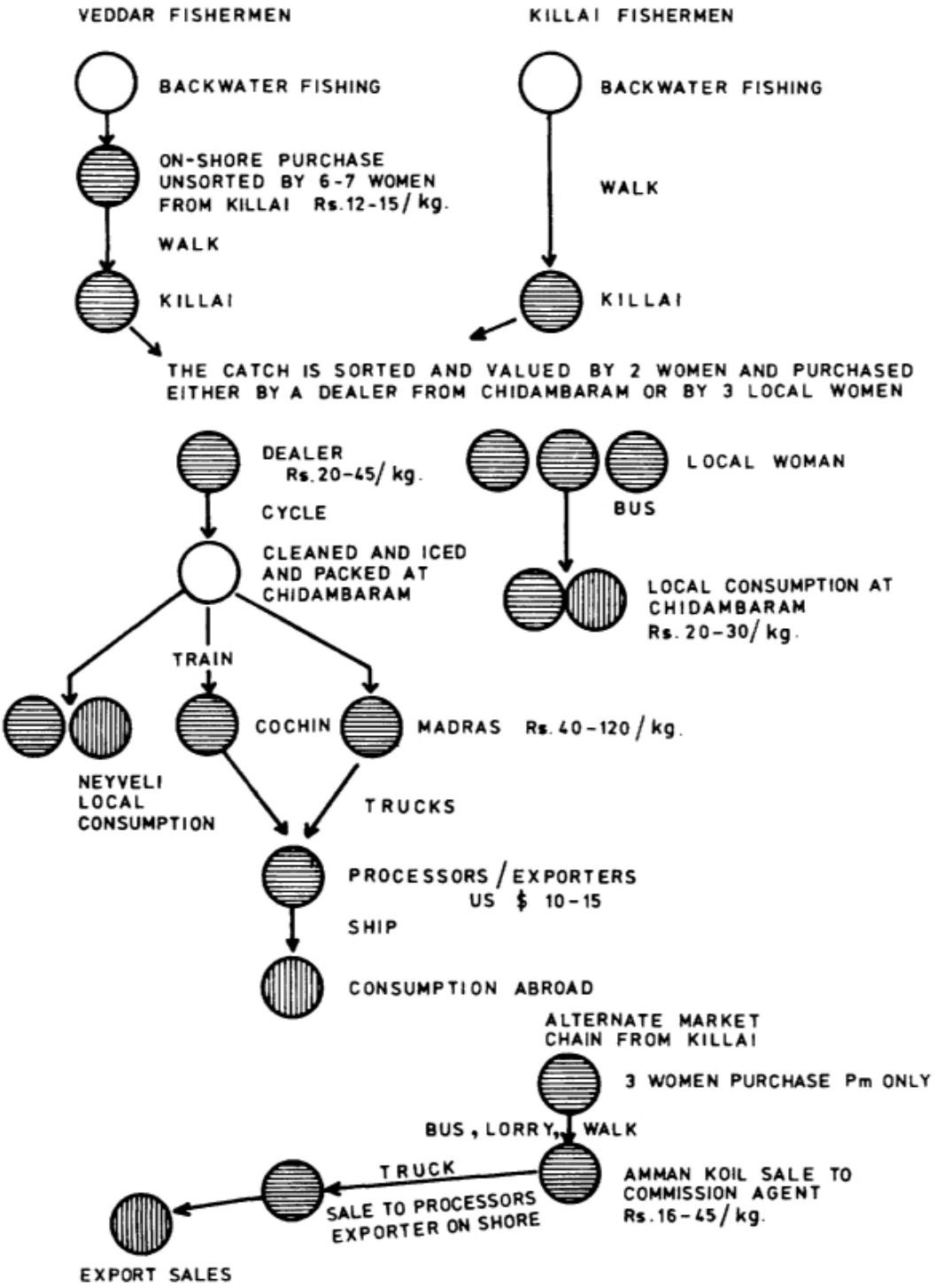
Marketing schematics of shrimp from the backwaters



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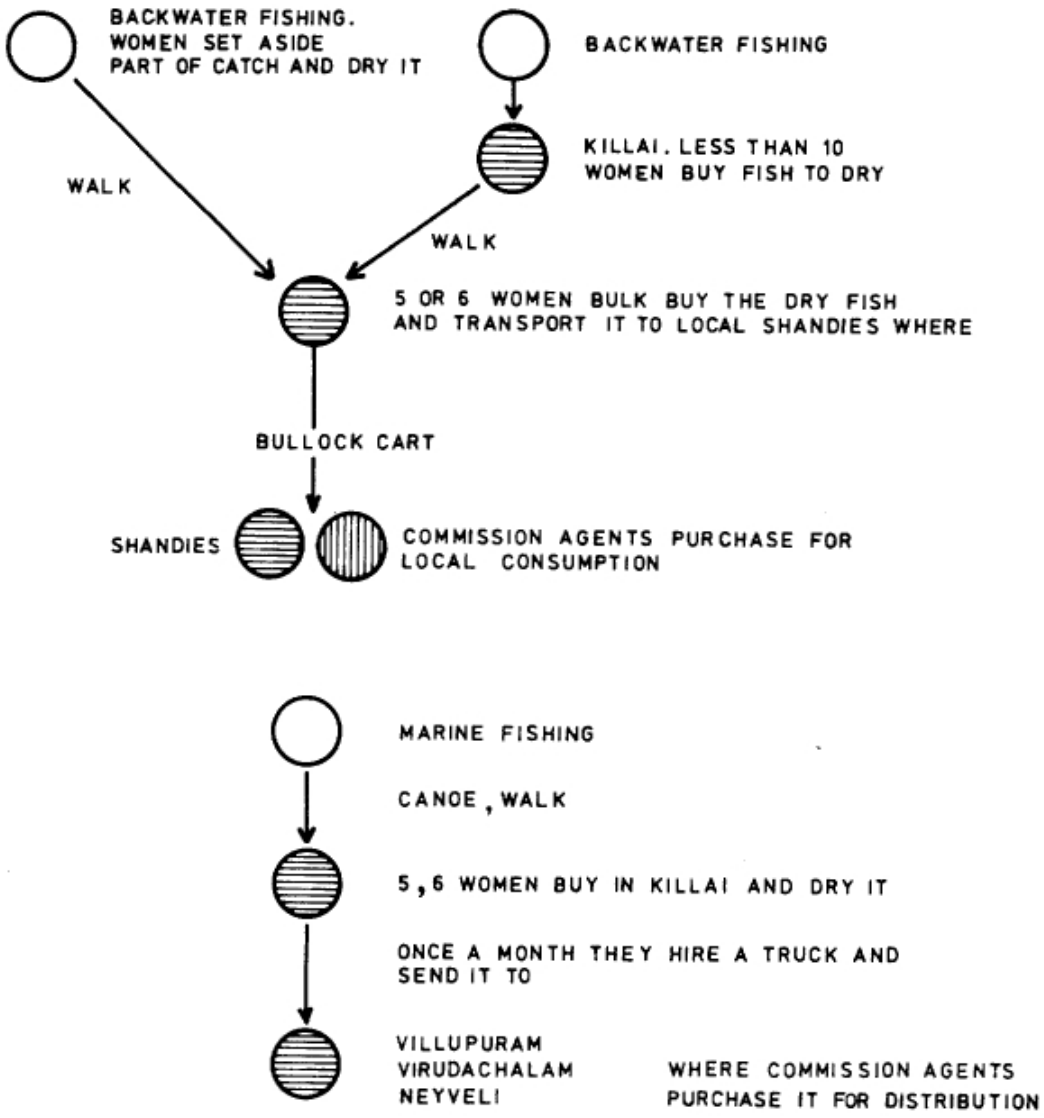
Marketing schematics of dry **fish* from the backwaters**



* The dry fish business is extremely profitable. The market is controlled by less than 10 women all of whom are major money lenders.

Estimation of fishing days

The average number of fishing days was estimated by reducing the seasonal working days by the days lost to festivals, illness and bad weather.

Marine boat owners	218 days/year
Backwater boat owners	307 days/year
Net owners	: 307 days/year
Veddars	: 316 days/year

For asset holding see Table 12, and for present indebtedness, sources of credit and interest rates, see Table 13.

3.3.1.3. Catch Information

	B	N	V
Value of catch per day per family	Rs. 131.84*	Rs. 29.25	Rs. 11.83
Weight of catch per day per family	20.640 kg.	5.980 kg.	2.325 kg.
Value of catch	Rs. 50.00	Rs. 13.11	

* This includes both marine and backwater boat owners; when separated, the marine boat owners have value of catch/family/day of 223.70 and backwater boat owners have value of catch/family/day of Rs. 55.29.

The catch information was arrived at in several ways. The fishermen were interviewed and asked to specify from memory their catch details over the previous week, and of averages during season and off-season. This information was augmented by random sampling * of catches as they came ashore and as they were brought into the different market points. Fish and shrimp are rarely sold by weight and the investigators had to estimate weights. All these factors affect the accuracy of the data but they are definitely indicative of the state of affairs. Several aspects of the data were cross checked in the discussions and interviews and found to be consistent. The only information that is statistically questionable due to the extremely small sample size is the catch data of marine boat owners. However, the investigators are of the opinion that the numbers even in their case are definitely indicative.

3.3.1.4. Estimates of income

	B(M)	B(B)	N	V
Average fishing days per year in days	218	307	307	316
Average catch value per family per day in Rs.	223.70	55.29	29.24	11.83
Average family income per year in Rs.	48,766.00	16,974.54	8,978.52	3,738.91
Average family size	5.68	5.68	4.19	3.41
Average per capita income per year in Rs. (entire population and not working population was considered)	8,585.66	2,988.44	2,142.84	1,094.52

* The data was collected once a week during August-September, 1983.

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Note: This income does not include incomes from secondary occupations like agriculture, fish marketing, money lending. While it was not possible to,estimate such incomes, the opinion of the respondents was that in multi-occupation families, the income from activities other than fishing accounted for anywhere from 25% to 150% of the fishing income.

3.3.1.5. Socio-economic aspects

The backwaters are central to the livelihood of the people of Killai, with about 58% of them depending on it for a major portion of their earnings. Other than fishing and activities related to fishing, such as marketing of fish and making of nets, there is not much else by way of economic activity in the area. There is some agriculture and tree farming and several of the fishermen own small bits of land which they lease out or get cultivators to work under their supervision. There are a few shops and some tertiary activity like teaching and services like post offices, banks and other government.services. The Killai region is badly in need of economic activity to supplement'and diversify earnings and production.

With fishing as the primary activity, the field is naturally dominated by those who have fishing assets. But there is more to it. Caste and class play a role. The Killai fishermen consider themselves to be of a higher social status than the Veddars, and for various reasons see the backwater commons as their 'own.' The Veddars are constantly harassed and prevented from plying their craft. And every now and then their catches are confiscated to reinforce the class stratification. The smaller, poorer and less organized Veddars are at the mercy of the Killai fishermen.

Literacy levels, as defined by the ability to read and write, are reasonably high, but few have any formal education and the general opinion of the communities is that education does not really help, except, perhaps in getting a government job, and what is more, it alienates and makes the educated indifferent and useless within the community. The communities feel the need for an education that would help them to learn and give them inputs to enable them to do their work better, such as management and accounting.

While the income levels seem very high, especially for the asset owners, the numbers need to be viewed in the proper perspective. Little information exists about their investments and expenses. High incomes can be deceptive if expenses and investments are also high. An indication that there may be an economic problem is the high level of indebtedness in the communities. As would be expected, those with assets take loans predominantly for consumption. The sources of credit are still money lenders, relatives and shop-keepers, in a village that boasts a rural branch of a nationalised bank. The inaccessibility of the bank, and rumours of bureaucratic and corrupt practices keep away those who most need low-interest loans and guide them to the more informal and expensive sources.

Most of the money lenders are women, and most of them make their money from the almost exclusive control they have of the fish marketing system. Except for the Veddar women, who work alongside their men in fishing, the Killai women are content with their role as marketers of fish and as housewives. Their involvement in fishing activities is marginal and done more out of necessity rather than out of interest or expertise.

A look at market schematics and the procurement prices at different locations would identify procurement prices as the central problem of the fishery. The people who benefit the most are the middlemen, often aided and abetted by their local agents. There are several reasons for this and they are known to the community. Lack of ice, storage, a transportation system, and cohesiveness and cooperation within the community to take their catch past the middlemen and into the more lucrative markets are the primary reasons. The middlemen are the financiers too, so eliminating them without radical changes in credit availability and procedures would affect the fishery adversely.

Every technology finally succeeds because society *is able* to evolve *social and commercial organizations to implement and nurture the technology.* The existing technology has at its base the family. Extra-family organization while prevalent is loose and unstable. For example, fishing teams have very high turnover rates. Almost no enterprise exists which requires cooperation and mutual trust in any serious form. In fact, even in marketing no cooperative behaviour is visible. The existing cooperative society is a classic example of non-cooperation. The concept has been exploited by the community to get scarce credit and to provide for

upward political mobility to some of the more ambitious leaders of the community. The society has not been able to help in technology transfer, marketing or in resolving the basic problems faced by the fisheries.

The Killai region has essentially two communities facing very different problems. The Killai fishermen are reasonably well off and developed while caught up in the systemic problems that any small enterprise faces in our socio-economic system. With proper inputs and infrastructural support they can step up their economic status. With additional social organization they can really move up. On the other hand, the Veddars are still in the process of assuring themselves of survival and the basic needs of life, They need employment as the first step towards self-reliant enterprise.

3.3.2. *Attitudes and opinions*

3.2.2.1. The use of backwaters

There seems to be no questioning the fact that the government owns, and has the right of use of, the backwaters. However, opinions differ when access and present day utilization are discussed. Most feel that the rrght of ,use should lie with those who depend on it for a livelihood now. A lesser group feels that lease holders have the right. A significant minority, namely, the Veddars, feels that the ownership, in practice, lies with the upper castes.

The communities do not share the use of the backwaters amongst themselves, nor are they interested in doing so with other communities. The Killai fishermen feel it is their natural right to use the waters exclusively as they are the original residents. The Veddars have no objection to sharing the waters with others but the Killai fishermen to the last heavily objected to sharing.

The question of the government allocating parts of the backwaters for exclusive use was received even more negatively. A few went so far as to threaten violence, while most felt that they would take it up with the panchayat. They did agree to the fact that the government had the right to allocate rights, but they insisted that they would fight such allocation either through the courts or preferably through the political system.

The vast majority felt that should the government insist on allocating rights, the only equitable and just procedure would be to ensure that everyone benefitted or none at all. Any form of allocation which was designed to benefit only a part of the population was suspect. This was especially so with regard to the criteria for selecting the beneficiaries.

Most fishermen felt that the catch in backwaters was diminishing; they justified this opinion by the fact that they are putting in much more effort now to catch essentially the same or lesser quantity than what they were used to in the past. The most important reason for this state of affairs, they felt, was the closure of the two barmouths and not, increasing fishing activity. The closed barmouths they felt were affecting nutrient supply and the salinity adversely. They also talked of fish and shrimp dying prematurely in large numbers. The only saving grace seems to be the fact that prices have gone up thus compensating for the lower catches.

3.3.2.2. Entrepreneurship

Most fishermen are fishermen because they are born into fishing families! They never had to affirmatively make a choice. A lack of skills, further aggravated by the inability of learning to acquire skills, and a lack of credit ensures low innovation and diversification. And the fishermen felt that this was their predicament. When questioned as to what would motivate them to take up sonie new enterprise they listed in order of priority dramatic *increases in earning power, improvement in quality of lifestyle and being able to give their children a better deal in life.* The Veddars are open to any work because they need to work to survive; for them there was no choice or debate into the whats and whys.

All enterprise is a risk. What would help them justify taking risks? *A clear demonstration of technical and* economic *viability. Availability of credit and infrastructural support. And, once again, an improvement in earnings by an amount big enough* to *justify the risk and change from the status quo.*

None of the respondents could name an innovation that had been introduced in the recent past into their profession. One vaguely recalled that he had heard somewhere that using a light at night on the boat tends to attract fish. Had he tried it out? No.

The commUnities were then asked about the activity being undertaken by the Fisheries Department and the BOBP on their very doorsteps. They were all aware of it but had little knowledge as to the activities of the project.

The Killai community felt that the project would not be a success and they had several reasons as to why not: they felt that water temperatures in shallow waters would rise and the shrimp would have no cool spots to go to because of the pen, resulting in high mortality; they felt that it would be very difficult to acquire feed for the programme; they felt that the programme had already failed as private groups who had attempted it in the region had lost money and given up the idea.

The Veddars, on the other hand, felt that some good would come of the exercise, and hoped that they would benefit in some manner from the findings of the study.

3.3.2.3. Lifestyles and cooperation

In discussing the possible changes in lifestyle that new ways of earning a livelihood may bring about, the fishermen felt that not getting paid on a daily basis would take some getting used to. The problem they felt would be their lack of planning and discipline in money matters. However, they felt that they could learn and get used to the new mode.

Killai fishermen hesitate to work in partnerships because they feel there will be personality conflicts and trouble when it came to sharing of profit. They seem to prefer employer-employee relationships to partnerships and other forms of cooperation. As one person rather clearly pointed out, they have no objections to working with others provided they are the dominant group.

Women in Killai work at marketing the fish and feel that they do so because they are good at it. In other areas of fishing they feel their involvement is more due to economic necessity rather than skill or interest. In fact, they felt that given the option, and the affluence, they would rather be housewives and even give up marketing.

The Veddar women, on the other hand, work alongside their men and see nothing unusual in it. They want to work and feel that they can do most things that their menfolk do.

Finally, when asked what the fishermen of Killai really wanted, the following lists of demands was received almost from every single respondent:

The demands of the fishermen of Killai were:

- The two bar mouths be opened, deepened and maintained.
- Some (preferably subsidized) form of transportation be created to move fish to the various market centres, thus getting a better deal for them and avoiding some of the intermediate market links.
- An ice factory be established in the region.
- Infrastructure to clean, pack and ice fish and shrimp be established.
- The Cooperative Society be reorganized, or, better still, a new organization be developed that would provide stable jobs, invest in their activity and provide for inputs and services to improve the returns from fishing.

The demands of the Veddars were:

- That they be given homestead rights to the land on which they have built up their huts.
- Credit be made available to them for fishing assets with simpler procedures and lesser corruption.
- That they be given official access to the use of the backwaters, and protection from harassment by upper caste fishermen.

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4. STRATEGIC PLANNING FOR EXTENSION OF SHRIMP PEN CULTURE

Technically, shrimp pen culture seems viable. There are still questions that need to be answered but there is enough for us to justify the next steps which, in turn, will provide answers to some of the questions. There is increased demand for fish production not only to meet local nutritional demand but to export and earn valuable foreign exchange. This immediately raises the first major question: as the market analysis shows, the economic feasibility of the technology may lie in the shrimp being routed for export. Should one promote a technology that will increase dependence on export markets and increase the possibility of exploitation? Or, to put it another way, like in the green and white revolutions, the only way to help the small fisherman to improve his life is to tie him into urban and foreign market demand and improve his technology to meet that demand! This needs to be reflected upon.

OrT the other hand, large stretches of poorly exploited coastal fallows and shallow backwaters do exist with their natural characteristics which make it possible to exploit the water bodies with low investment which in turn will create jobs, generate surpluses and improve the economic conditions of the hinterlands.

The economic analysis indicates that shrimp pen culture would not only be viable but also have the ability to generate jobs and surpluses that will go towards improving the quality of life, and may even promote the growth of the local economy via the multiplier effect. However, before full-scale extension is undertaken, certain technical questions need to be answered. The real effort and costs of seed and feed collection need to be determined. The vulnerability of the concept to management in real-life conditions needs to be ascertained. The long-term availability of seed and feed in all the backwater areas needs to be ascertained using rigorous stock assessment techniques. And finally, the ecological impact of the fisheries on the estuarine ecology, and in particular on the mangrove forests, on backwater capture fishing and on offshore marine shrimp fishing needs to be studied. All these cannot be paper studies, nor can they be done in scaled down experiments insultated from real-life conditions and problems. The option seems to be to go in for a pilot scheme large enough to allow for significant extrapolation of results any yet small enough to piggy-back the research components on to the project. The pilot test scheme will have to be run in the very modes that one would like eventual extension with, and without the close supervision and management of the promoters, to enable "failure" to surface without hindrance.

The next question is derived from the preceding one: how large can the scheme be, and yet be socially acceptable? As made quite clear earlier, there will be opposition from the people now dependent on the backwaters to any scheme of allocation of rights. There are several aspects to this problem: there is for example, 'capture-culture conflict.' By allocating rights for culture fishery the capture fishery is denied access to a part of what is essentially 'commons.' In spite of technical clarifications that this reduction in space may not affect his catch, it is difficult to explain away the social, behavioural and political aspects of such encroachment on a fisherman's access. With the government beginning to allocate land rights in government and community lands, as in homesteads to harijans and as a part of the Social Forestry Scheme, this basic conflict of capture *vs.* culture is going to play an increasing role in creating conflict in development. Unfortunately, no easy solution exists to such a problem. The other aspect is a variation of what Garrett Hardin referred to as the 'Tragedy of the Commons.'[12] Backwaters, like government and community lands, belong to nobody and yet everybody uses them for their personal benefit. Decision making on the part of the individual in exploiting such a resource only deals with private costs/returns and very rarely with social costs and returns. To the individual the commons gives returns at no, or very little, cost. This unfortunately leads to over-utilization as the behaviour is multiplied by several similar isolated arguments. The resource suffers depletion and mismanagement and yields drop. But this rationale still does not encourage an individual to lessen his exploitation because what he does not do, he figures, some one else will. So, why should he bother? Similarly, in reverse, allocating rights to commons seVctively, no matter how it is done, will cause conflict amongst those who are not allocated an exclusive share, because they only see the costs to themselves and not the returns to others and to the society or to the economy, This and the previous problem coupled with the clear and strong views stated by the community would

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require that we tread softly on the full-scale extension of the scheme, while we study the problem to see ways out of the dilemma. Here again, a smaller pilot test project will seem less threatening to the community, and in time show the community some of the benefits of having such activity in the backwaters. With luck the community will, in time, evolve the appropriate social and commercial organizational structures to carry the technology and even develop means and procedures of acceptable allocation.

There is a third aspect of inter-group and inter-community rivalry which also will have to be handled because the community has already raised the question in our study. In the Killai case, this may be resolved by looking at Killai fishermen and Veddar fishermen as being at two stages of development. This will enable the planning to generate entrepreneural opportunities for the Killai fisherman and employment opportunities for the Veddars. In time, it should be possible to introduce some form of profit sharing and equity sharing to equalize the communities. With the seemingly dominant role, the Killai fisherman should have less objection to the scheme, and with the Veddars providing for a large part of the labour input the relations between the communities will be seemingly the same and yet on the way to change.

With the next stage of extension being reduced to a pilot test, the next question is the commercial or social organizational structure(s) with which the test should be tried out. The government would naturally prefer the cooperative structure and give very low priority to individual or family ownership schemes. Very little needs to be said to eliminate the cooperative option, as for quite obvious socio-economic and political reasons the success rate of cooperative ventures has been dismal. The communities in Killai are also obviously not ready for any forms of partnership or sharing forms of management. So by elimination we arrive at the family ownership option. Which immediately raises a host of practical questions about the management of the enterprise. The family would need guidance and support in technical, managerial, financial and planning aspects of enterprise, not to mention trouble-shooting help, motivation and morale boosting. Most small and tiny enterprises fail because of managerial and attitudinal problems than due to credit and technical reasons. The question is who is going to supply these inputs on a sustained long-term basis. The BOBP and the Department of Fisheries could give technical guidance; the banks and other financial bodies could give the finance; we need a new type of organization to provide these vital inputs.

When large business and industry decide to go into new ventures they need the same type of specialized support and inputs on a long-term basis, in addition to finance. A new type of commercial institution has arisen to provide this combination of services, and they are referred to as venture managers, or, to use a much more emotive word, venture capitalists. It is recommended that we evolve a new form of organization in the spirit of venture managers to invest in and supply the important and necessary inputs to the tiny rural sector to encourage and make a success of enterprise. For want of a better name we would recommend that this new breed be called 'Development Managers & Financiers.'

Irt the case of shrimp pen culture the DMF group could consist of a technical person, a managerial person and an extension person, who, after training, could be released a "technocrats loan" to invest in enterprises in the tiny, rural sector. The group, with a financial stake in the enterprise, would actively participate in the business and help with information, training, guidance, morale boosting and trouble-shooting on-line, ideally, when the enterprise is out of its infancy and on its way to success the group would allow the entrepreneur to buy it out, at a profit, and go elsewhere looking for other groups to help and generate a profit for itself too. The concept may sound a little idealistic but all it asks for is a group which will not seek to exploit and maximise on profit — a not impossible demand, if the group members are properly chosen and motivated. And further, these DMF groups could well provide a useful way of utilizing the rural educated unemployed who have an entrepreneural aptitude blended with development consciousness.

The other option is to seek out a voluntary organization involved in development activity and give its members training to undertake a similar enabling task without the financial stake. The former mode has the advantage that it is a regenerative mode, quite unlike most development concepts.

The organizational concept of the pilot test scheme of the shrimp pen culture project is as follows:

- The BOBP should establish within framework, with autonomy, a Development Management & Financing Group (DMFG) with its own funds and treated (at least in accounting) as an independent profit centre. The group will be trained in the technical, managerial, developmental, extension, venture, entrepreneural and motivational aspects of small business promotion.
- The group will then undertake an education and promotional compaign in the Killai region to explain the pilot scheme and its experimental nature and seek entrepreneurs to participate in the scheme for purely commercial purposes. This is a crucial conflict-resolving aspect which will decide the success of the programme. Having identified a maximum of 12 families, the group will go into a formal commercial partnership with each family, independently, to run a one-ha shrimp pen culture farm. The financing will be from three sources: the banks, the entrepreneur and the DMFG.
- The contract between the entrepreneur and the DMFG will include a clause which will allow the entrepreneur to buy off the DMFG at a modest profit to the latter at some pre-determined stage of success.

  The DMFG should collaborate with a maximum of six entrepreneur families, and attach the other six to a voluntary agency, carefully selected and trained to undertake the other option.
- The technical inputs to the DMFG and the voluntary organization could be in the form of deputed officers of the Fisheries Department to enable this effort to be a learning experience fo r the Department.
- Other options, such as single family ownership, could be tried with technical and extension support of the Fisheries Department, as a control in the exercise.

The research components as suggested earlier and a study of vulnerability to management by the three modes of implementation should be carefully and unobtrusively introduced into the functioning of the farms. The idea being that a well managed and run farm would generate such information naturally to monitor and evaluate itself.

Like any industry, shrimp pen culture will need infrastructure and promotion incentives. Among these, the government should consider making available an ice-making unit and transportation for the fish and shrimp to the larger market centres. Financial incentives, in terms of loans and moratoria on principal repayment and on interest, may further promote the activity. There may be a need to establish an organization to supply feed reguarly at the right price.

At first sight the recommendation may seem impractical, and even controversial, but it deserves To be tried simply because it is *a concept evolved from studying the needs that ensure the success of developmental enterprises and also as an attempt to make the development activity as regenerative as possible, so that it becomes a people's activity rather than an external intervention.* Should the research component suggest that full-scale extension is possible, the organizational modes would help in selecting the right means of extension. It is recommended that the pilot project be allowed to run for at least three years. The funding shoold be strictly from nationalized banks and financial agencies, with BOBP contribution being restricted to the research component, technical guidance and establishing a DMFG with its associated educational, learning and training activities and a rolling fund for investment.

This is *a* conceptual strategic plan for extension to pilot phase based on the technical, economic and social studies that were undertaken. It is recommended that the suggested modes be tried to extend an obviously viable technology in a form that has an excellent chance of social acceptability, while the larger questions are answered.

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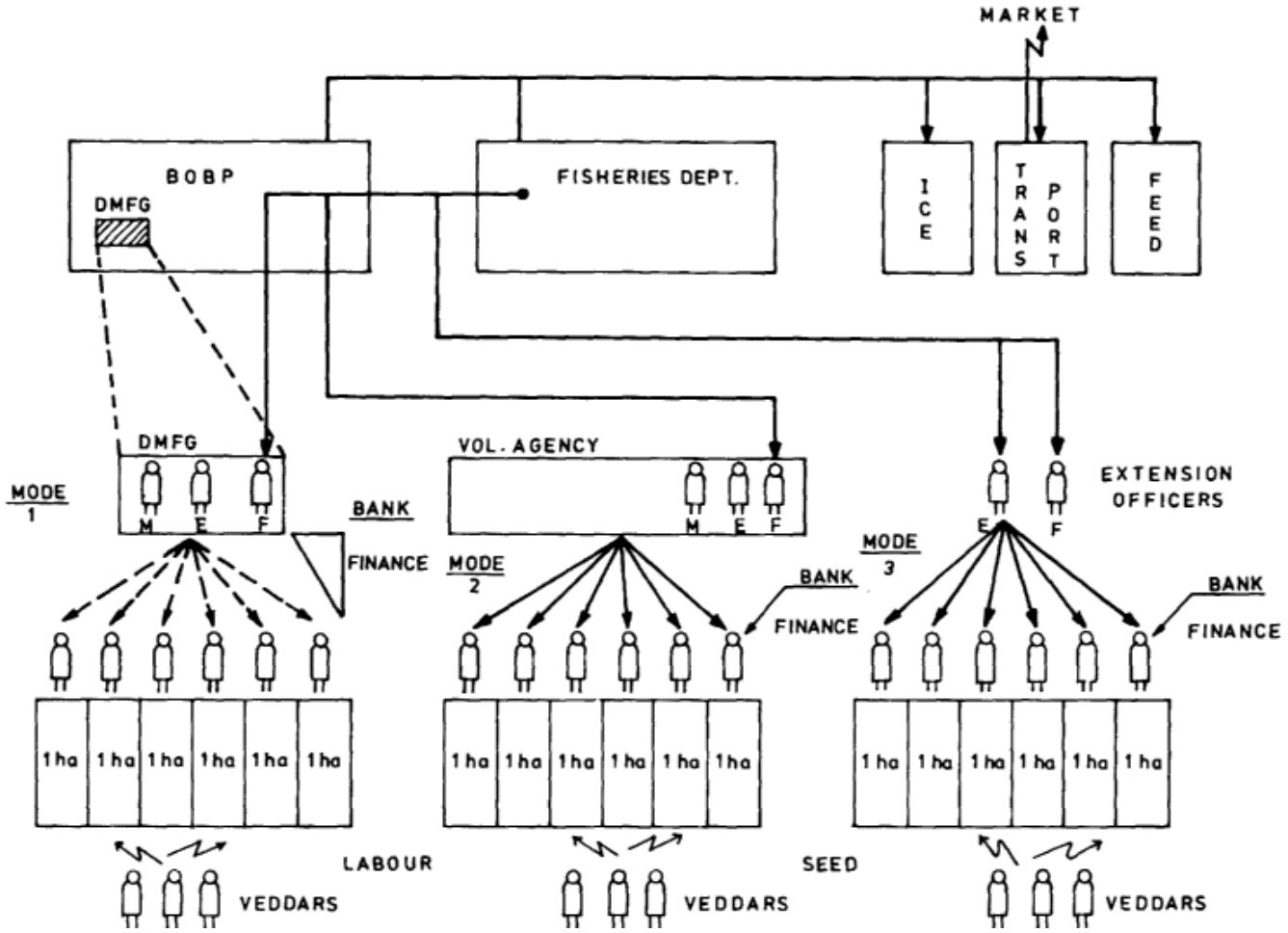

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POSTSCRIPT

In the period between data collection in August-September 1983 and publication early in 1985, we have gained a lot more experience and data, which requires us to rethink some of our recommendations.

Our findings can be broadly classified into four areas of concern:

1. *Investment costs:* Our calculations of investment costs were based on M. Karim's report which was upgraded to 1983 costs on the basis of detailed discussions with the project staff. Subsequent trials and data based on larger pond sizes indicates a definite and sizeable increase in investment cost requirements. A part of this increase may also be due to inflation but the substantial part of it is due to better calculations.
2. *The price* of feed: Our experience since the study shows that feed may not be available at the estimated rates, and this is of particular importance as the viability of the scheme is very sensitive to feed price.
3. Shrimp *production:* Our calculations of production were based on three culture trials undertaken during the 21-month technical development programme. Our subsequent data and experience suggests that our production figures of 460.33 kgs. of *P. monodon* and *P. indicus* and 330.33 kgs. of finfish and auto-stock shrimp per culture cycle are optimistic, and we shall have to accept lower production rates as a norm.
4. *The cost of shrimp:* In our study we had suggested that the shrimp harvest will have to be transported either to Cuddalore or even to Madras where they will fetch better prices and will ensure the economic viability of the project. While this recommendation still holds true, the actual prices at these locations were lower than what had been estimated in 1983.

On the basis of these findings we have to recommend a cautious approach to extension and technology transfer, unless further studies and trials are conducted to ensure the economic viability of the technology under present circumstances.

Rathindra Nath Roy

January 1985.

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