

Appendix 1

LIST OF PARTICIPANTS

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30. Dr. Ian R. Smith	Dy. Director General ICLARM Manila, Philippines
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32. Mr. K. Thayaparan	Director of Inland Fisheries Ministry of Fisheries Colombo, Sri Lanka

Appendix 2

PROGRAMME

Monday, November 26, 1984

0900	Registration of participants
0930	Inauguration Welcome : – R N Roy, Consultation Secretary – L O Engvall, Programme Director, BOBP A Andreasson, Head of Section, NSBF Inauguration by : Dr P V Dehadrai, Development Commissioner (Fisheries) Ministry of Agriculture, Govt. of India Keynote address : Dr Ian R Smith, Dy. Director General, ICLARM
1130	Briefing of participants on the case method Lunch
1400	Case study No. 1 “Planning for Extension of Shrimp Pen Culture in Killai, Tamil Nadu” (after briefing by case writer the participants will break into three committees to discuss the case).
1700	Session concludes.

Tuesday, November 27, 1984

0930 Case study No. 1. Discussions continue till 1300
1400 Case study No. 2 "Shrimp culture in Satkhira, Bangladesh"
1700 Session concludes

Wednesday, November 28, 1984

0930 **Case** study No. 2. Discussions continue till 1300

Thursday, November 29, 1984

0930 Case study No. 3 "Confined Tank Shrimp Culture in Chilka Lake, Orissa, India"
Case study No. 4 "Extension of Cage and Shellfish Culture in Phang Nga, Thailand" (after briefing by the case writers the group will break into two groups to discuss the cases).
1400 Case study No. 3 / Case study No. 4 Discussions continue till 1700

Friday, November 30, 1984

0930 Plenary session
Summing up of findings and recommendations of case study discussions followed by briefing on developing guidelines and recommendations for agencies on socially feasible coastal aquaculture – R N Roy
(the group will break into committees after the briefing for discussions)
1400 Discussion continues
1600 Plenary session :
Presentation of recommendations/guidelines and discussion

Saturday, December 01, 1984

0930 Plenary session
Presentation of recommendations/guidelines
Presentation by agency representatives of their organization's ideas/policies
1300 Consultation concludes.

Appendix 3

SOCIAL FEASIBILITY OF COASTAL AQUACULTURE : PACKAGED TECHNOLOGY FROM ABOVE OR PARTICIPATORY RURAL DEVELOPMENT?

Keynote Address by

Dr. Ian R. Smith,
Deputy Director General, ICLARM, Manila

ABSTRACT

The critical need to determine the social feasibility of coastal aquaculture in the tropics exists because of several factors : the rapid pace of technological development in coastal aquaculture systems; the expansion of potential export markets for the products of coastal aquaculture (especially shrimp) and the economic pressure for increased production; the fragile nature of the coastal zone, particularly mangroves, and the potential competition for its use that aquaculture development can bring; and the general lack of institutional preparedness to deal with this competition in the coastal zone.

A socially feasible aquaculture system requires that coastal communities participate in decentralized planning for the adoption of aquaculture technologies and that benefits be widespread. Projects justified solely on technical and financial grounds usually fail to take into account the socio-cultural and institutional setting of coastal communities, and there is the danger that the interest of these communities is being overlooked in the drive by many nations for foreign exchange earnings from such coastal cultured species as shrimp which require large-scale investments.

1. Introduction

A. *Technology and Development*

The appropriate role of technology in rural and agricultural development, indeed in economic growth and progress as a whole, has been the subject of intense debate for many years. Pitting purists against pragmatists, and involving a lot of others in between, the issue has always been contentious because technological improvement of one form or another is not only an integral part of so many approaches advocated to alleviate poverty around the world but also a challenge to the status quo. Technology, and the structural change it has wrought, is the centrepiece of claims to current prosperity in the west and is therefore espoused by Westerners as the solution to under-development and poverty elsewhere. Western approaches, though, are often criticized for their materialism and failure to appreciate socio-cultural differences elsewhere (Reddy 1976).

This criticism comes not only from individuals in societies which claim to be subjected to cultural and technological pressure from external sources but also from Westerners themselves. For example Will and Ariel Durant share this doubt about the direction that technology leads us all when they state :

“Sometimes, we feel that the Middle Ages and Renaissance, which stressed mythology and art rather than science and power, may have been wiser than we, who repeatedly enlarge our instrumentalities without improving our purposes.”
(1968, p. 95).

Concern for technology and its purpose and impact should be at the heart of the discussion regarding development of any sector, be it industry, commerce, agriculture or aquaculture. Measuring development solely in terms of increases in total output or monetary value is the easy though oft-misleading measure of impact; determining the fashion in which benefits from output expansion are distributed is much more difficult. Even more problematic is trying to *anticipate* these distribution effects and therefore being able to judge *a priori* whether or not to proceed down the path indicated by technical feasibility alone or in what fashion the path should be redirected to achieve social ends. Prediction will always be difficult, but experience with agricultural development over the past two decades, especially with the impact of the high yielding crops of the Green Revolution, can at least assist planners in other sectors such as aquaculture to ask the right set of questions.

B. *Social Feasibility*

The primary purpose of this paper is to develop the major issues relevant to assessing the social feasibility of technology for coastal aquaculture in the tropics. The issue of social feasibility will begin from the point where technical and financial possibility leave off, thus assuming that both of these aspects of technology evaluation have been answered positively.

The concept of ‘social feasibility’ as used in this paper is thus a broad one, essentially encompassing “all aspects except those which are technical and financial.” This distinction between techno-financial and other aspects is crucial because much of the current aquaculture development in the coastal zone in the tropics is undertaken by *private* entrepreneurs, motivated primarily, if not exclusively, by technical and financial considerations. It stands to reason, therefore, that issues related to social feasibility which include economic (in the social welfare sense as distinct from straight forward profitability), socio-cultural, legal, political and institutional dimensions of aquaculture development should be addressed by participants in the *public* planning process.

As the question raised by the subtitle of this paper implies (packaged technology from above or participatory rural development ?), equally important to consider as the right set of questions is the process through which answers are sought and in particular the degree to which coastal zone residents in the tropics can participate when questions of aquaculture development are addressed. For, at the heart of deliberations about social feasibility should be the question: “coastal aquaculture development for whom?”

One might well ask why at the current time questions of social feasibility of coastal aquaculture are particularly important. The critical need to address these issues arises because of the following factors :

- (a) the rapid pace of technological development in coastal aquaculture systems;
- (b) the expansion of potential exports markets for the products of coastal aquaculture and the economic pressure that this potential creates for increased production;
- (c) the need to add to the supply of aquatic protein available domestically;
- (d) the fragile nature of the coastal zone itself and the potential competition for its use and misuse that aquaculture. development can bring; and,
- (e) the general lack of institutional preparedness to deal with extreme competition for use of the coastal zone.

It is the underlying theme of this paper that ways must be found to balance the technical and financial arguments in favour of rapid expansion of large-scale capital-intensive coastal aquaculture with a concern for the long-term effects that such development will have on the coastal zone in the tropics and more importantly, upon the present inhabitants there, most of whom are small-scale fishermen and gatherers with few, if any, alternative employment opportunities.

Valuable lessons for aquaculture development planning and implementation can be learned from experience with the Green Revolution in agriculture and the 'appropriate technology' movement. Factors that need to be taken into account when planning socially feasible coastal aquaculture systems include : (1) Informal and formal institutions, especially those of a legal nature, that govern property or use rights in the coastal zone; (2) sources and degree of concentration of coastal community wealth; (3) male and female labour use patterns and availability; (4) extent of previous community collective action and strength of local leadership; (5) previous experience with aquaculture or technological change in other sectors; (6) present technical and managerial skill levels; (7) extent of community linkages with external institutions such as credit, extension and markets; (8) socio-cultural aspects of community power structures, role of local elites and consumer preferences.

This paper examines each of the above factors and concludes that socially feasible coastal aquaculture systems, such as bivalve culture and integrated farming that can be integrated with existing community activities, can be developed. Successful implementation of such projects will require long-term support and even subsidies for coastal communities. Also required is legislative change or enforcement to reserve parts of the coastal zone specifically for small-scale aquaculture activities of coastal communities which might otherwise be displaced by large-scale capital intensive corporate-managed shrimp farming. Aquaculture technologies will bring change to coastal communities which may be disruptive to the existing community structure, but this change can also be liberating for the majority of coastal residents who presently exist in conditions of extreme poverty.

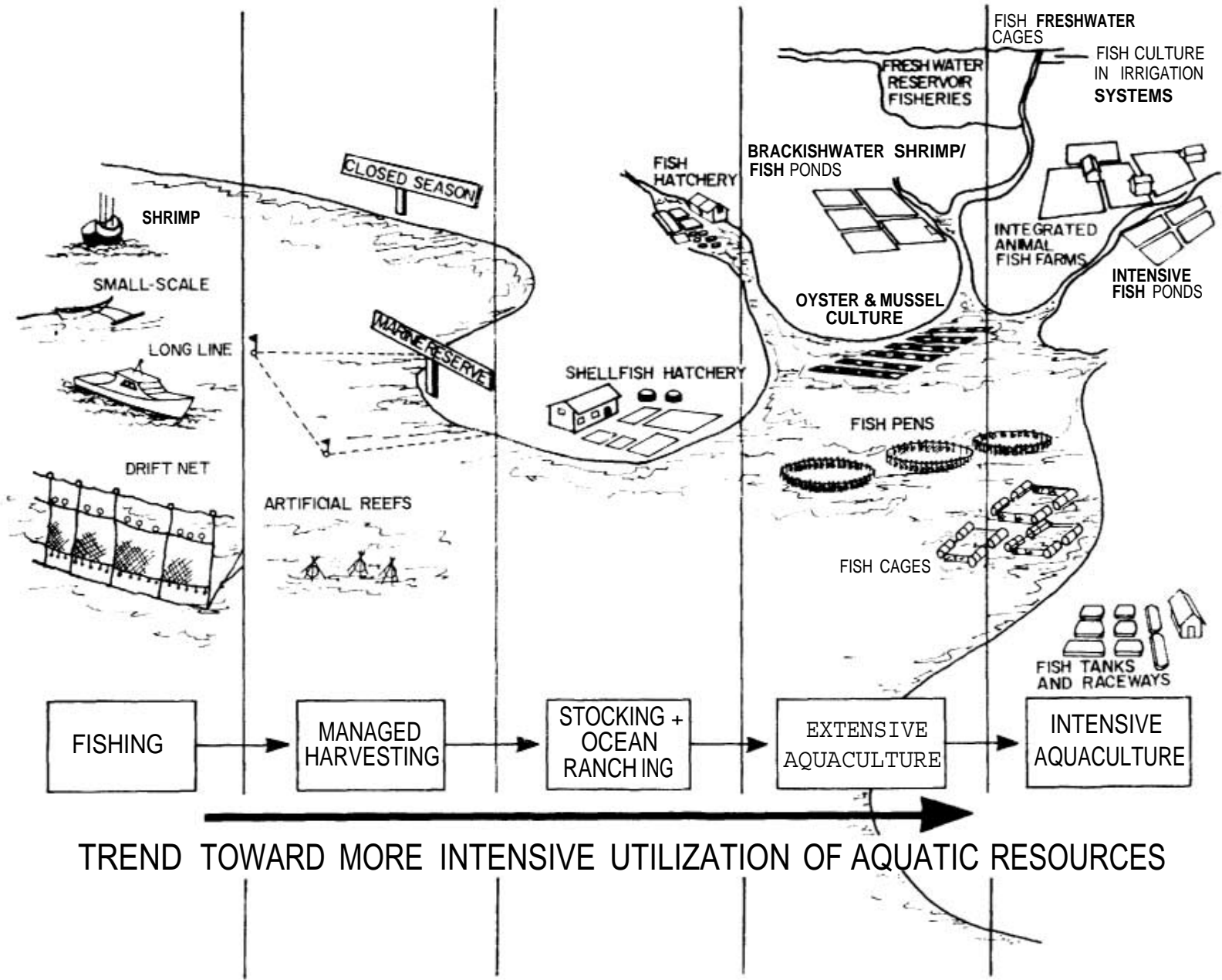
2. Coastal Aquaculture in the Tropics

A. *Production Trends and Systems Diversity*

With fish protein supplies levelling off in many countries as limits to capture fisheries production are reached, aquaculture is being viewed as the primary means of achieving the incremental growth in aquatic food supply necessary to keep up with continued increases in population and demand. In response to the favourable economic conditions created for aquaculture producers in many countries by these relative shifts in supply and demand, aquaculture production is already rapidly increasing. Although aquaculture currently provides only 9% of the total annual worldwide fisheries output of 75 million metric tons, production from aquaculture is growing at more than 7% annually, far outstripping the rates of increase in most other worldwide food producing sectors (FAO 1980). In some southeast Asian nations, annual rates of aquaculture production increase since 1980 approach 20%, a potentially gratifying development for consumers in these countries since up to 69% of the population's animal protein requirements are derived from fish.

While much of this increase worldwide comes from freshwater culture systems, especially those for carps and tilapia, coastal aquaculture systems are also experiencing rapid expansion and increases in production. Important species raised in brackishwater and nearshore aquaculture systems include milkfish, shrimps, mullets, various bivalves, and to a lesser extent certain marine species such as seabass and grouper. Of these, shrimps are the most important economically; indeed, it is the attractive export potential of shrimp more than any other factor which explains recent changes in coastal aquaculture production patterns.

(15)



There are important regional distinctions in aquaculture's status around the tropics, however. Tropical Asian nations (including China) account for 65% of the world's aquaculture production; Japan, outside the tropics, produces much of the rest. Between them, Latin America and Africa accounted for less than 3% of the world's production in 1975, although of late certain countries in Latin America (e.g., Ecuador) have been attracting both private and government investment, particularly for shrimp, providing indications of potential expansion (Luna 1983). In contrast to this embryonic industry, Southeast Asian brackishwater aquaculture area, which has more than 500 years of history in Taiwan, Indonesia and the Philippines, totals more than 400,000 hectares (Smith and Chong 1984). Most of this area is used for rearing milkfish (*Chanos chanos*) or for polyculture of shrimps (especially *Penaeus monodon*) with milkfish.

These regional differences in terms of prior experience with aquaculture have important implications for further development of coastal aquaculture systems. In much of Southeast Asia, where long-standing traditions of culture exist, the major debate is on whether production increases can best be achieved through the opening up of new areas (i.e. mangroves and swamplands) or through intensification of production techniques on existing pond areas. Private producers are well-established in Southeast Asia and influence government policies with respect to land use, credit, research and extension services. In other parts of Asia and in Africa and Latin America, coastal aquaculture is being introduced in areas where little previous aquaculture experience exists. In these areas a different set of development issues arises with respect to consumer acceptability of the product and the need for managerial skills and supporting infrastructure to foster those entrepreneurs or communities that initiate aquaculture activities (Smith and Peterson 1982).

In addition to these species and geographic differences, coastal aquaculture systems can vary greatly in terms of the resources that they use (land, water, labour and capital inputs) and the intensity of this use (see Figure 4). In the coastal aquaculture category, one can include on the one hand, very extensive systems such as ranching and pen culture of finfish or stake and bottom culture of bivalves that use few if any supplementary inputs, and very *intensive* systems such as cage culture and supporting hatcheries for certain marine species, on the other.

Straddling these two extremes that are practised primarily in nearshore waters, is brackishwater pond culture which uses large areas of land though it does not necessarily use large amounts of labour or supplementary inputs. Most of the area currently used for brackishwater aquaculture pond production was formerly mangrove forest and swampland and the range of yields, even for single species, can be large. Milkfish yields, for example, can range from 300 kg to 3 ton/ha/yr, depending upon the intensity of the technology used.

Despite these species, regional and systemic differences, there are a number of continuums across the coastal aquaculture spectrum that are relevant to this discussion on social feasibility of coastal aquaculture. These include (Figure 5) :

- (i) historical development and extent of previous aquaculture experience;
- (ii) the technical and managerial complexity of the system;
- (iii) the property rights arrangements that govern the ownership and/or use of the land and water resources required;
- (iv) population density and intensity of alternative use of these land and water resources; and
- (v) the degree of market orientation for the cultured product.

Each of the above continuums raises social feasibility issues that are relevant to individuals, communities, nations as a whole or all of these.

B. *Emerging Issues*

The rapid growth of aquaculture production in the tropics highlights certain emerging issues that can be broadly categorized as managerial, economic, nutritional, socio-cultural and institutional. Each has implications for this discussion on social feasibility.

1. *Managerial* complexity. First, aquaculture production techniques, despite a long history with certain species, are still in their infancy. The husbandry of most aquatic species is now at an elementary stage where the very basics of reproduction, nutrition and pathology are still being worked on (Pullin and Neal 1984). One would be hard pressed to claim that tropical aquaculture is currently managed on a scientific basis; most culturists, though in some cases backed by many generations of experience, still work on the basis of trial-and-error and certain 'rules of thumb'.

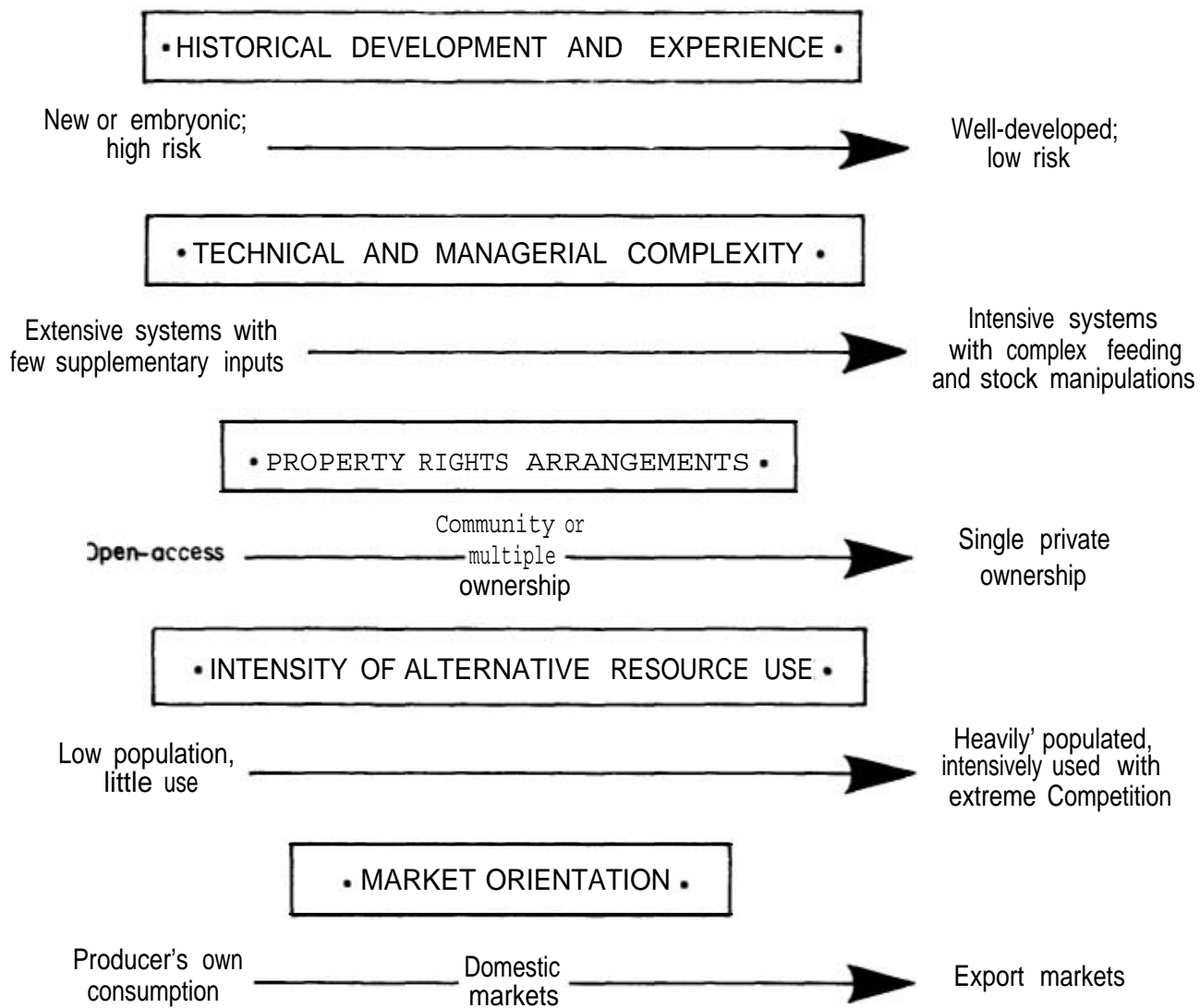


Fig. 5 Continuums across the coastal aquaculture spectrum

One could say the same of many traditional agricultural systems of course, but in the case of aquaculture the lack of a strong scientific base translates into additional unavoidable risks for producers. The more intensive the system (e.g. shrimp culture with supplementary feeding) the greater the risk and the more difficult the managerial task for the average producer. This production risk is further complicated for certain species, especially shrimp, by emerging constraints on seed (juvenile stocking materials) and feed availability and seasonal shortages. Where high risk systems are contemplated for areas with little previous aquaculture experience, the skill and managerial leap required of would-be producers from previous activities, such as small-scale fishing, can indeed be substantial. The managerial task is significantly reduced for more extensive systems Such as bivalve culture.

2. Economic incentives. Coastal aquaculture has an emerging export orientation that is guiding much of the current investment in aquaculture. Shrimp is the primary commodity of interest here. With nearshore trawling for shrimp now coming under increasing criticism because of its negative impact on small-scale non-trawl fishermen, many governments are turning to brackishwater pond culture of shrimp as a means of maintaining or even increasing the levels of foreign exchange that are earned by exporting shrimp to Japan, North America and Western Europe which depend for most of their supply upon imports. Indonesia, for example, earned US\$ 100-150 million annually from shrimp exports during the 1970's until trawling was banned in 1981 (Sardjono 1981); aquaculture planning in Indonesia heavily emphasizes brackishwater culture of shrimp from existing ponds and over 200 shrimp hatcheries are planned to support this effort,.

It has been estimated that world shrimp landings (mostly from tropical coastal waters and ponds) have remained steady at about 1.75 million tons live weight since 1977 (Rackowe 1983). Ninety per cent of this comes from the capture fisheries and perhaps 50% is exported. Additional imports required in Japan, North America and Europe by 1990 will be approximately 55,000 metric tons. Adjusting for local consumption and the percentage weight loss in post-harvest processing, the **additional** harvest of shrimp required from ponds (assuming no change in catch from trawlers) will be approximately 170,000 metric tons. Experimental farms can presently produce 2-4 tons per hectare per year; on-farm yields, **on** an average, are generally much lower at 0.5-1.5 tons/ha/yr (Hamilton and Snedaker 1984). Assuming that this lower level of production is profitable (and there should be some serious doubt about long-term profitability at these lower yields except under subsidized conditions – see below), a total of 170,000 hectares of brackishwater ponds will be required.

The actual area projected for development worldwide exceeds the area that will be needed, unless one can assume that coastal trawling will be further restricted. Driven by the currently attractive export prices and the need of tropical developing countries for foreign exchange, the shrimp farming race is on in Southeast Asia, South Asia and Latin America with large development bank funded projects for conversion of existing brackishwater ponds and expansion into new areas. Malaysia, which is just one of the countries in this race, has announced its intention to develop 110,000 ha for shrimp culture (Infosh **Marketing Digest** 4/84 : p.6). The Philippines plan to develop 30,000 ha (IFC 1984). Indonesia's plans for 200 hatcheries imply an intention to convert large areas of its 185,000 ha of brackishwater ponds to shrimp culture. Other projects are proceeding in India, Pakistan and numerous countries in Latin America. Almost without exception, these projects are to be undertaken by large-scale private entrepreneurs or corporations. One must wonder if all this proposed shrimp production and the conversion of mangrove areas that it entails is sustainable economically, much less environmentally and socially.

3. Nutritional needs. The fact that supply of aquatic products from the capture fishery is levelling off is leading to increased concern for declining nutritional standards among those nations and communities that depend heavily on fish. Many Asian countries, for example, depend upon aquatic products for half or more of their animal protein requirements. With an increased market orientation for fisheries, incidence of protein malnutrition is high even in many coastal fishing communities. The FAO has raised concern for nutritional issues to the international arena (Saetersdal 1979, Carroz 1984, Reeves 1984).

While aquaculture is frequently cited as a means of contributing to the solution of this emerging nutritional problem, it is not at all clear that aquaculture products will be directed primarily towards domestic markets. In fact there is a growing tendency for aquatic products to be exported to developed nations; some would argue that this is at the expense of domestic nutrition and markets (Kent, 1983). This actually remains to be proven, but certainly the current trend is to send the

aquatic products to the areas and countries with the highest purchasing power. Are assumptions that local producers benefit from these higher prices for their products correct? The relevant point here for "socially feasible" aquaculture systems is that measurement of the nutritional impact of aquaculture projects (either directly in the form of production for household purposes or purchased with higher incomes derived from aquaculture activities) should be an important criterion to consider during planning and implementation (Kent 1984).

4. Institutional *preparedness*. Is it possible then that all the socio-economic and institutional issues of trawling (intense competition in the coastal zone, displacement of traditional users, skewed distribution of benefits, long-term environmental damage) are simply being transferred from the nearshore to the brackishwater zone through economic pressure driven by attractive export markets for aquaculture products such as shrimp? This emphasis upon brackishwater pond culture of shrimp is intentional because it is here that that greatest divergence between techno-financial and social feasibility lies.

While the same issues of competition among nearshore users exist with cage culture of marine species or stake culture of mussels, the potential for integration of these systems into existing community work patterns with community capital resources is much greater than for capital-intensive high risk shrimp farming. With these systems, the social feasibility issues can be resolved at the community level. In contrast, the conversion of often fragile coastal ecosystems into shrimp farms is not only beyond the control of coastal communities at present, but the impact on these communities (both human and aquatic) is likely to be far greater and, because of lack of institutional preparedness, far more negative.

There are both scientific and institutional weaknesses that facilitate the conversion of mangroves, in particular, to pond aquaculture under private ownership or use rights. Mangroves are believed to be important breeding and nursery grounds for many aquatic species that are later caught in the nearshore areas by capture fisheries. However, scientists have been unable to establish in definitive fashion the exact quantitative relationship between mangroves and nearshore fisheries (Hamilton and Snedaker 1984); consequently, the potential fisheries losses that may occur by clear cutting mangroves are usually understated, if stated at all, in cost/benefit studies of coastal pond aquaculture. Other traditional users of mangrove areas such as shellfish gatherers, charcoal makers and nipa palm growers are also frequently ignored in these calculations, though the value of these activities can be substantial (Velasco 1980 and Ong 1982).

This incomplete assessment of the value of current traditional use of mangrove areas has resulted in the setting of ridiculously low user fees for conversion of mangrove areas for aquacultural purposes. For example, a 25 year lease for conversion of mangroves to brackishwater fish ponds can be obtained in the Philippines for only P30 (US\$1.50) per hectare per annum. Needless to say, this hardly acts as an effective barrier to entry. Transaction costs to obtain the lease may be higher, but these and loan processing fees are recoverable from any development bank loan obtained. While most mangrove area in the tropics is nominally public land, in many locations there has been institutional neglect governing its use that in effect encourages the transition of large areas from common property to private use. Large numbers of traditional users have undoubtedly been displaced in this process. Lending policies have encouraged rapid conversion through an emphasis on loans for capital and construction costs rather than for operating expenses such as supplementary inputs in existing ponds. These seeming inability of the scientific community and coastal zone management institutions (where they exist at all) to control the rate of mangrove conversion have led to the possibility that the incentives of private profitability will be able to proceed unencumbered by social and institutional considerations.

The above comments should not be taken (yet) as an argument against all coastal shrimp farming. It is the power and momentum of current economic arrangements and trends that link foreign markets, multinational or large local corporations, ready access to the coastal zone and large-scale development bank financing that are frightening. Again one must ask : "coastal aquaculture development for whom?" Is there not a better way to achieve close to the same levels of output or foreign exchange earnings, a way in which coastal fishing or agricultural communities can participate in this new economic activity proposed for the coastal zone, a way that assures more environmentally gentle and equitable use?

Just ~~because~~ aquaculture is a speciality activity dealing with aquatic rather than agricultural products, does not mean that the multi-faceted setting of rural agricultural and fishing communities in which it does and will operate can be ignored. In essence, aquaculture should be viewed as yet another rural innovation that is bound to impact on work patterns, sources of wealth, incomes, income distribution and local institutions. The task of those promoting and guiding aquaculture development is to work towards the adoption of systems that bring increased welfare to the community as a whole.

3. Lessons to be Learned from Agriculture

A. The Green Revolution

It was Robert Oppenheimer, describing his work on atomic weapons, who stated, "From a technical point of view, it was a sweet and lovely and beautiful job". (Dyson 1981, p. 89). A primary focus on technical aspects, a production emphasis, has also haunted agriculture's Green Revolution. Without getting into the highly debatable issue of who or which institutions should have had the foresight, initiative and courage to examine the non-technical aspects of the high-yielding varieties, suffice it to say that the early expectations of the Green Revolution have not been fully met (Hainsworth 1982). Production of grains has increased in many countries but the majority of rural producers find themselves no better off now than when they grew traditional grain varieties. In fact, in many countries producers are worse off with lower real incomes, greater indebtedness and increased dependence upon imported inputs, especially fertilizers. Wealthier landlords appear to have benefited disproportionately, while the numbers of landless labourers have grown. Structural change was brought about but not in the form anticipated and hoped for. It is debatable, of course, whether conditions are worse than they would have been without *any* development of high yielding varieties, but it can hardly be debated that 'technically sweet' alone is insufficient as a criterion for pursuit of improvement in well-being and incomes in rural areas.

More than anything else, this hindsight about the Green Revolution reflects disappointment that the full expectation of higher-yielding varieties to emancipate rural agriculturists was not achieved. Sociologists had long thought that the transformation of rural economies and traditional agriculture would be very hard to achieve (Rogers 1969). But with their emphasis upon the conservative, even irrational attitudes of peasant farmers, these sociologists were right about the rate of transformation but for the wrong reasons. There is now ample evidence of rationality among small-scale agriculturists just as there is among small-scale fishermen. Of the various socio-cultural, economic and institutional theories regarding agricultural change and growth, it is that of institutional constraints which appears most reasonable and is best documented by empirical evidence. The gist of the argument is that informal and formal institutions adapt slowly to changing technologies and thus often stand in the way of more equitable distribution of benefits from the application of these technologies. In other words, structural changes in economic, socio-cultural, legal and political patterns do not occur overnight.

B. Alternative Theories of Agricultural Change

The following brief overview of alternative theories of agricultural change summarized from the Chong *et al.* (1984) study of milk fish aquaculture in the Philippines, and the Stevens (1977) study of agriculture on small farms is presented to highlight and summarize previous research which bears on similar issues in aquaculture elsewhere, such as resistance to change, technology transfer and diffusion of innovations. The major theories of agricultural stagnation and transformation can be grouped into those that attempt to explain the farmer's behaviour through socio-cultural perspectives, those that assess their behaviour primarily in economic terms, and those that emphasize the role of formal and informal institutions.

1. Small Farmers are Poor Decisionmakers' Theory. This hypothesis assumes that more productive or profitable alternative production activities are available to traditional farmers but "they" do not make the right decisions about these new opportunities because they are poor decision-makers, irrational, ill-informed or even lazy. This hypothesis which underlies much of the rationale for community development programmes in Pakistan and India in the 1950s suggests that extension services, community development programmes and other forms of educational and management assistance have crucial roles to play to improve farmers' production decisions.

Parallel to this view of farmers' poor decision-making capabilities are explanations that focus on the "subculture of peasantry". This viewpoint suggests that traditional agriculture or other rural pursuits are essentially a cultural characterization of the way particular people live. Cultural attributes of farmers and the value system that farmers hold are cited as the major barriers to their increased productivity, adoption of innovations and transformation. For example, Lewis (1962, 1964) and Rogers (1969) cite such values as (1) strong disposition towards authoritarianism; (2) mutual distrust in interpersonal relations; (3) perceived limited good; (4) lack of innovativeness and resistance to change; (5) fatalism; (6) limited aspirations; (7) limited view of the world; (8) lack of geographic mobility, and (9) low empathy as characteristics that prevent farmers from participating in the agricultural transformation or modernization process.

Proponents of this viewpoint give primary importance to socio-cultural attributes as deterrents to the agricultural transformation process: If one accepts this socio-cultural point of view, overcoming these attitudes and constraints is primarily possible through education, training and extension programmes.

2. *'Small Farmers are Poor but Efficient' Theory.* In contrast to the above hypothesis, a widely accepted economic viewpoint discounts socio-cultural explanations of the *constraints* to the agricultural transformation process. This viewpoint espouses the belief that agricultural transformation is held back not so much by the farmers' cultural attributes and value systems but by economic factors that make any efforts at increased agricultural productivity non-profitable. This view is strongly endorsed by Schultz (1965) who advocates the concentration on high-payoff new inputs (both materials and human capital) to improve the state of the art of production techniques of farmers. According to Schultz, unless the rate of return to investment in inputs of production is improved, there will always be little or no incentive on the part of the farmers to increase productivity, nor for them to save and invest.

Theorists of this particular school of thought state that small farmers are poor, but efficient. This implies that traditional peasant farmers are generally good decision-makers, given their knowledge and resources, but the scarcity (high price) of capital, and non-access to and unavailability of new agricultural technology have deterred their agricultural transformation. Small farmers are trapped in a technical and economic equilibrium, and any reallocation of their resources would not appreciably increase income because, given prevailing prices of inputs (land, labour, capital), farmers are already efficient in utilizing the production inputs they have at their disposal.

Empirical support for Schultz's ideas has been found among Nigerian dryland farmers (Norman 1977), small farms in Brazil (Rask 1977) and Thai livestock producers (DeBoer and Welsch 1977) to cite a few. To overcome the low level equilibrium trap, Schultz argued for the introduction of high-payoff new technologies which markedly reduce average costs per kg of production. That was the approach, in simplest form, of the Green Revolution. Similarly, such a focus on high payoff new technologies appears to be behind much of the thinking of coastal aquaculture proponents today.

Acceptance of the view that small farmers are trapped in a low level equilibrium has led some economists to argue in favour of larger-scale farms to achieve greater productivity by taking advantage of economies of scale. Empirical research, however, has indicated that while theoretically possible, there are limited economies of scale in agricultural production in developing nations and that small farms can often compete effectively with medium and large farms or state farms (Takahashi 1970). While evidence accumulates that farm enlargement is not necessarily associated with increased land productivity, others have cautioned that the shift to science-based agriculture and use of technology also poses threats to rural employment and political equilibrium (Sinaga and Collier 1975). According to this view, small farms are threatened by the introduction of new machines that may displace labour utilization in the area.

3. *Induced Innovation and Rural Stagnation.* Economic viewpoints generally accept that breaking out of the technical and economic equilibrium described by Schultz cannot only be achieved by means of the introduction of advanced technology, but also by induced innovation (Hayami and Ruttan 1971; Ruttan 1977). Changes in relative factor prices or output prices and the provision of institutional support such as credit, extension and information dissemination will produce *disequilibrium* to which small farmers will respond positively. According to this viewpoint, technical change and institutional development are entwined.

The view that institutions are key to the transformation process is echoed by Bromley (1979b). However, he is less optimistic about the rapidity with which institutions will respond. According to Bromley's view, while technology is engine of economic change, institutions are barriers to the growth in the agricultural sector;

"We have seen decades of investment in new seeds, fertilizer plants, pest control, farmer training, and the like. We cannot say how great the transformation has been, because we do not have an experiment in which we can hold some other things constant. We of course know that some farmers in some countries have indeed made impressive strides in terms of increased production and increased incomes. We also know that there are still millions of subsistence farmers barely able to make a living."

The millions of subsistence farmers left behind who are barely able to make a living even after the Green Revolution give rise to a social phenomenon called "rural stagnation." Rural stagnation, according to Bromley, is caused by the inability of traditional agriculture to generate a sustainable economic surplus in the face of institutional barriers. Similar to socio-cultural explanations, this lack of sustainable surplus is attributed to a power-elite manipulating institutional arrangements in order that the economic environment of subsistence farmers be just sufficient to keep the subsistence farmers in production, yet not sufficiently propitious to encourage experimentation. Some observers claim this is one of the main reasons for the increasing numbers of landless labourers and resulting pressure on marginal lands (Lappe and Collins 1977).

These various viewpoints to explain rural agricultural stagnation and transformation have been presented above in a necessarily brief summary. However, this discussion serves to illustrate the need to examine the non-technical issues that must be dealt with in any serious examination of aquaculture development and its impact. Will the aquaculture development activity or project proposed reinforce existing socio-cultural and institutional power structures that keep the majority in poverty, or will it provide opportunities for a wider spread of benefits?

C. Relevance to Coastal Aquaculture

The above perspective on agricultural transformation and growth also has much relevance to the coastal communities in the vicinity of previous and proposed aquaculture development activities but with a different institutional twist. Rare indeed is the location in which there is ongoing activity which will not be affected by a new or expanded aquaculture endeavour. Coastal communities face an added dimension when use of coastal resources for aquaculture purposes is considered; even though the coastal communities themselves may view the nearshore waters, connecting waterways, mangroves and swamplands as "their" resource by virtue of traditional use rights, much of these areas are in fact viewed as public property by fisheries and aquaculture authorities at state and national levels. Planning for aquaculture development at these central levels thus not infrequently occurs without any consultation whatsoever with the current users of the resource. While within the coastal communities one will find many of the same inequities and institutional rigidities characteristic of agricultural communities (i.e., local power elites, patron-client ties, indebtedness to moneylenders), the interest of the whole community might be bypassed or over-run by new aquaculture developments that do not respect traditional use rights.

Large-scale aquaculture enterprises frequently displace small-scale fishermen and aquaculturists. This has already occurred in several locations, the most notable being the expropriation of over 30,000 ha of the 90,000 ha public waters of freshwater Laguna de Bay in the Philippines by large-scale milk fish pen operators. The largest of these private business operations exceed 5,000 ha and contain individual fish pens more than 400 ha in size. The 9,000-10,000 fishermen using the lake have seen their fishing area reduced by one-third; some but not all those displaced, have been hired as labourers by fish pen operators. Lack of management mechanisms to control use of the lake is the major shortcoming that has led to this undesirable situation (Smith 1983).

This bypassing of coastal communities is frequently true also of large-scale shrimp farms which are often corporate run. In other cases, true to the agricultural model, the elite group within the

community participates in the new development to the exclusion of most of the other community members, thus reinforcing local power structures. Labour requirements for pond aquaculture is not great. Some individuals may be hired as casual or part-time labourers but participation in management and profits is rare. The institutional twist in the case of coastal communities with respect to their traditional resources which are suitable for aquaculture is that most frequently no institution exists to protect the community's interests in the face of the 'technically sweet' and financially profitable project which may be, and usually is, proposed from outside the community rather than from within.

Although there are exceptions to this pattern, some of which will be presented as case studies at this workshop, the general rule for aquaculture development appears to be that of packaged technology imposed from above or by outsiders rather than through participatory rural development by coastal communities themselves. The residents of most coastal communities frequently have few alternative income generating possibilities; they may even be former landless labourers who are fishing or gathering in coastal waters as the "employer of last resort". It is therefore imperative that some compromise be found between national objectives of increased aquaculture production and foreign exchange, on the one hand, and coastal community requirements for increased employment and income, on the other hand. I would argue that the solution can best be found through (1) innovative forms of socially feasible aquaculture projects and management that permit community participation and (2) a willingness to adjust the pace of development to assure coastal community readiness to assume a full management function with respect to these aquaculture activities.

It is always easier (and less costly to most nations initially) to develop aquaculture through large-scale, corporate undertakings financed by development banks, probably at subsidized or below-market interest rates. Initial economies of scale in production, marketing and information (not to mention loan supervision) are often used as justification for approaches that exclude substantial development support for coastal communities and their small-scale endeavours. But can developing countries in the tropics afford the social and human cost that often accompanies this approach to aquaculture, just as they earlier experienced in agriculture and coastal fisheries? Violence between coastal small-scale fishermen and trawler operators has been widely reported; perhaps less widely known are similar cases in the Philippines and Thailand where aquaculturists use force to maintain their recently acquired 'use rights' from coastal and inland fishermen. Aquaculture need not become an elitist craft or one defended by rifles, but to avoid this, more than laissez-faire approaches and support for large-scale activities are needed. Direct intervention and involvement by governmental and non-governmental organizations in community based aquaculture is apparently required to achieve greater "social feasibility" in the sector.

What factors and community or individual attributes should such organizations be aware of to fulfill this goal of 'social feasibility'?

4. Major Factors Influencing Social Feasibility

Much of the recent worldwide enthusiasm for 'appropriate technology' has come about through a desire to develop productive activities and techniques which fit local resources and environments and thus benefit the majority of local residents. 'Appropriate technology' is thought to bring change with widespread benefits because it can remain within the control of the community that adopts it. Any change that reduces the tyranny and inequities of so many rural villages should be desirable, but to succeed will require courage by those who would try to get out from under the yokes of indebtedness and poverty, as well as long-term commitment and support from the individuals and organizations that wish to contribute to rural development through the use of 'appropriate technology'. Recent experience has shown that generally it is still groups outside the community that define what is and is not 'appropriate'; and it is now widely agreed that community participation in development of appropriate technology is essential (Roy 1982, Crombrugghe 1984, Miles 1984).

It is almost a platitude to say that the social structure, economic needs and cultural wishes of a coastal community must be understood before those who desire to work with such communities can contribute constructively to change and the community's possible adoption of aquaculture technology. A coastal community, be it a fishing or an agricultural community is not a single entity within which each individual and family has universally shared roles, concerns and ambitions. Most common among such communities are local power structures that allow individuals or groups

to concentrate control of the community's sources of wealth. In fishing communities, it may be the boat and gear owners or, more likely, the moneylender, fuel supplier or fish processor. Sometimes these three functions are consolidated in one and the same individual; perhaps, as occurs in the Philippines, this individual will be the wife of a village councilman. Such local power structures require that for assessment of the 'social feasibility' of aquaculture, distinctions be made among individual, family group and community perspectives and interests. In addition, the possible influence of others physically outside the community, an absentee landlord for example, should be determined.

A. Socio-Cultural Issues

There are important socio-cultural differences among and within tropical countries around the world. There are also differences between fishing and agricultural communities in the coastal zone. The more obvious differences relate to religious and cultural practices that reserve or prohibit certain activities for particular groups. For fishing communities in the Bay of Bengal region, these aspects have been discussed at length at previous workshops and in various publications (e.g., Fernando et al., 1980) which are available for this consultation. Comprehensive reviews have also been conducted for other parts of the world (see various papers in Smith and Peterson (eds.) 1982). The more obvious socio-cultural concerns of individuals, communities and nations that are important to appreciate when coastal aquaculture projects are being considered include attributes of both producers and consumers. For example :

1. Producers :

- religious prohibitions against killing of animals, including fish;
- cultural values regarding the appropriate role of the individual and family in a group setting (e.g., leadership and individual initiative, peer relationships, sharing systems, dependency on others, pursuit of education and new skills, importance of economic incentives relative to other social objectives, attitudes to change);
- cultural values of the community and nation (e.g., social stratification) which influence working relationships and tasks, access to sources of community wealth, roles of men/women and various age groups, and processes through which leaders evolve and are maintained.

2. Consumers :

- religious prohibitions against consumption of certain species of or even all fish;
- religious practices that create seasonal or weekly demand fluctuations;
- consumer preferences or prejudices with respect to fisheries products (e.g., species, size, colour, taste, texture, freshness and number of bones).

Sociologists would draw up a much larger checklist (see Pollnac 1982; Pollnac *et al.* 1982); perhaps this consultation will also do so. These lists are indeed useful and help avoid some of the gross mistakes that have been made with some aquaculture projects. Grivetti (1982) reports two such projects that could certainly have benefitted from such a checklist :

- (1) A project developed by foreign consultants for the Qattara region of Egypt which proposed making local residents into fish farmers to produce fish for their own consumption. The local 'residents', it turned out, were nomadic and rejected fish as human food.
- (2) A project for fish ponds in Botswana to produce fish to supplement diets of Kalahari tribes-people, who it transpired had dietary taboos against fish.

Extreme examples perhaps, but certainly there have been others where planning and implementation have gone wrong solely because of socio-cultural reasons.

B. Coastal Community Structure and Institutions

The broad definition of 'social feasibility' proposed at the beginning of this paper included not only socio-cultural aspects but also legal, political and institutional aspects. For aquaculture development, these factors are equally if not more important than the socio-cultural factors outlined briefly above. This is so because of the demonstrated technical feasibility and financial profitability of many aquaculture systems. For purposes of this discussion, these legal, political and institutional factors can be broadly classified as related to coastal community structure and institutions. To the extent that the characteristics of structure and institutions are shared by numerous communities they contribute to the structural and institutional setting for the coastal zone or nation as a whole.

Some will argue that a focus on structure and institutions is a retreat into economics rather than further elucidation of social feasibility, but this is not the case. Economics as generally practised with respect to aquaculture feasibility is little more than financial analysis, that is, the determination of private profitability. It may (but usually does not) take into account in a subjective way certain aspects of impact of the proposed projects on income distribution and other intangible costs and benefits (Gittinger 1972). The limitations of cost-benefit analysis have long been recognised (UNIDO 1972); conflicts of interest based upon the distribution of economic, social and political power are almost inevitable and cannot be dealt with through a narrow analytical technique that depends upon quantifying all variables.

In many cases, economists ignore or presume away many issues related to alternative property rights and use arrangements (Bromley 1979 a and b argues against ignoring them). Other economists, the sensible ones other social scientists would say, treat the legal, political and institutional factors as keys to determining project feasibility and to influencing the direction and pace of aquaculture development (Johnston 1977). Certainly, they are key considerations if the participation of coastal communities in aquaculture is to be encouraged.

In this context of working with coastal communities to develop appropriate aquaculture systems, the following aspects of community structure and institutions appear to be the most important :

- informal and formal institutions, especially those of a legal nature that govern property or use rights;
- sources of wealth (productive assets) and degree of concentration of ownership;
- male and female labour use patterns and availability;
- extent of collective action and strong leadership;
- previous experience with and reactions to technological change in aquaculture or other community activities;
- present skill levels, both technical and managerial; and,
- extent of linkages with external institutions, including credit, extension and markets.

Each of these is discussed briefly below.

1. Informal *and formal* institutions : Most coastal communities until recently had systems of traditional use rights that determined what type of activities could be undertaken in nearby land and nearshore territories, when and by whom. Such traditional systems still exist in certain parts of the Pacific Islands. In other areas of Asia they appear to have succumbed to technological advance (more mobile fishing vessels, for example) and to a lesser extent to population pressure. In Japan and Korea they have been resurrected in the form of community cooperatives that manage coastal fishery resources out to 40 km from the shore.

Coastal communities clearly need to retain or acquire use rights to the nearby coastal environment if external investors who may wish to use these areas for private aquaculture are to be excluded or to be charged reasonable user fees. Otherwise, disputes over rights to use the coastal zone for aquaculture will continue to be a problem as they are currently in Irian Jaya (Anonymous 19841 and will stifle its development just as they can do for agriculture (Vylder 1982; Khan 1980). Espinoza (1982) reports that disputes are highly likely in Latin America also, where fisheries laws are generally so "antiquated that they do not even mention aquaculture." There are too few instances of successful community managed aquaculture ventures to date; reservation of much of the coastal zone for community activities should be initiated immediately if it is to be available in the long-term for the purposes. The present highly centralized processes for allocation of use rights in the coastal zone need to be decentralized and institutions for management decisions created and strengthened at the local level. This is equally true for coastal fisheries as it is for aquaculture; lack of decentralization can be equated directly with lack of effective control over use and with environmental deterioration.

Not only do the institutions that deal with access and use rights have to be made locally relevant, but user groups need to actively participate; a decentralized structure which is still controlled by individuals from outside the community, such as a government official, will not suffice. These decentralized and more participatory systems also need to become strong enough to resolve resource use competition at the local level and to preclude takeover by elite self-interested individuals and groups from within the community. This type of challenge to existing power structures can perhaps best be accomplished through competition alongside the existing power structures rather than

immediate challenge to take them over. A cockle farming project in Kuala Juru, Malaysia, has successfully followed this approach by establishing a community cooperative alongside local traders and eventually displacing them.

2. Sources of community wealth : The more equitably distributed productive assets are in the community in the first place, the more likely is the whole community to unite around a common objective. For this reason, communities of small-scale fishermen make good potential aquaculturists. Often, the vast majority of families in these communities face common threats or constraints from outside sources such as landlords and moneylenders. There may be problems of transferability of skills between fishing and culture, but the fact remains that the vast majority of coastal aquaculturists have formerly depended primarily upon fishing. Referred to here are the vast numbers of households involved in cultivation of bivalves (cockles, mussels and oysters) in Southeast Asia, and not the much more limited number of shrimp farmers most of whom were previously or still are wealthy agriculturists or businessmen.

A high degree of concentration of wealth in a community, though warranting the more equitable distribution that small-scale aquaculture could bring about, may require more perseverance by the community and its supporters to introduce and maintain such technologies.

3. *Labour use patterns and availability* : The existing patterns of labour utilization of both men and women must be assessed before a new activity such as aquaculture is initiated (Banta and Jayasuriya 1984). Peak labour demand for agricultural activities such as transplanting and harvesting may coincide with the needs of aquacultural activity. However, in many coastal communities such as in Thailand, this does not appear to have been a major problem; while husbands have continued to fish, wives and other family members have undertaken bivalve culture and small-scale processing. This diversification is a useful strategy for most households during the early testing period for the new technology and may be reduced somewhat if the aquaculture venture is successful and can fully sustain the household. Still, labour availability must be carefully assessed, not simply assumed. Many African aquaculture projects have failed because existing labour use patterns and leisure requirements were overlooked (Grover *et al.* 1980).

4. *Collective action and leadership* : A coastal community without strong leadership or the potential for it, is going to be slow in adopting any aquaculture system that will be to the general benefit of the community as a whole. In most communities that now successfully engage in reasonably equitable systems of aquaculture, a key element all along has been the strength, patience and selflessness of an individual whom the rest of the community respects. Japanese systems are renowned for this, where the entire coastal rights system has evolved from the long-term efforts of a single individual (Hamlish 1980). The same is true in the sustained activities underway in Kuala Juru's cockle farming and in the tilapia hatchery systems of Bay Laguna in the Philippines (Gaité *et al.* 1983). The identification, even creation, of leadership qualities such as those found in Pak Salleh in Kuala Juru and Mang Pascual in Bay is a necessary condition for success in broad-based community aquaculture projects. Without such leadership, efforts to help any community to help itself will probably be in vain.

5. *Previous experience with technological change* : Communities with structures and institutions already undergoing modification due to technological change emanating from other sectors are also likely to be more willing to undertake new aquaculture endeavours if such previous experience has been beneficial for the majority. Communities more frozen in time or with negative experience are less likely to be receptive.

6. *Technical and managerial skill levels* : Any new aquaculture activity demands a new set of technical skills, and if the community is fishing rather than agriculture-dependent, then probably new managerial skills also. The jump from daily incomes and vessel management to deferred incomes and culture management can be extremely large. The more capital intensive the system and the more supplementary inputs required, the more difficult this transition will prove to be. Special technical and managerial training will be required in almost all cases.

7. *External linkages* : Institutional support, especially for credit, extension and markets will be necessary if the aquaculture activity is to be sustainable. While the community's preference may be to rely as little as possible on formal credit schemes, the lack of sound technical advice on production and inadequate market potential will surely result in much waste of community resources. Boom and bust cycles are not unknown in coastal aquaculture (see Smith and Pestano-Smith 1980, for a Philippine seaweed example). These are frequently caused by initial overestimation of

market potentials or sustainable prices and resulting overproduction relative to the markets that have been identified. Actually, this problem can affect not only individual communities. If all the shrimp farming projects that are currently proposed are successfully completed and meet their production targets, Japanese, European and American markets are likely to be awash with shrimps selling at prices below production costs of several countries. The higher the value of the species produced, the more likely is the market to be limited and easily saturated; only dramatic reductions in production costs will permit huge quantities of such products as shrimps and seabass to be marketed.

External linkages with credit and extension institutions will be especially important for community-based aquaculture projects. Credit at less than the moneylenders' rate, but retaining some of the same elements of flexibility in timing of repayment will be necessary. Supervision of large numbers of small loans will be required; a subsidy in other words, but why not? Credit subsidies have been made available to large-scale fishing and aquaculture endeavours; why not to small-scale activities that generate increased incomes and protein for local markets? The argument that development banks cannot bear the cost of added supervision for small loans is spurious; this added cost could easily be recovered by setting the interest rate at a level somewhat above those made available to the large-scale sector. Even at this higher rate, the interest rate would still be far below the rates charged by local moneylenders.

Extension services for aquaculture pose a very special problem in most tropical countries (FAO 1980, 1984). If the best approach to successful aquaculture development in coastal communities is essentially one of adopting a rural development and community organizing approach, most fisheries and aquaculture extension services are ill-equipped to do so. In fact, even technical qualifications in many services are low. Special training to upgrade technical qualifications is needed in most cases and partnerships with rural or community development organizations must be formed.

It is apparent that one cannot draw a line to clearly separate those communities that will successfully embark upon coastal aquaculture from those that will not. Nevertheless, inclusion of the above structural and institutional dimensions of coastal communities and their assessment into the aquaculture planning process will certainly increase the probabilities of success.

5. Appropriate Community-based Aquaculture Systems

Three major questions remain to be addressed. First, can appropriate community-based aquaculture systems be developed within the contexts of the socio-cultural and community structure dimensions discussed in the previous section, and, if so, what types of systems would they; likely be? Second, can a balanced approach be found that permits community participation in planning and management of their aquaculture systems while at the same time leaving the community receptive to adaptation of aquaculture technology that may have been developed externally at research experiment stations for example? Third, can community-based systems coexist with the capital-intensive often corporate-run systems that are currently invading the coastal zone?

A. Community systems

Most coastal communities in the tropics and the majority of residents in those communities are poor. The common characteristics of limited resources for investment for new activities and the jump in technical and managerial skill that would be required of the new aquaculturists, suggest that capital-intensive systems such as brackishwater pond culture of shrimp and shrimp hatcheries will not be appropriate. More appropriate will be small-scale activities such as :

- stake or raft culture of molluscs;
- bottom culture of oysters or cockles;
- culture of seaweeds;
- cage culture of marine species;
- integrated systems such as animal-fish culture in backyard ponds; and,
- managed ranching systems such as artificial reefs, pens or other enclosures.

All of these have the advantages of being amenable to small-scale part-time operation. They can begin at such a level that the other primary occupation of the individual or family, such as fishing, can continue to provide steady cash flow to the household while the cultured harvest is awaited. Labour requirements for all are within the likely levels available to households without need of hired labour; indeed they likely add to the productivity of household labour (Schmidt 1980). The level of

other inputs required from outside coastal communities is low. All can be operated by atomistic groups (individuals or families) or communally and can be expanded as managerial skills and markets (including household and community consumption) permits.

Both land-based and water-based integrated systems can be considered. On land, backyard ponds using waste from domestic animals or organic fertilizer need not be large; in the Philippines, ponds of 100-200 m² are successfully operated primarily for household fish (tilapia) consumption (Fermin 1983). Larger pond systems do not seem too feasible as access to land is difficult for many coastal communities and the development cost is extremely high. Several fish pond estates that anticipated groups of 30 small farms cooperatively organized with managerial support have been proposed for the Philippines but were not initiated because of the high investment cost per beneficiary. In coastal waters, integrated systems that grow bivalves as feed ingredients for higher value species could be considered in areas where no human market exists for the bivalves. Artificial reefs not only make coastal waters inaccessible to trawlers, they also enhance local resource productivity to the benefit of small-scale fishing. Bamboo and old tires can be used so the structures need not be extremely expensive.

Small-scale aquaculture systems are already being used in many communities in the tropics and some of these systems provide useful models for other communities to follow when local environmental conditions permit. In cases where social impact has been monitored, the effect on income distribution and employment has been quite dramatic and widespread within individual communities (e.g., Smith and Pestano-Smith 1980).

B. Community Participation and Technology Adaptation

Current systems of research and technology development for aquaculture are most often widely separated from coastal communities. This gap must be closed if culture systems appropriate to coastal communities are to be developed and if communities are to be receptive to rather than resistant to the technologies developed externally by the scientists. Certain basic research need not be linked directly with coastal communities, but there is no reason why technology development and modification cannot be conducted with the active participation of coastal residents.

An ongoing project of the University of the Philippines Marine Sciences Centre (UPMSC) and the International Centre for Living Aquatic Resources Management (ICLARM) provides an example of how this participatory research can be undertaken.¹ UPMSC and ICLARM are conducting research on the genetics and economics of various tilapia strains available in the Philippines. The growth trials are conducted by a small-scale fish farmer in six cages in Laguna de Bay. The cages and all labour were provided by the farmer; UPMSC and ICLARM provide the tilapia fingerlings and the feeds. Records are kept by the farmer of length and weight of the fish and costs/amounts of all inputs, including his own and family labour. Research assistants visit the project site regularly and results of the electrophoretic analysis that is conducted in the UPMSC laboratory to determine genetic purity or contamination are reported to the fish farmer.

A second phase of the project will expand the number of farm cooperators to six and will involve a non-governmental organization experienced in community rural development and organizing so as to spread the impact of the project beyond the fish farm cooperators. Finally, an audio-visual will be prepared about the on-farm experiments and extension work of non-governmental organizations.

This unique project thus has :

- a multidisciplinary research component;
- a partnership between the small-scale aquaculturist and the researchers with both evaluating the technical changes;
- involvement of a rural development NGO; and,
- multiplier effects through easy visibility of the project to other nearby farmers and further afield through the audiovisual component.

Partnerships between individual fish farmers or communities, researchers and non-governmental rural development organizations will be necessary to assure that technology developed by researchers will be appropriate for community adoption and modification. The role of rural development NGOs is particularly important because they are likely to have the expertise in judging 'social

¹ Partially funded by a grant from IDRC, Canada.

feasibility' that technicians in research organizations and government extension services lack. Such groups can also assist in training researchers and extension officers to build up the number of professional rural developers who also have an understanding of the technical, financial and managerial aspects of aquaculture. McGoodwin (1982) strongly advocates this approach to increase the number of rural developers who are willing to spend the time necessary (years, not months or weeks) patiently working with coastal communities to make their projects a success, technically, financially and socially.

Thomson (1979) cites an integrated approach of FAO that supports community-based centres for integrated development and demonstration of fishing technology which would appear to be suitable for model community approaches to aquaculture and thus worthy of further investigation.

C. Co-existence with Large-scale Systems :

Given the multiple use to which coastal zone resources could be put, to what extent can the full range of coastal aquaculture systems as shown in Figure 1 (page 5) co-exist? The lessons of the Green Revolution in agriculture seem to imply that there will be differential adoption rates with any new technology, that at least initially the rich will get richer, and that despite attempts to redistribute productive assets, these holdings may become more concentrated. The same process need not occur with aquaculture, however, as successful co-existence of large-scale and small-scale community activities is possible with careful planning.

To begin with, there are many more species and systems choices in aquaculture than for rice farming. This implies more specialization possibilities with wealthier farmers concentrating upon higher value (and higher risk) systems, such as shrimp, while other less-well-off producers concentrate initially upon less complex systems, such as bivalve culture for domestic markets. Market competition between systems is thus somewhat reduced.

Competition for space within the mangrove and backwater areas is much more difficult to resolve but it can be done. In most countries, neither enabling legislation nor management infrastructure to address resource allocation and use questions exist. *Ad hoc* decisions or lack of enforcement of mangrove 'moratoriums' is common and in most countries conversion of mangroves to shrimp pond culture is proceeding without too much consideration of existing or alternative use of the coastal areas. In addition to problems associated with shrimp farming, there are also questions to be addressed regarding competition between coastal mariculture such as mussel stake culture and the traditional small-scale fishing activities that this aquaculture displaces. This competition for space in the coastal zone thus has a wide national dimension (because it involves foreign exchange generation) and a more localized dimension that may extend no further than a single community. Resolution of both requires a means of taking into account the alternative uses of the coastal resource and a decision-making process that appreciates more than simply technical or financial facets.

If users of renewable resources such as fisheries, forests and coastal zone mangroves and wetlands are excluded from decision-making regarding use of these resources, one can be fairly certain that centralized attempts at the national level to regulate rates of use and types of users will be ineffective. Missing from most coastal zones in the tropics is the element of local control over use. National interests that award trawl licenses, logging concessions or shrimp farm permits at fees far below the true value in use of these resources are merely encouraging their over-exploitation and depletion. Resources such as mangrove or backwaters suitable for coastal aquaculture can be valuable sources of revenue in the form of rental fees which can be used to invest in other income generating activities in coastal communities. The key question is which entity national, regional or state, or local community should have the right to license users and hence earn the income from these user fees?

Since national systems of regulation have generally failed to meet basic conservation guidelines and avoid over-exploitation, a decentralized approach to coastal zone management is clearly called for. Decentralized management decision-making and infrastructure operating within certain scientifically prescribed limits has many advantages. Not only will such an approach be essential to resolving issues of competition at the local level, it will potentially generate income for coastal communities which are among the rural communities most in need of such income. For example, the case of extremely low annual leases (\$1.50/h/yr) was cited for the Philippines. The value in use of the mangrove areas is clearly more than this. Why could not a system of ownership over

these resources be established for the local municipality, with the municipality entitled to charge higher lease fees? Well-defined limits would need to be established for the amount of area out of the total available area that could be leased out in each locality, but such a system would certainly be preferable to the present approach which enables local or multi-national corporations to gain access to these areas by paying nominal rents. Even if decentralized approaches are not possible, at the very least, the fees payable by fish or shrimp pond culturists to gain access to coastal wetlands should be significantly increased.

Most of the aquaculture systems that appear to be appropriate for coastal communities are not land-using because unlike pond culture, they can be undertaken in coastal and backwaters. The primary concern of producers in these bivalve, pen and cage culture systems is that they be able to recover the products of their labour. Poaching and even sabotage by competing fishermen is a problem with almost all of these systems and local granting and enforcement of use rights is really the only way in which this problem can be kept within reasonable limits.

Thus, both for large-scale capital-intensive culture systems and for the more extensive community-based systems, some element of legislative intervention and delegation of management authority is necessary if both systems are to co-exist, even in a dualistic fashion. There must also be a willingness to sacrifice short-term foreign exchange goals for longer-term social feasibility and income distribution goals. Finally, redirection of some of the current research effort and credit facilities away from capital-intensive systems towards support of community systems will be needed.

6 Conclusion

As Goulet (1977) has quite rightly pointed out, in most instances, technology is a two-edged sword. While it can potentially liberate and add to general community welfare, it frequently does so at the cost of established socio-cultural values, community structures and institutions. In the case of coastal aquaculture, however, two major factors must be kept in mind with respect to this issue :

- (1) The vast majority of residents in coastal communities are desperately poor. They are poor because of their lack of access to alternative employment opportunities and because existing community and national structures and institutions most often allow local elites to capture the bulk of any benefits that come from more productive technologies introduced to or adopted by such communities.
- (2) The common-property nature of the coastal zone's resources, especially mangrove areas, is being rapidly eroded by the conversion of much of these areas to private fishpond use. This use and misuse of the coastal zone is made possible through subsidized financing and institutional arrangements that favour the large-scale private or corporate investor over the small-scale, perhaps, communal, investor.

The above two factors imply that for the majority of residents in the coastal zone there is nothing particularly beneficial in existing community power structures and institutional arrangements. It is naive or worse, therefore, to speak of trying to maintain these structures and institutions intact for the sake of some socio-cultural ideal. Rural communities are only idyllic to the casual or misguided observer; they are hardly so to the majority of residents who directly experience the poverty there. Besides, the economic pressures to use the coastal zone for the benefit of society as a whole make it virtually impossible for coastal communities to remain untouched by technological advances. Most often, those communities have experienced only the negative aspects of this technology; for example, in the form of large-scale trawlers that have led to the over-exploitation of many coastal fishing grounds. What has been missing in much of their experience to date with technological advance is an element of community control over its development and use.

Aquaculture, because it can be small-scale and because it has such widespread potential to add to locally available protein supplies and income can be a most attractive technology from the community viewpoint if it is guided by 'social feasibility'. It need not be developed externally from the coastal community and then imposed upon it; experience has shown that participatory development is possible. It has the potential to add to community income and nutrition and to do so in a more equitable fashion than many other alternative activities that may require access to large areas of land. Precisely because it offers the potential for involvement of large numbers of rural residents, it also offers the potential for modifying community structures and institutions in ways that will benefit the majority. To the extent that aquaculture can help circumvent or overcome oppressive rural power structures while maintaining or even adding to the number of rural-based

employment opportunities, it should be encouraged. In this context, Hayashi (1984) stresses that the "task of government is to liberate technology from its classed class structure and make it accessible to society at large."

Participatory development on the part of coastal communities will require conscious efforts to involve them in the process of aquaculture development; it certainly will not come about without efforts to decentralize control and decision-making over the coastal zone itself and the technologies that are appropriate there. Nor will participatory development come about without efforts of interested researchers, extension workers, rural bankers and non-governmental community developers to make certain that communities are directly involved and supported over the long-term. Involvement of these cooperative and supportive groups is also necessary to help individuals and families adjust to the changes and new roles that aquaculture activities bring.

If current trends of aquaculture development in the coastal zone that favour large-scale corporate endeavours are not modified in some way, not only will the likely environment damage be great but 'social feasibility' in terms of more equitable growth, better local nutrition and increased employment opportunities will not be achieved. Deliberate interventions and innovative approaches to facilitate community involvement in coastal aquaculture will be required to increase the 'social feasibility' of many of these 'technically sweet' activities.

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Appendix 4

This Appendix reproduces a note circulated to workshop participants

A NOTE ON THE CASE METHOD

1. What is the case method?

The definition of the case method starts with the definition of a case. A case is a short description, in words and numbers, of an actual situation in our case the planning and implementation of coastal aquaculture projects. Most cases stop short of presenting all the actions and decisions taken by the decision-makers in the real world situation. Thus the case leaves open to the participant the selection of options and decisions which could and should be taken. It is expected that participants will study the cases, come to their own conclusions about what is and what should be done, then discuss the case in a committee describing and defending their suggested courses of action. The case method puts the participant, or almost puts him or her, into the position of the real world decision maker - in our case YOU, the aquaculturist, or project manager, or fisheries department official, or government administrator, or banker or development and funding agency representative, who has to make the decisions and prepare plans of action and then implement them.

2. The Consultation has been planned around four cases based on actual instances of coastal aquaculture in three countries in the Bay of Bengal region. The cases describe projects at various stages of development; one at a stage when feasibility is being discussed, prior to the decision to extend the technology; one other which was planned and has been implemented; a third which

was not really planned, but which 'happened' as a result of various economic and environmental conditions that existed in the area, and so on.

3. In each of these cases the participant, in individual study and through committee discussion, is expected to:

- (a) decide on what the objective of the project in the case is (or should be) and why, in terms of who the beneficiaries of the project are (or should be) and what constitutes 'benefit' and 'project success';
- (b) identify and understand those social, cultural and political factors which may affect the success of the project or effort; and
- (c) evolve a strategic plan (if it is felt that it is feasible to do so) to work towards a socially feasible project under the specified circumstances.

4. A further expectation of the Consultation is that it should draw out and clarify the general concepts involved in this cluster of cases in order to suggest guidelines to implementing and funding agencies on the types of organizational, planning and implementation strategies they could use to work towards socially feasible coastal aquaculture projects.

5. How to study a case

It should go without saying that the case method requires participants to do most of their studying before the committee session, as contrasted with attending the lecture-presentation-based meeting, in which most of the effort and learning occurs in the question period and later while reviewing and reflecting on the lecture and notes. If you are going to understand and appreciate fully the arguments and presentations of your colleagues in the committee, not to mention giving a good presentation of your own, you must be prepared before hand. In effect, you must place yourself in the role of the responsible decision-maker in the case situation, and make the decisions and plan the action called for by the facts as you interpret them.

6. Steps in case study

Read the case through once, very quickly. The purpose of this reading is to make you familiar with the local environment, the people, the technology and the agencies of development, the cast of characters, the decision-makers whose role you will play as you analyse the case, the general nature and quality of the evidence with which you must work, and some idea of the problem that must be solved.

7. Read the case thoroughly a second time. Take note of important facts in the written passages, and study each quantitative exhibit to decide what important fact or facts can be identified there. By the end of your second reading, you should abstract from the case a statement of the problems involved, the nature of the decisions facing the decision-makers, and most of the major elements (constraints, opportunities and resources) which influence the decisions and plans.

8. It is at this point that you will prepare your analysis and recommendations, using your understanding and particular experience. You will also prepare to defend in the committee your recommendations and views, as you would in the real world of decision-making. The committees have been carefully formed to include as many types of backgrounds and functions as one should expect to encounter in the planning and implementation of developmental fisheries projects. At the end of each case, on the yellow sheets, the case writers have suggested some propositions and questions to help and guide you in the direction of the objectives that the Consultation sets out to achieve. See Paragraph 3.

9. Case discussion

We have allotted one morning and one evening session of the Consultation to each case study. The case study will begin with a briefing, in plenary session, where participants will have an opportunity to clarify their doubts and seek further information. The briefing will be done by the case writer(s) and participants familiar with the region and the project. They will also be requested to act as resource persons. After the briefing, the participants will divide themselves into three smaller committees and discuss the case in depth. Each committee will have a moderator and a rapporteur to enable the deliberations to proceed smoothly.

10. Case output

Each committee should submit to the Secretariat a summary statement, not more than 3-4 typed pages in length, that clearly states what the group sees are the factors that affect the success of the project under discussion, what strategies they recommend to achieve social feasibility, and why. These summary statements will be typed, duplicated and distributed to all the participants at the end of each case study and will be used in the plenary discussions at the end of the Consultation when an attempt will be made to draw out and clarify the general concepts involved and to suggest guidelines to agencies to work toward social feasibility

Appendix 5

PLANNING FOR EXTENSION OF SHRIMP PEN CULTURE IN KILLAI

A Case Study

by

Rathindra Nath Roy
Consultant, BOBP

I The Process

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.

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 brackishwater 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. Further studies were made by a two-member Thai TCDC aquaculture mission organized 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 alia*, 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 of 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, the Government of Tamil Nadu and the BOBP, went on line in May 1982.

A year and a quarter and three 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.

The Tamil Nadu Government, which ultimately would be the agency of development, has clear and well-stated guidelines which help it to determine beneficiaries for its development and technology transfer programme. Development programmes are expected to preferentially benefit the weaker sections of society, defined by their membership of scheduled castes, scheduled tribes and backward classes. The Government, in principle, prefers collectives to individual enterprise to receive the technology and undertake development programmes. The Government protects the interests of those who have historically been in a trade or practice by giving lower preferences to those **seeking to** migrate from one occupation to another; for example, when transferring fisheries **technologies**, fishermen (by caste) are preferred to others in spite of their practice of fishing.

In the case of shrimp pen culture, the Government of Tamil Nadu wants to transfer the technology to the economically and socially weaker segments of fishing communities of the Killai region.

BOBP undertook a social feasibility analysis in order to help give direction to the Government of **Tamil** Nadu's policy of extending shrimp pen culture to the fisher-folk of the Killai backwater region. This case study is derived from the techno-economic and social analysis that formed the social feasibility study. On the basis of the study, the BOBP and the Government of Tamil Nadu are planning an extension programme which is expected to go on-line sometime in 1985.

The case first looks at the technology in all its aspects and then looks at the target communities in terms of their living conditions, their attitudes and their needs.

II The Technology : Working towards feasibility

Shrimp pen culture – the technology in brief.

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 nutrient 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 do not depend on fuel-dependent pumps as they are 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 juveniles caught in their natural habitats using push nets are first stocked in nursery ponds and transferred to grow-out pens when they reach a particular size, usually in about a month's time. Once in the grow-out pen, the farmer has to concern himself with several problems that may arise and affect the growth of the shrimp and occasionally even jeopardize their life. Among these are:

- (a) Damage to nets by crabs and other pests, their subsequent entry into the pen and the consequences – competition for feed with the culture stock and, in the case of predators, consumption of culture stock. This problem has to be overcome by systematic and regular inspection and repair of nets and removal of pests at regular intervals.
- (b) Salinity changes in the water due to environmental and climatic influences. Nothing can be done about these, except that when the crop is threatened it can be harvested and sold for what it is worth.
- (c) Large temperature changes which can jeopardize the crop. The response to this is similar to that in the case of salinity changes.

(d) Diseases and ailments of the culture stock which have to be checked by regular sample harvests and dealt with as above.

Except for damage to nets, the other problems do not occur too often, but constant monitoring is required to save the crop.

Technological feasibility

The technology of shrimp pen culture was tested and optimised and its feasibility calculated over a 21-month technical trial at the BOBP shrimp farm in the Killai backwaters. Table 111 gives the production data and details of the three trials that convinced BOBP and the Fisheries Department of the Government of Tamil Nadu that while there were technical questions yet to be answered, there was enough data to suggest technical and (to a certain extent) economic feasibility.

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 fin fish, crabs and auto-stocked shrimp was 330.33 kg/ha/cycle. Using the 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 Killai-based shrimp culture project has had three trials since its inception. Unfortunately, their results are not comparable because of differences in season, water area, stocking rates and the growth period. However, with weighted averages and extrapolated trends, one can get a reasonable idea of production characteristics.

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 2 half ha pens and the overall extrapolated figures came close to figures extrapolated from the half ha pen's productions.

The Fisheries Department undertook three studies of area, seed and feed availability to ensure that shrimp pen culture would be technically viable in the Killai region. They first ensured that there would be suitable water areas that would fit the environmental and management requirements.

Table II/1 : 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. 5794.50 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

Earnings per ha Rs. 14117.42/cycle.

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

Production of *Pm* + *Pi* was 214.6 kg and was sold for Rs. 9334.00 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/ha : Rs. 25669.89/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 NA

P. indicus 10.7

Production of Pm + Pi was 511.4 kg and was sold for Rs. 9347.00 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. 7468.00/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. 14998.85/cycle

Rs. 44996.55/year

The backwater system at Killai extends to about 1300 ha as estimated from topographical 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 the highest high tide.

The criteria used for selecting suitable areas were

- a. a minimum depth of 300 mm keeping in mind the minimum ecological habitat depth requirements of shrimp
- b. a maximum depth of 800 mm keeping in view the construction costs of pens and vulnerability to maintenance and management
- c. shorelining the areas to enable shore-based management
- d. that the areas selected 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 by making appropriate seasonal corrections, 15 potential water sites satisfying these 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.

The second study looked at the availability of seed in the Killai backwater eco-system. The entire Killai backwaters were covered on foot and boat and 30 probable sites were identified as nursery grounds, and sample collections were made of 25 minutes each using four types of gear. 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 the months of June and July 1983. Naturally such a small and seasonally restrictive 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.

Availability of seed is critical to the success of the technology and to assure oneself of the validity of the results of the study a simple back-of-the-envelope type of exercise was performed. From the socio-economic data collected the approximate amount of shrimp now being captured in the Killai 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 one's numbers are off by one order of magnitude. Thus the seed resources survey, in spite of its small sample, indicates that the Killai backwaters can supply sufficient seed for the 85 ha available area suitable for shrimp pen culture.

While one **can** be reasonably sure that the Killai backwaters have enough seed supply capability, it is important to ascertain the seasonal availability of seed (in order to successfully stock the farm, year around) and to determine the actual effort (in terms of manpower and cost) that would be necessary to capture the seed.

The study estimated that a man using a push net and working 4 to 5 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 seeds. This would require 57 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.

A further aspect that needs to be studied, but has not been, is the ecological impact of seed collection and seed collection activity on the capture fisheries in the backwaters and on in-shore marine shrimp fisheries which use the backwaters as nurseries.

The third study estimated the availability of feed. Table II/2 proposes a feeding protocol that, in the opinion of the BOBP and Fisheries Department staff, should have been followed. It has not followed in practice due to factors that were beyond the control of the staff. For example, the feed composition depended on the availability of the various components, and in their absence these were substituted by others. The contractors who provided the feed insisted on a uniform supply amount irrespective of the growth stage and it made practical sense to feed what was on hand. The table also proposes a feed mix based on practical factors like cost and availability rather than on optimal growth and cost effectiveness.

The feed survey looked at the availability of squid offal, prawn heads, trash fish, squilla and crabs, clam, oysters and mussels in and around the Killai area during June and July 1982. Non-meat sources like rice bran, ground nut cake and tapioca were also studied. In terms of quantity, the study indicated 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 the study suggested 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 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 the prices that the culture practice will be able to afford for feed.

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 debatable 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 seemed 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 the 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 seed collection, catch/collection effort, alternate demand for feed, and the costs affordable by the culture practice economics.

The three cycles of culture experiments and the survey of area, seed and feed indicated that shrimp pen culture had a better than even chance of being technically viable in the Killai region. They also raised several questions that needed to be answered before full-scale extension could be undertaken.

Economic feasibility

The analysis of economic feasibility is based on private costs and 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 thorough economic analysis including social cost benefit analysis should 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.

All the calculations are for a 1 ha shrimp pen farm consisting of 2 half hectare pens in the Killai region. The data was derived from the estimates made by BOBP staff and on the basis of long and detailed discussions with the field staff who were able to provide their expert guesstimates. This had to be done because the pen size/farm size for which calculations were being done did not exist; hence the data had to be evolved out of the existing data base and expert opinion.

Table II/3 shows the investment costs and annual depreciation of a 1 ha shrimp farm.

Table II/4 estimates the labour demand for pen erection and for culture activities. It also differentiates between hired labour demand and the demand for essentially unpaid family labour contribution.

Table II/2 estimates feed demand considering the proposed protocol, the recommended feed mix and 1983 prices.

The market determines the revenue and as such is perhaps the single most important variable controlling profits; and to get an understanding of the market mechanisms that the Killai fishermen encounter, the socio-economic study obtained price and organizational data all the way up the market chain beginning with shore sales and ending in export procurements. The numbers begin to make sense when visually simplified as in Table II/5. In addition to the obvious fact that prices seem to increase upstream, one has to notice 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 price 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 distance to Madras. This does not really happen as Table II/6 clarifies. Longer and larger hauls turn out to be ridiculously cheap. For example, shipping shrimp in bulk by refrigerated truck from Killai to Madras would cost a 1 ha farm about Rs. 103/year – a per kg cost increase of about Rs. 0.10. This is quite different from the local picture in Killai where the transportation to Chidambaram adds substantially to the price. This is the irony of scale.

The price data was collected over a 2-month period which is a small sample for the widely fluctuating shrimp trade. However, relative positions along the market chain seemed to remain stable and thus the figures are indicative. The gap between export-supported procurement prices and local consumption prices is so vast that even with violent fluctuations the production would be drawn towards export.

Table II/7 sums up the annual costs and returns and estimates the returns expected, assuming rates received at Cuddalore or Madras. The residual returns are also estimated. A sensitivity analysis was done to identify those factors which particularly affect the profit (or loss) by their changes; and the two most critical factors were found to be the cost of feed and the rate received for the shrimp.

(Tables III/2 to III/7 on pages 42-46; text continues on page 47)

Table II/2

Feed demand for 1 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					2820
Feed for nursery pen at 10% of above					282
Total <i>feed demand/cycle</i>					3102 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	1.00	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. 4963.20

Per year cost of feed/ha = 3102 x 7.6 x 3 = Rs. 14890

Table II/3
Investment costs and annual depreciation for a 1 ha shrimp pen

Items	1983 costs (Rs.)	Estimate of useful life (years)	Annual depreciation (Rs.)
1. Pen construction materials :			
Nylon webbing/10 mm mesh	10780	3	3593.33
Nylon webbing/6 mm mesh	2480	3	826.66
HDPE rope/5 mm	570	3	190.00
Nylon twine	70	3	23.33
Casuarina posts	1200	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	1560	3	519.99
Sub-total for pen materials	<u>17160</u>		<u>5719.97</u>
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
Castnets (2)	800	2	400.00
Feeding trays	100	1	100.00
Crab traps	100	1	100.00
Sub-total for equipment	<u>2310</u>		<u>1061.66</u>
3. Guard shed :	500	3	166.66
Sub-total for shed	<u>500</u>		<u>166.66</u>
4. Labour for pen construction 30 m-d @ Rs. 12/m-d	360		
Sub-total for labour	360		
5. Contingency:	940		
Sub-total for contingency	<u>940</u>		
Total Investment costs	<u>Rs. 21270</u>		<u>Rs. 6848.29</u>

Table II/4
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 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 subsequent efforts	Sk		X	100	12	1200
3. Seed collection : (3500 seeds/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 Activity 2	Sk		X	180	12	2160
Total				<u>550</u>		<u>6600</u>

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. 4080
3. Internal labour (family contribution)	180 m-d	@ Rs. 12/m-d	Rs. 2160

• Sk : Skilled; NSk : Non-skilled; Int. : Internal; Ex. : External; m-d : man-day.

Table II/5 Summary of shrimp procurement prices at various locations.

(45)

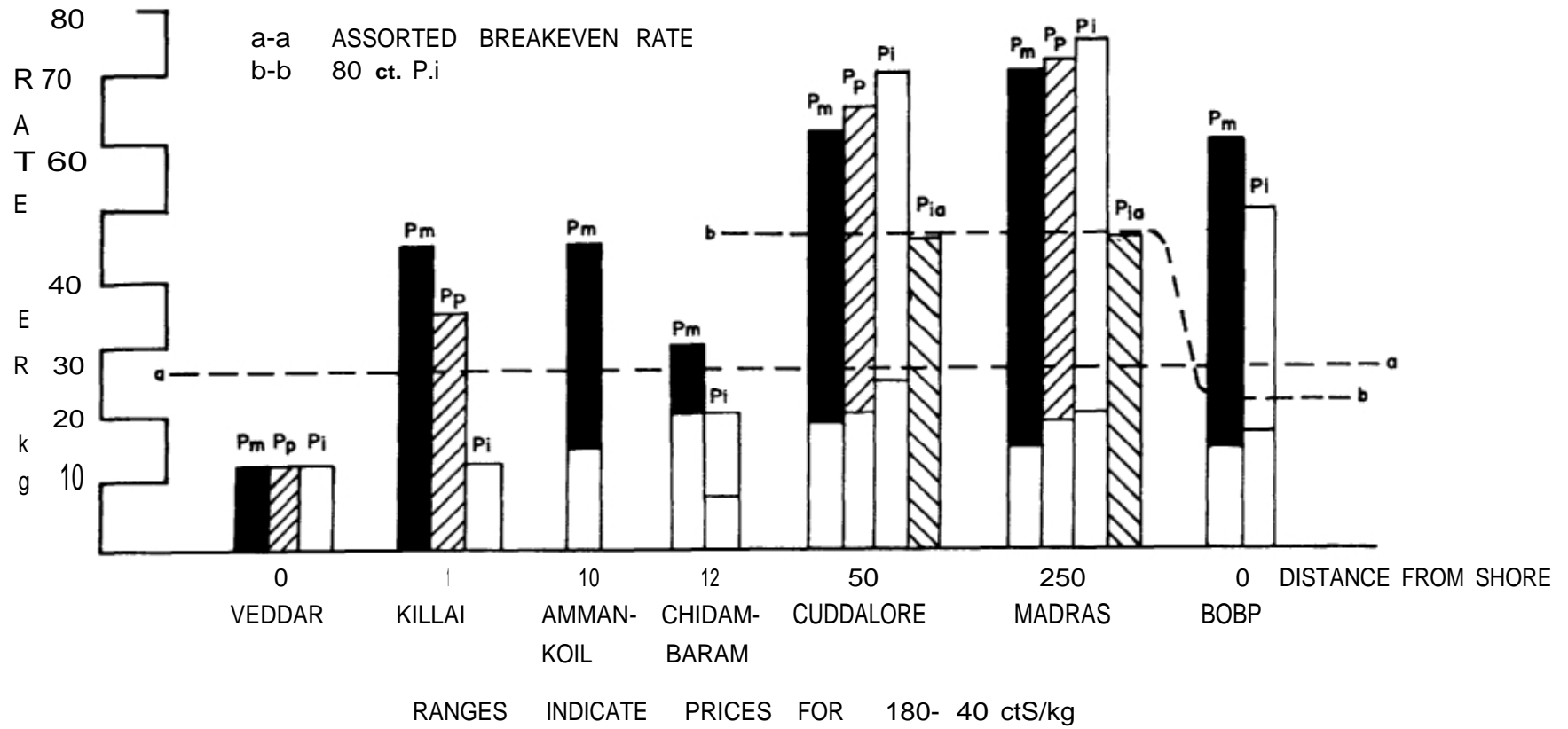


Table II/6
Transportation costs by refrigerated trucks

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

Cost per tonne - km = Rs. 0.28.

Cost of transportation from Killai to Madras (250 kmi of 1.5 tonnes (1 ha's production per year).

= $1.5 \times 250 \times 2 \times 0.28$

= Rs. 210.00

Cost added per kg due to transportation = Rs. 0.14

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

Table II/7
Annual costs and returns for a 1 ha shrimp farm

1. Capital investment :		<i>Rs</i> 21270.00
	For pen construction materials, equipment, a guard/tool/storage hut and labour for pen construction (See Table II/3)	
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. 5000 @ 12.5%)	
	Rs. 10232.00	Rs. 10232.00
4. Returns :		
	P. monodon + P. indicus	
	460 kg x 3 cycles x Rs. 45/kg average price = 62100.00	
	Fin fish + crabs + auto stock shrimp	
	330 kg x 3 cycles x Rs. 3/kg average price = 2970.00	
	Rs. 65070.00	Rs. 65070.00
5. Total costs (2 + 3)		Rs. 31571 .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	

Cash flow analysis indicated that with a loan to cover capital expenses and an overdraft facility of Rs. 5,000 both at a non-subsidised 12.5% interest, the farmer should have no cash flow problems and actually generate sufficient surplus to provide for a reasonable profit and enough to provide for working capital for the second year.

While the availability of data at this stage of operations makes it 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 1 ha pen and extrapolated for the 85 ha scheme; and 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 by boat owners and others.

The present earnings of the Veddars and net owners (who would be employed by the project) were estimated from the socio-economic data. The project earnings from the expansion scheme were estimated using a per day labour rate of Rs. 12. Two options were then considered : (i) the substitution option wherein those not employed by the project would continue to earn at present levels while those employed would earn only from the project; (ii) the complementary option where labour would work in the project and continue their present occupation, thus earning from both sources.

While the present earnings of 276 Veddars and net owners who are not 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 32.17%, 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 his or her present occupation and also do the work of the farms.

One important aspect is that in computing present earnings, gross returns are being considered. If the opportunity cost of labour be deducted, the residual returns turn out to be far less and would make the increases in earning due to the project far more attractive. However, one must be warned that people generally do not set a cost to their own labour and as such the logic of deducting opportunity costs may not be a real exercise.

III. The People

Socio-economic data on Killai backwater communities ;

The community 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 consider itself as 'belonging' to Killai, on closer examination they fall into distinct groups : those who have permanently moved away and practise marine fishing, 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; 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 of fishing assets. The family was considered as the unit of study because the family is the existing commercial and social unit of organization.

All the fishermen – in fact the entire Killai community – belong to one caste of Hindus : Parathevars, a scheduled and hence backward caste. The other community in the backwater area who live off the backwaters are a tribal, semi-nomadic group who are referred to as the Veddars, but who in all probability are an off-shoot of the wandering Irula tribes of south India. This community moved into the region a decade ago, with the hope that the Government would allot them homesteads. Their hope has remained unfulfilled but they have remained, eking out a livelihood by working the local fields, working in construction and fishing the backwaters with their bare hands and basket nets.

Community size of Killai fishermen	
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 who depend on the backwaters for a major part of their livelihood is 219, or 57.51%.

Population characteristics, literacy and occupation

Characteristic	B	N	NA	v
Female/male ratio	00.67	01.09	01.78	01.00
Family size	05.68	04.19	03.54	03.41
Literate females %	14.03	15.78	28.00	04.76
Literate males %	54.11	61.53	57.14	09.52
Literate population %	38.02	37.61	38.46	07.31
Females in fishing %	42.10	28.07	16.00	76.19
Males in fishing %	56.47	48.07	07.00	40.47
Population in fishing %	50.07	37.61	12.82	59.75
Economically dependent %	48.59	58.71	71.79	40.24

Note : the following abbreviations will be used to denote the various groups in this datapac : (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 of various media was ranked by importance.

Exposure to influence by order of importance

B	N	NA	V
Radio	Community	Community	Community
Community	Radio	Visits	Radio
Print media	Visits	Radio	Print media
Visits	School Teacher	Print media	Visits
School teacher, Coop. official, Political cadres	Political cadres	Political cadres	Political cadres

Seasonal routines of Killai fisherfolk are summarized in Table III/1.

Table III/1 : **Seasonal routines in marine and backwater fishing and agriculture, and festival days**

Months	Backwater fishing	Marine fishing	Agriculture	Festivals
Chitrai	f P	f	r	
Apr.15-May 15	f p	f		
Vaikasi	f P	f		
May 15-Jun.15	f p	f		
Aani	f P	f		
Jun.15-Jul.15	f P	f		
Aadi	f	f		2 days
Jul.15-Aug.15	f	f		
Aavani	f P	f		5 days
Aug.15-Sep.15	f P			5 days
Puratasi	f P		r	
Sep.15-Oct.15	f P	Off	r	
Ipasi	f P	Season	r	1 day
Oct.15-Nov.15	f P		r	
Kartikai	f	f	r g	
Nov.15-Dec.15	f	f	r g	
Marghazhi	f	f	r g	
Dec.15-Jan.15	f	f	r g	
Thai	f P	f	r g	4 days
Jan.15-Feb.15	f P	f	r g	
Masi	f P	f	r g	
Feb.15-Mar.15	f P	f	r	
Panguni	f P	f	r	
Mar.15-Apr.15	f P	f	r	

f = fishing activity

p = peak season

r = rice

g = groundnut

Daily routines of Killai fisherfolk are summarized in Table III/2.

Estimate 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

Asset **hol di ng** of Killai fisherfolk is summarized in Table III/3.

Present indebtedness, sources of credit **and** interest rates are summarized in Table III/4.

Table III/2
Dally routine of various categories of people

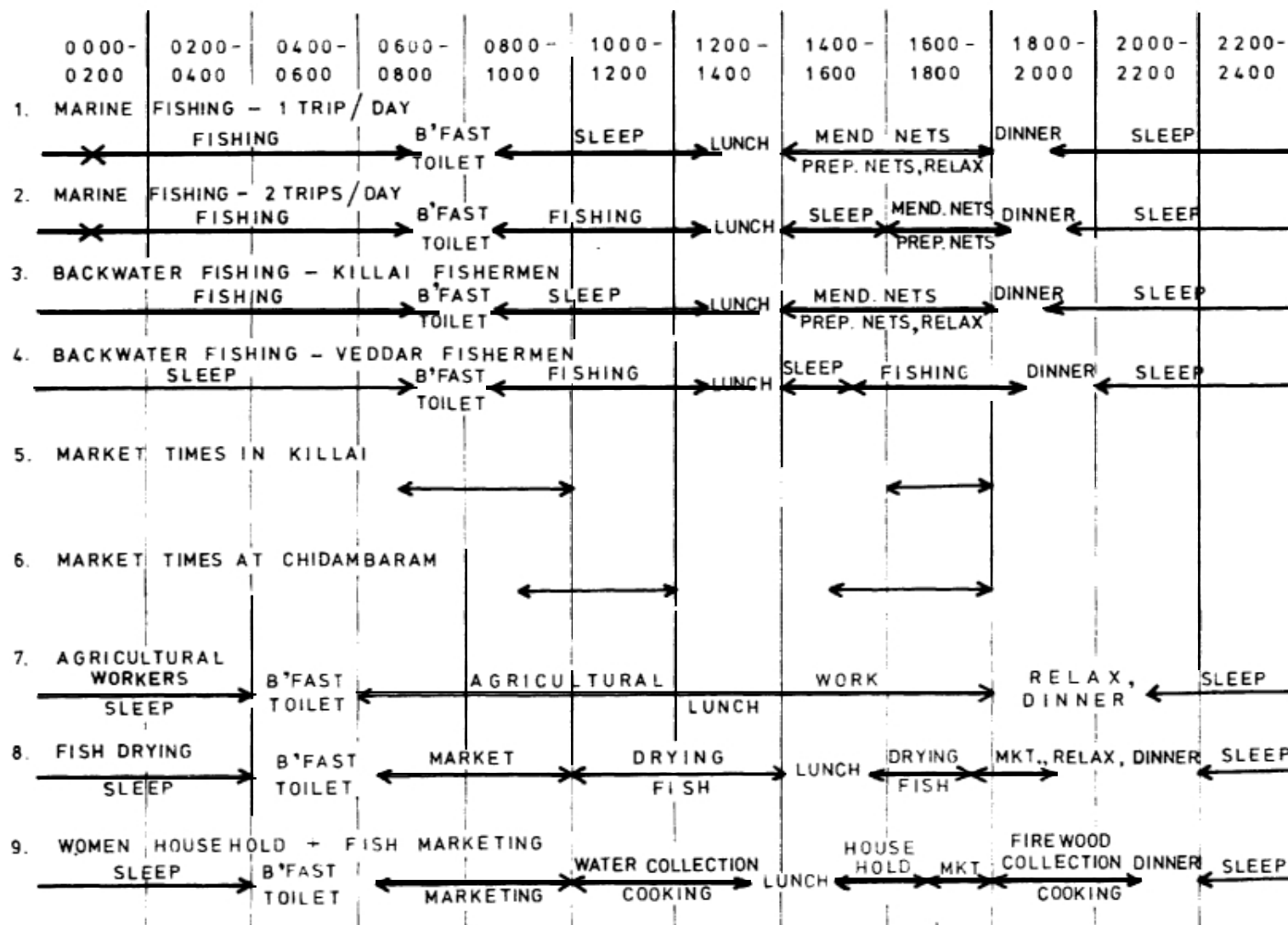


Table III/3
Asset holdings by strata

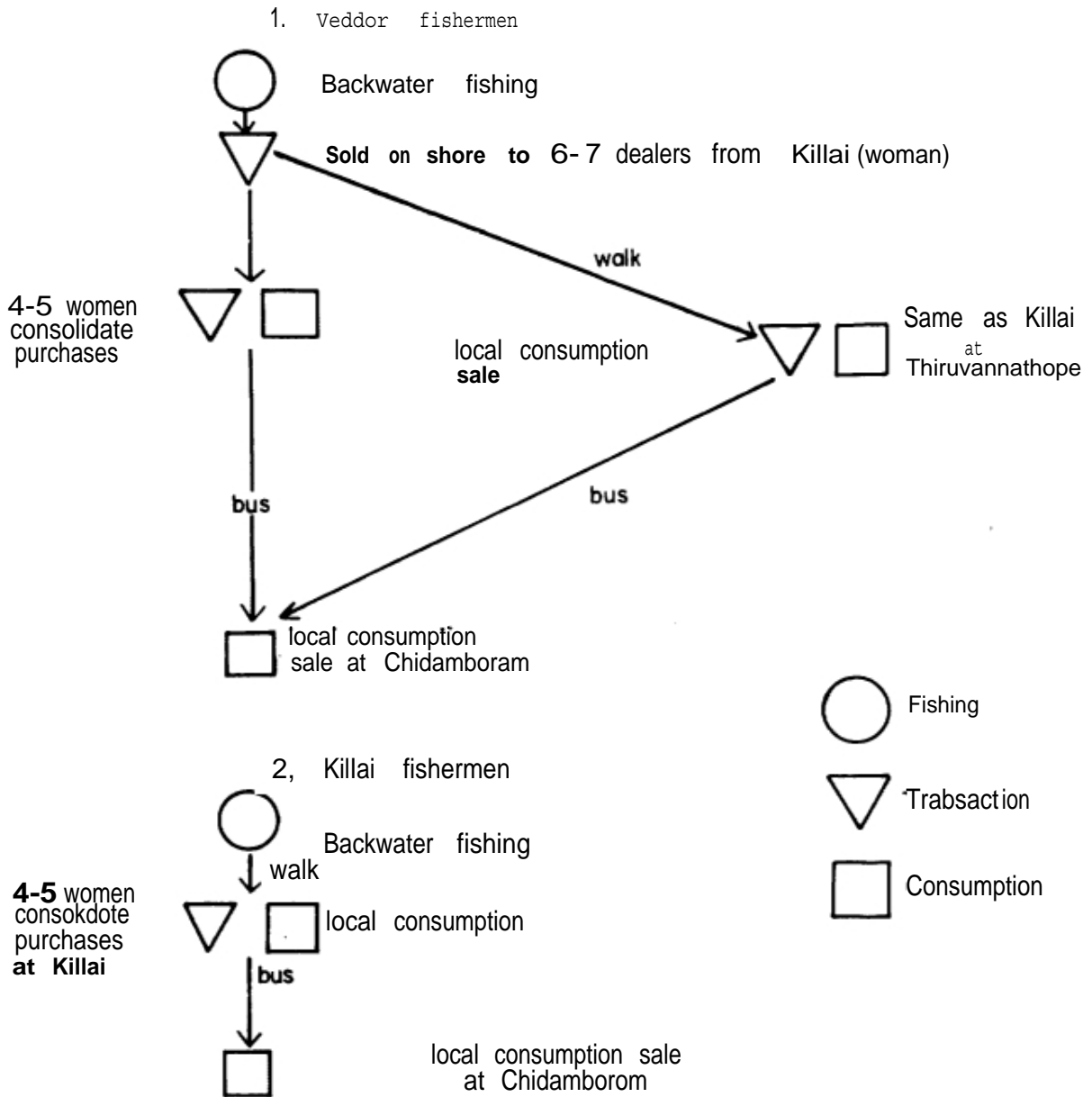
	B	N	NA	V
House				
Per cent owning houses	100	96	91	100
Per cent living in rented houses	0	4	9	0
Land				
Per cent owning land (wet)	56	(43)	19.23	(15.15)
(dry)		(57)		(84.55)
Average family holding	1.21a	1.15a	1.31a	0.5 a
Per cent working themselves	14	40	0	100
Per cent hiring cultivators	86	60	100	0
Cattle				
Per cent owning livestock		36	19.23	9
				16.66
Boats				
Per cent owning boats	100			
Boats per family	1			
Per cent buying boats on cash purchase	72			
Per cent buying boats on credit-cum-cash purchase	20			
Per cent buying boats on credit purchase	8			
Nets				
Per cent owning nets	100	100		
Net/family	4.92	2.19		
Per cent making nets themselves	96	96		
Per cent purchasing nets	4	4		
Per cent buying through credit purchase	8	8		
Per cent making net in instalments	92	96.92		

Table 111/4
Present Indebtedness. Sources of Credit & Interest Rates

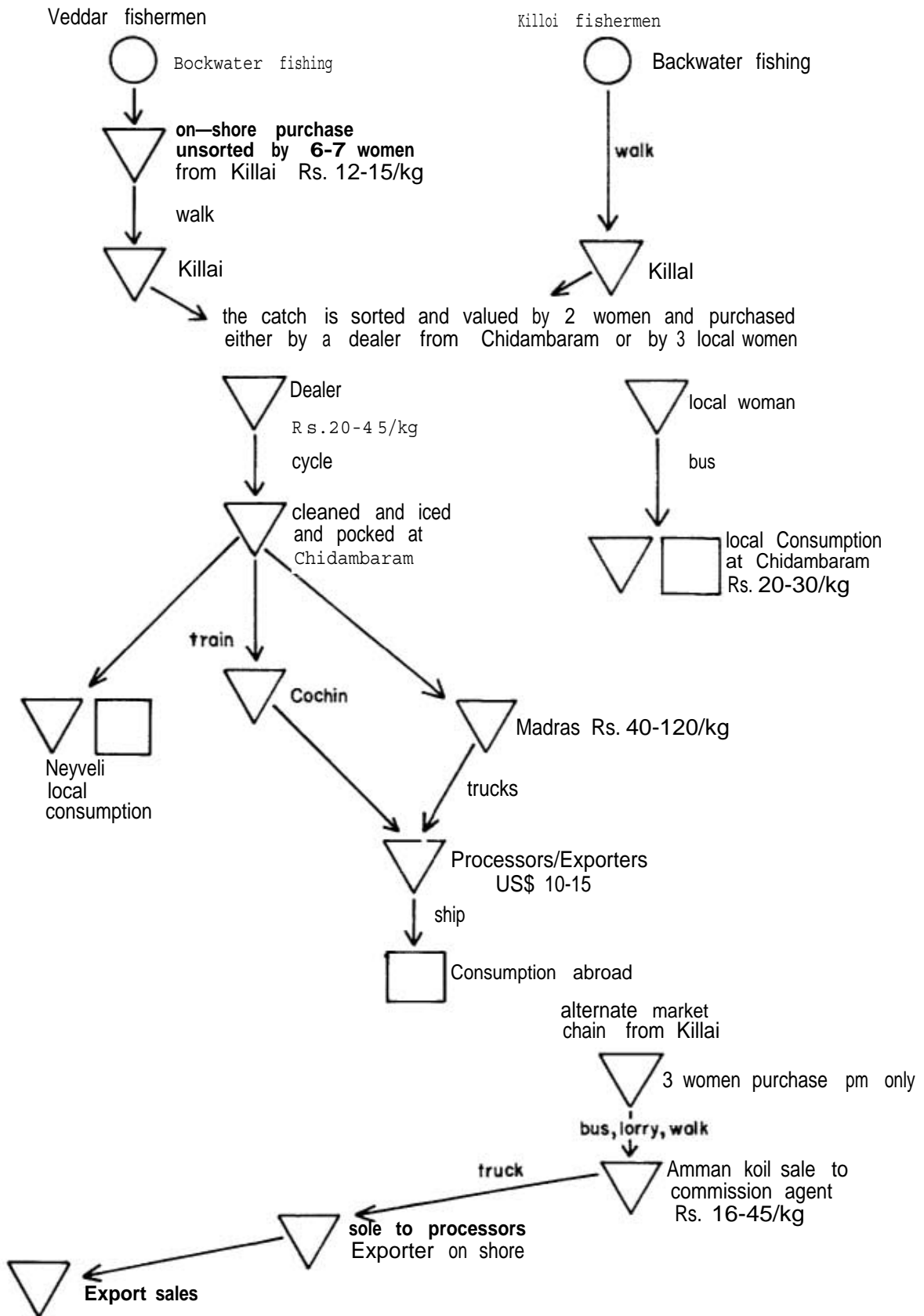
		% of those in debt.	Sources of loans (%)						Total in debt. (%)	Amount loaned per capita	Interest rates
			Relative	Bank	Money lender	Thread shop	Co-op. Society	land owner			
Boat owners	C	0							60		
	S	46.66	100							3514.28	120% 48% 36% 0%
	W	53.33	37.5	50	12.5					3093.75	200% 120% 36% 13% 12/5% 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	25% 15% 13% 0%
No fishing assets	C	42.85	66.66		33.33				63.63	833.33	15% 13%
	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 labour 0 Exclusive buying rights
	S	8.33						100		800	0 Exclusive buying rights
	W	8.33			100					300	50% of harvest

Note: C = Consumption loans S = Special loans for festivals & family rituals = Work-related loans

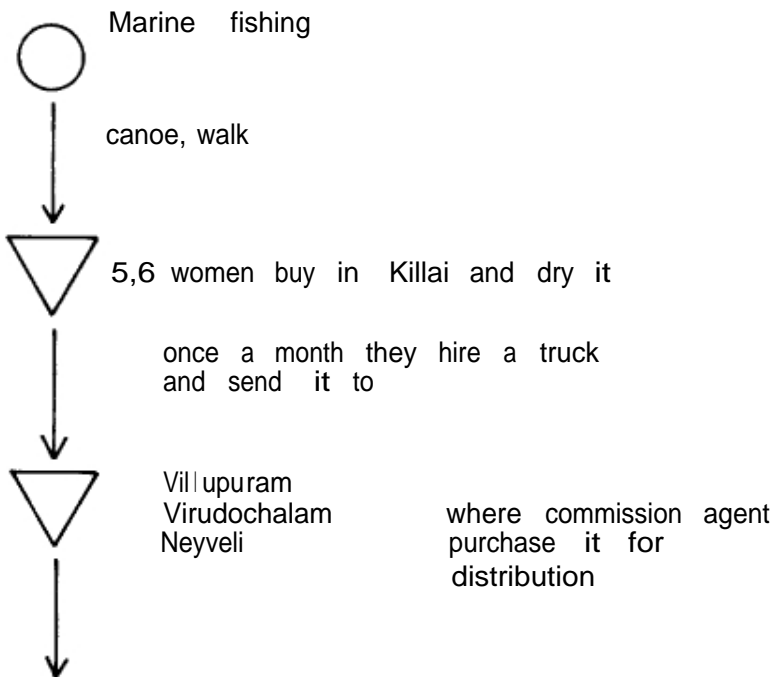
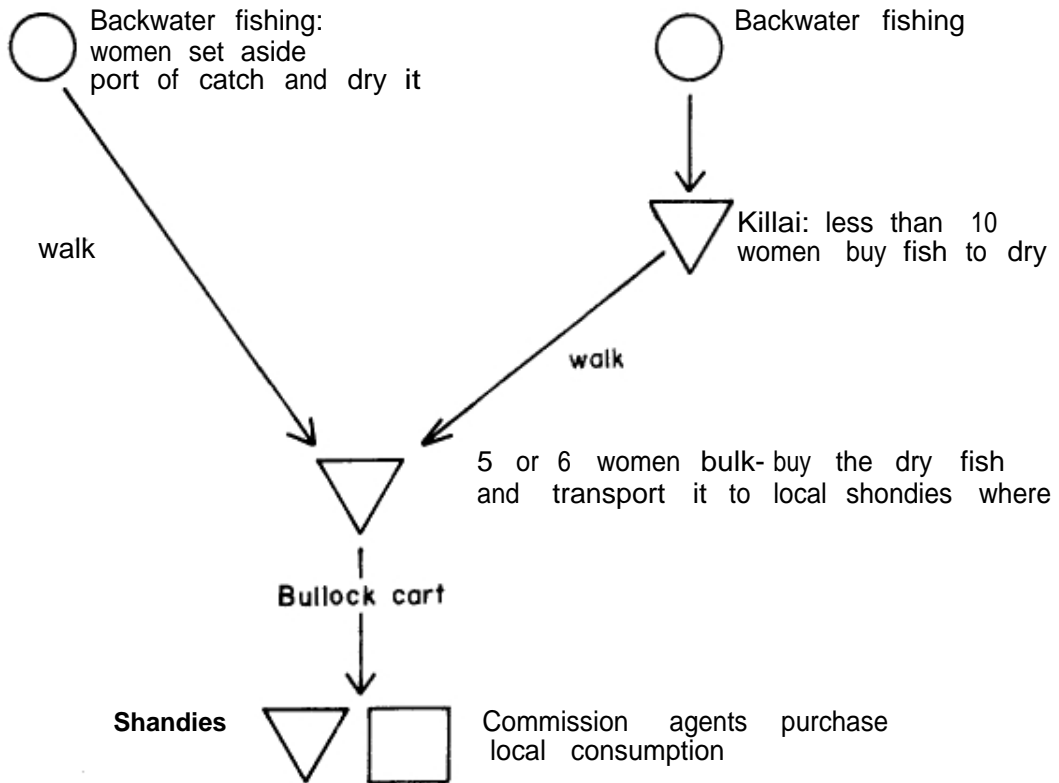
Marketing of backwater fresh finfish



Marketing schematics of backwater shrimp



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.

Catch information

	B	N	V
Value of catch per day per family (in Rs.)	131.84 ⁿ	29.25	11.83
Weight of catch per day per family (in kgs.)	20.640	5.980	2.325
Value of catch per net per day (in Rs.)	50.00	13.11	

* This includes both marine and backwater boat owners; when separated the marine boat owners have value of catch/family/day of Rs. 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 during 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 extremely small sample size is the marine boat owners' catch data. However, the investigators are of the opinion that the numbers, even in their case, are definitely indicative.

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.)	48,766.99	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.)	8,585.66	2,988.44	2,142.84	1,094.52

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.

B. 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 fishermen own small bits of land which they lease out or get cultivators to work under their supervision. There are a few shops, a couple of schools, and some service institutions like post offices, banks and government bodies.

With fishing as the primary activity, the field is dominated by those who have fishing assets. But there is more to it than just asset ownership. Caste and class play a role. The Killai fishermen consider themselves higher in 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 community is that education does not really help, except, perhaps in getting a government job, and what is more, it alienates the educated and makes them indifferent to and useless within the community. The communities feel the need for an education that would 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. So, high incomes can be deceptive if expenses and investments are 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 credit for work-related loans and those without assets take loans predominantly for consumption. The sources of credit are still the money lenders, relatives and shopkeepers, in a village that boasts a rural branch of a nationalized 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 toward more informal and expensive sources.

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

A look at the market schematics and the procurement prices at different locations would identify procurement price 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. Inadequacies in supply of ice, in facilities for storage and transportation, and lack of cohesiveness and cooperation within the community to take their catch past the middlemen and into 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 carry 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 its more ambitious leaders. The society has not been able to help in technology transfer or marketing or in resolving the basic problems faced by the fisheries.

The Killai region has essentially two communities with very different problems. The Killai fishermen are reasonably well off and developed while caught up in the systemic problems that small enterprises face 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.

C. Attitudes and Opinions

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 right 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 temporally or areawise 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. Except for the Veddars, who have no objection to sharing the waters with others, the Killai fishermen to the last, heavily object to sharing access.

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

* The community through the cooperative society pays a nominal lease for the right to fish the backwaters to the Revenue Dept. However, fishing is not restricted to lease holders, nor is the control exercised by the government

take up the matter 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 preferentially 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 benefited or none at all. Any form of allocation which talked of benefitting less than all was suspect in terms of the criteria for selection of the lucky few.

Most fishermen felt that the catch in the 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 less than what they were used to in the past. The most important reason they felt for the state of affairs was the closure of the two bar-mouths and not increasing fishing activity. The closed bar mouths, 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 compensating for the lower catches.

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 some new enterprise they listed in order of priority dramatic increases in earning power, improvement of quality of life-style and being able to give their children a better deal in life. The Veddars are open to any work because they need 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 to 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 the 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 at their very doorsteps. They all knew about it, but very little of what was really going on. They blamed the Fisheries Department for keeping them in the dark and for having moved into their fishing grounds without even an explanation. Feelings towards the Fisheries Department were quite hostile and a part of this hostility could perhaps be explained by the fact that police had been brought in following the community's attempts to discourage the Department's activity by tearing the pen netting.

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 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 suffered losses and given up the idea; they felt that officers of the Fisheries Department were corrupt and would distribute jobs and allocations of rights in an unequitable manner and that too only after receiving bribes; they justified this attitude by relating rumours, which they could not substantiate, that they knew of fellow fishermen who were being allowed to secretly remove shrimp from the pens for private sale upon payment of appropriate amounts of commission. The complaint that the programme had already failed gives some credence to the implication that the Fisheries Department had not communicated with the fisherfolk; the programmes that had failed were pond culture experiments and had nothing to do with the present exercise. Such confusions are difficult to explain without involving a communication gap.

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. The general opinion expressed

about the Fisheries Department was that the Department would not do any good for the people unless pressure was brought to bear upon it from political sources.

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 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 comes to sharing 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 objection 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 than to 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 Veddars 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 were received almost from every single respondent :

The demands of the fishermen of Killai were :

1. The two bar mouths be opened, deepened and maintained.
2. 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.
3. An ice factory be established in the region.
4. Infrastructure to clean, pack and ice fish and shrimps be established.
5. 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 :

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

Appendix 5

CASE STUDY ON SHRIMP PEN CULTURE EXTENSION IN KILLAI, TAMIL NADU, INDIA

Case Discussion Guide

The participants are requested to address themselves to :

- i) identifying and understanding the social, cultural, political and techno-economic factors that may affect the success of an effort to extend shrimp pen culture to the communities in the Killai region, and
- ii) to evolving strategies that would enable the transfer of the technology to the weaker sections of the Killai community in a socially feasible manner.

I. *The Process*

- 1 The Government of Tamil Nadu had clear and well stated guidelines which determine beneficiaries for its development and technology transfer programmes. Similarly, the BOBP also has its stated objectives to improve the conditions of small-scale fisher-folk and increase the supply of fish from the small scale sector. Could you reflect on what the rationale for wanting to develop coastal aquaculture could have been for the Tamil Nadu Government and for BOBP, which resulted in their undertaking the effort at Killai?
- 2 The rationale in each case would suggest what each agency would construe as 'success'. Could we list some of the factors that the agencies may have considered as constituting success?
- 3 The choice of the particular technology (in this case, shrimp pen culture) could have been done on the basis of resource availability, environmental conditions, the state of the art in fisheries science, markets for the products, income generating ability of the technology and such factors, or it could have been done on the basis of the real and felt needs of the community that it is meant to benefit, keeping in mind their local resources, skills and abilities. What do you think happened in the Killai case?
4. Could you reflect on whether the existence of, or the ability of an agency to develop, a technology should determine the target community that gets helped and how, or whether the needs of a particular target community should move the agency to seek or evolve particular technologies to solve that group's problems. Or, to put it differently, should solutions determine which problems receive attention or should problems lead to the development of solutions?

II. *The Technology*

1. In studying the technology and the efforts and methods to determine its technological feasibility, are you satisfied that this technology is 'ready' for transfer? State your reasons. Could you suggest some criteria by which an agency could go about determining the readiness of an aquaculture technology for transfer to the community?
2. Ideally we should satisfy ourselves with aspects such as the impact of the technology on the environment (and on other users of the same environment) and the long term viability of the technology. But such investigations take time and money. And can delay the benefits that may reach the people. How should an agency approach this problem and where does it draw the line between concern and indifference?
3. The economic feasibility analysis looks promising, at least from the entrepreneur shrimp farmer's point of view. Keeping in mind the target group the agencies have in mind, do you feel that the technology is appropriate? Do you feel that the communities have or can acquire the technical, managerial and entrepreneurial skills that may be required to make a success of this technology?
4. The economic analysis suggests that the worker (as different from the owner who may also work) may only make 30 per cent more than he does now by working on the farm in addition to doing what he is doing now. Do you feel the increase in earnings would motivate the person to additionally work in the farm? What incentives would have to be developed to attract people to work in the shrimp pens and to improve their conditions?
5. Put yourself in the position of a fisherman-entrepreneur. Given the data base and given the methods that have been used to establish economic viability would you be willing to invest? Is there any other way to go about testing for economic viability that will not only give us the answers needed but also make the advantages quantitatively visible even to casual observation,

and thus increase the credibility of the technology. Further, could we think of ways by which the experience of working the technology could be made more accessible to the target community during its testing?

6. Is the technology compatible in terms of daily, seasonal and leisure routines of the community? Does it require labour with caste, sex balances different from existing social mores? How serious are these problems in terms of affecting the success of the programme?

III. *The People*

1. Killai fishermen practise capture fisheries, and the Veddars are not really fishermen, for they fish to survive. The transfer of aquaculture technology has been more successful when the receiving groups have had a tradition of aquaculture practice. This suggests that perhaps the psychological, social and historical characteristics of a community may make the transfer of a particular technology more or less difficult. Do you feel this aspect may prove to be a problem in Killai? What, if anything, can be done about it?
2. Could you try to put yourself in the place of the Killai fisherfolk and Veddar communities and try to see what advantages could come your way by accepting shrimp pen culture, and what disadvantages? Would you consider the advantages financially and in terms of the economic and social restructuring of the community sufficient to make you accept the technology?
3. The communities in Killai are socially and commercially organized around the family. Do you feel this type of organization is suitable to carry the technology of shrimp pen culture? While the actual culture can be family-run, the infrastructure required to efficiently and economically acquire the inputs and to market the output would require collective action. Do you think that the community can organize itself to such collective action? How could you promote it?
4. How do you feel the shift from daily incomes and gear management to deferred incomes and culture management would affect the lives of the people of Killai? Would this aspect affect the strategic design of the project?
5. The area available for shrimp pen culture will make it possible only to help a fraction of the community directly. Considering the views and attitudes expressed how do you suggest the project be designed to overcome the problems of competition between capture and culture in the commons, of equity and of selecting 'beneficiaries'?
6. Who should undertake the task of making the people of Killai aware of the technology and what it can do for them, of motivating them and enabling them to accept the technology and how – especially considering their views and attitudes towards the government and towards the technology as they see it being developed in Killai?

Finally, some general thoughts and questions :

1. Shrimp pen culture can generate incomes and surpluses. In an undiversified economy like Killai which has no ability to absorb investment and generate wealth such generation of surpluses and incomes would only increase the flow of goods from, and the flow of money to, urban areas. Would you consider this real development?
2. The success of the entire concept is based on the existence of export and urban markets that need shrimp and can absorb the high prices. The community's development would be totally locked into the behaviour of the international shrimp market. Is this real development?
3. The coastal regions of India (the inshore regions to be specific) are being overfished, leading to ecological crises and often to social and economic conflicts (consider the Kerala case) One of the reasons for the worsening of this situation was the effort to 'develop' marine fishing (both industrial and artisanal) with an eye to the export market. In moving into the coastal backwaters (an as yet underexploited region) are we not just moving the problem from the in shore to the backwaters? What can we learn from the inshore crises to evolve a framework and legislation that will help to convivially support and protect the region and its people?
4. What a development agency does and how it does it could be seen as a manifestation of its perception and appraisal of underdevelopment, its understanding of the 'causes' of underdevelopment and therefore of the 'cures' of underdevelopment. Please reflect on this factor, for the culture of the agency is just as crucial to technology transfer as the culture of the receiving community and of the technology being transferred.

1. Objectives

The Fisheries Department of the Tamil Nadu Government wants to help and aid the fishing communities. The Veddars, a nomadic tribal community, are not classified by the government as a fishing caste group and therefore fall outside the purview of the government's objectives.

The Bay of Bengal Programme has an overall objective to improve the living conditions of small-scale fisherfolk, whom they define as people who make their living through artisanal fisheries. In the short term, the BOBP's objective for the Killai project is to test the technical feasibility of shrimp pen culture technology.

2. Target beneficiaries

The Killai fisherfolk are expected to be the primary beneficiaries who will benefit from the extension of the shrimp pen culture technology.

The Veddar community were not included in the target beneficiary group but it is expected that some secondary benefits will flow to them.

3. Benefits to the community

3.1 Direct benefits

- employment generation
- income generation
- development of entrepreneurial skills

3.2 Ancillary benefits

The project hopefully will benefit the Killai community in the following ways :

- establishment of an ice-making plant : since ice procurement is difficult in Killai it was suggested that a small and economically feasible ice plant could be considered as part of the project. This would not only help freeze the shrimp to ensure quality and a good price but also cater to the needs of the other fishermen who now have to travel quite a distance to procure ice.
- local feed procurement and processing : feed for the shrimps is at present got from Porto Novo and Cuddalore. If feed gathering and processing can be done as a local enterprise, it would provide employment opportunities to persons within the village.

4. Project feasibility

Neither technical feasibility nor economic viability was thought to have been adequately demonstrated in the project to date.

A. Technical aspects

Extreme production (yield/ha) variation was noted among the production trials, because stocking ratios (*P. monodon* vs *P. indicus*), stocking densities, feeding materials and pen sizes varied in each trial and between 'replicates'. There appeared to be no scientific basis to the recommendation that 0.5 ha to 1.0 ha pen sizes were the best size pens for family operation. The extrapolations of yields to 1 ha pen sizes were also questioned since experimental pens were much smaller in size and also benefited from sound technical management by the Fisheries Department field team; per hectare yields from pens operated by new pen operators would be likely to exhibit even greater variation.

B. Economic aspects

The uncertainty due to yield variation was compounded by great variation in prices received for the shrimp. The annual costs and returns were apparently based on Madras prices on the assumption that pen shrimp would be sold directly to this urban market. However a recalculation of the cost and returns using prices actually received during the trials, showed losses of Rs. 9100 during trial 3 and positive returns of Rs. 10,600 for trial 1. Trial 2 was the most profitable; revised annual residual return per ha was Rs. 13,200. This variation in profitability, due to price fluctuations over which the producer has no control, is yet another risk for the producer.

C. Socio-cultural aspects

The Killai communities' (fishermen and Veddars) wishes regarding possible participation in the project are not yet clear, since to date only a few individuals have been involved peripherally in the

project. Participation by all on an equal basis, while theoretically desirable, will not be practical due to resource restrictions. According to the government order, Veddars cannot participate as pen lessees or operators. Veddars can however provide labour (seed gathering, pen maintenance). Whether they would provide full-time hired labour is not yet known. Since the project income from pen operation is likely to be insufficient to attract boat owners, primary participants are most likely to be non-asset owners. The fishing community's idea that either "all residents or none" should participate may thus change, based on the revised economic projection.

D. Political/Institutional aspects

Lease rights appear to pose no problem as the fisheries department can lease to the community cooperative; however, no lease period is specified in the government order, thus adding another element of uncertainty for potential producers. Also, bankers will need to be assured that leasehold rights can be reassigned for a fairly long period to the bank as collateral.

5. Strategy

Possibilities of activities for the Killai communities other than pen culture were not discussed as the group felt it had inadequate information to evaluate other options. It was concluded that the pen culture project was not yet ready for commercialization and warranted an additional testing period but with the involvement of Killai people. The following framework is recommended :

A. Testing period :

Should include 1 year (3 production cycles) plus time for pen construction and training of family operators.

B. Size of area

Total of 4 ha, divided as follows

4 pens of 0.5 ha = 2 ha

4 pens of 0.25 ha = 1 ha

8 pens of 0.125 ha = 1 ha

C. Input.5

Standard stocking densities/ ha and feeding rates /ha should be used on all the above pens, so as to test for the effect of pen size on yield/ha. From these results and economic data on inputs cost and products sold, the optimum pen size could be determined.

D. Management

4 families (probably fishermen without any assets), each operating 4 pens totalling 1 ha for a minimum of 1 year. Each family would operate one 0.5 ha pen, one 0.25 ha pen and two 0.125 ha pens.

E. Technical Advice

Existing management set-up (Fisheries Department and BOBP) plus advice of an extensionist for selection of the four families and further advice and training in extension methodologies (by BOBP).

F. Supplementary studies

This further testing period should resolve questions of technical and economic viability and clarify potential for Killai fishermen to manage pens. Additional issues that still need clarification before proceeding to commercial scale extension with additional families, are as follows :

- reliability of feed supply and effect that shrimp pen demand for trash fish and shrimp offal will have upon the current consumers of these products;
potential impact of clam exports on availability of clam for shrimp feed;
- potential for improved polyethylene net supplies within India;
- community nutrition standards in Killai; need (if any) to improve fish protein intake and potential for the project to meet their need; also the potential for the project to provide income to women;
- evaluation of marketing and distribution options (given projected shrimp pen harvesting quantities and schedules) including local ice requirements and potential for local ice making; local sales of shrimp from pens vs. other more distant (urban) outlets and transportation costs to reach the latter; and
- assessment of community interest and extension requirements for possible subsequent commercial operation.

The funding source for this additional necessary testing period needs to be identified.

Case Study of Shrimp Pen Culture Extension in Killai, Tamil Nadu, India

CASE DISCUSSION SUMMARY : GROUP II

1. Project Objective

The objective of this project is essentially social in its orientation, i.e., improvement of living conditions among the economically weaker segments of small-scale fisherfolk in the area, broadly defined to include both certain segments of the Killai fish&folk as well as the entire Veddard population. This could be translated into the more specific objective of increasing the income level of these target groups.

The means to attain the goal would be a shrimp pen culture project on a family-unit production level and the required support activities such as seed and feed collection and preparation. Nevertheless, there are major reservations as to the technical viability of the project given various factors listed in the next section.

2. Factors Affecting Success

Although it was pointed out in the discussion that increased monetary income does not in itself necessarily lead to an improvement in living conditions, the group came to the conclusion that a demonstrated increase in income among the target group would certainly constitute one indicator of success. On the other hand, there are a number of factors that are crucial towards attaining this end. The group listed the following four types :

Social factors : the social structure in the area with its associated aspects of inequalities in control over, and access to, water resources and power in general.

Economic factors : shrimp production is highly vulnerable to fluctuations in world market prices.

Technical factors : shrimp pen culture may be constrained by the number of production cycles, seed and feed supply, post-harvest handling (levels required for export market) and environmental consideration.

Management factors : flexibility in approach so as to permit maximum local participation; proper marketing strategy; the need for close supervision.

3. Strategy for Social Feasibility

Assuming that shrimp is the only commodity in pen culture with a reasonable chance of being economically viable, the group proposed the following strategy for the project to become socially feasible :

- a. In order to stimulate the active involvement of local people as well as to ensure that the design is made in accordance with the capabilities and particular experiences of the producers themselves, a pilot project involving a limited number of families should be the first step. These families should be selected from among the Killai group according to certain criteria set up to ensure that they are representatives of the economically weaker segments of this population.
- b. In order not to expose the participants to the risks that are unavoidable at this stage of the project, the farmers participating, in addition to the capital inputs needed, should also be given financial support for operational costs as well as living allowances calculated on the basis of full-time employment. The farmer should also have the exclusive right to the future harvest although at this stage he may not be the owner of his culture pen.
- c. One way to make the Veddard group benefit from the project without disturbing the existing social structure would be to help them establish themselves in supplementary economic activities. The group, in this context, suggested the collection and selling of seeds and feed to the Killai shrimp farmers as one way in which the Veddards could be involved. It was recommended that parallel with the pilot project among the Killai fisherfolk, efforts should be made by the project to gather information for this type of involvement on the part of the Veddards and the kind of support they would need.
- d. Since one of the objectives of the pilot project is to foster direct participation by the farmers themselves in experimentation, planning and implementation, it is essential that training and supervision be organized accordingly. The group came to the conclusion that this should preferably come directly from the BOBP in collaboration with the Ministry of Fisheries, rather than through the existing cooperative. The project could also be instrumental in assisting the farmers organize their own "committee" in an independent manner.

Case Study on Shrimp Pen Culture Extension in Killai, Tamil Nadu, India

CASE DISCUSSION SUMMARY : GROUP III

The objectives of the case discussion were :

1. to identify and understand factors that may affect the success of an extension of shrimp pen culture in Killai
2. to evolve strategies to work towards a socially feasible extension, and
3. to learn from the case, rise above it and evolve guidelines to help agencies involved in development and funding development

1. Some thoughts on project objectives :

- the technology development exercise at Killai evolved out of the agencies' understanding
 - of the needs of the state (at that level of aggregation)
 - of the resources, particularly environmental configurations, available for exploitation
- this translated into the need to exploit (as yet under-utilized) coastal waters, with their specific environmental attributes to increase fish production, to generate earnings and to do it in a profitable manner.
- the particular environmental factors and not the needs of a particular community determined the choice of the technology.
- specific communities are rarely contemplated at the technology development/planning for development stage.

2. Some thoughts on the 'why' of shrimp pen culture;

- the technology was designed for the environmental configuration
- it was a 'fine-tuned' technology
- no other options and alternatives were considered to use the same resource/environmental configurations
- questions like 'for whom is it?' 'of what specific benefit to them?' and 'how would they absorb it?' did not arise until after the technology was developed.

3. The Group decoded that agencies ought to ask themselves certain questions *before* they decided 'which technology' and the 'process of extension'

- for whom is it, specifically?
- do we know these people?
- do they know us?
- what are their needs as expressed and prioritized by them?
do we and they understand the causes of their problems?
- how is the community organized socially and commercially to 'carry' the technology?
- what are the people willing to do for themselves and by themselves?
- do we understand their concept of advantage?
- will a single technology ensure equitable spread of benefits or will it require a range of technologies?
- what constitutes an appropriate technology for these people at this point of time and at this stage of development?
- are we committed to and will the people participate in the planning, choice of technologies and implementation?
- keeping in mind the existing social and power structure in and around the community, do we know who will get what and why?
- who else involved in the process would benefit and how?

4. The group decided that an agency ought to answer the above questions by building in a 'socio-economic and developmental' function into their structure which has its inputs at the policy and R & D planning levels (and not at extension levels where they are usually found, *after* the fact of technology development).

5. The Group decided that in evolving strategies for social feasibility we must consider the option of saying no (1) to particular technology(ies) for particular people(s) at a particular time, and suggesting alternatives such as
 - changes in the basic objectives of the effort
 - many technologies instead of one to help more people and to better utilize the resources
 - more holistic programmes to answer a range of needs instead of a solution-in-search-of-a-problem

Moving on to shrimp pen culture and the people of Killai

6. The Group identified the following 'social' factors that may affect the 'success' of technology based development programmes
 1. Confusion as to who the target groups are – should they be as determined by existing policy or should they be the (functional) fishermen who depend on the backwaters with preference to the *presenr* and those *who are there now*.
 2. The tension between the Killai fisherfolk and Veddars may affect programmes that require them to cooperate and which may reorganize the existing social power structure.
 3. The concept of advantage (from a technology or a programme) of the Killai fisherfolk/Veddar folk.
 4. Social/commercial organizations to carry the technology
 - the government prefers cooperatives,
 - the Killai fisher-folk deal in families and have had bad experiences with cooperatives, and
 - the Veddars are inherently cooperative.
 If one does not begin with the 'givens' there may be problems.
 5. Problems associated with shifting from fishing gear management and daily earnings to culture management and deferred earnings.
 6. Limited resources in the region (for the one particular technology) and the community's insistence that all should benefit (not necessarily from the same technology) or none.
 7. – The questions of who will work with the people; enable them to critically understand their environment, identify their needs, decide on choices and alternatives available to them; enable their development; enable sharing of technology(ies).
 - and how all this will be done by agencies with whom the Killai/Veddar folk do not seem to relate to or cooperate with well.
7. The Group decided that it was too early to evolve specific strategies for the extension of shrimp pen culture to Killai because the technology in their opinion was technically and economically not ready for sharing.

The factors that motivated this decision were :

1. possible environmental impact of the technology,
2. 'sophistication' of feeding; availability of feed,
3. uncertainties in pen design/construction/performance,
4. the dependence on 'juveniles'; seed availability,
5. salinity risks to culture
6. socio-economics of the high labour demand of the technology,
7. the 'optimal' size vs. the smallest economical size of pen culture,
8. complexity of technology/management,
9. non-consideration of any alternative means of exploiting the same eco-configuration.

The following general strategy was recommended :

1. Shift programme objectives of the agencies from development of fisheries to development of fisher-folk.
2. Decide on a region and people specifically;
3. Work with the people and motivate and enable them to critically understand their environment and to identify their real and felt needs ;
4. Help the people in their process of selecting from range of technologies and methods that may address their identified needs;
5. Evolve participatory development of technologies ;
6. Enable sharing of the technologies keeping in mind the types of issues and questions raised elsewhere in the discussion.