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PN-AAG-142

Recommendations Concerning the Feasibility

of a

Proposed Assistance to Small Scale Fisheries Project

to be

Developed by Indonesia

Report from the

International Center for Marine Resource Development
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Contents

I. Summary and Recommendations

A. Summary

Briefly summarized below are six sub-projects that have been evaluated. These are:

1. Artisan fisheries management.
2. Floating fish cage/enclosure tests.
3. Ice plant at Meringgai.
4. Macrobrachium culture.
5. Tambak development in North Central Java.
6. Rice field fish culture.

1. Artisan Fisheries Management

Nowhere does Indonesia face more important, difficult, and serious problems than it does in the development and management of small scale fisheries. These fisheries produce most of the fish for human consumption. Certain areas like those of the north coast of Java are very heavily and probably over exploited. Resources in other areas such as the south Java coast, west and south of Kalimantan and parts of Sulawesi could bear more extensive development

However, there does not at present exist an adequate system for coastal resource assessment or monitoring. Such a system is essential to effective development planning, resource management and fleet management.

It is proposed therefore that operations in two zones be initiated: 1) the north Java coast and 2) the south Java coast. Operations on the south coast would consist of exploratory fishing and stock assessment utilizing existing vessels. The purposes would be to demonstrate the effectiveness of the exploratory fishing and stock assessment methods using existing vessels in the small scale fisheries environment and to train people in these methods to be applied elsewhere.

Operations on the north coast would concentrate on establishing appropriate management practices based upon information obtained using small scale fishery information. The purpose is to establish monitoring techniques that will assist in resource and fleet management.

The operations would require technical assistance of three specialists for three years. One specialist to be a fisheries biologist, the second a fisheries biologist with applied fisheries experience, and the third to be a fisheries economist.

2. Floating Fish Cage/Enclosure Tests

Various kinds of cage culture are practiced in many parts of Indonesia. Areas with a considerable potential for increased output due to availability of sites are in Sumatra and Kalimantan.

It is recommended that an experimental cage culture facility be developed in association with the Inland Fisheries Research Center at Palembang. This center would be able to provide technical assistance to establish the station and to initiate experiments for a period of 18 months. The objectives are to provide technical assistance to establish the station and to initiate experiments for a period of 18 months. The objectives are to provide a better experimental basis for cage management and design and to serve as a demonstration center for cage farmers. Experiments would relate to feeding, species selection, cage design, stocking density, etc.

3. Pilot Ice Plant at Meringgai

The relative isolation of many landing sites for fish in Indonesia presents particularly severe problems for supplying ice and, in consequence, severe problems of fish preservation. The result is that fish is lost due to spoilage or, more important, goes to lower valued uses such as drying and salting. This diversion of fish to lower value uses reduces incomes to fishermen except where it is necessary to increase storability of seasonal peak supplies.

The low level of ice use is partly attributable to the very high price of ice and the fact that there is no observable premium paid to fish preserved in ice. However, it should be noted that the failure to use ice limits the mobility of the fleet by restricting trips to one or two days at most.

With two exceptions there are no flake ice plants in Indonesia. A major advantage of flake over block ice plants is that they can be easily started and stopped as the demand or lack of it warrants. A major advantage of flake ice is that it chills fish much more quickly (and without bruising) than does crushed ice. While, with improper handling, flake ice may freeze into blocks these can easily be broken without machinery.

The cost of flake ice is much lower than that of block ice and the investment cost per ton of capacity is lower. Flake ice may readily be made from either fresh or salt water and hence one does not necessarily require a fresh water supply.

To meet the needs of small and scattered landing sites both fixed and floating ice facilities are possibilities.

The major problem in any ice installation is the availability of replacement parts. While most makes of ice machiner are supported from Singapore, the delays in obtaining parts and clearing customs can be considerable. No flake ice machine suppliers appear to operate in

Indonesia and therefore a parts supply must be maintained at the facility. This will, of course, increase the initial cost somewhat.

Therefore, it is recommended that a flake ice plant of 8 tons capacity (per day) be constructed at Meringgai.

Meringgai is a landing site that presently lacks sufficient ice, services a fairly large number of boats and has access to the major market of Djakarta.

4. Macrobrachium Culture

Macrobrachium culture, or experiments in culture, were initiated several years ago in Java. These early efforts were followed by the construction of two hatcheries and several more are planned. Farmers have shown a great willingness to grow macrobrachium, particularly those served by the hatchery constructed at Adireja. The attempted pace of development in this field is very rapid.

Two major problems exist: 1) there is insufficient skilled manpower to effectively manage the existing and planned hatcheries along with the necessary extension problems and demonstration programs, and 2) the present hatchery at Adireja is inhibited in its productivity by a fresh water shortage and shortcomings in its green water system. Other sites have similar difficulties if careful fresh water exploration is not first conducted and adequate supplies established.

The potential for macrobrachium culture in many existing farm ponds in the southern part of Java is considerable. Thousands of ponds suitable for macrobrachium exist. There are also existing hatcheries in the area that could effectively be used for demonstration and experimental purpose (for example, Banyumas and Singaporna). The existing and new macrobrachium hatcheries with the fish hatcheries in the hinterland can form the basis for a macrobrachium supply and extension network. That a demonstration and extension network is required is demonstrated by the fact that present farm productivity is low and this cannot be attributed to water problems but rather to management problems.

A model extension and management program can be developed around the Adireja hatchery provided that: 1) the hatchery system is improved and, 2) technical assistance of a macrobrachium specialist is available for two years.

Market conditions for macrobrachium are such that it is unlikely that market prices will be much depressed by increased supplies however some attention will have to be given to a collection system that will provide regular outlet for macrobrachium from an expanded system to avoid local gluts that could depress prices. More attention will have to be given to produce preservation as well as distances to market increase and supplies increase.

In summary, macrobrachium culture in south Java is technically and appears to be economically feasible. However, care must be taken in hatchery siting and design in order to avoid costly mistakes that could raise the production costs of juveniles to prohibitive levels.

5. Tambak Development in North Central Java

The tambaks of Central Java have been known for sometime to be less productive than those of many other parts of Indonesia. In recent years, however, under the inpetus of loan programs, many Tambaks have been rehabilitated and production has increased. However, productivity has not yet demonstrably increased although it is difficult to imagine that rehabilitated ponds could possibly be less productive than they formerly were.

Farm management practices may have changed but it is not obvious that this is the case.

The demonstration farms are not yet serving their purpose effectively.

The root of the problem of management would appear to be in the rather disorganized extension program. It is not clear that extension workers have an understanding of their mission nor does it seem that they have been adequately instructed as to their functions. Furthermore, without reasonable supporting information from central experimental work or from demonstration farms it is difficult for the workers to convincingly advise farmers on their practices.

Farmers themselves may be tempted to blame such factors as fry shortages or inadequate water for production problems and seek solutions in those areas. However, were the fry and water problems solved where they exist there would be an even greater need for effective management to avoid the risk of loss through mortality of costly fry and the misuse of expensive feeds and fertilizer. It should be understood that it is not that the professionals, both national and international do not understand what constitutes "good" management. The problem lies in persuading farmers that it is "good" management.

However, to seek a solution to the extension mission, organization and operational problem for the Tambak areas of northern Java alone would fail to recognize that the same kinds of problems exist for capture and other culture fisheries as well. It seems clear that the formulation of a clear extension policy is complicated by the nature of the relationships between the central government, the provincial governments, and the Kabupaten governments. The divided and dispersed authority is not as severe a problem as the lack of a coherent policy at all levels of government.

At this time an investment project cannot be recommended. The already developed tambaks suffer from low productivity and the demonstration farms are not effectively operational. It has been noted that the organization and functioning of the extension and demonstration programs have not been particularly effective and a certain confusion appears to exist in the administration of Tambak programs.

However, extension programs generally, not only for tambaks, suffer seriously from a shortage of qualified manpower as well as from as lack of clear definition of mission.

It is therefore recommended that technical assistance be provided in the form of an extension specialist, to review the administration, organization and mission of the extension programs, particularly for North Central Java and for other areas as well.

6. Rice Field Fish Culture

The culture of fish in paddies (sawah) has shown declines throughout Southeast Asia during the last ten years. Fish production from paddies (sawah) has also declined in Indonesia. These declines have been attributed to the increased use of high yielding varieties (HYV) of rice. On its face the prospects for increasing fish production from paddies would not appear to be promising. However, several developments warrant a reconsideration of this view. First, the development of pest resistant varieties of rice shows promise of reduced pesticide use. Second, cultural practices used to control pests may provide a greater opportunity to grow fish. Third, more effective practices in management of paddies may provide an opportunity for increased output.

It should be appreciated that there are many systems of growing fish in paddies. In Indonesia, these fall into three broad categories: 1) fish after a rice crop, 2) fish between rice crops, 3) fish during rice production. The systems are further complicated by the fact that fish of almost all sizes have a market either for stocking or for human consumption. In consequence, the growing of fish in paddies does not imply growing fish for the consumer market. The fish from paddies may be sold to stock other paddies or to stock fish ponds.

The growing of fish in paddies is most concentrated in West Java and North Samatra. A particularly interesting opportunity exists in North Samatra in Simalungun Xabapaten where the brown leaf hopper has been a severe problem. To interrupt the life cycle of the insect, measures are being taken to control both planting and harvest times for rice and to provide a period where no rice is being grown. During those enforced abstentions, the paddies may be used for other crops one of which is fish. These disease control measures effectively provide more potential fish pond area than has heretofore existed.

Considerations of the species to be used in paddy-fish culture is important. The species most useful in paddy-fish applications are carps and tilapias. These species groups are widely distributed in Indonesia and in general are well known. However, the markets are quite different. Market conditions would suggest common carp since prices are three to four times those for tilapia. However, the high price of carp precludes its use by the poor. The tilapia at a lower price may have some potential as food for the poor although under any significant supply pressure prices might fall still further and production would not be possible. Given the potential productivity and experience with carp along with good market conditions it would appear to be the best species for expanded paddy culture. However, the application of management methods employed in the Philippines in trials should be attempted for possible use in paddies while rice is being grown.

The purpose of developing rice-fish culture in the Simalungun area has been variously stated to include tilapia culture to provide cheap fish for the poor, to develop carp culture and tilapia in rice and fish combinations, to provide an alternative to rice as more stringent management methods are being attempted in order to control the brown leaf hopper.

Several things need to be noted: 1) there are a number of private hatcheries for carp now operating but at low efficiency, 2) the price of carp is high and it is estimated that most (80%) of it leaves the area for other markets, 3) the price of tilapia is relatively low and a major market for it does exist, 4) the present hatchery is just adequate for the tasks of providing fry and fingerlings although it has not functioned well in the past, and 5) the present hatchery has space to conduct experiments with paddy-cum-fish culture methods for the future.

It is therefore recommended that the mission of the present hatchery be threefold: 1) to provide fry and fingerlings to farmers at competitive prices, 2) to serve as a demonstration and extension center for paddy-cum-fish culture, 3) to serve as a demonstration and extension center for fish hatchery operations and to provide brood stock to hatcheries at competitive prices.

It is recommended that this activity be provided with technical assistance for a period of two years. This assistance to support the management of the hatchery, the experimental paddy-cum-fish work and the development of extension services for culture and hatchery operations in the area.

Collectively, the six sub-projects make up a meaningful well selected assortment of assistance programs. The first, directed to the artisan capture fisheries, is the most comprehensive and, unlike the others, calls for the greatest effort in the way of further planning and execution as the work progresses. Accordingly, accomplishments in this area constitute the greatest challenge to the advisors that may become involved and to the Indonesian personnel ultimately responsible to fulfill the objectives; however, as is pointed out later, this subject promises the greatest returns. In contrast, the various aquaculture projects can be more clearly defined and may in some cases lead to four or five-fold increases in production, all very impressive even for the work on floating fish cages which, in perspective, constitute a very small fishery resource. The sub-project involving the construction of a pilot ice plant is, of course, a highly specific unit. It is of considerable merit as a demonstration and useful unit.

Though a full section has been prepared relative to the environmental effects, these are so minor that they are not mentioned in the condensed listing of feasibility recommendations; however, a suggestion relative to siltation and dredging is added.

B. Recommendations

1. Artisan Fisheries Management

The recommendations for improved management and further development of the capture fisheries are grouped under three headings:

1. Activities to increase the harvest by small scale fishermen of relatively unexploited stocks.

2. Activities to safeguard and enhance the interests of small scale fishermen of the heavily exploited waters along the north coast of Java.

3. Creation of the information base essential for the overall controlled exploitation and management of the Indonesia fisheries.

The justification and general background of these recommendations are given in Annex B.

For activities to increase the harvest by small scale fishermen two phases are suggested. (The first phases is recommended in this statement.)

Phase I. (First three years.) Engage a specialist for harvest technology and associated biological problems. This expert should carry out a program on the south coast of Java to expand the range of the fisheries between ports and to tap other unexploited resources on this coastline.

Phase II. At a later stage a similar specialist would be engaged t carry out a program on the south coast of Kalimantan and South Sulawesi promoting the harvest of underexploited resources from these areas which serve as the second line of supply to Java.

For activities to safeguard and enhance the interests of small scale fishermen along the north coast of Java it is suggested that a specialist in fisheries biology with a knowledge of fisheries technology be engaged to focus on the development of untapped resources such as those of the deep reef and outer edges of the coastal waters, to consider means whereby the small scale fishermen can take a larger share of the relatively unexploited pelagic resources, and to better assess the competition between larger vessels and the smaller boats in order that management practices may cope with this problem more effectively.

For the creation of the information base essential for the overall controlled exploitation and management of the Indonesian fisheries three parts are suggested. This is to be used in conjunction with economic information for the development of effective fleet management systems.

Part I. Design and set up an activity in which information on the population biology of the species harvested will be obtained on an adequate, regular, and continuing basis.

Part II. Test, in the first two years and at two representative sites, the utility of this activity as the essential management tool for optimum, and, wherever possible, increased yields to the small scale fishermen. The representative sites indicated are: Pekalongan on the north coast of Java, Cilacap on the south coast.

Part III. Provide, with particular attention to increasing the in-country supporting professional capabilities, for the continuity of this population biology information gathering activity. This activity would join activity of the two biologists-technologist and a fisheries economist who would coordinate the program.

2. Floating Fish Cage/Enclosure Tests

It is recommended that a program of field trials be conducted to ascertain the potential for achieving even greater growth and densities in floating cage culture as practiced in South Sumatra. The trials would involve considering alternatives as to the species that may be used and determining the relative importance of factors which can be manipulated, with a view toward maximizing production and/or the net returns to the operators. In addition, general comments on floating fish cages, other suggestions that bear upon this culture, and details concerning the program of field experiments that are recommended are discussed later.

3. Meringgai Pilot Ice Plant

This is a highly feasible and workable project. The appraisals in support of this are to be found in Section D. Specifically, the recommendations are as follows:

a. Buy a 8 ton/day flake ice plant.

b. Build a structure to contain:
Ice Plant
Diesel Generator Room
Insulated Cold and Storage Rooms
In this structure provision should be included for another 9 ton/day unit.

c. Build a bulkhead to reinforce the existing boat wharf before dredging the river channel. (At present, fishing boats cannot berth at the wharf.)

4. Macrobrachium Culture*

The objective of this project is to: 1) increase the productivity of the prawn hatchery at Cilacap on the southern coast of Java, 2) identify problems and problem areas and make specific recommendations on improvements for this hatchery, and 3) review potential sites for a third prawn hatchery with demonstration ponds to be located on the southwest coast of Java. Also suitable sites should be identified to demonstrate the profitability of prawn culture in ponds which are too small to provide a living for their owners through the production of fish.

* The title of the sub-project is reworded from "Freshwater Applied Research" in order to better represent the intended effort.

Recommendations:

In order to expand the outreach of present prawn production programs from the two hatcheries located in central Java it is recommended that:

The necessary expenditures in capital, personnel training, and expatriate assistance be made to make the Cilacap hatchery an effective operation.

Construct two new deep artesian wells with at least 10,000 liters per day capacity.

Provide required capital equipment to allow the present broad-stock ponds to be refitted for alternative use for water storage, sedimentation removal, mixing water to proper salinity, and green water production.

Improve larval rearing methodology, through further out-of-country training of Indonesian personnel.

Import a steam cleaner to reduce the bacterial fauna in larval production tanks.

Implement a two year project at the Cilacap (Adireja) hatchery through expatriate assistance to supervise the construction, to implement a hatchery methodology training program, and to demonstrate new grow out technology in the extension program.

As part of the expatriate assistance program, develop a feeds and feeding program for carp and prawn production.

Develop new larval and post larval feeds for prawns using alternative feeds.

Future site selection should be based on the following criteria: soil characteristics, topographical and edaphic factors, hydrographical investigations, nature of the physical environment, economic environment, administrative framework, legal framework, land ownership, and social factors.

5. Assistant to Tambak Small-Holders

It is recomended that assistance be provided to assure the continuity of extension progrmas directed both to tambak farmers and extension workers who function in an advisory capacity in the field. Such assistance should include:

Support of an expatriate expert as an advisor on extension organization and methods to the program. Short-term overseas training opportunities for station personnel to become acquainted with advancing techniques in the culture of shrimp and Chanos chanos.

6. Rice Field Fish Culture Development With Special Attention to the Hatchery at Kerasaan

In order to improve the rice field fish production in the North Sumatra area it is recommended that:

Technical assistance be provided to extend the effective outreach of the Kerasaan facility wherein fry produced will be effectively distributed to small scale farm operators and to improve the technologies of private hatchery operators.

This program should also include:

Selection of strains of Cyprinus carpio which will grow and survive better in this environment.

Experimentation on improved pond and paddy/fish production techniques.

Introduction of new species to farmers, principally CLARIAS sp. and Tilapia nilotica.

Improvement in the technological understanding of hatchery operators and extension workers through further training.

Technical assistance should be provided for a period of two years.

II. Some Contraints and Assets for Fisheries Development Assistance in Indonesia

Some of the fishery resources along the north coast Java are probably already over exploited. Very likely there is a gradation between excessive exploitation resulting in sub-optimum yields close inshore to less exploitation and a greater potential for yields offshore. This has a major bearing on planning for small scale fishermen since, by and large their present capability for harvesting the distant offshore resources is quite limited. Present management practices, which attempt to administer a stratification in the exploitation permitted, with increasingly larger boats being required to fish at increasing distances from the shore, seem unworkable.

Off the east coast of Java in the Bali straits there is a pelagic sardine fishery which is probably heavily stressed, although some increased harvest may be possible from better management.

As to areas relatively unexploited, attention should be directed to parts of the south coast of Java, particularly between the relatively far spaced ports of fishing operation, to ports of the west coast of Sumatra where conditions are somewhat the same, and to the southern and east coasts of Kalimantan. Other promising areas possibly offering further harvests are the south and north coast of Sulawesi, also the coastal areas of a number of the more distant islands to the east and southeast. Finally, the deeper waters of the Java Sea, less excessible to early fisheries development of the Java seas offer some promise.

In short, this is a pattern in which the immediate north and east coasts of Java has been very heavily exploited, while a number of less excessible areas offer greater future promise. In this connection it should be noted that in some of the coastal areas the heavy fishing for shrimp, which commands a very good price and is used largely for export, is bringing about some depletion of other fish resources.

Turning to the brackish water situation, there seems to be little possibility for expansion of tambak areas...in... Central and East Java or in South Sulawesi, yet production in the tambak may be greatly increased through improved methodologies. In the South Sumatra some of the areas where attempts have been made to develop tambak have been abandoned because of an insufficient rise and fall of tide. Generally speaking, wherever tambaks are being developed there is a need for further sources of seed, particularly milkfish fry. The environmental conditions in some of these brackish areas have proved something of an obstacle. Soil characteristics, local pH problems, and some local contamination are often deterent to success. Finally, any mention of the potential in brackish waters whould take cognisance of the fact that expanding tambaks is an activity which eliminates vast stretches of the ecologically highly valuable mangrove swamp areas.

In fresh water the problems that one encounters may revolve largely aroung the great seasonality in water supply. Conflicts with agriculture arise not only for water but for landscape.

A number of economic considerations come to the fore in thinking about fisheries development in Indonesia. The country experiences tremendous unemployment problems thus programs which might involve advances in the economic efficiency of operations could very well aggravate the employment question. People already suffering financially could easily be hurt even further by projects which involve an intensification of effort. For example, one might very well recommend larger and more extensive tambak enterprises and in the process undermine the participation of the small operators, which this assistance project is intended to help. Finally, almost everywhere the small-scale fishermen are confronted with problems of getting sufficient capital even for the most modest improvements, as the bank loan policies do not favor this sector of the population.

Probably the most delicate questions to deal with are those that go into the realm of social and political considerations. First it might be noted that Indonesia has a good many landless peasants and many of these either are or might become involved in the small scale fisheries which this project intends to assist. As efforts progress, however, one must contend with regional, group and ethnic rivalries which are considerable throughout the country. The bureaucracy to be dealt with in carrying out an assistance program is highly structured and it is difficult for it to realize its potential in efficiency without an accompanying overbearing atmosphere.

Something should be said here about the national program for transmigration designed to take people out of overcrowded areas into less crowded regions. If this can even keep abreast of growing population pressures, it should help counter a trend toward an even greater stress on the fisheries of the north coast of Java and might lead to increased fisheries in relatively unexploited areas.

III. Artisanal Fishery Management

From a preliminary review, admittedly involving rough approximations throughout, we find that the capture fisheries make up over 90% of the present total fishery production of Indonesia of about 1.5 million tons annually. Our prediction is that production can be increased to 7 million, with over 4 1/2 million additional tons realized from the capture fisheries. This is a very conservative appraisal since the capture component of fisheries production should be augmented by more growth in the pelagic fishery sector and further use of the resources in such southeastern waters as the Arafura, Timor and Sawu which are to be studied under future German-Indonesia survey efforts. While we see possibilities for very spectacular percentage increases in production from some of the aquaculture subsectors, for example, the possibilities of ten-fold increases from tambaks and cage culture and a five-fold increase from polyculture practices linked to rice production, the absolute gains that may be possible in the capture fisheries obviously dwarf the increments from aquaculture.

Though the totals, percentages and suggested increments just presented are based on lengthy analyses of the current literature that applies to Indonesia, it should suffice to present on this page the following summary table of broad groupings of the production.

Present (1975) Fish Production and Estimated Potential Production for Indonesia

	Total	Marine	Tambak	Paddy	Cage	Inland Open Water	Inland Ponds
Present	1,488,000	1,043,000	86,000	86,000	500	230,000	56,500
Percent	100	72	5.9	2.2	0.3	15.7	3.7
Estimated	7,000,000	4,500,000**	800,000	150,000	50,000	250,000	500,000

All data in metric tons

**Our prediction, worked out independently, comes very close to the GOI estimate that only 23% of the annual renewable marine resource is havested annually.

We do not have data with which to compare number of people involved in capture fisheries with numbers involved in aquaculture but since, in general, aquaculture involves some land holdings or water rights whereas the capture fisheries tap only the public domain, the participants in the capture fisheries must at least equal, and very likely exceed, the proportionate numbers suggested by the production ratios. In so saying we do not overlook the fact that equipment (boats and gear) are a requirement for entry into the capture fisheries but the minimum to start with, i.e. a dugout and handline, is more within reach than is the purchase of land.

Recommendations:

Recommendations for improved management and further development of the capture fisheries with special attention to the needs of those who operate on a small scale are grouped under three headings:

(1) Activities to increase the harvest by small scale fishermen

a. A specialist be engaged for harvest technology and associated biological problems to carry out a program on the south coast of Java to expand the range of the fisheries between ports and to tap other unexploited resources of this coastline.

(2) Activities to safeguard and enhance the interests of small scale fishermen along the North Coast of Java

a. It is suggested that a specialist in fisheries biology with a knowledge of harvest technology be engaged to focus on the development of untapped resources such as those of the deep reef and outer edges of the coastal waters, to explore means whereby the small scale fishermen can take a larger share of the relatively unexploited pelagic resources, and to better assess the competition between larger vessels and the smaller boats in order that management practices may cope with this problem more effectively.

(3) Creation of the information base essential for the overall controlled exploitation and management of the Indonesian fisheries.

Three units are suggested:

a. Unit I - Design and set up an activity in which information on the population biology of the species harvested will be obtained on an adequate, regular and continuing basis.

b. Unit II - Test, in the first two years and at two representative sites, the utility of this activity as the essential management tool for optimum and, wherever possible, increased yields to the small scale fishermen. The representative sites indicated are Pekalongan on the north coast of Java, Cilacap on the south coast.

c. Unit III - Provide, with particular attention to increasing the in-country supporting professional capabilities, for the continuity of this population biology information gathering activity.

Further Elaboration and Justification of the Recommendations

The specialist for harvest technology and associated biological problems to carry out a program on the south coast of Java to expand the range of the fisheries between ports and to tap other unexploited resources of this coastline is justified on the following grounds:

There are some nine workable sites along the south coast of Java. Small to intermediate sized fishing craft operate out of these ports. In general the smallest are sail driven, the largest mostly powered by western style outboard motors. None are particularly well adapted to ranging far from the home port, especially in these relatively rough waters. As a result there is something of a void in fishing effort between ports, not to mention potential catch increases if the boats were to range farther out to sea. In addition, this comparatively precitpitous southern coast appears to be a likely area for increased catches of deep water fishes, such as snappers and groupers, following further exploratory work and the possible introduction of new technology such as deep sea reels in place of handlines.

It is suggested that an expatriate be selected to fulfill this role; that he be affiliated with the Directorate General of Fisheries, and that he work out of Cilacap. Funds should be made available to charter boats and to acquire gear for the various exploratory, trial and demonstration aspects of their activities.

The specialist in fisheries biology and associated technical problems willl focus on the development of untapped resources such as those of the deep reefs and outer edges of the coastal waters, to explore means whereby the small scale fishermen of the north Java coast can take a larger share of the under exploited pelagic fishes, and to better assess the competition between larger vessels and the smaller boats in order that management practices may cope with this problem more effectively.

A number of specific suggestions need attention:

Work should be done on the methodology for harvesting relatively unexploited demersal species such as the snappers (Lutjanes spp.) and groupers (Epinephalus spp.) which live in deeper waters and rocky bottoms (see Unar, M. 1974). A note on marine fisheries management in Indonesia. FAO-IPEC/74/SYM/17).

One needs to know where these resources abound and to develop improved gear, such as mechanical reels and multiple-hook lines, in order to harvest this potential.

Exploration should be carried out in much the same way, for other resources just off the deep outer edge of the coastal waters, probably accessible to but not commonly harvested by the small scale fishermen with present boats and gear (see section 2.b. where some comments are included on extending the seaward fishing range of the small scale fishermen).

Technological improvements should be considered whereby the small scale fishermen can increase their harvests of the larger pelagic species (see Unar, M as cited above, also Gulland, J.A. 1973. Some notes on the assessment and management of Indonesian fisheries. FAO/IOFG/DEV/73/31).

There should be a review of all small scale fisheries methodologies applied in the area from the standpoint of suggesting technological innovations; new methods being considered should be tested.

It is of critical importance that an examination be made of the interactions and competition between the small scale fisherman and the fishing by larger boats, particularly trawlers, in the inshore waters where the present management practice calls for a seaward progression of fishing zones according to boat size. Since the fish involved undoubtedly move across these zones, it is important to consider the life habits of these species in relation to this zoning and alternative conservation management measures which might relate better to the populations being fished and might also be easier to apply.

It is suggested that an expatriate be selected to fill this role; and pursue these objectives; that he be affiliated with the DGF; that he work in close cooperation with the Marine Fisheries Research Institute; and that he establish his center of activity in Semarang. Among other things he could, in this setting, assist the faculty of the University of DIPONEGORO in its program to develop marine science studies. Funds should be made available to charter boats and to acquire gear for the various exploratory, trial, and demonstration aspects of these activities.

None of technologically oriented aspects of this project should be viewed, *per se*, as being a motorization project for the following reasons:

- On seeing the large numbers of sailing craft used by the small scale fishermen along the north coast of Java one realizes that they have been tested over centuries of use, that they are adopted to local materials and building conditions, that they are fairly well suited to operating under local weather conditions and for certain types of fishing, and that the local people have attained considerable skill in building and sailing them and in working from them. It is also apparent, however, that in the minds of these fishermen the first step "up-the-ladder" toward a greater output is some form of motorization for one sees adaptations of sailing craft with western style outboard motors, longtail outboards, and finally inboard motors which usually call for significant modifications in hull design.

The more usual off-hand reaction of those interested in encouraging development is to further encourage motorization in one form or another but looking at this in depth, particularly with respect to the interests of the small scale fishermen, a number of opposing thoughts arise:

Since such large numbers of small boat owners are involved, adequate motorization can probably only be applied to a small percentage, with the great majority of small scale fishermen becoming disadvantaged in the process.

Conversion to motorization of the larger craft alone could cost, at the very conservative figure of $2,000 per boat unit, in the order of

$40,000,000 in total. Thus, instead of hastily advocating motorization, it is useful to reflect on the fact that the features and performance of the sailing craft might be improved significantly. Saying this does not indicate a disregard for the evolution of the various native designs. Instead this is supported by the observation that some such designs are superior to others, often on a regional basis, and one can reasonably project a progression from the poorly conceived boats to the better native craft and aspire to something even better upon further consideration of the design and construction possibilities. Some boat materials, currently regarded as impractical because of expense, may prove cost effective upon futher analysis. Comments that fishermen would be reticent to adopt any such materials are refuted by noting how quickly they switched to nylon monofilament netting once its effectiveness was demonstrated. Some of the materials that might be considered in boat construction are dacron sales (the fishermen now regularly use dacron line) and copper bottom paint which, though expensive, might, in some applications, result in net savings through keeping boats in operation with fewer haulings and for longer years of service.

Since some of the native craft have a very limited range and some quite the opposite, there is good reason to believe that more optimal range features, along with greater seaworthiness, can become a general rule if design features are broadly upgraded.

New design objectives could focus additionally on optimal fishing technology features.

In entering an era of fuel shortages, rising fuel costs, and the need to conserve energy, there is considerable merit in improving on such an energy conservative system as sail power. And, perhaps to the surprise of some, there is evidence (see Wahjudi, Bambang 1977. The Economics of Fishing Effort on the North Coast of Java. U.R.I. Masters thesis) that, even with present sailing craft, the return for capital invested is better than for some motorized craft.

Reflecting on such points it seems quite logical for an area, such as the north coast of Java where extreme fishing intensities now exist, to stress the development of sailing craft which should improve the prosperity of the small scale fishermen without adding the fishing pressures bound to result from unchecked motorization.

A combination of skills is needed for this undertaking namely:

1) a small boat designer and rigging expert - 6 months apportioned as 4 months of in-country travel to review native craft and 2 months of design work. 2) a specialist on boat building materials, na... and imported, and on boat construction methodologies - to review the native boat building methodologies, capabilities, and prospects for adaptation to change, and concurrently to assess, in terms of cost effectiveness, appropriate materials, both the traditional and those under consideration as innovations - 4 months in-country travel to review native craft and 2 months of design work; and 3) an anthropologist to consider the cultural adaptation invetable in such a venture - 4 months, all in-country.

Unit I - Design and set-up an activity in which information for management of the species harvested will be obtained on an adequate continuing basis so as to be able to interpret sustainable yields and the population trends of the various species in relation to these yields. Such a data base is not being gathered at present. Thus, there is a pressing need to design, carry out, and relate to the management effort a program for systematically collecting such information as:

species composition	sex ratios
length frequencies	catch and effort statistics
age and growth	cost and earnings information

All models and methods for predicting yields and for determining management regulations, such as minimum size limits, mesh limitations, conservation zones, escapement provisions, etc., depend on gathering such information as well as careful economic analyses. When a program is properly designed a relatively small subsampling of catches is all that is needed for these purposes, but this must be done by people appropriately trained. Consistency and continuity are essential.

As already noted the plight of the small scale fishermen concentrated all along the north coast of Java and competing with larger vessels can only be dealt with if we know something about the fish populations that are seemingly under such stress. As the government approaches this with such schemes as restricting fishing zones in a seaward progression according to boat size, it is in the unfortunate position of attempting well-intended conservation measures without supporting information whereby these and alternative practices can be appraised. Even more questionable without more information are those proposals which would reduce the number of larger vessels in certain regions and actually, in the process, reduce the employment of a number of fishermen (crews of 30 on a 15 ton purse seiner and over 10 on a trawler of comparable size) whose well-being should be protected.

In another setting, that is with respect to the inland fisheries, it is found that harvests declined 8% between 1973 and 1975. Until the basic biological information is acquired this can only be dealt with through relatively blind and arbitrary management practices such as curtailing all fisheries development. Finally, as one projects and encourages expanded fisheries on resources that are relatively untapped, as along the south coasts of Java, Kalimantan and South Sulawesi, and eventually as increasing distances to the northeast and southeast, it will be important to follow the fishery populations in the early stages of exploitation and thus to avcid repeating past mistakes in these new frontiers.

Unit II - Test the utility of data gathered in the first two years considering Pekalongan and Cilcap as representative sites. This may serve as a critical exercise in testing the utility of the biological and economic information gathering program and showing the way to modifications where the experience of applying the actual data accumulated indicates. Furthermore, working out such applications with professional associates in Indonesia is the best first step toward transferring these capabilities which are to become an ongoing function of government management personnel. Finally, the two ports selected are highly representative of management concerns in behalf of the small scale fishermen:

> Peklongan is in the central part of the north coast of Java. Here there is a heavy concentration of small boat fisheries in some apparent conflict with the larger fishing operations. This is an area where the pressures are very great and the need to consider management information is particularly acute. Cilacap on the south Java coast represents a somewhat similar set of problems in a different environment.

Unit III - Provide, with particular attention to increasing the in-country supporting professional capabilities, for the continuity of the population biology information gathering activity.

To accomplish the objectives described above it will be important to have one senior and one associate level expatriate selected to work in association with the staff of the DGF for program design, for testing the application of the work at two representative sites as listed, for working with the DGF to train its field personnel in the essential data gathering work, and for relating to counterparts in the DGF who will be continuing the work in the future. At least three of the counterparts should be sent abroad for graduate training (2 to masters and 1 to the Ph.D. level) in these aspects of fisheries biology. The general undertaking may be divided into two steps. The program, design and initial activation would be carried out in the first two years, also the initial application of the program at Peklongan and Cilacap can be covered under this step. A second step to be considered after program review in two years would consider three added years of technical assistance. This should see the program to the stage wherein it could be handled entirely by in-country personnel. Within the final three years the counterparts sent abroad for training will have returned and assumed their appropriate roles in the overall effort. The expatriates and others engaged in this information gathering activity will obivously have much in common with the scientific staff at the Marine Fisheries Research Institute. Also, the Institut Pertanian Bogor has progressed far in freshwater fisheries but needs further staff development if it is to serve equally in the marine areas. The expatriates in this program should seek to assist IPB in advancing such educational capabilities. They might undertake this through regular visits to Bogor or perhaps through instructional services at the new IPB marine science facilities being established in Ancol.

The principal objective of the project is to provide a rational basis for the exploitation and management of fisheries resources exploited by artisan fishermen. The potentials for increased output are great in many areas and resources are heavily pressed in others. Appropriate technologies are necessary to the expansion of fisheries. Solid biological and economic information are essential to effective fleet and resource management. Hence a team of specialists, two in biology/technology and one in fisheries economics is necessary to affect this subproject. The immediate suggested term is three years. However the project should be reviewed after two years with a view to extending it for three additional years for the purpose of extending activities to other islands than Java.

In order for an activity such as this to be continued beyond a technical assistance period more than on-the-job training is required hence the graduate education of biologists and economists is necessary. In addition to the fisheries biologists (1 Ph.D. and 2 M.S.) one economist should be brought to the Ph.D. level.

The artisan capture fishery will remain the major source of fish protein and a major employer into the foreseeable future. This project will help assure a rational development of one of Indonesia's major food resources.

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IV. Floating Fish Cage/Enclosure Research

According to the latest available statistics, "Fishery Statistics of Indonesia No. 5", only 500 tons of fish were produced by cage culture techniques, both floating and fixed. This is considerably less that 1% of the total of 1,488,000 tons of fish produced in Indonesia during 1975.

The results of site visits in the vicinity of Bandung in Java, and in Palembang and Jambi in Sumatra, clearly indicate that the problems of cage culture and the potential are highly variable by province or area in Indonesia.

Effective utilization of many water courses has already been made in the Bandung area practicing culture in fixed cages in sewage outfalls, canals, and ditches. In general it appears that the design of the fish cage has been ingeniously adapted to a particular site and the returns to the fisherman justify the effort. Cages were seen ranging from a length of two meters to more than 610 meters in one case. The size of the cage was clearly site related.

Culture in floating cages and the prospects thereof in the area around Jambi and Palemburg is probably more similar to that in the Mekong delta and other large river systems where such culture has been practiced extensively and successfully. In the vicinity of Jambi cage culture is already practiced on a fairly large scale. There are approximately 30 cages on a lake of about 80 hectares. Each cage was approximately 2x3x1 meters in size. All were made of bamboo lathes spaces with only about 5 mm. between lathes. A privy was located above each cage that was located near shore and connected to the banks by planks. The cages were floated by means of log floatation. The cost of such cage construction was estimated to be on the order of 4,000 rp. and the cost of the log floatation about 30,000 rp. for a 2x3x1 meter cage.

Stocking of these cages was with Leptobarbus spp. fingerlings obtained during December, January, and February. About ten fingerlings/cubic meter were initially stocked. Fingerlings were on the order of 2 to 3 cm. total length at stocking. Fish were retained in cages from 8 months to two years depending on the size desired, and upon local market conditions. Returns to fishermen were estimated to be between 100 and 600 kg. per cage per year, depending on the harvest practice.

All cages were supplied with supplemental foods (plant materials) in addition to human excrement. Chopped casava was used. Leaves of other trees and other vegetable matter was fed daily without chopping. Sometimes rice bran was used. Feeding seemed to be of an opportunistic nature.

In the Jambi area cage culture of Leptobarbus is integrated into the livelihood of the workers who have another prime source of income such as capture of wild fish by traps, gill nets, and lift nets, or the capture and sale of wild ornamental fish. A combination of cage culture with land farming is another pattern.

In the Palembang area, the Musi River was briefly surveyed. The width of the river was more than 300 meters in some locations, and the possibility of conflict between cage culture and other water uses is considered to the minimal. Though active cage culture is not practiced as yet in Palembang, this location is considered a very acceptable site for a pilot research and demonstration project.

In general, the design of cages, their present stocking density, and the fish species all seem to have been nicely adapted to local conditions. The price of *Leptobarbus* is approximately 600 rp./kg. Carp, *Cyprinus carpio*, are priced at as much as 1700 rp./kg., but they are not raised in cages in the Jambi area because fry (fingerlings) are not available for stocking, i.e. hatchery facilities at Jambi are not presently adequate to meet the demand. Reflecting on this it would seem that the possibility of introducing carp to cage culture in the Jambi area is reasonable. The present limiting factors are: a) source of fingerlings (as just noted), b) inadequate information on feed requirements, c) cost effectiveness of artificial carp feedings in cages versus present practices with *Leptobarbus*.

In the Palembang-Jambi area as interest was expressed in the possibility of using catfishes and snake heads, as well as *Leptobarbus* as candidate species. Indeed, one experiment on catfish has already been run by Indonesian fisheries personnel. They grew to 1 kg. in one year from fingerlings. Additional production data are not available.

Another possible topic for further study involves the nature of the available feeds for floating cage culture. It appears that the large rivers will not provide adequate natural food for any intensive type of culture. Food, particularly high protein type fish food, may well be a limiting factor for some species.

Summary of Observations on Cage Culture in Indonesia

1. The design and construction details of both fixed and floating cages appear to have been well adapted to particular local conditions.

2. In areas with limited water supplies, some conflicts between cage installations and other water users (irrigation) appear to have developed primarily because debris caught on the cages sometimes creates blockages of flow. No easy solution to this problem is available.

3. In some areas with large natural water supplies cage culture has not yet developed. In these regions, where fish are still easily available for capture, there seems to be little socio-economic demand for cage culture at present.

4. The species used, stocking rates, feeding regimes, and strategies for harvesting seem to have evolved through local requirements, and local availability of fish and fish food.

5. No success has yet been reported with cage culture of Macrobrachium, according to reports from fisheries personnel at Palembang.

6. In the Palembang and Jambi areas vast stretches of the large rivers are available for cage culture and, though there would be no conflicts with other uses, the practice has not been fully developed. If further use can be justified on economic grounds, and if there is suitable water chemistry to prevent kills which, according to report, have sometimes occurred after flooding, the potential for expansion in these areas is quite high.

From the summary comments of the following suggestions should be considered:

1. Construction Aspects

It seems possible to design cages, with rounded ends to minimize the probability of trapping floating debris. However, the extent of area where this type of cage is required is not known at present. This is not, in any event, considered a big limitation to cage culture.

For floating cages, the cost effectiveness of replacing floating logs with styrofoam or other synthetic floatation material ought to be investigated due to the high cost of logs and the requirement for drying them at two year

The possibilities of extending the life of the bamboo lathes by treatment seems worth considering. Other cage construction materials (plastics) might be considered, if economic. Toxity of treatment materials should be considered.

2. Biological Aspects

The possibility of replacing Leptobarbus with common carp in floating cage culture in the Jambi-Palembang area seems worth considering. Current problems involve lack of information on the growth of carp on vegetable matter feeds locally available in South Sumatra.

In the Musi River, a limited possibility of raising snake heads in cages using locally available fish and fish scraps might be considered as a pilot demonstration. Other indigenous species could also be used.

Specific Field Tests to Improve Floating Cage Culture

In the Jambi and Palembang areas of South Sumatra, large rivers and lakes make floating cage culture very practical without creating any conflicts in the use of the waterways. To date, however, most such culture has been confined to the lakes, with the broad rivers of the region constituting a relatively untapped potential. Though all cage culture represents far less than 1% of the total fish production in Indonesia, the floating cage component is amenable to expansion by combining an expansion of culture activities with possible improvements in the technology. We are recommending field trials focusing on the latter, i.e. possible improvements in methods, with the belief that this along might at least double production. The Annex to this section shows just how this might be done.

Annex IV A

Floating Cage Culture Field Trials

Location

Palembang and Jambi areas of South Sumatra. (See attached map.) Justification for selecting this region is that large rivers and standing bodies of water (lakes) are available and no use conflicts are anticipated. Not much development (especially in rivers) has occurred to date; however, cage culture is practiced in lakes. (See attached map.)

Objective

To demonstrate high density cage culture potential in the South Sumatra area, and to determine the relative importance of factors which can be manipulated with a view toward maximizing production and or net returns to cage operators.

Experimental Factors

1. Stocking Density

Present stocking densities have been derived through trial and error. Though guidelines have been developed through years of experience, no objective data on the effects of stocking density are currently available for any species.

2. Location

It is highly desirable to test location effects to evaluate the range of variability induced by differing environments.

Tentatively, three sites are suggested as desirable.

a. In Palembang - site D in the Ogan River.

b. In Palembang - A site on the Musi River near a fishing village (for a and b see attached map).

c. A site on the River Batanghari in the Jambi area.

3. Species

In this region, the possibilities are very large since at least 50 species of freshwater fishes are utilized commercially. However, the species tried should be restricted to those with high market value and for which some data are available. Suitable candidate species include:

a. Snake heads - 3 species are presently utilized: Ophiacephalus striatus, micrupeltes, and pleurophthalmus.

b. Leptobarbus spp.

c. Common Carp, Cyprinus carpio.

d. Catfishes.

4. Feeds

Diets will vary by species--snake heads are generally carnivorous while Leptobarbus is omnivorous, but grows well apparently on vegetable matter. The minimum protein requirements of carp for a cage system are unknown. Feeds can be varied by type and by consistency, i.e., pellets versus moist bound and unbound feeds. Although fish nutrition is important, the simplest and most basic available diets should be tested first and the details of nutrition should not be considered in initial studies.

5. Other Variables

There are several other factors or variables which will affect the results of experiments on cage culture. Though these may not be tested explicitly in the first experiments, their effects could be determined in continuing work. These include: 1) season of the year, 2) shape or size of cages, 3) proximity of cages to each other, i.e. metabolite effects, 4) feeding frequency, 5) size at initial stocking, 6) predation and other mortality effects, 7) temperature effects, and 8) water quality effects.

6. Response Variables and Ancillary Data

These will include growth factors, mortality and production.

7. Growth

Representative samples should be measured and weighed (individually) at two week intervals for the duration of each experiment. The total weight should be directly determined at two week intervals.

8. Mortality

Mortality should be determined by actual counts at two week intervals. Any unusual conditions (kills, for example) should be recorded as they occur.

9. Feeding

The daily feed rate, feed consumed and water temperature, should be recorded daily, and feeding rates should be adjusted as percent body weight at biweekly intervals.

10. Production

At the termination of each experiment all data should be converted to standard production data, such as feeding efficiency, gains per unit time, harvest density, market price, etc.

11. Experimental Design

The experimental design might consist of a multiple factor analysis of variance. For example, the four factors mentioned above might be considered as follows:

			L1			L2			L3	
S1		D1	D2	D3	D1	D2	D3	D1	D2	D3
	F1	-	-	-	-	-	-	-	-	-
	F2	-	-	-	-	-	-	-	-	-
S2		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
S3		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-

Where S1, S2, S3 are either species 1, 2, 3 or season 1, 2, 3.

L1, L2, and L3 are locations 1, 2, 3.

D1, D2, D3 are stocking densities at 3 levels.

F1 and F2 are two feeding rates or feed formulations.

To provide replicates of all treatment combinations it would be necessary to have a total of twelve cages at each location for a total of 36. Either seasons and/or species could be considered in a sequential manner using the same 36 cages.

The suggested size of cage for such experiments is 2x3x1 meters where the dimensions are width x length x depth. All cages should be identical materials and treatments should be randomly allocated to cages. The suggested duration of each experiment is on the order of 200 days longer. Records of all source data, prices, size at starting, and other relevant data should be recorded individually by cage.

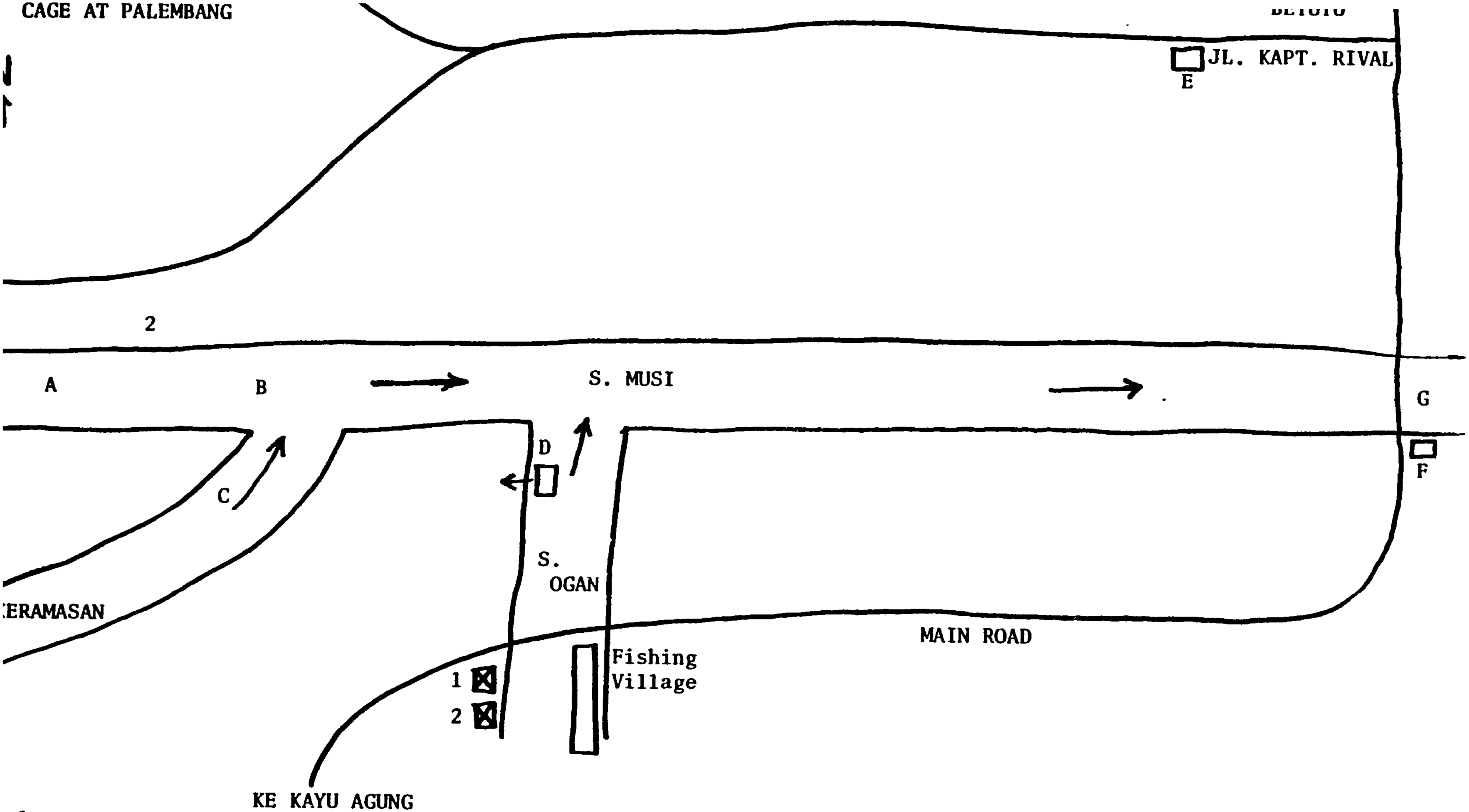
The results of the experiments would be treated as multiway classification analysis of variance designs. In the design briefly outlined, stocking densities are within locations as are feeds.

12. Duration and Personnel

Duration: Two years.

Personnel: 1 expert from outside Indonesian for one year and one counterpart. On site staff - non-professional, 3-6. A report on the sequence of experiments should be prepared at the end of the project period.

CAGE AT PALEMBANG



1 ☒ - Factory refining rubber effluent (10" pipe at 1/2 capacity when observed) discharged into stream draining into S. Musi.

2 ☒ - SAWMIU - River used to transport logs saw dist. and fiber particals discharged to S. Musi.

A KMP GANDUS
B KMP KARANGAUGAR
C KMP S. BNaya
D KMP KERAMASAN
E Kantor Dinas Perikanan Propinsi SumSel
F Kantor Dinas Perikanan Kota Madya Palembang
G Jembatan Ampera

V. Pilot Flake Ice Plant in Meringgai, Lampung

The use of ice in preserving the freshness of fish and thereby the protein content is well appreciated by the fishermen and the marketing people. Since the iced fish also brings a higher price, the use of ice is only restricted by its availability and price. At the present time, crushed block ice is used in the ratio of 1/2 kg. to 2 kg. of ice per 1 kg. of fish. However, because of the high price and scarcity it is often not used at many sites. At present, block ice is shipped from Jakarta or ice plants elsewhere in Lampung to Meringgai in inadequate quantities and at a high price. There does not seem to be any evidence of the use or appreciation of the benefits of flake ice in preserving the freshness of fish.

One ice plant in Karang Hantu, West Java was visited and found to manufacture plate ice. The ice is made using Thai Refrigerating Company equipment where thin blades of ice are produced and crushed immediately resulting still in ice particles that damage the fish flesh and have small surface contact with the fish. On the other hand, a real flake ice allows greater surface contact between the ice and the fish cooling it more quickly and more efficiently. The structure of the flake is more than that of snow in not exerting point pressures on the fish thereby not bruising or damaging the fish flesh.

Flake ice flows freely (when properly made and handled) after five to ten days in the pens or sections of the hold of the fishing vessel. It will last longer in storage. Flake ice melts around the outside and forms a thin crust which protects the mass of ice from excess air contact, melting, and temperature rise. After breaking the crust this stored ice mass will be loose, easy to handle and well below the melting point of ice. This subcooled ice will form a new crust where disturbed and again will protect the good storage quality of the ice. Subcooled ice lasts longer than ice at 32°F (0°C).

Ice flakes are the right size and shape to preserve fish. Both close contact with the fish and drainage through the ice are necessary to preserve fish. The flakes gently form around the fish giving maximum surface contact for maximum cooling. The ice flakes will not bruise, mar, or injure the skin or flesh when pressed against the fish.

Ice flakes will give lower flesh temperature in a shorter time than conventional crushed block ice or ice at melting temperature. For fishing vessels that operate in coastal waters a load of flake ice guarantees refrigeration, cooling, and proper catch preservation. This eliminates the need for on-board refrigeration.

The reasons for recommending a pilot flake ice plant in Meringgai are first of all to make more ice available to the fishermen and fish buyers at a reasonable price and secondly to demonstrate the superiority of flake ice over crushed ice.

To achieve these objectives a small pilot flake ice plan is recommended for installation at Meranggai.

The proposed ice plant at Meranggai has been designed in such a way that it is fully portable. All it needs from outside is a supply of water.

The building is prefabricated ferro-cement structure with its own floor and footing required only a compact soil area for erection. It can be regarded as a prototype of a series of mass produced small ice plants that can be transported and erected at desired sites. If their usefulness ends at one location, they can be dismantled and erected at another.

An alternate ice plant building structure is also given that is cheaper and can be constructed by local labor.

Recommendations

1. Since the need for more and cheaper ice supplies has been demonstrated it is recommended that a pilot flake ice plant be constructed at Meringgai, Lampung. The pilot plant suggested is North Star model no. M-20-WC-30 or an equivalent plant producing a nominal 8 metric tons of flake ice per day.

2. A sufficiently large building be constructed to house the ice plant and a possible future addition of another unit when the demand for flake ice warrants.

3. Since the existing water supply can provide approximately 30 tons of water per day and the ice plant at full capacity operation will require under 9 tons of water per day it is recommended that no additional water supply be constructed at the present time. When other uses of water increase and the additional ice maker is installed the water supply should then be increased.

4. Accommodation for the operators of the ice plant should be provided.

5. Steel sheet piling wall to be installed in front of the existing concrete landing wharf to permit safe dredging of the river bed adjacent to the Auction Hall and the Ice Plant location.

6. Factory training to be provided for the operator-engineer of the ice plant.

7. A pilot floating ice plant (FIP) may be considered in the future to be on a ferrocement self-propelled barge to service out of the way fishing communities that have limited road access and limited ice requirements.

Justification

The recommendation for the construction of an ice plant in Meringgai, Lampung is based on the examination of the site and the information supplied by the Fisheries Office of the Lampung Regency. The information provided is in the form of a background report and diagrams of the site, see Enclosure A.

The statistics presented are convincing for the need of additional supplies of ice in the Meringgai area and also in the whole Lampung Regency. Analysis shows that if all the fish landed at Meringgai were to be iced at the rate of 2 kg. of ice per 1 kg. of fish, the average daily rate of ice availability in 1977 would have to be 38.10 tons per day. The ice actually used, brought in from Jakarta and Lampung Regency was 0.51 tons per day, leaving a requirement of 37.59 tons per day to be satisfied.

The above figures need to be corrected for the amount of fish requiring ice and for the ratio of fish to ice.

Thus, out of a total catch of 11,479 tons in 1977, anchovies accounted for 2834.6 tons; shrimp, 46 tons; and jelly fish, 172 tons. Since anchovies and jelly fish are not iced and ice for shrimp is provided by the PUMAR Company (however at the high cost of 35 rp./kg.) it leaves 8426 tons of fish that need ice. If one to one ratio of ice to fish is assumed since flake ice is much more effective and the distances the fish have to be transported are not that great then 8426 tons of ice would have been required in 1977. This gives a daily average of about 26 tons per day. The proposed pilot plant with 8.2 tons of ice per day output will provide a substantial 32% of the total technical ice requirement at Meringgai. The cost of flake ice from the plant will be less than half the current price of ice.

With two such ice makers as a future projection and assuming that some of the lower quality fish will always be dried or salted it seems that the present level of fish production could be provided with ice.

Additionally, the availability of locally produced ice, at a much lower price, will greatly benefit the local economy.

The estimated cost of the ice making plant together with the auxillary equipment are given in Annex A.

The Director General of Fisheries office produced a preliminary drawing showing the building to house the ice plant that the GOI is contributing to the project.

It is understood that money has been provided for the ice plant building in the 1978-79 budget by the GOI.

This plan will have to be modified to accommodate the requirement of the North Star equipment in having the ice maker located above the ice storage room.

A recommended arrangement of the ice plant building is shown in Figure 1. It provides for a:

3.5 m x 6 m	Cold Room
2.5 m x 6 m	Passage Room
3 m x 3 m	Ice Bins
5 m x 6 m	Diesel Generator Room
6 m x 6.5 m	Ice Maker Room
	Workshop and Wash and Dress Room

The design provides spaces for the installation of a second ice making machine if need is established in the future.

The insulation of the ice bins and the cold room will be best accomplished by means of the prefabricated system which consists of panels of polystyrene instulation prepainted galvanized steel skin which produces completely finished walls and ceilings. The floors are polystyrene insulation slab covered by a concrete floor.

The combination of the North Star ice maker package unit, the prefabricated ferrocement ice plant building with panelized insulation provides an easily assembled ice making plant system. Such a plant could be shifted to a different location if situation arose that the ice supplies are no longer required at the original location.

An alternate design of the Ice Plant building is shown in Figure 2. This design represents an attempt to reduce the cost of the building to minimum.

The landing wharf alongside of the auction hall and the water tower in Meringgai has been concreted for a length of about 30 meters. Apparently, no pile support has been provided for the concrete structure. The river bed alongside the wharf is badly silted so that a low tide over half the river width is dry and the boats cannot come closer than 15 meters from the wharf.

Plans are made to dredge the silted area alongside the wharf to a depth of three meters. Due to the apparent lack of support for the concrete wall, the concrete structure may collapse if the dredging is done without some remedial action.

Two solutions are suggested:

a. Extend the wharf area about 2 to 4 meters into the river by means of a wooded platform supported on wooden piles.

b. Reinforce the concrete wall by steel sheet piling driven flush with the wall.

Solution b. is recommended for the following reasons:

a. No reduction in navigable width of the river will be necessary.

b. The steel sheet piling will last many times longer than wooden piles and decking.

c. Long range cost of maintenance of sheet piling is much lower.

d. The outside row of wooden piles will always be subjected to scour and will have to be watched for possibility of collapse.

e. Protection of wooden structure both from rotting and attack by borers will be costly.

Probably the most important single requirement for the successful operation of any plant is the well trained operator. It is therefore recommended that the operator of the proposed ice plant be trained by the supplier of the equipment in the operation and maintenance of the plant.

To reach fishing locations, where the access by road is difficult and building an ice plant even of the smallest economical size would produce an over-supply of ice, a mobile floating ice plant is suggested. Such a plant would be mounted on a self propelled barge. The barge would have a maximum 1000 kilometer radius of operation and in addition to ice would carry fuel supplies for the local fishing boats. It will also have a cold room on board for transportation of fish from limited access places.

The advantages of a floating ice plant are many:

a. Only one plant with one operating crew is required for supplying many locations with ice and fuel.

b. Since the ice making plant produces ice from salt water no deep wells or other fresh water supply systems are needed.

c. No port facilities are required since the fishing boats can be supplied directly from the barge anchored offshore.

The shore ice storage places can be stocked by small boat transfer of ice from the barge.

d. No ice plant buildings are required except for simple insulated ice bins at convenient places ashore.

e. The mobility of the floating ice plant will permit the changes in areas of operation of the plant with any shifts of fishing patterns.

f. The floating plants can also be moored or tied to a shore base permanently or for long periods of time. In this case, a barge without the engine would be used and towed to its destination. There a bottom pipe could be used to bring in salt water for the ice making machine.

Ice Plant - Construction Details

The pilot ice plant at Meringgai will consist of:

1. Flake Ice Making Machine

It is recommended that the North Star Model 20 Catalog No. M20-WC-30 package unit or equivalent be used. This unit can be modified by buying the ice maker without the water cooled condenser and substituting an air cooled condenser which will be placed outside the ice plant building. This modification can be performed by P.T. Pagoda Sakti Raya, Jl. Hayam Wuruk "Glodok Baru" Blok D. Lantai II, Jakarta, who are the unofficial, at present, agents of the North Star.

2. Cooling Unit for Cold Room

Bitzer Type VL or equivalent can be obtained from P.T. Pagoda Sakti Raya. Details are shown in Figure 7. This unit consists of the cooling unit, air cooled condensing unit, evaporator, control box and piping.

3. Diesel Generator

MWN Diter D325-6 or equivalent set rated at 52.5 HP. at 1500 rpm. It can be obtained from P.T. Setia Sapta, Jl. Gajah Mada 183-184, Jakarta.

4. Ice Plant Building

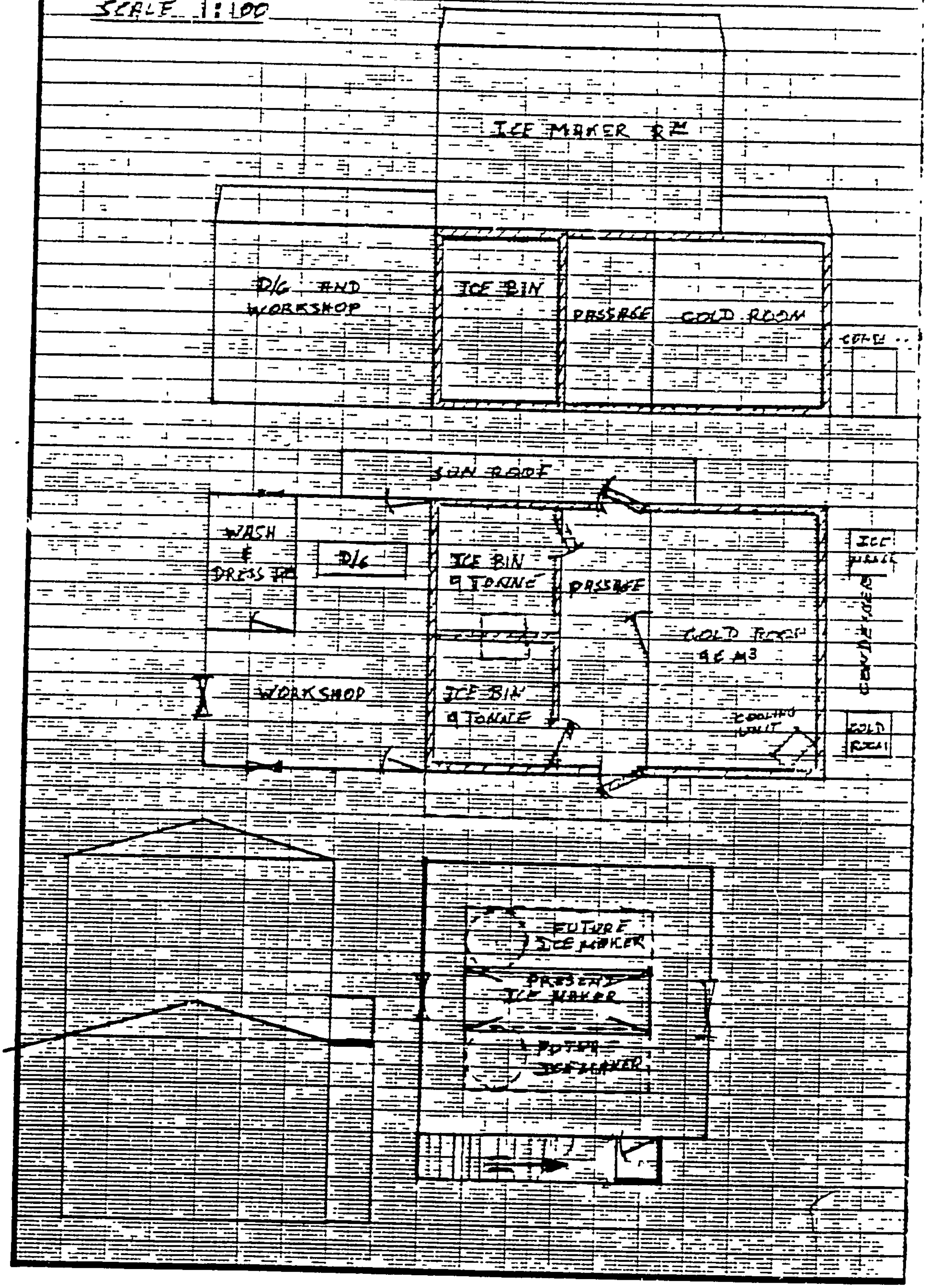
It is recommended that a prefabricated ferrocement structure is purchased from P.T. Kodja (Persero), Jl. R.E. Martadinata Ile, Tanjung Priok, Jakarta Utara. Letter from the company dated July 1, 1978, giving the price of the prefabricated building at approximately Rp. 12,600,000 which represents a unit cost of Rp. 100,000 per square meter of floor area. The building would be prefabricated in Jakarta and shipped to Meringgai where the erection would be relatively simple. The unit can be placed on compacted ground with polystyrene sheet insulation placed on the ground in the way of the cold and ice rooms. The structure has its own footings. The ice plant building schematic drawing (Figure 2) shows the location and sizes of the different rooms. Ice bins, cold room and connecting passage are all insulated. It is recommended that Rudnev System of Polystyrene Panels be used to insulate these rooms. The supplier in Jakarta is P.T. Pagoda Sakti Raya. Pamphlet describing the insulation system is shown in Enclosure F. Two ice bins are provided so the ice maker can fill one bin while the other is being emptied. This also provides sufficient ice storage for the future addition of second ice maker. Each ice bin can store 9 tons of flake ice. Passage space can be cooled by means of two louvered openings 0.75 m. x 0.75 m. located near the top corners of the insulated wall between the cold room and the passage. The duplication of cooling equipment and the diesel generators instead of one of the same total power would substantially increase the cost. Since the ice making machine produces ice within 30 minutes and then about 1/3 ton per hour, any short breakdown period could be overcome by transferring the ice from the ice bins to the Cold Room. A prolonged shutdown will, of course, suspend the whole operation. A space of 30 m^2 has been provided for workshop, diesel generator space and wash and clothes changing room.

The ice maker is located in a 6 m. x 6.5 m. room above the ice bins so that ice can fall by gravity into the bins. A deflecting flap should be provided to allow the filling one or the other of the bins as required.

Sufficient floor space and volume has been provided in the ice plant building for installation of another ice making machine and second diesel generator to double the ice making output of the plant.

FIG-1 - ICE MAKING PLANT BUILDING
(FERRO-CEMENT)

SCALE 1:100



VI. Macrobrachium Culture

Aquaculture production of prawns in Indonesia represents a very small amount of the total freshwater culture production. Although prawns represented approximately 2% of the total inland open water fishery in 1975, the production through capture fisheries has declined in recent years.

Due to high demand prawns have a well established method which can in the future provide small scale operators with a high value cash crop in small ponds.

There are two primary prawn production facilities in central Java which have on-going extension programs. They are located in Jepara and Cilacap. These extension programs include training of personnel in larval rearing techniques, applied research in grow out production, water management training, as well as stocking of small scale farm ponds.

Justification in 1976 the Jepara shrimp production facility developed a plan to stock water prawn post larvae in farm and demonstration ponds in the central Java region. The central objective of the program was to increase the income to the small scale farmer. The initial outreach to approximately 100 ha. of ponds with a production of 2×10^6 post larvae was based on an estimate made from preliminary experiments conducted by Jepara station personnel.

It was demonstrated that 50-60 gm. animals could be produced in a 5 month growth cycle with 30% mortality from (PL's) with an initial stocking density of 12,000 post larvae (PL)/ha. Some data resulting from this program is available and it appears that 400Kg was the average production in farm ponds participating in this out reach program. See Annex VI-A for pond data summary.

It has been estimated that 100-300 ha. of ponds are available for stocking in the central and west Java regions. Some of the receiving areas include Banyamas 65 ha., Cilacap 20 ha., Parbelinggo 15 ha., Banjarnegara 20 ha., and Magelang 15 ha. of which data is available from only 11% of the total stockable area at this time. Approximately 1.32 X 10^6 PL survived to be stocked in these farm and demonstration pond areas. Assuming 2 X 10^6 PL's were produced only 66% survived to be stocked in units in the central Java region.

The GOI has budgeted 1978-79 funds for construction of two new demonstration freshwater ponds, one in Banyumas and the other in the Ciamis. Both areas are suitable for present planned demonstration pond facilities, and have sufficient available water to allow for future expansion to 15-25 ha. of stockable pond area. (See Annex VI-8)

It is difficult to exactly estimate the available stockable area in the West Java region as most of the available production units are presently used for carp production and productivity is very high. But there should be an alternative production method provided to the small scale (<.5 ha) Farm Pond Operators. Although prawns have 2-3 times the market value of carp, past productivity in ponds units will have to be significantly improved in order to reach a larger number of farmers in West Java.

The Adireja-Cilacap hatchery is now completing its first year of production. Although there have been problems, approximately 350,00 PL's have been distributed to farm and demonstration ponds in the central Java region. (See Annex VI-C) Some of the receiving areas include Banyumas 28 ha. stocked, Cilacap 1 ha. stock, 2nd Banjarnegara 1.5 ha.

extremely low salinity water. It is therefore recommended that 8 of the 9 existing pond units be reallocated to be used for water storage, mixing to adjust salinity and to extend the green water Chollea sp. production. The last should provide sufficient space to hold brood stock.

Using these units in this manner would increase the water storage capacity and reduce the requirement for continuous pumping for hatchery use. Excluding one unit for holding brood stock yields 13,333 m^2 in 8 1667 m^2 units which will allow for storage of each type of water as well as aging, mixing to proper salinity and green water production. (See Annex VI-E)

Improvement of larval rearing methods would allow increased productivity withing the present constraints (ie. freshwater). These include capital items such as a steam cleaner to reduce the bacterial fauna which grow in porous surface of cement larval tanks and increased aeration in larval culture system.

Increased capacity to hold post larval prawns prior to shipment to farm ponds is necessary. Six circular swimming pools 30' diameter or 707 ft^2 would solve this problem. These units if stocked at 0.02 gms. at 25/ft^2 could be held for one month when adaquate feed is provided prior to stocking with 20-30% mortalities. The result being, the stocking in grow out units a larger animal (1 gm size) which would increase survival and growth rate, and in doing so increase harvest yield in small scale farm ponds.

Further improvements in productivity can be had by implementing further training of key personnel in the Avenue laboratory of the State of Hawaii for applied training in larvae and grow out production methods.

It is recommended that future sites be selected based on following criteria. Soil characteristics, topographical and edaphic factors, hydrographical investigations, nature of the physical environment, economic environment, administrative framework, legal framework, land ownership etc., and social factors.

While the Pelabuhanratu area is suitable for development of a prawn hatchery facility and demonstraction pond complex capable of producing sufficient (PL) to develop a large scale extension program in West Java,it is regarded as premature to launch another effort until the experience of a successful hatchery, demonstration pond, and extension effort has been assimilated. (See Annex VI-E)

Pangandaran is unsuitable for development due to a variety of technical and logistical problems at this time.

A major factor in the development of either a mono or polyculture prawn systems will be the effectiveness of a demonstration and extension system to assist farmers in the management of producing units. In addition the hatchery operation at Cilicap obviously needs to be and can be improved. To aid in these tasks it is recommended that technical assistance be provided for a period of two years. This technical assistance to be argumented by training of three technicians in Hawawi.

Pelabuhantrau water quality data

Well #1 (Cisolak village)

pH 7.8 26^{o}C 0% salinity < .1 mg/LNH_4-N

3 meters deep, and dug, coral rock base

Well #2 (Ice Plant)

pH 8.1 26^{o}C 0% salinity < .1 mg/L NH_4-N

12 meters deep, operator claimed 50 liters/minute

-but was not used in dry season.

- plant located 20 meters from ocean.

Eel grow out facility

pH 7.4 - 25^{0}C 0.2 - 0.4 mg/L NH_4

-Water used to grow out elvers to commercial size anguilla, was obtained from Irrigation canal from mountain area approximately 3 km away.

7 am	25.7^{0}C -	7.0pH
	26.5	7.4
	27.0	7.6
	27.5	7.2
	27.6	7.8
	27.9	7.4

Interesting observation pH at 7 am stable but fluctuation throughout the day in pH due to run off from agriculture.

6) There are projects in the area concerned with improving the road system and flood control but at the present time these potential problems are major obstacles to development of this site even if there is adequate fresh water.

about 1 season (5-6 months) to dry these paddy areas enough to begin construction.

2) Another site is located in a communialy owned soccer field and could also present social problems.

3) The wells tested showed no salt intrusion but this is the end of the rainy season and it was said that the well in Cisolak village (3m deep) did not produce very much water in the dry season. The well at the ice plant (11m deep) also was not used during the dry season because of low output. A deep well in this area could if it was used as the only source of fresh water lower the water table.

A hydrological survey and a deep well would have to be drilled and pumped for approximately one week during the dry season to determine potential capacity and affect on water levels on neighboring wells. At this time water quality should be determined.

This Pangandaran site has a number of conditions that its use difficult. These are:

1) The fresh water supply has not been demonstrated.
2) Limited space for future expansion
3) Limited availability of erosion-resistant soils for pond dikes for growing or holding.
4) Sandy beach area as this site, is undersirable. Ponds constructed behind site (further inland than actual site) had a salinity of 0-8% depending on sample location.
5) Although rail transportation is available in this area, use of this service on a regular basis to transport juveniles to grow out units inland does not seem possible. The road system is inferior to that of other sites.

Annex VI-E

Prelabuhanratu

Pelabuhanratu area contains three sites.

All sites are located on the sea side of the road extending from Pelabuhanratu to the Village of Cisolak. The first is approximately 3 1/2 km outside of Pelabuhanratu and the last is 1 km below Cisolak which appears to be far enough away from fishing and port activities that possible pollution of sea water should not become a problem.

The advantages is locating the prawn hatchery in this area are numerous. A few of the obvious ones are:

1) Good transportation to farm ponds

2) Close proximity to Bogor-Inland fisheries institute and university as well as Sukabumi extension and training center.

3) In 1975 the inland open water, water capture fishery for prawns in Java increased by 247% over 1974. Of this increase 96% was due to the capture fishery in West Java. Which indicates an established interest in the economic aspects of this of this species in this area.

4) Preliminary water quality data taken from two wells in the area indicate no adverse factors to prohibit development in this area.

5) There is an eel production facility located in a previously established carp facility, which is rented from the COI. This site has possibility of being developed into a prawn production facility at low cost.

6. Water quality data from the two wells and the hatchery is presented in (Appendix 6).

7. A prawn hatchery capable of producing 12 X 10^6 post larval prawns per year is minimum required to implement an extension program in West Java.

Although the potential for development of a prawn hatchery in Pelabuhanratu is good problems do exist. Among which are the following:

1) Two sites are located in existing paddy areas. It will take

Saltwater supply is from the river adjacent to the hatchery. Paddy field runoff is certainly a primary factor in the water quality, and prawn larval are extremely susceptable to toxicants of this nature.

Water Requirements for Larval Production

40,000 liters of fresh water are required to fill the total rearing capacity based on above assumptions. (12% culture water 20% salt water)

Present Management	Improved Management
60 Day larval period	45 day larval period
1/6 rearing capacity exchange daily	1/2 rearing capacity exchange daily
2.4×10^6 liters/year	7.3×10^6 liters/year
4.6 liters/second, 6575 liters/ day flow from an artesian well	13.9 liters/second

---

- An improvement of this nature requires two deep wells of (+) 10,000 liters/day capacity year round.

Alternative uses of existing facilities

- Presently there exists (9) ponds of 1667 m^3 for a total of 15,000 m^3 of available area which is used only to hold br-od stock.
- The initial plan for these ponds was for demonstration of grow out capacity. To do this would require an excessive amount of fresh water as the soil is sandy and seepage is considerable. A conservative estimate of 25 gpm/surface acre or .100 L/4048/m^2 or 247 L/ha flowrate/ minute.

This site (1.5 ha.) would require 370.5 l per minute, that is 533,520 liters per day. This is beyond any expectation possible from a freshwater well. It was therefore recommended that the existing pond area reallocated for new uses, ie., water storage, mixing to proper salinity and green water production.

Annex VI-D

Cilacap Data Summary

Larval Rearing Capacity

10 Larval units @ 12 ton capacity

-10 units x 10,000 liters culturable area x 5 (PL) produced per production period = 500,000 PL's.

-Assuming 60 day larval growth period to PL 6 turn overs per year per unit, ie. $6 \times 5 \times 10^5$ or total potential capacity of 3×10^6 (PL's) per year can be produced.

Present and potential production

PRESENT MANAGEMENT	POTENTIAL WITH INCREASED SKILLS
5PL/liter	7 - 15/liter
60 day growth to PL	45 - 50 days
6 turn overs/year	8.1 - 7.3 T.O./year
PL's produced-3×10^6 (PL's) max	5.11×10^6 - 12.2×10^6 PL's

Water Supply

Fresh water is available at the rate of 4.3 - 5.8 tons per day @1/2%. Assuming that larvae are reared at 12% and salt water is available at continuous level of 20% from river. This would allow a total of 10.75 to 14.5 tons of rearing capacity to be exchanged on a daily basis, ie. (10.75% to 14.5% of total capacity).

Salt water source has variable (3-30%) salinity throughout the year. Fresh water source contains 1/2% salinity now. This is the end of the rainy season. In the dry season salinity, unwanted or possible toxic minerals will be taken in from this source.

Annex VI-C

Macrobrachium post larvae production at Cilacap.

350,000 post larvae have been produced up until April 1978. 35.5 Hectares have been stocked and a total of 272 fish farmers have received (PLs). The distribution of these fish farmers is a follows:

Kabupaten	Banyumas	280,000	Pl's	(28 ha.)	200 farmers
"	Cilacap	10,000	"	(1 ha.)	10 farmers
"	Banjarnegara	15,000	"	(1.5 ha.)	20 farmers
"	Karanganyar	10,000	"	(1.0 ha.)	12 farmers
"	Klaten	15,000	"	(1.5 ha.)	15 farmers
"	Snagen	15,000	"	(1.5 ha.)	15 farmers
U.G.M.	Jogyakarta	5,000	"	experiemtal	

The above stocking program as a projected harvest point in the first week of July 1978.

Data on the production from this program was unavailable at the time of the survey.

VII. Assistance to Tambak Small Holder

It appears that, with improved methodologies, the production of existing tambaks might be increased five-fold, perhaps even ten-fold. Two needs must be met to achieve this.

A continuation, with constant upgrading, of field extension services meeting the requirements in terms of seed, both shrimp and milkfish. Obviously the Jepara station lies at the heart of all this. It has been the center for training extension workers and farmers and it is developing the capability to produce shrimp as needed. The fact that the milkfish, Chanos chanos, cannot be induced to reproduce in hatcheries as a limiting condition. Surmounting this shortcoming is probably beyond the capability of a relatively small station such as Jepara; however, the staff at this center should keep abreast of developments along these lines wherever these may occur, for instance at Ilo Ilo, at the Oceanic Institute, or in Faiavan.

One should note that these recommendations focus on increasing production in existing tambak areas. A careful review of existing conditions should be undertaken before expanding the tambak area where such ponds now exist or into new territories.

In keeping with the above comments the recommendations being presented focus on supporting the work of the Jepara station but also recognize what appears to be less a technical or training problem but an organizational problem.

The physical condition of the tambak areas of north central Java are enormously improved over what they were a few short years ago. This development has been assisted by government loan programs but inhibited by tenure problems which prevent farmers without proper certificates of ownership or operating rights from obtaining loans. There is some evidence that the loan programs, particularly for operations are not adequate for good management.

A further problem is that the demonstration units around which the extension program was presumably designed to function are not effectively operational. In addition the relationship between the demonstration farm management and the extension workers appears at best ill defined. An important link in the extension system also seems to be very weak and this is in the feedback from field workers to coordinators, to directors and to research workers. In short, the information transfer systems are not functioning very well while major investments are being made that might improve technology and the welfare of tambak operators.

The roots of the problem are not clear. Some may be, and appear to be in the organization and structure of the system others may be in the level and type of training of workers, others may be in the nature of the relationship of the extension workers with the farmers.

Because of the complex nature of the extension education process, it is recommended that a specialist in extension organization and structure be brought in to analyze the present system and develop improvements.

While this specialist would concentrate on the problems of north-central Java and tambaks he should also review conditions existing elsewhere in extension education in both capture and culture fisheries.

During the year of his service the specialist would assist in the development of programs and materials with the Jepara station, with provincial governments with educational institutions and with the Directorate General of Fisheries. His counterpart and responsible officer should be in the Directorate in Jakarta.

VIII. Rice Field Fish Culture Development in North Sumatra

From a preliminary view "paddy-cum-fish" and paddy and fish rotation are widespread aquaculture practices throughout Indonesia. According to 1976 data the total area where fish culture is practiced in paddys in some form covers approximately 73,000 hectares. This represents only about 1% of the total area of rice production in Indonesia. Approximately 38% of the total paddy fish culture production, involving approximately 28,000 ha, is located in Java.

Various methods of fish production in paddys are employed depending on an area's topography, edaphic factors of the soil, quantity of available water, and the cost of labor. Three methods of production were observed, and details are presented in appropriate annexes. These include: 1) rice and fish in rotation, with fish as a second crop, 2) rice production between two crops of fish, and 3) paddy cum fish, where fish is cultured along with the rice crop.

Presently, and in keeping with local government policy to counter disease in the rice crops, farmers are producing rice and fish (usually carp) in the Northern Sumatra. In Simalugan Kabupaten, typical production of rice ranges from 3,300 to 5,000 kg per ha. On the other hand, the fish production which follows is extremely low. Food fish production was approximately 85 kg. of 340 gm fish in 3 months or twice that amount in a year (Annex VIII-A) with little input of feed or fertilizer. Although rice accounts for approximately 90% of the total cash value to these farmers, the common opinion seemed to be that growing fish in the paddy was advantageous because it allowed year round utilization of the land and fish production involved less risk than did rice.

Though predominating, paddy-fish rotation was not the sole method practiced in North Sumatra for paddy-cum-fish production was observed in the Paranginan Village (Annex VIII-B). This method employed the production of large fingerlings, throughout the year in a very deep paddy. The productivity of fingerlings in this case only depended upon the availability of fry used to stock the paddy. This village was a self sufficient producer of fingerlings and periodically sold surplus in the local market. An example of yearly net earnings in this village is:

PADDY CUM FISH PRODUCTION IN THE PARANGINAN VILLAGE

PERIOD	HARVEST (Kg/ha)	VALUE (Rp.)	COSTS (Rp.)	NET (Rp.)
I	Fish (70)	56,000	62,000	-6,500
II	Fish (100)	80,000	18,750	61,250
III	Rice (3,300)	270,600	---	270,600
IV	Fish (25)	25,000	5,000	20,000
V	Fish (25)	25,000	5,000	20,000
VI	Fish (25)	25,000	5,000	20,000
		481,600	95,750	385,850

In this case the net value of fish produced via this method was approximately (36%) of the total net value.

Rice Production Between Two Crops of Fish

Pond culture of Cyprinus in the North Sumatra in general was observed to be producing at a marginal level. The best examples of production encountered were 1710 kg/ha to 1176 kg/ha of Cyprinus fingerlings. (Refer to Annex VIII-C). It was the opinion of this farmer mentioned in Annex VIII-C that the production alternative used depended upon the price for fingerlings in the local market. More complete information as to variation in availability and fish fry market data for 1977/1978, is presented in Annex VIII-D.

The producers referred to sold only enough to cover on a monthly basis their operating expenses. The majority of the production of the farmers interviewed in the Pematang market area was held until the market value was, in their judgement favorable enough to warrant marketing large quantities. Although the example laid out was producing high yields, this was the exception to the general rule. Average pond productivity was found to be approximately 400 kg/ha in this area.

Small scale fish fry production facilities are widespread in the Northern Sumatra providence. Hatcheries were observed from the Siborongborong, Posea areas to the Siantar City area. Production in these small scale facilities ranged $1x10^6$ to $3x10^6$ fry produced per year. The number of fry-fingerlings sold in the government run fry market place does not reflect the total quantities involved in this area. Most of the fry produced are sold in local markets or transported from the Posea area to market areas closer to Medan.

The Karasaan carp hatchery is presently in a transition from the construction to operational phase. Although it has produced small quantities of fry in the past years (refer to Annex VIII-E) its potential has never been realized.

The DGF facility has from time to time taught short term practical courses in hatchery production methodology to DGF personnel and field extension operators. Again this is the largest carp production facility in Northern Sumatra and this capacity is not well developed.

Capital improvements made in this facility since 1962 certainly are not justified when they are compared to productivity, in the last 5 years. But this facility although it has problems with water supply in infrastructure and poorly coordinated provincial and national governmental inputs there is a great potential here which could be developed.

Recommendations

It is therefore recommended that: 1) the production of the Kerasaan facility be expanded. 2) This facility should provide fry to farmers and serve as an extension center for farmers and private hatchery operators. 3) This program should also include an element of selection of strains of Cyprinus carpio which perform best in this situation. Once this has been determined then distribution to small scale hatchery operators of broad stock would have the best long term effect on pond and paddy fish culture production. 4) A further step in this program should involve experimentation on improved pond production and paddy/fish production techniques. This field testing should involve new strains of carp to be introduced to farmers, also the introduction of new species in to the paddy cum fish paddy/fish rotation methods. Principally; Clarias spp. a facultative air breathing catfish and Tilapia nilotica which does not reproduce in the paddy, could be evaluated. 5) This program should be coupled with improvement in the understanding of the hatchery operators and extension workers. This is an essential element if the above program is to be introduced or popularized to the farmers in this area. 6) It is recommended that technical assistance be provided to develop the above programs for a period of two years.

The Kerassan project should be used as a demonstartion project. An overall feasibility study of fish culture in paddy field in other areas in

Indonesia, other than Java, should be conducted to identify the possibility for implementing similar project(s).

It is further recommended that village areas like Paranginan which are now productive at low levels be targeted for demonstration out-reach program concentrations. Demonstration of improved paddy cum fish culture methods and modifications in existing technology in the Paranginan village for example, could produce a 2-3 fold increase in paddy production, and introduction of new strains of *Cyprinus* or other suitable species could double the present yields.

Annex VIII-A

Paddy/Carp Rotation

Pematang Marihat Area

This farmer rented one hecture of paddy which he used for paddy/fish rotation. He has never tried two crops of rice per year. He stated that the return from carp was about one half that of the rice yet the risk was lower and the time to harvest was shorter. This, coupled with lower maintenance costs, preparation, and labor make Cyprinus culture very attractive to this farmer.

Operation Costs and Time for the Rice Phase of the Rotation

Paddy preparation	12 people	2 days	@	500/day	12,000 rp
Paddy marked and scraped	1 man	6 days	@	1500/day	9,000 rp
this is done twice	"	"		"	9,000 rp
Planting paddy	25 people	1 day	@	500/day	12,500 rp
Weeding	50 people	1 day	@	350/day	17,500 rp
Berm Maintenance fertilizing and	1 person	10 days		500/day	5,000 rp
Pesticide spraying	1 person	1 day		500/day	500 rp
Harvest	40 people	1 day		500/day	20,000 rp
Food	162 (man days)			150/day	24,300 rp
					109,800/ha

Rent 1250 kg of rice/(6mo) season x 76 rp 190,000/ha/yr

Costs for the Carp Phase of the Rotation

Paddy Preparation

Digging Canal around the outside of paddy	1 man	10 days	@	600 rp/day	6,000 rp
Food for labor	1 man	10 days	@	150 rp/day	1,500 rp

Stocking Cyprinus 300 fish/ha @ (8-12 cm qt 65 gm) (5 rp/rish) 1,600 rp

Fish Harvest

3 month growth period

250 fish/ha (16.7% mortality) at 340 gm/fish

$\frac{250 \text{ fish}}{3/\text{kilo}}$ X 800 Rp./Kilo = 66,666 rp.

This is done twice so total revenue is 133,332/ha/6 months

Summary of Paddy and Carp Production

	PADDY (6 mo.)	Fish (3 mo.)	Fish (3 mo.)
Costs	109,860	9,100	9,100
Rent	95,000	47,500	47,500
(Total Costs)	204,860	56,600	56,600
Revenues	380,000	66,666	66,666
Net	175,200	10,066	10,066 = 195,332
		20,132	

Paddy/Fish Rotation

1. Farmers observation about value of crops (paddy vs. fish) is erroneous

   TOTAL NET YIELD (P&F) = 195,332 of which 20,132 or (10.3%) is from fish.

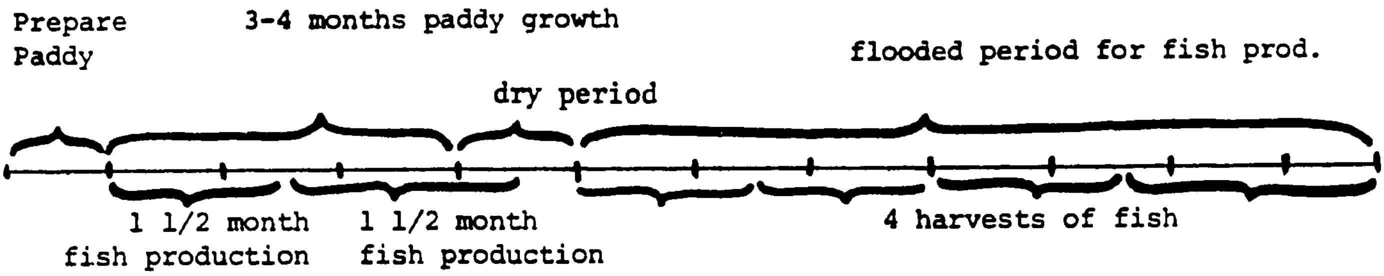
2. Although the paddy/net yeild is (90%) of total value to the farmer, This operator thought it more advantageous in this area to grow fish, in rotation, as it was thought that it provided a less risky enterprise.

Annex VIII-B

Sumatra Paddy Cum Fish

Paranginan Village

This village harvests only one paddy crop/yr on the following pattern:



In this mode of production there were 6 harvests of Cyprinus and 1 harvest of rice. This village used a local variety of rice. When questioned about this point it was stated that high-yield variety required additional fertilizer and pesticides and didn't allow for maximum production of fish in the paddy.

3.3 tons/ha. of rice were produced which were sold locally for 82 Rp/Kg. for a total value of 270,600 Rp./ha of paddy.

The average size of paddy owned by farmers in this village was .5-.6 ha. each. Stocking density was (SD) 2,500 Cyprinus/ha. at 3-4" size which were purchased in the village at 25 Rp/fish (62,500/ha. costs). It was said that the reason for stocking fish at this point is that the fish eat weeds before they become a problem and reduce the work for the farmer. At the end of the first period the farmer harvests about 1750 fish/kg. or 70 kg. of fish of (40 gm size).

From the beginning of the production cycle through the rice harvest the following operating costs and earnings take place:

	Costs	Income	Net
Fish	62,500	56,000	-6,500
Fish	18,750	80,000	61,250
Rice	---	270,600	270,600 (325350)

Costs do not reflect labor costs or opportunity costs to the farmer.

After the rice harvest the stocking density was 10,000/ha of 1-3 cm <u>Cyprinus</u> which were purchased at 0.5 Rp./ha for a cost of 5,000 Rp/ha.

The 1 1/2 month growth period had 50% mortality with a harvest of 4-6 cm fish (5 gms) which were sold at 5 Rp./fish with the follwoing results:

	Costs	Income	Net
Fish	5,000	25,000	20,000

Net returns to paddy-cum-fish during the year

PADDY	FISH	TOTAL	
270,600 (66%)	134,750 (33%)	405,350	$989 US/ha

It is difficult to ascertain what part of production used for consumption by farmer and what is sold. But direct cash value as is the case above, excludes opportunity costs and labor expenses.

Annex VIII-C

Rice Between Two Crops of Fish

Pematang Marihat Village

This farmer (owned) 1 1/2 ha of ponds and 1/2 ha of paddy and fish. He was using a paddy/fish rotation technique.

Fry are purchased at 1.5 Rp./each and are sold at 3-5 cm size at 10 Rp./each after 2 1/2 month growth period.

This farmer uses a rotating harvest method in that he harvests (10) times per year approx. 3,000 fish (fingerlings 3-5 cm size which are marketed locally for 10 Rp. each). Average (SD) stocking density per growth period was 35,000 fry in a 1.5 ha. pond or approximately 23,333 fry/ha. Mortality during the 2 month growth period accounts for 30-40% of the (SD) or 18,666 - 16,333 fingerlings are harvested.

Investment

1 ha. of pond previously constructed at 3 million/ha	Rp.	4,500,000
7 sluice gates for water control		
7 x 75,000/each		525,000
Total Investment		5,025,000

Total Operating Costs

Pond bottom preparation	Rp. 84,000	
Buffalo manure outside source	15,840	
*Fry C. Carpio	252,000	
Pig manure "local" weekly application	3,600	
Full time employees	120,000	
Bonus	60,000	
Maintenance	120,000	
Total		655,440

It must also be stated that this farmer was in the practice of holding his animals until the market value was what he considered favorable and selling only small amounts monthly to cover operating costs.

Annex VIII-D

*Value of <u>Cyprinus</u> <u>carpio</u> fry in Perbandingan during 1977/78

	1-3 cms.	3-5 cms.	5-8 cms.	8-12 cms.
April to June	500. to 800.	6,000 to 8,000	12,000 to 16,000	25,000 to 28,000
July to December	800. to 1200.	8,000 to 12,000	16,000 to 20,000	28,000 to 32,000
January to March	500. to 800.	6,000 8,000	12,000 to 16,000	25,000 to 28,000

*Value of size classes given in Rupiah/1000 fingerlings.

Table II. Fingerling Distribution 1977-78

Maximum amount of fingerlings per size class data presented as millions of fingerlings.

	1-3 cm.s	3-5 cms.	5-8 cms.	8-12 cms.
From outer areas	4,790	1,500	1,000	-----
To other areas	,850	,600	,630	,500
Perdagangan local	1,500	,600	,500	,300

Annex VIII-E

Production of *Cyprinus carpio* at KARASSAN FISH HATCHERY

Year	Numbers of Fingerlings
1973	375,000
1974	412,000
1975	510,000
1976	271,000
1977	303,000

IX. Environmental Considerations

The projects present very few environmental problems, all of which are minimal; also in some instances a general upgrading may result from the technical assistance suggested.

The recommendations for the artisan fisheries are aimed at further fisheries development under improved management. Inherently the goal of such efforts is to achieve safeguards against the ecological imbalance that can result from overfishing.

Two units of the program involve construction or modifications of existing construction. For one of these, the ice plant at Meringgai, the impact is negligible especially since the water requirements amount to only nine tons per day using a pumping and supply system with a capacity of 30 tons per day which comes from a flowing stream that probably exceeds this by at least an order of magnitude. Water problems cannot be set aside quite as readily in the efforts involving Macrobrachium hatcheries in settings where deep well water must be used for the fresh water supply. Pumping from any such well could conceivably lower the water supply for domestic and other used. For such hatchery needs test drilling and pumping, along with interpretations of the drainage geomorphology, are recommended. These should include a critical evaluation to make sure the use does not interfere with the domestic water supply.

Of the remaining units of the program two involve standing water, a feature which must always be regarded with concern from the standpoint of the malaria problem. One of these would encourage the use of rice paddies for growing fish on a rotating basis, i.e. one rice crop is usually followed by the planting and grow-out of fish (mostly carp). In this, however, the flooded pond containing fish is regarded as a low density mosquito larvae habitat as compared to the planted and growing rice paddy which it replaces for several months each year. The other practice, namely tambak culture, favors the larvae of malaria vectors and this is only relieved when the tambaks are well maintained with the dike edges kept trim so as to drain effectively, with floating algae cleared from the water surfaces, and with the supply canals well engineered and sustained. Such objectives are included in the scope of the tambak effort and thus should alleviate rather than accentuate the tambak malaria problem.

The one remaining unit in the program involves improvements in floating cage culture. This could lead to a greater use of the waterways but without conflict with other uses. To be sure an extreme multiplication of such cage practices could add to the B.O.D. loading on these water, but, in a setting where the common practice is to load human and other organic wastes indiscriminantly to the environment, it would be far fetched to be concerned over the input from the cages.

1.a. Artisanal Fishery Management - a program with modest plans for upgrading the capture fisheries throughout Indonesia.

b. Environmental considerations have been covered by an interdisciplinary team from the University of Rhode Island, two on the team, Professors

Nelson Marshall and Saul B. Saila, being professional ecologists from the University faculty.

c. The sub-project does not present any environmental problems inasmuch as the intent is to improve management techniques and to endeavor thereby to better protect the fishery stocks and to develop safeguards against any ecological imbalance that might result from overfishing. Any suggested expansion in the artisan fishery should, according to the proposed projects, be carried out in close conjunction with such improved management.

d-g. Not applicable

2.a. Floating Fish Cage/Enclosure Research - a two-year program of trials intended to optimize returns from the floating fish cage culture as practiced in the Palembang and Jambi areas of South Sumatra.

b. As above

c. The intended optimization of growth in floating cages will undoubtedly be accompanied by an increased organic loading on the waters involved from the excretion and fecal deposits of the fish being cultured. Since the floating cage culture under consideration is practiced in open lakes and broad rivers, it is highly doubtful that a B.O.D. will develop in excess of the assimilation capacity of these waters; furthermore the added organic loading merely accompanies the widespread practice throughout Indonesia of deliberately adding human organic wastes directly the waterways, often under regimes, as in this cage culture, in which some of it at least is readily converted or recycled into edible products. Conceivably the human wastes may transmit disease whereas the fish involved in cage culture are not known to transmit diseased to man and, if anything, may help to alleviate any possible disease transmission through the human waste pathway.

d. In carrying out the trials the works involved should direct attention to the question of how much the cage culture practice might be increased in representative water bodies, such as the test areas, before the B.O.D. could become a problem.

e. Not applicable

f. The workers carrying out the trials should forward samples of the fishes involved to the Inland Fisheries Research Institute in Bogor to be examined so as to check the assumption, stated in "e" that they will not transmit diseases to man. Should the assumption prove incorrect, further steps, perhaps some curtailment or modification of the cage culture, might be deemed necessary. Even such an unfortunate and unexpected turn of events would not, however, be regarded as environmentally negative since, in essence it would be casting light upon a problem currently overlooked and needing attention.

g. Not applicable

3.a.. Meringgai Pilot Ice Plant - an 8.2 ton ice plant to be constructed at the Type C fishery landing site at Meringgai in Lampung Province, Sumatra.

b. As above

c. The landing site is being developed by the Indonesian government and any land modifications, including the displacement of poeple, are within the scope of the GOI plan which seems to provide amply for the concerns of the people and the protection of the environment. The completion of the ice plant simply fits into this GOI program. The ice plant will draw about nine tons of fresh water per day using a pumping system currently in operation for wash water, etc., and having a capacity of 30 tons per day. The water comes from a stream tributary to the estuary where the landing site is being developed. A negligible amount of waste heat will be vented to the atmosphere when the ice plant is operating.

d-e. Not applicable

4.a. <u>Macrobrachium Culture</u>

b. As above

c. As to the hatchery operations it is recognized that any such culture program is bound to release some organic matter downstream from the site. This is contributed as waste products from the organisms grown therein and possible excesses from fertilization practices. Obviously, the goal is to avoid fertilizing in excess of growth needs and overall, it would be unusual to experience an effluent increment greater than 1 ppm NH_4. Where "green water" is used, the *Chlorella* or whatever forms are involved, tend to take up the N wastes. In a regions where there is already indiscriminate loading from human wastes and disposal practices it seems far-fetched to be concerned over releases from a hatchery. A far more serious problem could arise from a hatchery drawing its water supply from a well which might lower the water table to the detriment of domestic and other supply needs in the immediate vicinity. Thus, added to the suggestion that a thorough survey of the underground water potential must be made in conjunction with siting a hatchery is the imperative that such a survey must include checks to make certain that other water supplies will not be endangered by hatchery requirements. In hatchery and grow-out ponds for Macrobrachium one can expect a heavy build up of organic detritus. For effective hatchery and pond use this must be removed periodically. It is ideal garden fertilizer and should be used as such, thus leading to an environmentally advantageous rather than burdensome situation.

d. Not applicable.

e-f. See comment under "c" regarding the survey of the underground water potential.

g. Not applicable

5.a. Assistance to Tambak Small-holders

b. As above

c. When tambaks are established one faces very complicated questions as to the ecological trade-offs between the tambak habitat complex and the mangrove swamps which constitute the natural environmental areas that are sacrificed in construction. However, since this sub-project involves improvements of existing tambaks and not the expansion thereof, the trade-off question does not arise. In fact a number of the improvements should be ecologically beneficial as noted below.

There is widespread concern that tambaks create a greatly increased larval habitat for two species of Anopheles which are prime malaria vectors and tolerate high salinities, even in excess of 25o/oo. This problem is greatly accentuated when tambaks are poorly managed with grasses growing at water level on the dike margins and with algal scum being allowed to accumulate on the water surface. The intent of this sub-project is to counter such degradation in tambak management.

Also the better engineering recommended for canals, etc., should relieve some of the mosquito problems linked to poor drainage. Finally, if the farmers elect to encourage mangrove growths on the dikes and perhaps, within practical limits, within the ponds, such vegetation which is not so optimal for mosquito growth yet contributes to the organic input and stability of the area should serve as an ecologically desirable alternative to the grasses and algae. All told the practices suggested would not eliminate the malaria problem but should alleviate it considerably.

Organic detritus accumulating in hatchery ponds may be substantial and would need to be removed from time to time to avoid anaerobic benthic conditions. It is good garden fertilizer and, assuming it is so used, presents no burden on the environment. Where fry are planted for grow-out, such organic detritus spreads out over the paddies, is plowed in, and benefits the crops.

The fish culture practices under consideration do not involve the use of pesticides. Pesticides applied for rice production in the same paddies used for grow out are lethal to the fish but the forms and applications approved by the government's Pesticide Commission are not persistent. Thus in a rotation system, there is no concern regarding contamination.

Widespread concern with respect to malaria dictates precautionary considerations for any practice in which standing water is involved. In this case the practice being augumented is to grow fish in the ponds, after the rice crop has been harvested. A paddy used in this way harbored fewer mosquito larvae than a paddy used instead for a second crop of rice.

For the optimum tambak culture recommended pesticides are used prior to stocking to rid the ponds of chironomid larvae. These pesticides, however, are the degradable forms approved by the government's Pesticide Commission and should be applied at the rates approved by the Commission. These practices should be free of adverse effects both to the environment and the human consumer. Expert attention has been directed to the use of these pesticides and should be continued.

Notable publications are:

Duursma, Egbert Klas 1976
Indonesia: Role of pollution and pesticides in brackish water aquaculture in Indonesia. A report prepared for the project on shrimp and milkfish cutlrue applied research and training. Restricted FI: INS/72/003/4.

Duursma, Egbert Klas and Adi Hanafi 1975.
Use of pesticides in brackish water ponds.1. Effects of diazinon on fish and shrimp. Bull. Shrimp Cult. Res. Cent., I (2): 56-58

d-g. Covered under "c" to the extent applicable

6.a. Rice field fish culture development

b. As above

c. Since this sub-project invovles an increase in the output of the hatchery at Karasaan increased loading of waste organic matter from the fish being produced may be evident immediately downstream from the plant. In this setting, where human wastes and other organic matter are added indiscriminately to the waterways, it would be far fetched to be concerned over any such hatchery impact, in fact with the filtration practices involved in prepareing water for hatchery use and with settling taking place in hatchery ponds, the project may improve rather than burden the waters affected.

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Another Envioronmental Consideration

The very heavy silt loads characteristic of so many Indonesian streams present problems at the mouths of estuarias which are of obvious importance as small harbor areas and are frequently used as major landing sites. The problem is aggravated by the continuing increase in this silt load, and there is no reason to expect the pattern will be reversed in view of the ever-growing need for agricultural expansion at the sacrifice of native forest cover. In the face of this, desirable harbor area is either lost or is maintained under occasional and sporadic dredging regimes that do not seem well conceived.

One point that tends to be overlooked when this problem is discussed is the fact that, in some settings, the sediment actually may enter by advection from offshore. Also, in discussions of the problem one is prone to hear suggestions as to baffles, groins and other structures intended to alter the flow to induce hydrodynamic effects that might carry away the fill. Such relatively easy answers are not likely to work simply because of the basic coastline principle which predicates that silt removed from one locale inevitably becomes deposited elsewhere. Faced with the above problems, two measures that might be useful are suggested.

1. Engage in a study in which appropriate experts would be called upon to focus on this general estuarine mouth-fill problem as it effects fishery harbor and landing areas. Such a study, if it is to be at all reasonable, would have to be generalized and could not involve the rather elaborate modelling approach so often deemed necessary where harbor siltation is considered on a grand scale.
2. Explore the feasibility for a programmed, often repeated, dredging regime with suitably designed, movable equipment that might serve multiple sites at an acceptable cost.

MACROBRACHIUM AQUACULTURE PRODUCTION IN CENTRAL JAVA

LOCATION	UNIT SIZE (m^2)	DURATION OF STUDY	STOCKING DENSITY	STOCKING SIZE	HARVEST DENSITY	MEAN SIZE	(%) SURVIVAL	AMOUNT FERTILIZER (Kg)	GROWTH GM/WK	FEED FEED KG (F.C.)	TYPE OF AQUACULTURE	PRODUCTION TOTAL
iek ral Java	2,000 110cm deep	March to July 77	3.0/m^2	4-6cm 2.5 gms	3,620	80 gms	60%	2,000	3.9g/wk	275kg (1.1)	mono- culture	290 kg/12,00 (1315 kg/ha)
	7,600 90 cm deep 3 ponds	Oct.74 to Apr. 75	3/9/m^2 prawn 150 mola 3,000 Puntius	0.2gms 10.0gms 5.0 gms	9,684 146 2,632	40 gms 600 gms 80 gms	32.3% 97.3% 87.7%	5,000	1.4g/wk 21.g/wk 2.7g/wk	887.6kg (1.18)	poly- culture	prawn 388 kg (+ 500 kg/ha mola 87 kg Puntius 21[illegible] TOTAL: 686 kg 17,60
n Banyumas	6,000 60 cm deep	July to November 1976	1.0/m^2 prawn 30,000 Puntius	6.0 gms 10.0 gms	4,200 18,000	120 gms 60 gms	70% 60%	Ad.lib. horse manure House- hold scraps	4.75g/wk 2.25g/wk	ad. lib.	poly- culture	Praion 420 K (+ 550/ha.) Puntius 540K (+ 750Kg/ha) 960kg 16,00
	3,000 60 cm deep	June to August 1976	10/m^2 prawn	0.2 gms	16,500	6 gms	55%	"	.48g/wk	"	mono- culture	sold: $15./1,000
Minggu .D.)	100m^2 45 cm deep	90 days	4/m^2 6/m^2 8/m^2	9.0 gms 9.0 gms 9.2 gms	---- ----	31.3gms 30.5gms 28.9gms	24% 46.1% 23.7%	---- ---- ----	1.86g/wk 1.78g/wk 1.74g/wk	Pellet (U.G.I.)	mono- culture	3Kg/100m^2 (300Kg/ha) 8.44Kg1100m^2 (844Kg/ha) 5.48Kg/100m^2 (548Kg/ha)

Annex A

Budgets

Ice Plant, Maranggai

1.	**Capital Costs (Ice Plant)**	
a.	North Star Flake Ice Plant M-20-WC-30, including shipping	48,000
b.	Diesel Generator MW M DITER D325-6	12,000
c.	Insulation, Kudneu panels	13,000
d.	Ferro-cement building	32,000
e.	Pipes and fittings	2,000
f.	Labor	13,000
g.	Freight, Jakarta-Maranggai	3,000
h.	Construction management and supervision	18,500
i.	Reinforcing dock	12,000
		153,500
2.	**Other costs**	
a.	Consultant from North Star for start-up 3 weeks @ $150	3,150
b.	Consultant travel and P/D	3,500
	Total Other	6,650
	TOTAL	160,450*

*This cost may be reduced by 20,000 if the building is made of wood and sheathed in galvanized iron. The maintenance cost would be significantly higher.

Macrobrachium Culture (2 years)

1. Wages and Salaries

a)	Macrobrachium specialist @ 34,320/a	68,640
b)	Driver @ 130/mo.	3,120
	Total	71,760

2. Travel and transport

a)	Overseas travel of professional incl. P/D 2 trips @ 2500	5,000
b)	Overseas travel of family 1 trip each @ 2500	7,500
c)	Internal air travel	2,000
d)	Motor vehicle operation	5,000
e)	Vehicle purchase	8,000
f)	Airfreight household effects and supplies.	10,000
	Total	37,500

3. Living Costs

a)	Cost of living allowance	3,000
b)	Rental @ 600/mo.	5,200
c)	Rental @ 600/mo.	14,400
d)	Utilities @ 200/mo.	4,800
	Total	27,400

4. Project operations

a)	Laboratory and other scientific equipment	5,000
b)	Calculator and computer time	1,500
c)	Office supplies & equipment	1,000
d)	Communications & copying @ 150/mo.	3,600
	Total	11,100

5. Project capital costs

a) Well drilling @ 25/ft.		50,000	
b) Other equipment for cleaning and aeration		42,000	
	Total	92,000	

6. Other expenses

a) Language training		4,440	
b) Workman's Compensation		1,100	
c) Consultant & other support		9,000	
d) Training of 3 technicians in Hawaii @ 6210 ea.		19,530	
	Total	34,070	
	Total		273,830

Rice-fish Culture (2 years)

1.	Wages & Salaries	
	a) Fisheries biologist @ 34,320	68,640
	b) Driver @ 130/mo.	3,120
2.	Travel and transport	
	a) Overseas travel of professional in P/D 2 trips @ 2500	5,000
	b) Overseas travel of family 1 trip ea. @ 2500	7,500
	c) Internal air travel	2,000
	d) Motor vehicle operation	5,000
	e) Vehicle purchase	8,000
	f) Airfreight	10,000
3.	Living costs	
	a) Cost of living allowance	3,000
	b) Educational allowance	5,200
	c) Rental @600/mo.	14,400
	d) Utilities @ 200/mo	4,800
4.	Project operations	
	a) Laboratory & other scientific equip.	5,000
	b) Calculator	1,000
	c) Office supplies & equipment	1,000
	d) Communciations & copying	3,600
5.	Other expenses	
	a) Language training	4,440
	b) Workman's compensation	1,100
	c) Consultation and other support	9,000
	Total	$161,800

Floating Fish Cage/Enclosure Tests (1 year)

1. Wages and Salaries	
a) Fisheries biologist @ 34,320/a	34,320
b) Driver @ 130/mo.	1,560
2. Travel and Transport	
a) Overseas travel incl. P/D 2 trips @ 2500	5,000
b) Internal air travel	1,500
c) Motor vehicle operation	2,500
d) Purchase of vehicle	8,000
e) Air freight & excess baggage	2,000
3. Living Costs	
a) Cost of living allowance	1,500
b) Rental @ 600/mo.	7,200
c) Utilities @ 200/mo.	2,400
4. Project operations	
a) Equipment & supplies	20,000
b) Laborers - 2 @ 150/mo.	3,600
c) Laboratory & other scientific equip.	10,000
d) Office supplies & equipment	1,000
e) Communications & copying	1,200
f) Calculators & computer time	1,500
5. Other expenses	
a) Language training	4,440
b) Workman's compensation	600
c) Consultants and other support 30 days @ $150	4,500
Total	$112,820

Tambak-Small Holder (1 year)

1. Wages and Salaries		
a) Extension specialist		34,320
2. Travel and Transport		
a) Overseas travel incl. P/D		5,000
b) Internal air travel		1,500
c) Internal ground travel		1,000
3. Living Costs		
a) Cost of living allowance		1,500
b) Rental @ 600/mo.		7,200
c) Utilities @ 200/mo.		2,400
4. Project operations		
a) Office supplies & equipment		1,000
b) Communications		1,800
c) Secretarial Services		1,000
	Total	$56,720

Autisanal Fisheries Management (3 years)

1. Wages & Salaries

a) Fisheries economist @ *34,320/a		102,960
b) Fisheries biologist/technologist @ 34,320/a		102,960
c) Fisheries biologist @ 34,320/a *Includes fringe & post differential		102,960
d) Secretary @ 200/mo.		7,200
c) 2-Drivers @ 130/mo. each		9,360
	Total	325,440

2. Travel and transport

a) Overseas travel of professionals 2 trips ea. @ 2500		15,000
b) Overseas travel of families 2 trips ea. @ 2500 for 3 members		45,000
c) Internal air travel of professionals 1500/a. each		13,500
d) Motor vehicle operation @ 2500/a each		15,000
e) Purchase 2 vehicles @ 8000 each		16,000
f) Airfreight of household affects & supplies @ 10,000		30,000
	Total	134,500

3. Living Costs

a) Cost of living allowance @ 1500/a. each		13,500
b) Educational allowance @ 1300/a for six		23,400
c) Rental @ 600/mo.		64,800
d) Utilities @ 200/mo.		21,600
	Total	123,300

Autisanal Mge. page 2.

4. Project operations

a) Vessel charter (with crew and equip.) 150 da. @ 50 = 7500 150 da. @ 100 =15000		22,500
b) Fishing gear and supplies		15,000
c) Laboratory and other scientific equip.		10,000
d) Calculators & computer time		6,000
e) Office supplies and equipment		4,000
f) Communications & copying		10,800
g) Shore Labor @ 150/mo.		3,600
	Total	71,900

5. Other expenses

a) Language training @ 4440 ea. incl. P/D		13,320
b) Workmen's compensation		5,000
c) Consultant on vessel design 16 m.mos. Travel & P/D 30,720 Fees 64,000		94,720
d) Graduate education 4 students for 3 years each		144,000
	Total	257,040