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Report on a Visit to Sri Lanka to
Study Technical and Socio-economic
aspects of the BOBP Post-harvest
Fisheries Programme

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Abbreviations and acronyms

BOBP	Bay of Bengal Programme
FRP	Fibre Reinforced Plastic
IREC	Innovations et Reseaux pour le Development
MFAR	Ministry of Fisheries and Aquatic Resources
NARA	National Aquatic Resources (Research & Development) Agency
NIFT	National Institute of Fisheries Training
NRI	Natural Resources Institute
ODA	Overseas Development Administration
PIB	Permanent ice Boxes
Rs	Sri Lankan Rupees
TVB	Total volatile bases
UAE	United Arab Emirates

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Summary and Conclusions

The team consider that the general marketing and post-harvest handling of fish and fish products in Sri Lanka is efficient given the resource constraints. Conditions of under supply and high consumer demand promote competition. The fisheries sector is highly dynamic and responsive to changes in demand. Post-harvest losses in value, and quantity are minimal, though some issues of quality were identified.

Key Findings & Recommendations

1. *Permanent Ice Boxes*

The mission found that, though there seems to be a strong financial and economic case for installing ice boxes in areas of poor or uncertain ice supply, institutional and social constraints presently out-weight these benefits. Consequently, given the social and institutional difficulties in implementation highlighted by the mission, the consultants cannot recommend proceeding with installation of permanent ice boxes in either Dodanduwa or Weligama.

However, it is recommended that trials are conducted, under controlled conditions, at NARA to compare traditional ice storage methods with an improved ice box made from man-made insulation and fibre reinforced plastic. This will assess the financial and technical advantages of improved ice storage.

Action: NARA

2. *Fish Quality.*

The contamination of fish with histamine is clearly a problem and it is recommended that the scope of this problem be investigated. It will probably be necessary for on the job training to be given to NARA staff in analysis of histamines when the necessary equipment is available in NARA.

Action: NARA/NRI

3. *Bicycle Traders*

Increased use of bicycles and motor-bicycles for wet fish marketing presents the possibility of applying technical improvements such as insulated ice boxes.

The consultants recommend that the project include itinerant bicycle and motor-bicycle traders in its programme of research. This should include an in-depth socio-economic bench-mark study of current practices and conditions. Adaptive research into ice box design should also be undertaken in consultation with 'cycle operators. Consideration of credit and institutional arrangements for extension of the technology should be an integral part this programme. Recruitment of a suitable person to implement this study should proceed as soon as possible.

Action: NRI/BOBP/NARA

4. Fish gutting at sea

Gutting fish at sea is unlikely to be successful at the moment for the following reasons:

- . Wet fish is currently under supplied to the Sri Lankan market. Under these circumstances there is little or no premium for quality.
- . There is a market for guts lower down in the marketing chain.
- . There is evidence of considerable consumer resistance to gutted fish products.
- . Under present handling and storage conditions, gutted fish are in fact of poorer quality than ungutted fish.
- . There are on-board constraints to producing high quality gutted fish including lack of space on-board, lack of labour on-board, poor ice/fish stowage conditions, lack of adequate gutting and washing conditions and safety considerations.

It is therefore felt that gutting on multi-day boats is an impractical proposition under present conditions and unlikely to repay the additional effort and expenditure involved. It is, therefore, recommended that survey work be discontinued for the time being.

Action: BOBP/NARA

5. Training in Sri Lanka

Despite a definite need for training in post-harvest fisheries matters the consultants cannot recommend implementation of a training programme at the moment. This is due to the absence of a recognisable Government policy

for fisheries extension. This recommendation should be reconsidered if and when a clear extension policy is forthcoming.

6. Overseas Training

It is recommended that a key member of the Institute of Post-harvest Technology (NARA) should attend the NRI course on 'Handling and Quality of Fish in the Tropics' during financial year 1992-3.

Action: BOBP/NARA/BC

7. Further Inputs.

A further input by UK consultants will be needed to further progress the work on ice boxes, bicycle traders and histamines, perhaps in the first quarter of 1992. It is considered important, for the sake of continuity, that the team should consist of officers already familiar with the programme.

Action: BOBP/NRI

MAIN REPORT

Introduction

1. The FAO executed Bay of Bengal Programme for fisheries development funded by SIDA/DANIDA has been working in Sri Lanka on various aspects of pre harvest fisheries development for some years but it was not until early in 1991 that agreement was reached for the ODA funded and executed post harvest component of the programme to initiate work in Sri Lanka. For the ODA post harvest programme the Institute of Post Harvest Technology, a division of the Sri Lankan National Aquatic Resources (Research and Development) Agency, would be the main organ through which activities would be channelled. In February/March 1991 J F Rogers of NRI made a preliminary visit to Sri Lanka to particularly look at the needs of the fishing fleet with regard to on board handling of fish, to investigate handling at fish landing sites and to study the handling of fish during the low catching season. For operational reasons it was not possible for this first visit to include any socio-economic studies.

2. The mission reported on here, by a fish technologist and a socio economist, was a follow up to the Rogers mission and consisted of a number of components. These included a review of socio-economic aspects of Sri Lankan fisheries particularly within the post harvest sector and whether there is scope for BOBP involvement, further work on the proposals made by Rogers concerned with gutting skipjack at sea and the installation of ice boxes at specified landing centres, making a general appraisal of the fish handling systems applied in Sri Lanka during the peak fishing season to ascertain whether avoidable losses occur and to discuss and evaluate the possibility of training activities for staff of organisations involved in fisheries development and extension. The full Terms of Reference for the mission are given in Annex I.

3. The mission lasted roughly four weeks and included extensive field surveys and discussions with relevant institutions. In addition, a trial was conducted to study the technical and financial viability of gutting fish at sea. A full itinerary is at Annex II.

Overview of the Sri Lankan Fishing Economy

Introduction and background

4. In the absence of comprehensive data on fisheries resources, the following is a condensed overview of recent and current changes and trends. Much of the information is from secondary sources, particularly the FAO Sector studies of 1988 and 1991.

5. Expansion of the off-shore fishing fleet since the mid-1970's characterised by the introduction of large numbers of vessels capable of multi-day use, is the most significant change in the sector. It is estimated that 650 purpose built multi-day vessels are currently catching about 20,000 tonnes of fish per year. In addition, the profitability of this activity has encouraged the widespread conversion of smaller vessels for multi-day use. Increased availability of engines, the use of ice (both on-board and on-shore) and the introduction of increased competition in the marketing chain has characterised the fish economy in the past decade. The efficiency of this sector may be measured against five criteria:

1. losses caused by spoilage;
2. losses caused by deterioration in quality;
3. efficiency of handling localised gluts;
4. ability to overcome localised supply shortfalls;
5. level of marketing margins between producer and consumer.

These are considered below.

Spoilage losses and quality deterioration

6. Information on these criteria are purely indicative in the absence of empirical data. Work undertaken by Fernando and the Marga Institute (Panyantou, 1985) suggests that spoilage during production, assembling, wholesaling and retailing is negligible. Standards of post-harvest handling are adequate given consumer attitudes to quality and it is not felt that additional investment in quality improvements will be repaid by higher consumer prices. The primary concern of lower income consumers is price and not quality.

Fish supply and demand

7. In 1989 total supply of fish was 285,968 tonnes made up of domestic marine and inland fisheries plus imports (see Table 1). The majority of the national catch enters the

marketing chain in wet form. Un-iced fish is preferred by consumers. Iced and frozen fish are associated by consumers with poor quality.

8. Recent Government policy changes withdrawing support for inland fisheries, plus the fall-off in fish supplies from the troubled Northern Districts have resulted in supply shortfalls and price increases. Shortfalls are met by importation of dried, cured and canned fish. Despite this, there is no expectation of any reduction in the current gap between supply and demand assuming constant per capita consumption rates. Consumer preference for wet fish will reduce domestic availability of fish for drying and curing which must be met by further importation.

Table 1: Fish Supply, 1989 (tonnes)

	Marine	Inland	Imports	Total	Percent
Wet	135,155	29,790	-	164,945	56%
Dried 1/	30,410	9,930	72,637	112,977	38%
Canned 1/	-	-	17,352	17,352	6%
Total	165,565	39,720	89,989	295,274	
Share of total (%)	56%	13%	31%		100%

Source: MFAR quoted in FAO (1991)

1/ Converted to wet fish equivalent using a factor of 2.5

9. The Ministry of Fisheries have projected that at current rates of population growth and given constant per capita consumption of fish, the supply gap to be met by imports by 1994 will be approximately 165,654 tonnes, or 43% of domestic demand. x

Fish gluts

10. Conversations with village traders and assemblers suggests that during localised gluts, fish are purchased and processed into dried products. Evidence on the impact of longer gluts (ie, the skipjack glut) was not available and should be sought.

Fish Consumption Patterns

11. ODA (1985) found that per capita expenditure on fish rises steeply with income. It also suggested that substitution occurs at higher income levels between dried fish and wet fish products.

12. On average, households spent 65% of their income on food. Naturally this varies between low and high income households, the former spending proportionally more of their income on food necessary for survival. Thus, the proportion of household expenditure allocated to animal protein varied between under 9% at the lowest income level and over 26% at higher levels. This holds true for expenditure on fish products, which varies between 4.07% at the lower income levels and 10.43% at the highest income level.

13. Further disaggregation shows that, more is spent on wet fish (56%) than dry (38%). Urban consumers allocate more of their income to wet fish (73%) whilst the estate sector relies heavily on dry fish (62%). The rural (non-estate) sector appears to share consumption between wet (51%) and dry (44%).

14. This suggests that any input designed to increase fish availability or reduce unit costs of current production will disproportionately benefit higher income consuming groups, but that expenditure on improving dry fish production will have greater benefit at lower income levels.

Dried fish production

15. Data available from the Ministry of Fisheries shows that between 1980 and 1990 dried fish production has averaged 9,956 mt per annum or about 6.4% of total fish production by weight. In wet fish equivalents, this represents nearly 20% of landed catch. The most important areas of production are Jaffna (63%), Puttalam (14%) and Mannar (12%).

16. During most of the 1980's the gap between demand for dried fish and domestic supply has been met by imports (see Table 2). Imports of dried fish averaged 18,700 mt during the period 1980-89. Primary sources of imports are India, Pakistan, Thailand and UAE.

Table 2: Availability of dried fish, 1980-89

Year	Production	Imports	Total Supply
	-----('000 mt)-----		
1980	8.6	11.4	20.1
1981	10.6	3.9	14.5
1982	11.5	7.2	18.7
1983	9.5	10.3	19.9
1984	5.1	33.4	38.4
1985	9.0	23.4	32.4
1986	9.7	22.6	32.4
1987	10.7	28.5	39.2
1988	11.3	29.2	40.5
1989	12.2	17.0	29.2

Source: Ministry of Fisheries (1990)

17. Information on dried fish prices are inconclusive, but a survey of inter-seasonal variation in prices did suggest that peaks in demand occur during months with important religious festivals. (Ministry of Fisheries - 1990)

Ice production

18. Available statistics show that installed capacity for ice production is 860 tonnes per day at 69 ice plants. Many of these plants are not operating. Others are operating inefficiently, and are poorly sited. FAO (1991) estimate that annual production is in the region of 64,000 tonnes. This may be expected to increase in the near future as a result of the Government divesting itself of the Ceylon Fisheries Harbour Corporation facilities (6 plants with a capacity of 13,500 tonnes per year). In addition, several of the major banks have recently begun releasing funds for ice plant construction by the private sector.

19. Apart from multi-day fishing, where ice is carried to increase the time available over fishing grounds, the use of ice rests almost entirely within the marketing chain, the fisherfolk selling only uniced fish. Assemblers and wholesalers who operate vehicles usually bring ice as a return load and this has proved a relatively efficient system. In return for providing this service the middleman extracts a risk rent which is included as part of profits.

Fresh Fish quality

20. Fresh fish marketing in Sri Lanka is characterised by a general lack of attention to quality on the part of the consumer. As has been already stated, because of the high demand and under supply situation prevailing most of the time, there is very little if any price premium for better quality fish. In addition, the use of ice to preserve fish is not acceptable in many areas. This suspicion of iced fish probably has arisen because in the past only fish that could not be sold fresh having spent a day without ice on a market stall was put into ice for overnight storage and sale the following day. This meant that only already spoiled fish was iced and, therefore, the consumers associated iced fish with spoiled fish.

21. This situation is now showing signs of change. In the Colombo area, for instance, some retail market stalls use ice in the displays, have ice boxes for storage of the bulk of the fish and ice is used extensively by itinerant traders using bicycles and motor-cycles for transport. In addition fish on ice is transported from coastal regions to inland markets on ice using both bicycles and motorised transport.

22. However there is still a marked reluctance to use ice on inland markets with consumers distinguishing between fresh fish (fish without ice) and iced fish. The mission found little evidence of ice being used on market stalls in the inland markets visited. Even those run by the Ceylon Fisheries Corporation who have a cold store in Kandy along side their retail sales outlets and also sell from the back of insulated vans in some of the major towns do not use ice. One private trader selling from the back of a van in Kegalle however brings four or five boxes of iced fish from Negombo and sells fish direct from these boxes with ice. All other retail sellers contacted in the inland markets visited display their fish without ice and normally use deep freeze chests for overnight storage of unsold fish.

23. As a consequence of these poor handling regimes at the retail markets fish, which might arrive in good condition from Negombo or Trincomalee on ice, often spend long periods at ambient temperatures under very unhygienic conditions. Many of the market stalls were infested with flies and the fish (particularly the larger species cut into pieces and displayed for sale) are generally of very poor quality by midday. As has been said this poor quality does not materially affect the final selling price and so there is little incentive for retailers to improve the situation since this would undoubtedly require further investment on their part.

24. However there is cause for some concern from a public health point of view. A number of consumers and members of the public interviewed by the mission at inland towns reported a reluctance to purchase "blood fish"; tunas, skipjack etc. This is because these fish often cause a "peppery/itchy taste in the mouth". This is a classic symptom of scomberotoxin poisoning caused by the build up of biogenic amines in tuna-like fish kept for long periods at high temperatures. The allergic reactions in humans from the toxic amines produced can be very severe and if, as seems likely, Sri Lankan consumers regularly suffer from this there could be substantial benefits from reducing the incidence of the poisoning.

25. This situation leads the team to recommend that a survey be conducted to measure the extent of the problem in Sri Lanka and the effect that it might be having on the economy.

26. NARA are expecting the acquisition of a fluorescence spectrophotometer by the end of this year (1991) and using this equipment it will be possible for the staff to measure levels of Histamine in fish tissue. Histamine is one of the amines involved in causing toxicity and can be used as a measure of the extent of the problem. It is recommended that when the spectrophotometer is available in NARA that a UK consultant familiar with histamine assay be recruited to train NARA staff in the techniques and to set up a survey programme.

Fish Marketing Trends

Introduction

27. The marketing of fish in Sri Lanka has developed to minimise risk rather than maximise profit from the sale of a highly perishable commodity. The marketing chain for fresh fish in Sri Lanka is elaborate and often involves a number of market intermediaries. Risk of spoilage and loss is subsumed to a greater or lesser degree by these market intermediaries in return for a profit which includes a "risk rent". These intermediaries, whilst extracting risk rent and in some cases monopoly profits, provide the fisherfolk with a guaranteed market for landed fish. Marketing margins amongst intermediaries interviewed were found to be as high as 70% of total retail value. However, in the light of the high risk involved, this margin is not considered excessive and compares very favourably with margins experienced by fisherfolk in other parts of Southern Asia.

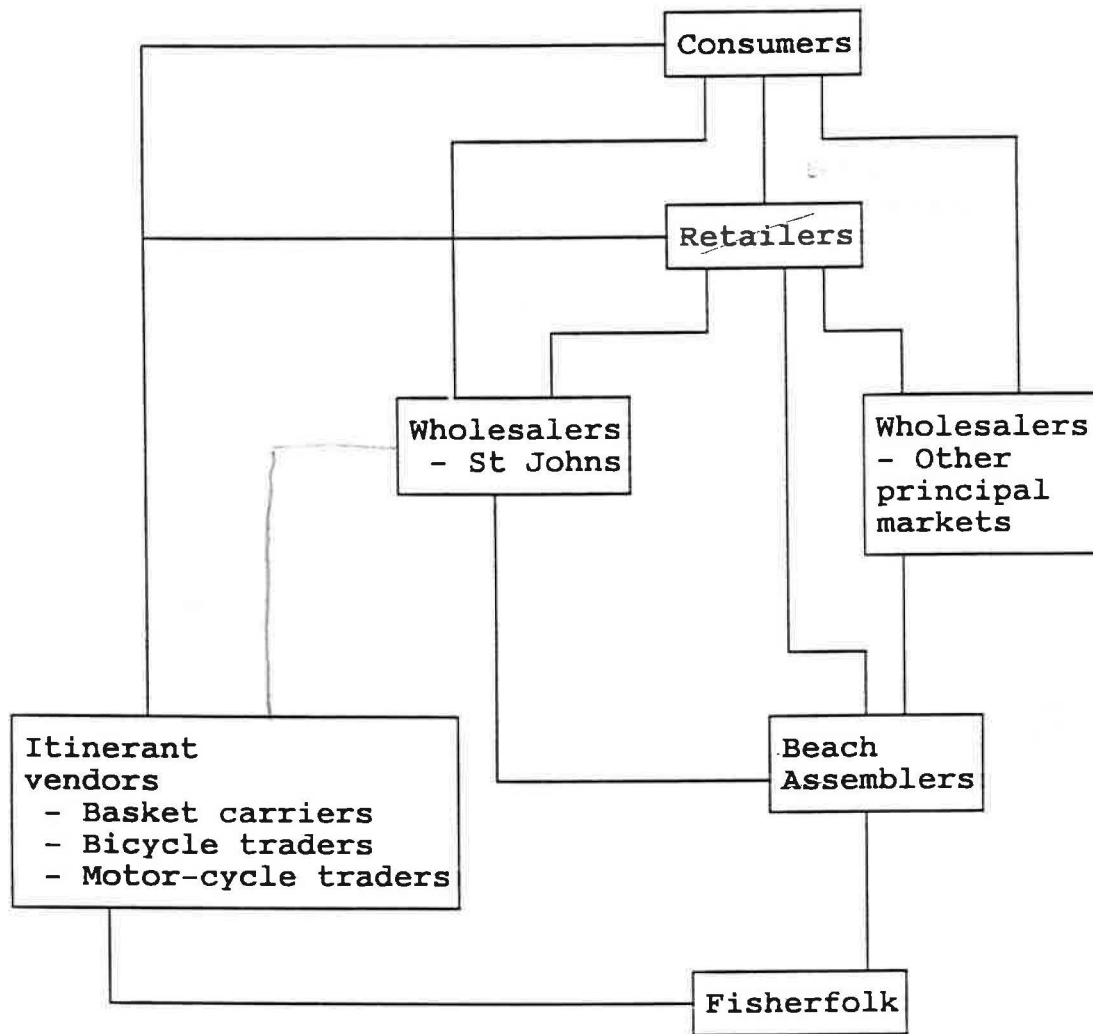
28. A graphical representation of the market structure is presented at Figure 1.

29. It is the general opinion of the consultants that the marketing of fish in Sri Lanka is conducted efficiently given the existing constraints of a resource poor economy. Wet fish is brought to the consumer in reasonable condition and at a reasonable price given the risks involved in marketing.

30. The great majority of catch is disposed of through pre-arranged sale to assemblers/wholesalers or through competitive auctions. Many fisherfolk have long term patron-client relationships with their respective middlemen who, in return for regular supply at fixed prices, provide fisherfolk with credit facilities.

31. More recently there has been a trend towards increasing presence at many landing sites of itinerant traders who purchase small quantities of fish for direct sale to consumers. Fishermen believe that this has generally increased competition at landing sites.

Figure 1: Fish marketing structure



32. All fish landed is productively disposed of even during glut seasons. Marketing margins are considered reasonable under current conditions which include monopolistic and oligopolistic marketing scenarios.

Local supply shortfalls

33. Interviews conducted at landing sites, internal markets and with itinerant vendors indicates that even in the more inaccessible areas of Sri Lanka wet fish is available at roughly twice the landed value. There may be areas where supply shortfalls are severe, but due to the security situation the team were unable to identify these. The increasing population of itinerant traders in Sri Lanka is promoting supply of fish to more remote markets. It should be noted that market accessibility and price are strongly related, therefore, in internal markets fresh fish is more likely to be consumed by higher income groups.

Itinerant traders

34. These can be divided into three main types: basket sellers, bicycle sellers and motor-bike sellers. A typical bicycle trader purchases about 25kg of fish on the beach at auction or at a wholesale market for Rs375 (June 1991 prices). S/he travels anything up to 15 kilometres selling to regular customers, receiving Rs20 per kg. At these price levels the vendor's margin is Rs5 per kg. Overheads include the cost of a bicycle (Rs3000) and a wooden box (Rs125). Basket and bicycle traders outside Colombo do not commonly use ice and therefore only buy as much fish as they might expect to sell before quality deteriorates to unacceptable levels. The further the sellers go from the place of purchase, therefore, the less power they have over prices.

35. It is proposed to make a socio economic and technical study of the numerous itinerant fish traders operating each day from St John's Market, Colombo. At least 250 of these traders use bicycles for transport and about 50 use motorcycles. Each of these vehicles has a box strapped to a rear carrier behind the saddle. The mission spent some time talking to these traders and observing their operations. They almost invariably use ice to preserve their purchases and cycle many kilometres to sell fish during the morning. As part of this study improved insulated ice boxes suitable for use on the back of the bicycles.

36. The possible advantages to itinerant traders of improved ice storage are:

- . reduced ice requirement;
- . increased market area and time available for marketing;
- . increased distance from fish source (and therefore higher fish prices);
- . greater fish carrying capacity due to reduced weight of ice;
- . reduced risk of spoilage or total loss;

For the consumer the advantages include:

- . reduced health hazards and improved fish quality
- . increased competition and fresh fish availability
- . reduced "rent of risk" and therefore better prices

Possible disadvantages of ice boxes include:

- . cost
- . consumer resistance to iced or chilled fish for the reasons outlined in paragraph 20 above

37. Measurable financial benefits from ice boxes are reduced ice and increased fish capacity. If a bicycle trader buys 25kg of fish a day at Rs 70 per kg, plus 5kg of ice at Rs 0.80 per kg, his/her total variable costs are Rs 1750 for fish and Rs 4 for ice. It is estimated that at the moment ice represents about 17% of total carried weight. If this could be reduced by 50%, it would allow 2.5kg of additional fish to be carried. With an average profit margin of Rs 10 per kg this represents an additional Rs 25 per day profit, plus Rs 2 per day less ice.

38. Table 3 gives some idea of the expected pay-back period under a number of different costs of capital. These include government subsidised loan rate (15%), an approximation of the bank lending rate (20%) and an rough approximation of the rate expected from money lenders operating on the St John's market (30%). A range of ice box costs are included. It should be noted that not all benefits are included, therefore estimations are considered conservative.

Table 3: Estimated pay back period for ice boxes

		Estimated cost of box (Rs)			
		4,500	5,000	6,000	7,000
		-----pay-back period (months)-----			
Annual interest rate (%)	15%	8	9	11	13
	20%	9	10	12	13
	30%	10	11	13	15

NB: One month assumed to be 24 working days

39. Further work is required to clarify the real costs and returns to improved ice boxes for itinerant traders. An outline survey is proposed at Annex III.

Technical aspects of itinerant bicycle fish trading

40. The boxes used by these traders are not of a standard design. The majority are made of wood although some were seen that were made of galvanised iron sheet. Most have a drop in or hinged lid, although outside Colombo similar traders do not use lids but simply cover the contents of the box with sacking. Since there is no standard box in use on either bicycles or motorcycles the size of boxes in use varies. When asked what was the best size for a box, most bicycle traders indicated a box roughly 67 cm (26 inches) long by 43 cm (17 inches) wide by 27 cm (10.5 inches) deep. For a motorcycle a deeper box is preferred. None of the boxes seen by the team were insulated and so ice meltage is relatively fast.

41. A first prototype insulated box has been designed using 1.25 inch (33mm) thick expanded polystyrene insulation sandwiched between .25 inch (6.4mm) plywood boards and coated in Fibre Reinforced Plastic (FRP). The design incorporates a drop in lid, carrying handles which will be used for strapping the box to the carrier of the cycle, rails for holding cutting knives and chopping board and a drainage hole for ice melt water. Plans for the design are given in Annex IV.

42. Two boxes of this design were ordered by the mission for manufacture immediately and when complete these will be taken to St John's market to ascertain the reaction of traders. The possibility of loaning the boxes to traders for trials should be investigated as part of the study. Monitoring of their performance, longevity and practicality

must be made and adaptations and changes made as the trials progress. The cost of these initial prototypes was Rs 4,500 compared with less than Rs 150 for a conventional box. It is probable that costs of the new boxes will be reduced considerably if bulk orders are made and as the builders become familiar with the construction techniques.

Permanent Ice Boxes

Socio-economic aspects

43. Financial and economic appraisal suggests that the widespread use of ice boxes should form an important element of any project to improve the quality post-harvest handling, reduce risk in the marketing chain and more efficiently use the national energy resources. However, the relative efficiency of the existing supply structure, the general under-supply of fish and the considerable institutional problems which would result from the multiple ownership of such structures suggests that only single owner boxes should be considered. This may, therefore, fall outside the BOBP preferred target beneficiary group of small-scale fisherfolk.

44. Case studies are provided below and at Annex V illustrating the positive and negative aspects for permanent ice boxes.

Case study - 5 brothers in Merrisa

A family of fish assemblers buying morning landed fish, storing in ice and transporting to Colombo in the evening. on average they buy 35 boxes of 25kg fish a day during the 4 month peak season and 10-15 boxes a day during the rest of the year. Each box is iced twice a day using half a bloke of ice each time. Ice costs Rs40 per block undelivered. Delivery cost about Rs 10 per block. Assuming a 50% saving in ice consumption if an ice box is used and a 6 day working week (allowing for inclement weather and festivals).

Total peak season ice saving:

35 boxes x 104 days x 1/2 block of ice (Rs25) = Rs91,000

Total off season ice saving:

10 boxes x 208 days x 1/2 block of ice (Rs25) = Rs52,000

Total saving in ice consumption as a result of using an ice box = Rs143,000

Estimates for the cost of ice boxes vary between Rs46,000 and Rs90,000. At these costs this represents a sound investment with an exceptionally short pay-back period.

45. However, it should be noted that the above case may be exceptional. Ice represents a significant proportion of total variable costs because of a fixed arrangement between

assemblers and wholesalers in Colombo. In reality, the majority of assemblers transport the early morning purchases immediately in order to reduce the risks associated with storage.

Economic benefits of ice boxes

46. In addition to a clear financial case for using ice boxes there is almost definitely a sound economic case based upon the reduced overall energy requirement necessary to maintain a constant supply of ice for fish marketing. Economic valuation attaches additional weight to items which are internationally tradable which are valued at their opportunity cost. This measures benefit on a national scale. Ice plant, energy production plant and fossil fuels are all imported items in Sri Lanka requiring the expenditure of scarce foreign exchange. An overall ice provision strategy for Sri Lankan fisheries should include permanent ice boxes as one method of evening out ice supply and maintaining fish quality at minimal economic cost.

Social and institutional issues

47. Fixed ice boxes could, in principle, be used by individuals or by groups such as fishing villages, groups of traders or cooperatives. However multiple ownership does present problems such as:

- . lack of easily identifiable innovators to allow adaptive experimentation
- . difficulties with management and access to multi-owner ice boxes
- . civil disturbance in areas most likely to benefit from more secure ice supply

48. Single operator ownership overcomes problems relating to management and access. However, beneficiaries will be traders and market intermediaries, who as a group are usually less dependent on outside sources of capital and more able to look after themselves than impoverished fishing families.

Proposed Ice Box Trials

49. Consequently the authors do not recommend the provision of ice boxes in the field at the present time. Nevertheless ice boxes would be of great advantage in ensuring the more efficient use of ice. It would therefore be useful to have more information on the costs, benefits and operating problems of using ice boxes. The mission therefore

recommend a series of trials be conducted by NARA on the lines outlined in Annex IIX

Ice Box Designs and Costs

50. Various design options for the storage of ice and/ice and fish have been proposed and investigated. All the designs have been based on the need to store approximately 1.5 to 2 tonnes of ice or fish and ice and to slow the melting of ice so that it will last with negligible losses for at least four days.

51. Three basic designs have been investigated.

a. Upright walk in store made of Fibre Reinforced Plastic insulated with 4 inches of expanded polystyrene with a side hung door, as detailed in the Roger's report of March 1991.

b. Top loading fixed box of brick insulated with 4 inch expanded polystyrene as built by BOBP in Southern India for storage of fish and ice.

c. Top loading box constructed of plywood covered with Fibre Reinforced Plastic and insulated with 4 inches of expanded polystyrene.

52. The costs of construction of the three options are as follows:-

- a. Rs 95,750 (Blue Star Marine Ltd)
- b. Rs 46,900 (Karundasa - Dodanduwa)
Rs 61,000 (Negombo Builders)
- c. Rs 39,000 (Nicholas - Negombo)

53. The original quotations from Blue Star Marine for the first type of box obtained at the time of the previous visit by Rogers were less than Rs 50,000. However the company have started construction of such a box (for the ODA Sandskipper Project) and have subsequently revised their quotations upwards to the present figures.

54. The second type of box as specified for use in southern India is not portable and would need to be made locally at each location. Several quotations were obtained from house builders/masons during the visit and a range a of figures given.

55. The third type of box (illustrated in Annex VI) is designed specifically for storage of ice blocks and can be made by local carpenters who have had experience of making insulated ice boxes/holds to fit onto local boats.

56. It is recommended that a box of the third type be made and installed at NARA for trials. The box will hold roughly 30 fifty Kilogram blocks of ice (1.5 tonnes). A series of trials will be undertaken at NARA comparing the melting rates of ice blocks stored in the box with ice stored in the traditional fashion (buried in wood shavings/chippings).

57. Traditional ice storage depends on the limited insulation properties of wood shavings. A typical ice storage unit consists of a hut or other covered area the floor of which is covered with roughly 1 meter of wood shavings. To store ice the shavings are scooped to one side and the blocks of ice are buried into the shavings with a covering of at about 10 to 15 cm. The blocks are stored in a single layer standing upright on their long sides. When more than one block is stored they are placed side by side with their long faces touching one another.

58. The ice box recommended for trials has been designed so that blocks of ice can be stored in a similar fashion but without the use of wood shavings and hopefully with a slower melting rate.

Trial design and implementation

59. The objective of the trials will be to ascertain the financial viability of using an improved storage method for ice. The criteria to be used in measuring this will be the amount of ice saved from melting before sale. This requires that ice melting rates under traditional and boxed storage conditions be measured. Suggested methods for doing so are in Annex IIX.

Indicators of effectiveness of traditional storage

60. From discussions with various sellers of ice it was possible to get some indications of the effectiveness of the traditional ice storage method using wood chippings.

61. It seems that 50 kg blocks of ice stored in this way lose approximately 25% of their weight after 24 hours and within another day are down to about half of the original (ie 25 kg). It seems that all ice has melted after four days storage. A typical sales regime is as follows:

62. Ice is purchased as 50 kg blocks at Rs 50 per block (delivered). The normal sales unit to bicycle traders is 1/8th of a block sold at Rs 10. This means that if sold on the day of purchase one block can sell for Rs 80 (8 x Rs 10) - a mark up of Rs 30. However if not sold on day one the block will only make 6 units of sale ie Rs 60 - a mark up of only Rs 10 and by the next day so much ice will have melted that only enough remains for 4 units of sale and the block is sold at a Rs 10 loss.

63. The unpredictable nature of the fishing industry and the irregularity of ice supplies mean that there are often times when ice in stock is unused and wasted or ice is not available because of unexpected larger than normal catches. If an ice box proves to be able to keep ice sufficiently well to take the risks out of purchase then it will not only help the fishing industry by allowing a more constant and reliable supply but also assist the ice sellers to minimise their losses.

Gutting Tuna at Sea

Introduction

64. With the advent of multi-day fishing by pelagic gill netters a greater proportion of the large pelagic fish landed is iced at sea. The multi-day fleet presently undertake voyages of about 5 to 7 days but there are reports of boats staying at sea for 10 to 12 days. It was thought that with the extended fishing times it might be advantageous for the fish (particularly skipjack) to be gutted at sea so that their quality at landing would be better and their remaining shelf life would be longer so enabling them to be distributed further. In order to test this hypothesis a number of trials were undertaken. One trial was completed by NARA staff prior to the arrival of the mission in Sri Lanka. A further three trials were undertaken during the mission itself.

65. The crew of the NARA vessel were asked to gut 25 fish from each catch. These fish were tagged and a similar number of fish from the same catch were left untagged but also tagged. The fish were then stored in the insulated hold of the boat in ice along with the rest of the catch in the normal way. On arrival at Negombo the tagged fish (gutted and untagged) were separated from the rest of the catch.

Quality of gutted and untagged Skipjack.

66. A sample of the tagged fish from each days fishing was taken to the NARA laboratories and subjected to visual and olfactory examination. In addition an indicator market survey was conducted using the remainder of the fish from these batches.

67. In order to rationalise the visual inspection procedures and to produce realistic comparisons a visual inspection scoring system for Skipjack was devised during the mission which could be used to classify the fish into one of four grades depending on quality. The system was based on one previously devised and used by the American tuna industry and thus would save considerable time for NARA staff if it could be successfully adapted for use in the Sri Lankan industry. This can be used instead of the laborious and difficult to interpret system used previously by NARA whereby visual descriptions were written out to describe colours, odours, and other physical parameters of the fish. The descriptors used in the revised scoring system are given Table 4 below.

Table 4: Grading System for Skipjack

<u>Characteristic</u>	<u>Grade 1</u>	<u>Grade 2</u>	<u>Grade 3</u>	<u>Grade 4</u>
Gills	Bright blood Red	Pale Red to Brown	Dark Brown to Yellow Brown	Yellow-White Slimy
Eyes	Clear/Bright Protruding	Flat/Sl Sunk Cloudy or reddish	Sunken/White or red	Very Sunken White Spot
Skin	Normal fresh colour, clear and bright	Dull but no slime Some Lustre	Dull colour No lustre Slime	Discolouration and much slime
Head Colour	Grey	Light Grey	Yellow/Grey	Yellow
Odour General	Fresh, Typical of freshly caught fish	Flat/Neutral slightly fishy	Slight Stale or rancid	Sour Putrid Stinking
Odour of Belly	Fresh and sweet	Slightly Rancid	Strong Rancid/Sour	Putrid and foul
Damage	None	Slight skin marks or damage to fins or tail	Some skin damage broken flesh/fins/ tail	Gross damage of flesh/fins etc Exposed flesh
Firmness	Firm & very elastic	Firm but not very elastic	Soft	Very Soft & Mushy

Based on the American System for grading Raw Tuna as presented in Table 7.1 Table I in "The Southern African Tunas and Billfishes" - Molteno C J & Riley F R (1986). The South African Fishing Industry Research Institute, University of Cape Town

68. By using this system it was relatively easy to divide fish into different quality grades corresponding to those prevailing in the Sri Lankan industry whereby fish in grades 1 and 2 would enter the fresh fish market grade 3 fish would be thought suitable for curing but not for the fresh fish trade and grade 4 fish would probably be difficult to sell though not necessarily unsalable.

69. The results of the inspection of three batches of fish examined using this system are presented in Tables 5, 6 & 7. It can be seen that at the point of landing both gutted and ungutted fish were graded as grade 2 or grade 2-3. Where grade 2 is commercially acceptable for the fresh fish trade and grade 3 are marginal and might be down graded for use as cured products (Salting and sun-drying). It can also be seen that the ungutted fish tended to score slightly better than the gutted fish with the gutted fish particularly suffering more physical damage than the whole fish. These examinations were made when fish had been between 3 and 5 days in ice. Samples were stored for a further week in ice at the NARA laboratories and examination after 10 to 12 days revealed that the gutted fish were almost invariably unacceptable where as the non-gutted fish were still just acceptable as fresh fish.

70. These results clearly indicate that the expected quality improvements from gutting skipjack at sea were not realised and that in fact gutting adversely affects the landed quality. There are a number of possible explanations for this, all of which may play a part:-

1. Conditions on board the boats are such that it is difficult for gutting to be done properly. The boats have no facilities for gutting and the crew are unable to gut and wash the fish thoroughly. The crew of the vessel indicated that they had great difficulty in gutting the fish on a number of occasions because of the movement of the boat and there were potential safety problems associated with using gutting knives under the cramped conditions on board.
2. Extra handling is involved in the gutting operation causing more damage to the fish such as broken fins and tails.
3. Gutting takes time and the fish to be gutted therefore are not put into ice as quickly as ungutted fish. The crew of the

Table 5 Results of Visual Inspection of Gutted and Ungutted Skipjack - Trial 1

Date: 21/6/91
 Days in Ice: 3

Character	Gutted Fish Score				Whole Fish Score			
	1	2	3	4	5	6	7	8
Gills	2	2	3	2	2	2	2	2
Eyes	2	2	2	2	2	2	2	2
Skin	2	2	2	2	2	2	2	2
Head Colour	2	2	2	2	2	2	2	2
Odour General	2	2-3	2	2	2	2	2	2
Odour Belly	2	2	2	2	-	-	-	-
Damage	2	2-3	2	2-3	2	2	2	2
Firmness	2	2	2	3	2	2-3	2	2
Overall	2	2-3	2	2-3	2	2	2	2

Table 6 Results of Visual Inspection of Gutted and Ungutted Skipjack - Trial 2

Date: 21/6/91
 Days in Ice: 5

Character	Gutted Fish Score				Whole Fish Score			
	1	2	3	4	5	6	7	8
Gills	2	3	2-3	2	2	1-2	2	2
Eyes	2	2	2	2	2	1-2	2	2
Skin	2	2	2	2	2	1-2	2	2
Head Colour	2	2	2	2	2	2	2	2
Odour General	2	2	2	2	2	2	2	2
Odour Belly	2	3	3	2	-	-	-	-
Damage	2	3	2	2	2	2	2	2
Firmness	2	2	3	2-3	2	3	2-3	2
Overall	2	2-3	2-3	2	2	2	2	2

Table 7 Results of Visual Inspection of Gutted and Ungutted Skipjack - Trial 3

Date: 1/7/91
 Days in Ice: 4

Character	Gutted Fish Score				Whole Fish Score		
	1	2	3	4	5	6	7
Gills	3	2-3	3-4	3	2	2-3	2
Eyes	2	2	2	2	2	2	2
Skin	2	2	2	2	2	2	2
Head Colour	2	2	2	2	2	2	2
Odour General	2	2-3	2	2	2	2	2
Odour Belly	2	2-3	3	3	-	-	-
Damage	3	3	3	2	2	2	2
Firmness	3	2-3	2-3	2	2	2	2
Overall	2-3	2-3	3	2-3	2	2	2

boat indicated that gutted fish may be iced 2 to 3 hours later than un gutted fish.

4. The fish is bulk stowed on the boat with no horizontal shelves being used. The holds are over two meters deep so that fish at the bottom are subjected to considerable pressure. Ungutted fish by their very nature are more robust and able to withstand this pressure more easily than gutted fish.

71. There are therefore fundamental on board fish handling changes that are required if gutted fish are to be landed as better quality fish such as:

1. Facilities for gutting at sea safely and quickly. eg specialised tables, more crew etc;
2. Washing facilities so that fish can be adequately cleaned after gutting;
3. Shallower on board stowage in ice by using boxes or horizontal pound boards;
4. Use of refrigerated or chilled sea water instead of ice to reduce physical damage and handling times on board.

72. These types of changes would require a longer term look at the design of the boats and considerable investment in improved facilities and probably extra crew.

Is Improved Quality by Gutting at Sea Justified ?

73. The experimental work reported above has indicated that under present on-board conditions on the multi-day boats gutting at sea does not lead to better quality fish being landed and in fact it is difficult to produce better quality fish by gutting at sea because of the various factors outlined above. In addition it must be questioned whether improved quality from gutting is justified in terms of improved financial returns. There are various factors that indicate that in fact there may be disadvantages to gutting fish at sea under the present market conditions in Sri Lanka.

1. There is little if any premium paid for better quality fish at the landing point and at the consumer/retail markets prices are

fixed with no premium being paid for quality.
(1)

2. Consumers expect to see whole ungutted fish on the market stall and there may be consumer resistance to buying gutted fish.

3. At the retail level skipjack and other tunas are often sold as cut pieces (Steaks), the guts, gonads and livers being removed by the fish seller and sold as separate items. This practice occurs at many produce markets visited by the team and even in some of the supermarket outlets for fresh fish in Colombo. In short there is a market for the guts which are an integral part of the overall value of the fish. (2)

4. Where a consumer buys a whole tuna he/she may take it to a specialist on the same market who will clean and cut the fish into steaks, fillets or chunks for a small fee. The specialist will remove the contents of the gut cavity at this stage and will often sell these on to a third party. The guts therefore constitute an important income earner for these fish cutters. This practice is particularly prevalent at the main wholesale/retail fish market in Colombo (St John's Market).

5. The Sri Lankan consumer calls Skipjack and other tunas, "blood fish" and associates good quality tunas with a bright red bloody flesh. Gutting the fish has the effect of partially bleeding the blood from the flesh producing a orange/brown colouration. This was particularly noticeable in the fish gutted at sea and kept for 10 to 12 days in ice and may make for difficulty of sale.

1. The team did however find that there is a small but growing market for very high quality tuna for the Japanese market which may attract premium prices. At the moment these premiums do not seem to be reaching the fishermen.

2. Bicycle and motorcycle traders interviewed said that a portion of the guts is often given to the consumer as part of the transaction when purchasing cut pieces.

74. All the factors outlined above lead to the conclusion that under present circumstances it seems unwise to expend limited resources on investigating gutting at sea further. NARA have however expressed an interest in strengthening their capabilities in the area of quality assessment methodology and guidance was given to the staff on the procedures for conduct of ice storage trials.

75. In addition it is recommended that one of the NARA Research Officers attend the next NRI course on "Handling and Quality of Fish in the Tropics". The officer should concentrate on a study of organoleptic assessment of fresh fish quality. Ms M Perera would be a suitable candidate.

Results of market trials

76. A brief indicative survey of initial market acceptance of gutted tuna was conducted. This consisted of selling batches of pre-weighed, gutted and ungutted fish on a fish market under normal conditions at Negombo fish landing/auction. A short questionnaire was completed for each batch sold (see Annex VII). The results presented at Table 8, though inconclusive, suggest that it is possible to sell gutted fish, but that premium prices are not available at present. The level of competition at the market, as measured by the number of bidders for each batch of fish, was high, though some buyers were unaware in the dark of the early morning that they were buying a gutted product.

77. When the technical problems associated with gutting tuna at sea are overcome, it is recommended that a longer term market survey along these lines is conducted. This should include several landing sites. In addition, focus group interviews should be undertaken with groups of fishermen, traders, wholesalers, retailers and consumers to identify perceptions of fish quality and facilitate the development of a framework for the placement of a high quality gutted product in the marketing system.

Table 8 Summary results of Negombo market survey

Batch code number	No. of fish in batch	Gutted (G) or Ungutted (U)	Weight (kg) Actual weight	Whole fish equivalent 1/	Total Sale Price (Rs)	Price per kg (Rs)	Number of bidders	Point of next sale	Estimated sale price (Rs per kg)	Estimated marketing margin (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	14	U	78.2	78.2	1750	22.4	4	Bait	-	-
2	12	G	82	96.8	1980	20.5	3	Vagangoda	45.0	54.5
3	10	U	67	67.0	2600	38.8	4	Landing site	41.0	5.4
4	10	G	73	86.1	1290	15.0	8	Landing site	18.5	19.1
5	8	G	47	55.5	1316	23.7	3	Dried fish 2/	23.3	-1.7
6	5	U	34	34.0	1000	29.4	1	Pallewela	19.9	-47.8

1/ Whole fish equivalent calculated using a conversion ratio of 1.18 and assuming no additional value for fish offal

2/ For 5 and 6, dried fish sale price based on a 3:1 wet to dry fish ratio

Training and Extension Needs

78. Training of staff of Government bodies involved in fisheries, NGO's, banking staff involved in fisheries credit schemes and others was considered by the mission. Whilst recognising that there are staff in a number of institutions that would benefit from training in fish handling, marketing and extension methodology the mission feel that presently there is insufficient evidence to suggest that knowledge gained from such training would in fact be useful in developing the fisheries of Sri Lanka. There is no Government of Sri Lanka policy framework for extension. Nor is there a body whose responsibilities include extension. This brings into doubt the eventual impact of any training ultimate goal of which is to provide the ability to extend recommendations developed as a result of BOBP/ODA project inputs or as a result of NARA's research and development activities. These issues should be resolved prior to the commencement of costly training inputs.

79. There is a serious shortage of locally developed extension material such as leaflets, posters, booklets etc both for extension staff and fisherfolk. Though NARA staff have recently undertaken training in the production of such materials, professional back-up (ie, artists and video technicians), money for paper etc are unavailable. Assistance to NARA in the post-harvest area should be linked to the production of firm extension recommendations, close links between extensionists (and therefore fisherfolk) and technical staff, and the joint production of extension materials.

80. Consideration should be given to methods of assessing the actual extension needs of fisherfolk. This should form the basis of future development for staff of the Institute of Post Harvest Technology (NARA) and other departments within the Ministry of Fisheries and Aquatic Resources.

81. The main role of NARA is to research and develop technologies of use to the Sri Lanka fishing industry. This requires that NARA are able to identify the problems of the industry and so tailor their research efforts to the real needs. The organisation is presently severely understaffed and this has a detrimental effect on the ability to fulfil this important role.

82. This has lead to a general isolation of NARA from Fisheries extension system and especially from its clients the fisherfolk. This highlights the need for improved linkages between technical and field staff and the promotion of an adaptive approach to both training and technology development. Encouragement of such activities is considered a primary objective of post-harvest training.

83. The consultants would like to stress the importance of clearly identifying the needs of fisherfolk for training before further extension is considered.

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Annex I: Terms of reference

During a four-week visit to Sri Lanka (June/July 1991) the consultants should undertake the following, working in close collaboration with NARA:

Technologist

1. Provide advice on implementing an investigation into the extension of storage life of fish at sea in off-shore vessels by gutting including:

- . practical demonstration of gutting, washing and icing practices;

- . organisation of quality assessment of gutted and un-gutted fish on landing by formal taste panel objective analysis such as TVB; and

- . organisation of controlled trials on land to compare the storage life of gutted and non-gutted fish on ice

2. Finalise the proposed permanent ice box programme with Dodanduwa Fishing community. Obtain firm quotations from local builders on PIB construction and supervise installation of one or more units. Provide advice to the community on the correct use of the PIB.

3. Make a general appraisal of the onshore handling systems, during the peak season for fish derived from both the inshore and off-shore fisheries. Particular attention should be paid to quality deterioration of fish destined for both fresh and dried/salted markets, and any prospects for reducing this.

Economist

4. Appraise loss reducing measures proposed by Technologist, with particular attention to financial, economic, social and institutional factors.

5. Identify and help establish a system of data collection which will provide the data necessary for a financial appraisal of

- a) the gutting trials (if continued after the visit)

- b) the Dodanduwa PIB, and

- c) the Weligama PIB (if the consultants decide to go ahead with this component)

6. Briefly review the fishing economy, in terms of the importance of various subsectors and participants. In collaboration with the Technologist, assess losses in volume, quality and financial value of fish due to poor post harvest handling. Assess the social and economic implication of such losses to the fishing community.

Both consultants

7. Hold discussions with NARA and the Ministry of Fisheries NIFT directorate with regard to proposed basic Post-harvest training and extension methodology input. TOR's to be prepared for 1-2 m/m NRI input during FY 91/92.
8. Reappraise the case for Weligama PIB (with reference to Tim Bostock's BTOR 8-16/5/91). If operation of the box appears feasible (in technical, financial and institutional terms), set up a programme for its use, and the collection of data for subsequent evaluation of the programme.
9. Return to the UK via Madras for debriefing with the post-harvest adviser, submitting a brief written overview of findings and the same time.
10. On return to the office submit a back to office report within one week, and a full written report within four working weeks of completion of field work.

Annex II: Itinerary

Date	Activity
Wed 12th June	Arrive Colombo
Thu 13th June	National Aquatic Resources Agency
	Dr S Subasinghe, Director, Institute of Post Harvest Technology
	Dr M U Jayasekera, Director General
	Dr S Y Namaratne, Research Officer, Chemist
	M F Mohideen, Research Officer, Microbiologist
	W M K Perara, Research Officer, Fish Nutritionist
	C V Liyange, Research Officer
	K S Heltinachah, Research Assistant
	K S Seetha, Research Assistant
	R Samaradinakeri, Research Assistant
	P Amarasinghe, Research Officer, Quality control
Fri 14th June	Negombo market and inspection of NARA boat
	- multi-day fishermen
	- day fishermen
	St Johns Market, Colombo
	Bay of Bengal Project
	C Fernando, Development Adviser
Sat 15th June	Sandskipper Project
	J Cunning, Marine Engineer

Mon 17th June **Ceylon Fisheries Corporation**

O Perara, Chairman

Sri Lanka Standards Institute

L L S S K De Silva, Assistant Director

British Council

J Payne, Assistant Director

Dr R Wickramaratne, Science Projects
Manager

Tue 18th June **IRED**

W Gamage, Senior Research Officer

M De Silva, General Manager, Puttalam
Regional Development Association

Export Development Board

P C De Silva, Deputy Director

Blue Star Marine, Negombo

Wed 19th June **Ministry of Fisheries**

H S G Fernando, Assistant Director of
Fisheries

G Piyasena, Director of Planning

K B S Wijeratne, Director of the National
Institute of Fisheries Training

I Jungeling, UNDP/FAO Extension Project

A Rodrigo, Statistics Department

BOBP/NARA

Thur 20th June **Ministry of Fisheries**

A Attapattu, Director of Fisheries and
Aquatic Resources

Bank of Ceylon

A S Sarath de Silva, Deputy General
Manager (Development Banking)

BOBP/NARA

Preparations for market survey

Fri 21st June Negombo Fish Landing

Peoples Bank

B Balathsinhala, Assistant General Manager
(Co-ops and Fisheries)

BOBP/NARA

Survey summary work and taste panels

Sun 23rd June Team travels to Galle

Mon 24th June Galle Harbour and Suriyacaharwela landings

NORAD Project, Kalamatiyu

V G Nelson, Project Officer

Fisheries Training Institute, Tangalle

S Karandaniya, District Fisheries
Inspector

Kudawela evening market

Tangalle fish landing

Tue 25th June Kudawela morning market

Dondra fish landing

Rohuna University, Matara

Dr O Almersinghe, Head of Agricultural
Economics

Weligama fish landing

Dodanduwa fish landing

Wed 26th June Poya day

Weligama fish landing

Mr Ratnatilaka, Fisheries Inspection
Officer

Thur 27th June Sandskipper Project

BOBP/NARA

L Joseph, Programme Officer

Fri 28th June **Colombo Retail markets:**

- . Kalapitiya
- . Bambalapitiya
- . Dehiwala

BOBP/NARA

Sun 30th June Weligama
Dodanduwa

Mon 1st July Negombo fish landing - gutting trials

Tue 2nd July Dry fish production:
Kalpitiya, Chilaw, Negombo

Wed 3rd July Inland markets:
Nittambua, Kegalle, Matara, Wattagama,
Wattegadara

Thur 4th July Inland markets:
Kandy, Ellalamulla, Attanagalla
British High Commission
M Foord, Second Sec (Aid)

Fri 5th July Dry fish market, Colombo
Wet fish markets: Nugegoda and Kirulapore
T Bostock arrived ex Madras

Sat 6th July **NARA**
Report writing

Sun 7th July Dodanduwa
Meetings with cooperatives/ice sellers etc

Mon 8th July **BOBP/NARA**
Negombo
Ice Box Quotations

Tue 9th July St John's market - bicycle traders

Wed 10th July Bennett to Philippines
Clucas return to UK

Annex III: Bench-mark study of bicycle and motor-bicycle fish traders in St John's Market, Colombo

Objectives

To increase the incomes of small-scale itinerant traders, initially in Greater Colombo and eventually throughout Sri Lanka.

To reduce the risk inherent in trading fish, a highly perishable commodity and in doing so to increase fish availability to consumers, enhance competition at beach landings, and lessen the health hazards associated with poor post-harvest handling.

Terms of Reference

In close collaboration with the Institute of Post-harvest Technology (NARA) to conduct the following activities:

1. Provide an in-depth understanding of the workings of the community of itinerant traders based on St John's market, Colombo including *inter alia*, their social status, incomes, modus operandi, credit relationships and marketing methods. This study should be completed over a period of time which should include both peak season and low season fish catches.
2. Undertake individual case studies of bicycle traders, motor-bicycle traders, ice sellers, money lenders and any other operators important to the itinerant traders.
3. To map the home and working areas of traders to identify the time taken and distance travelled during the marketing process.
4. Quantify the potential benefits and costs of improved ice boxes for traders and the likely impact of new technology on other dependents such as families, traditional box makers, ice sellers, etc.
5. Identify the most appropriate method of providing credit for the supply of such boxes.

Subsequent to the introduction of trial ice boxes and in close collaboration with the staff of NARA:

6. Monitor feedback from traders and consumers to new ice boxes, acting as the link between technical staff (NARA) and clients (itinerant traders).
7. Provide advice on social and economic implication of technical changes to ice box design proposed by NARA. Assist NARA in appropriate design changes to ice boxes based on information gathered from traders.

Main Activities

Interview traders groups.

Conduct field surveys of fish buyers.

Investigate the socio-economic status of traders by conducting interviews and surveys.

Map trader operating areas.

Investigate the credit situation and level of indebtedness of traders.

Provide inputs into a workshop on traders to be held after one year.

Outputs

1. Interim report summarising findings from bench-mark study. To be completed within six months of commencing the project.
2. Final report within one month of project completion.
3. Summary papers for workshop on traders.

Criteria for recruitment

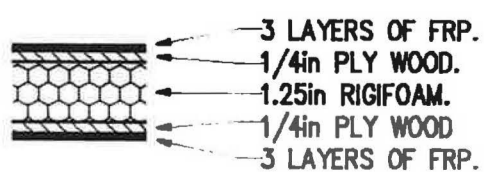
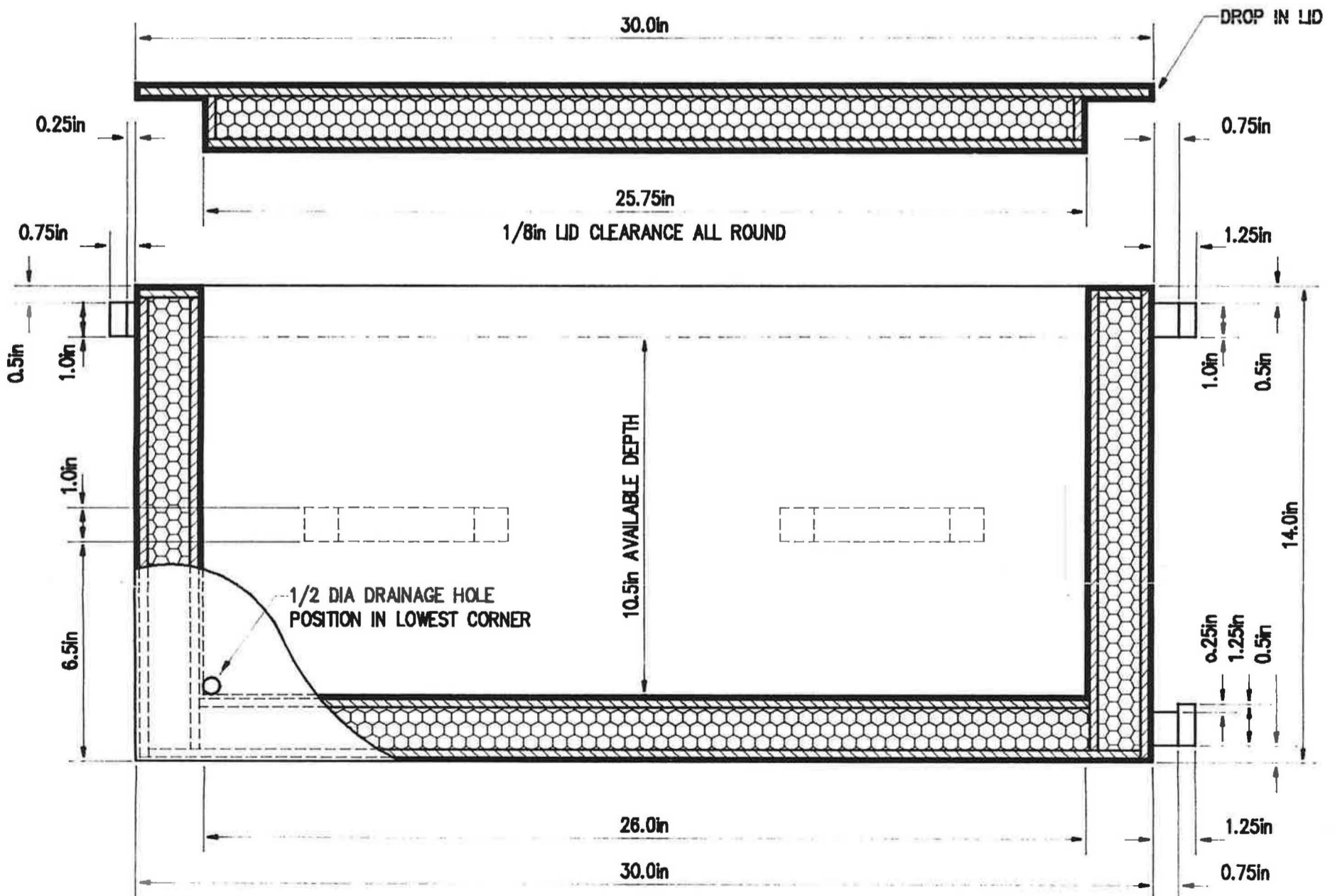
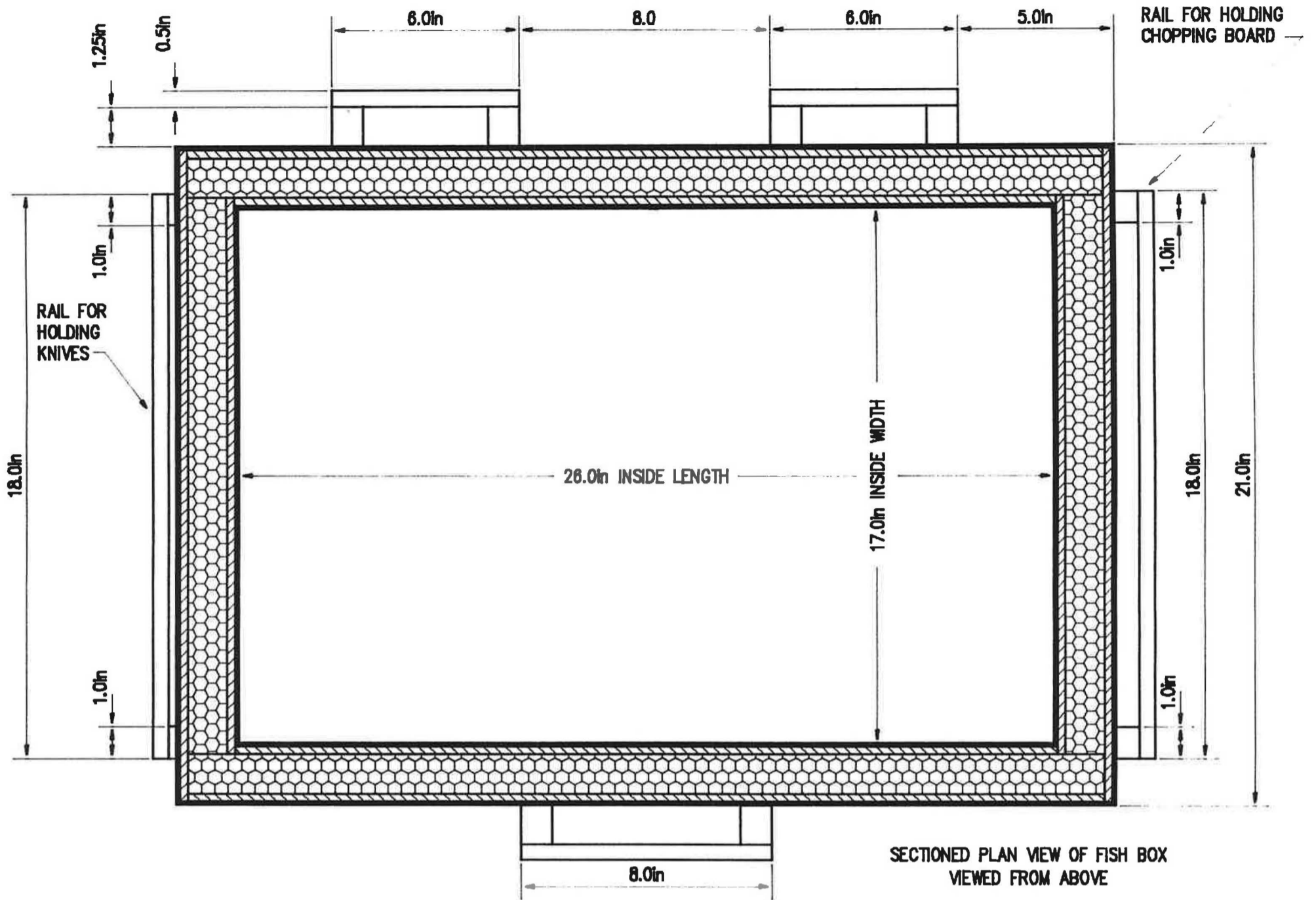
Must be a fluent Tamil and Sinhala speaker.

Previous experience in social surveys including focus group interviews, survey design and enumeration etc. Should be familiar with methods of rapid appraisal such as focus group interviews, wealth ranking etc.

Must be fit and prepared to follow traders on foot, bicycle and motor-bicycle.

Must be prepared to live close to St John's market for the period of the study to facilitate regular contact with market operatives particularly during early morning activities.

ANNEX IV : BICYCLE FISH BOX



PART SECTIONED SIDE VIEW OF FISH BOX

TITLE BICYCLE FISH BOX	DRG No T0311-02 SCALE 1/4 FULL SIZE	DRN G.G.A.
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Annex V: Case study: Ice sellers in Dodanduwa

This case study illustrates the dangers inherent in identifying inappropriate media for the initial testing, adoption and diffusion of new technologies. Specifically, it shows how a comparatively simple and clear cut need for assistance in the shape of technical change as identified during an aid mission could have resulted in loss of livelihood, and dislocation for an impoverished family who were in no position to innovate.

Ajantha, a teenage girl, supports her extended family of seven including sisters, brothers and mother from the proceeds of her sales of ice. She was given the monopoly of ice selling on the Dodanduwa beach when her father, a much respected local fisherman, died. At dawn every morning she takes up to 15, 50kg blocks of ice, which have been stored under wood shavings in a concrete structure outside her door, puts them in a cart and drags them down to Dodanduwa fish landing about 300m from her home. On a good day, when there are plenty of fish being landed by the traditional out-rigger canoes, trade is brisk. Bicycle traders pedal in from all over to buy fish. These men are in a high risk occupation. Once they buy their fish at auction from the fishermen on the beach, the time that they have to sell them before they deteriorate is very limited. It is 7.00am and they must reach their markets and find buyers in about four hours. To get the best prices they have to cycle inland considerable distances, some say 40 kilometres. All they have to preserve their fish is a wooden box on the back of the cycle with a piece of sacking to cover it. Recently, to reduce the risk and allow them to cycle further, they have taken to buying small amounts of ice from Ajantha. It is a careful calculation. There must be enough ice to get to market but not so much that it makes it harder to pedal or the costs outweighs the benefit. Anything up to fifty cycle traders are present each morning plus ten or twenty motor-cycle traders who take their fish greater distances to areas where supply is short. They also need ice.

Business is booming, more cycles are coming each year, but still Ajantha has a problem. Demand for ice is highly unpredictable and fluctuates wildly. Ajantha must decide each day how much ice to buy. If she does not buy enough she misses an opportunity and disappoints her regular customers who rely on her. If she buys too much ice and takes it down to the landing her profits melt away into the sand.

The obvious solution for Ajantha was an ice box. Situated at the fish landing this would allow her to maintain a regular stock of ice, minimise her losses and benefit traders by providing regular assured supply. It seemed a clear cut case and a perfect place to try out ice boxes in Sri Lanka whilst providing real benefit to a very deserving case.

A rough estimate of the possible benefits was calculated as follows. Assuming Ajantha buys 20 blocks of ice a day at Rs 50 per block delivered for 200 days a year, her annual

expenditure is Rs 200,000. She breaks each block into 8 pieces for sale at Rs 10 giving possible gross annual return of Rs 320,000 (or a profit of R 6.25 per individual piece sold). After discussion with Ajantha, we calculated that 40% of her annual turnover must be stored over night with a subsequent loss due to meltage of 1/4, and that a further 10% of her annual turnover must be stored for two nights with meltage of 1/2. This represents a loss due to meltage of approximately Rs30,000 a year. Additional benefits might accrue from greater turnover and an ability to hold larger stock would also accrue.

This was the situation in June 1991 the team visited Dodanduwa to consider the arrangements for installing the ice box.

Negotiations began with the local fisheries cooperatives of which there are three. Ajantha's father was a member of society one, started by the government to assist inland fishermen but recently disenfranchised by the governments policy change banning assistance to inland fisheries for religious reasons (see figure 1). When Ajantha's father died it was this society that loaned her the Rs 5,000 to start up her ice business. The second and most powerful society, controls access to the beach and has as its members all the off-shore fishermen. When Ajantha's father died they allowed her to trade from the beach as a special dispensation. Communication between the rival societies is minimal with conflict apparent over scarce fishing resources and government/NGO assistance. The third society, recently formed to benefit from government assistance promised to cooperatives, is geographically based and its catchment area includes Ajantha's family home. All these societies have claims on Ajantha's loyalty and she must maintain good relations with each.

An additional complicating factor, only discovered after four separate field visits by BOBP staff, is that Ajantha is not the only ice trader in Dodanduwa. Situated off the beach in a purpose built hut is another lady who sells ice to traders. She has separate clients to whom she provides credit in return for regular custom and she has been in business longer than Ajantha.

The pre-project situation is one of balance. Ajantha is tolerated on the beach, but not allowed a permanent structure because that would represent encroachment on the territory of one society by another. Both ice traders are happy, they share transport costs and have separate clients. Neither is a threat to the other. Neither is powerful enough to force the other out of business and neither can command monopoly prices. Ajantha's society feel they have done their best by their members daughter and the traders get a regular supply of ice at a competitive price.

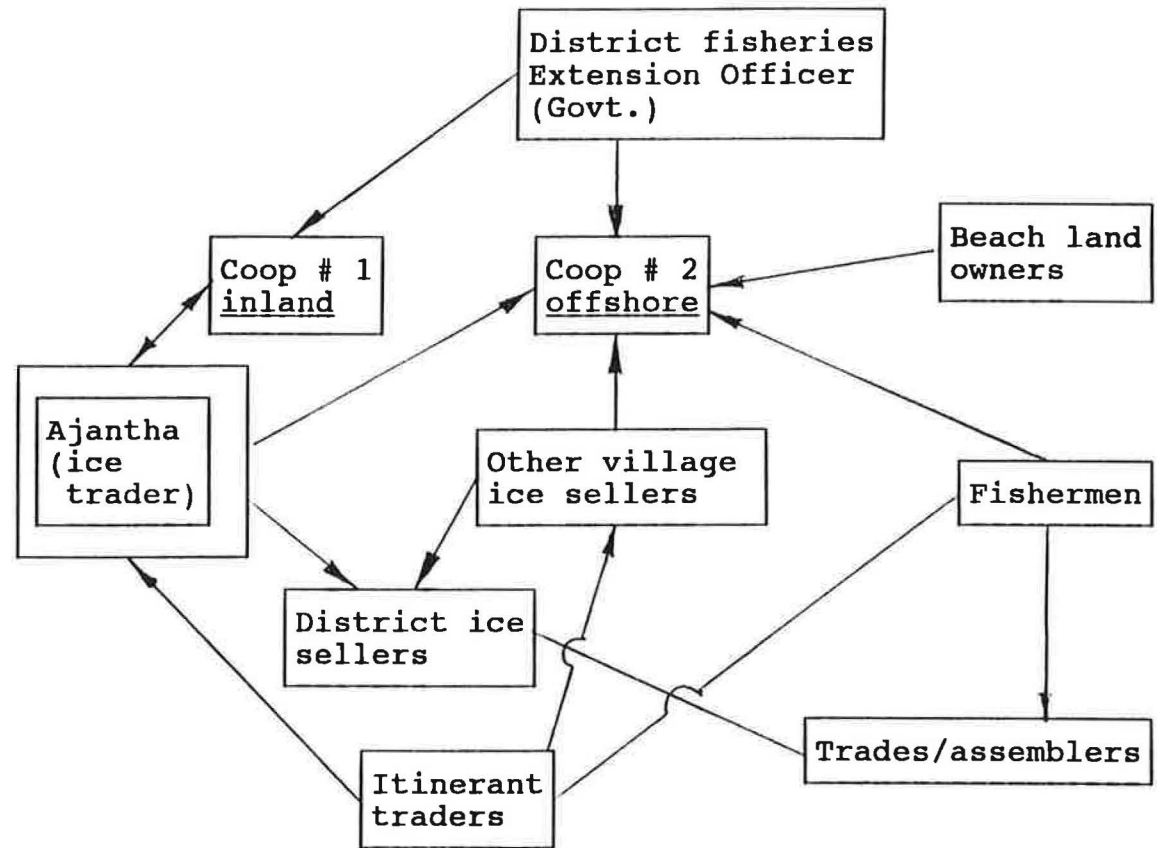
Into this situation of comparative balance and symbiosis an attempt was made to introduce ice boxes. Given that the beach society will not allow the construction of a permanent ice box

FLOW CHART OF TARGET BENEFICIARIES DEPENDENT RELATIONSHIPS

Indirect Influences

Local MP
 Priests (Buddhist, Hindu, Catholic and Muslim)
 Local Government Representative
 Neighbours
 Family/Relatives
 Other government departments
 Non-government organisations
 Other producer co-operatives

Direct Influences



Source: Discussions in Dodanduwa village, June/July 1991

N.B. Only critical relationships have been denoted for the state of clarity. Arrows denote debt relationship measured in money, kind or services.

on their land (or land over which they have *de facto* control) a compromise was sought. Two ice boxes were offered. The ice sellers can set up on the beach next to each other. All will benefit. A number of meetings were held, all the societies were consulted and it was generally agreed that this was the only fair and pragmatic solution. Ajantha, however, was not happy. Unable to express herself at the public meeting where an intimidating, entirely male cross section of local interest groups were present, she later presented the team with a letter explaining her reservations. Operating from the beach is "her only advantage" she claimed and begged us not to allow the other ice trader access to her customers.

Studies of adoption and diffusion of new technologies 1/ over time suggest that adopters or non-adopters in a population can be classified into (i) innovators, (ii) early adopters, (iii) the early majority, (iv) the late majority, and (v) laggards, depending on the time lag between innovation and adoption. Diffusion is defined as the cumulative process of adoption measured in successive time periods 2/. A typical pattern of adoption/diffusion (illustrated below) shows that innovators and early adopters are the key leading groups. These groups are more able to cope with the possible dangers of innovation such as: indivisibility of technology, uncertainty of financial returns, "lumpy" nature of investment, unfamiliarity, need for additional "human capital" inputs (ie, training and experience), and finally, access to complementary inputs (ie, credit, communication and purchasing power). Ajantha cannot be described as fitting into any aspect of this definition of an innovator.

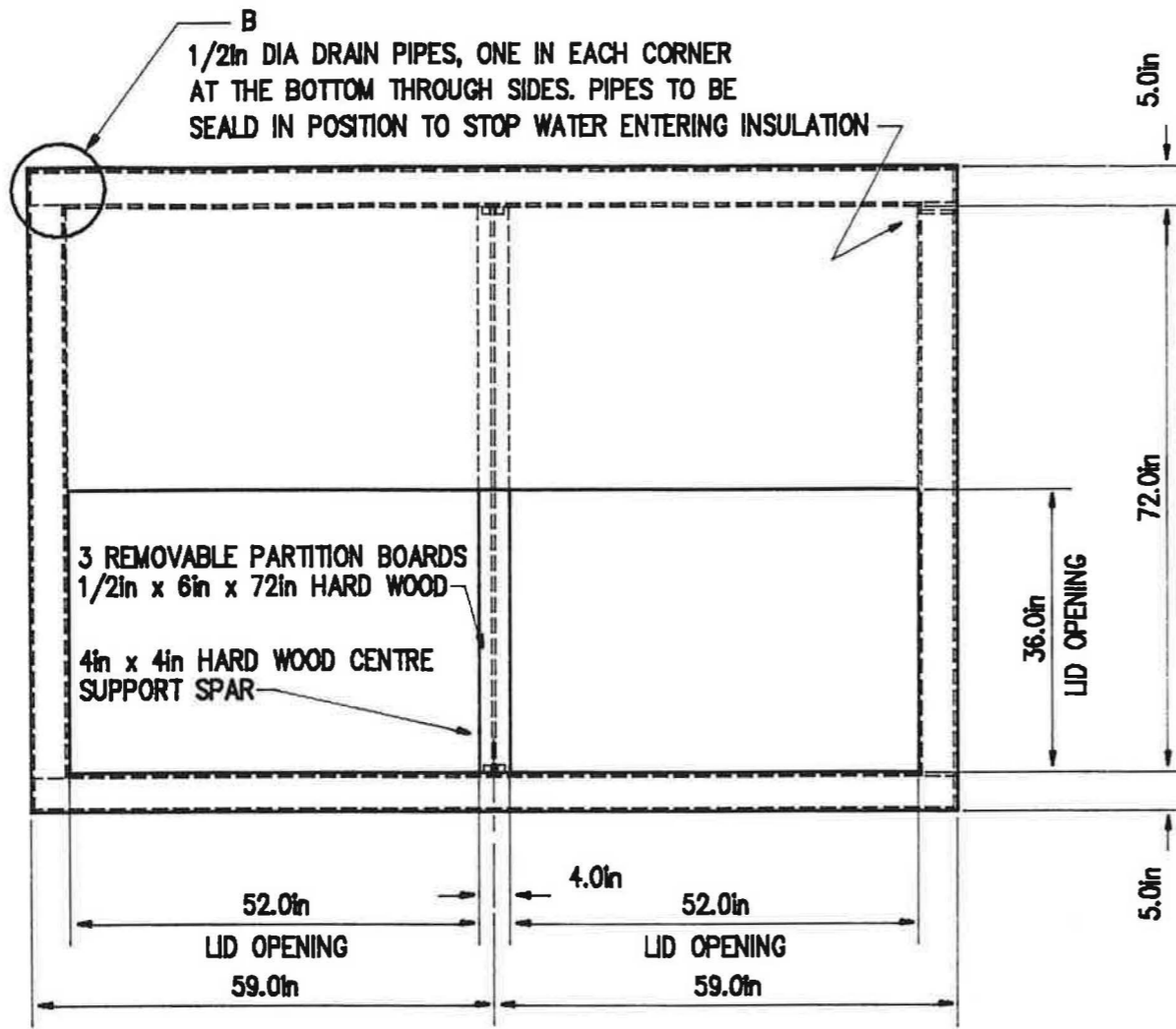
What this case study shows is the dangers inherent in change and particularly those presented by indiscriminate experimentation. Ajantha's situation remains precarious. She is already taking great risk to ply her trade in the most perishable of tropical commodities. She is a small player in a larger web of complex patron-client relationships which operate on her at many levels from government down to family ties. The imposition upon her of even the smallest change might have caused her to fall out of this system. It shows how important it is to understand the true context of beneficiaries and to look beyond the purely technical and financial benefits to seek the impact of change at institutional, cultural and social levels. Although Ajantha has a number of dependant relationships which reduce her income earning ability, her access to a livelihood relies on the maintenance of those relationships. Thus, many of the changes in her environment are outside her control.

1/ For example see Feder G R, Just and Zilberman D (1985), *Adoption of Agricultural Innovations in Developing Countries: A Survey*, Economic Development and Cultural Change, 33 (2) or Thirtle C G and Ruttan V W (1987), The Role of Demand and Supply in the Generation of Diffusion of Technical Change. Harwood Academic Publishers.

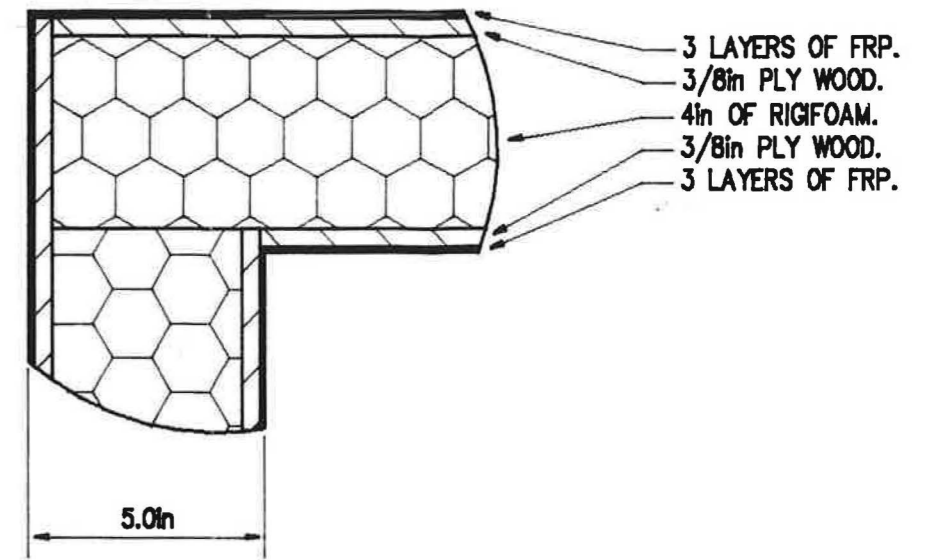
2/ Coleman and Young (1989), p60

The situation in Dodanduwa remains as it was before the mission. The risks inherent in innovation are not for the likes of Ajantha.

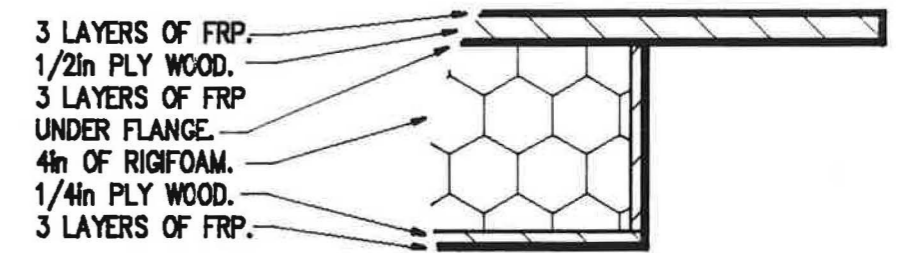
ANNEX VI: ICE STORAGE BOX



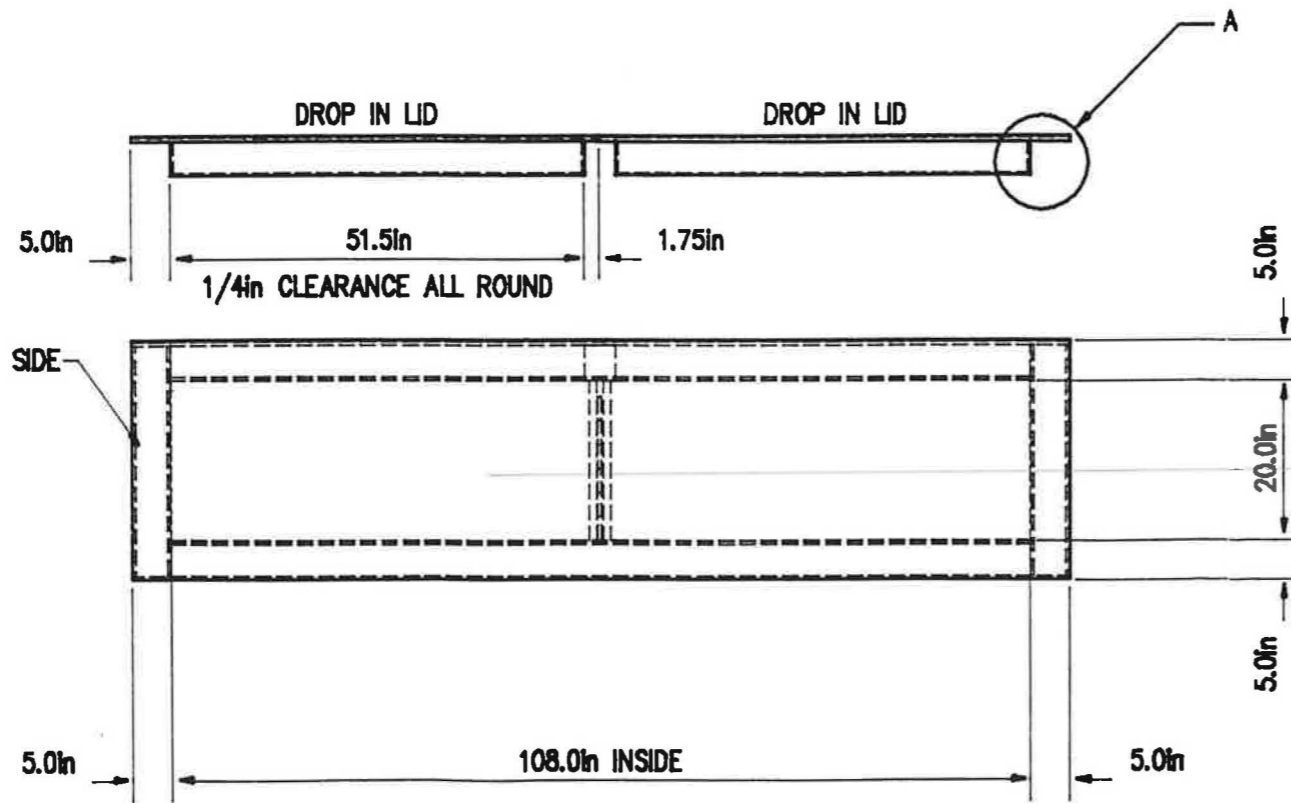
PLAN VIEW



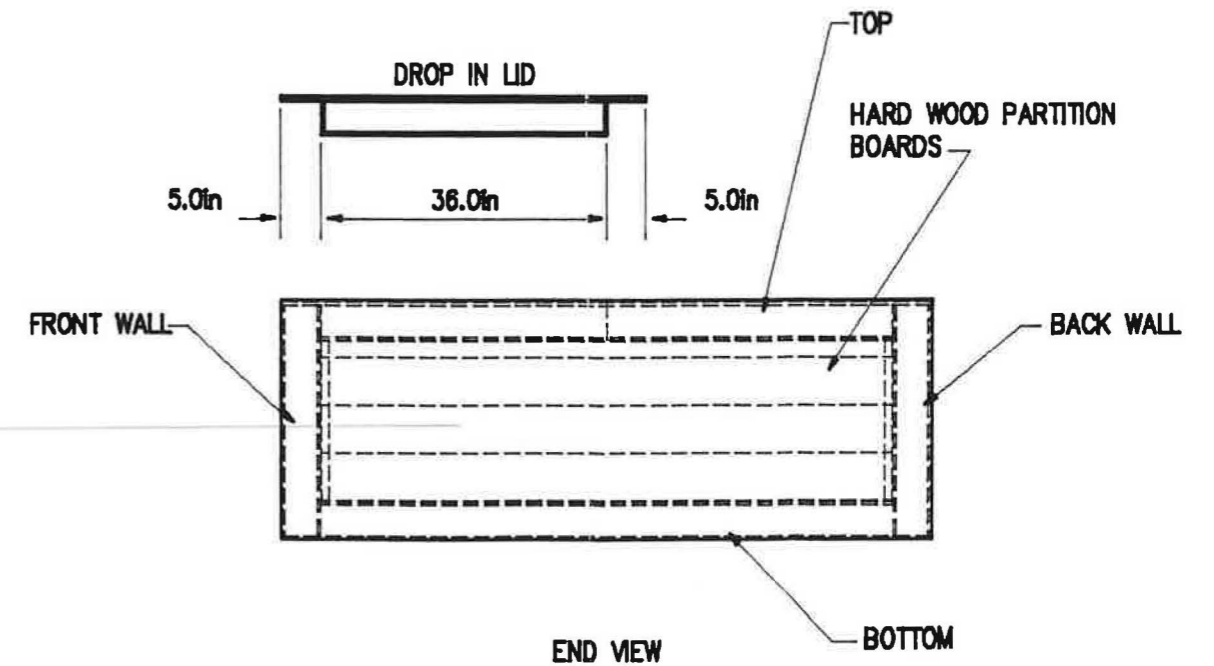
TYPICAL CORNER SECTION VIEW AT (B)
SCALE 1/4 FULL SIZE



TYPICAL LID SECTION VIEW AT (A)
SCALE 1/4 FULL SIZE



FRONT VIEW



END VIEW

TITLE	DRG No T0311-01	DRN G.G.A
ICE STORAGE BOX	SCALE 1/2in = 1FT	NRI

Annex VII: Fish market survey questionnaire

1. Batch code number _____
 2. Number of fish in batch _____
 3. Total weight of fish (kg) _____
 4. Species of fish
(ie, yellow fin, skipjack etc) _____
 5. Is the fish gutted or ungutted (U or G)?

 6. Date of capture (dd/mm/yy) _____
 7. Date of sale (dd/mm/yy) _____
 8. Number of bidders identified _____
 9. Total sale price of batch (Rs) _____
 10. Name of buyer _____
 11. Contact address _____

 12. Point of next sale _____
 13. Expected sale price (Rs per kg or per fish)

 14. (Ask only if gutted) Were you aware that this fish was
gutted (yes or no)? _____
 15. (Ask only if gutted) Why did you buy this gutted fish
rather than a whole one?

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16. Which of the following do you consider most important when buying fish (tick each mentioned)?

Size	_____	Gills	_____
Species	_____	Colour	_____
Smell	_____	Eyes	_____
Texture (feel)	_____	Slime	_____
Damage	_____	Other (specify)	_____

Annex IIX Measuring Ice Melt Rates

There are various alternatives available for measuring ice meltage rates.

a. Weigh each block at the set time intervals.

This will be a long a laborious process but would give the most accurate measure. Unfortunately because of the time taken to do this it may will lead to excessive ice meltage whilst the blocks are out of the box or wood shavings. The blocks buried in wood shavings will also have to be carefully cleaned of shaving before weighing by brushing away the shavings. The blocks must not be washed with water to remove the shavings as this will cause excessive melting.

b. Weigh a sample of the blocks (say 25%) and estimate the total weight from the sample.

This will be quicker than weighing all the blocks but its accuracy will depend on the selection of a representative sample of blocks. It is likely that not all blocks will melt at the same rate, those on the out side melting more quickly than those on the inside of the box.

c. Measure the dimensions of the blocks and from this calculate the weight of the ice remaining.

This method could be employed without having to remove the blocks completely from the box or from the wood shavings and therefore would overcome problems of ice meltage during the measuring process. However it would assume that the blocks melt evenly and remain cuboid in shape. In practice this may not happen and the uneven melting particularly of blocks on the outside may make this impractical.

d. Measure the ice melt water

This would be possible by collecting the water draining through the lowest drainage hole of the ice box and weighing it. It would not be possible to do this with the ice stored in wood shavings.

It is recommended that to begin with option one (weighing all blocks) is used to measure meltage but at the same time the other alternatives be investigated to see whether short cuts are feasible for subsequent trials.

Trials 1 and 2

Take 30 blocks (50kg each) of ice, stack in box and close lids.

Take 30 blocks (50kg each) of ice, and bury in wood shavings in the traditional fashion.

Every 12 hours measure the amount of ice remaining or the amount ice melt water produced. Continue the trials until all the ice has melted.

Trials 3 and 4

As for trials 1 & 2 but using 20 blocks of ice in each store.

Trials 5 and 6

As for trials 3 & 4 but using 15 blocks of ice in each store.

Trials 7 and 8

As for trials 5 & 6 but using 8 blocks of ice in each store.