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Report on Visit to Momase Coastal
Fisheries Development Project - GTZ
- Papua New Guinea. Fish Handling,
Processing and Marketing.
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Contract C0307

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Abbreviations

ATDI	Appropriate Technology Development Institute
cm	centimeter
DFMR	Department of Fisheries and Marine Resources
FFI	Finschafen Fishing Industry
FRP	Fibre Reinforced Plastic
ft	foot
GTZ	Deutsche Gessellschaft für Zusammenarbeit GmbH
K	Kina
kg	kilogramme
lt	litre
MCFDP	Momase Coastal Fisheries Development Project
mm	millimeter
mth	Month
NGMW	New Guinea Motor Windings
NRI	Natural Resources Institute
PNG	Papua New Guinea
TOR	Terms of Reference
UNITECH	University of Technology - Lae

Exchange Rates

K1.00 = US\$ 1.0357

K1.00 = £ 0.5362

INTRODUCTION

This report is the result of a three and a half week mission to Papua New Guinea on behalf of GTZ to study the fish handling and marketing aspects of the Momase Coastal Fisheries Development Programme plus desk work by the second author in the financial and economic aspects of the proposals recommended as a result of the field work. I J Clucas of the Natural Resources Institute, UK spent from 19th July to 10th August 1992 in PNG after a briefing in GTZ Frankfurt. A full itinerary for the mission and Terms of Reference are given in Appendices 1 and 2 respectively.

BACKGROUND

The Momase Coastal Fisheries Development Project (MCFDP) is a Technical Cooperation Project between the German Government (Ministry of Economic Cooperation) and the Government of Papua New Guinea, being executed by the Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ). In its present form the Project covers coastal fisheries in the MOMASE Region, that is the four Provinces of Morobe, Madang, East Sepik and West Sepik. GTZ involvement however started in 1987 with the Morobe Coastal Fisheries Development Project which as its name suggests was concerned with just the province of Morobe. In 1991 after the first phase of the Morobe project the brief was expanded to cover the four provinces of the region. For historical and logistical reasons therefore the focus until very recently has been on activities in Morobe based at the Fisheries Division in Lae. Activities in Madang have so far been concentrating on strengthening the structure of the Fisheries Branch of the Provincial Government and setting up systems for collecting data on the fishing activities in the coastal zones. Activities in the two Sepik Provinces are in the process of being initiated.

NRI were asked to provide assistance to the project working to the TOR in Appendix 2. NRI suggested initially that the TOR should be covered by inputs by both a Fish Technologist and a Marketing Economist totalling some 8 man weeks in the field. After some considerable discussion between NRI and GTZ agreement was reached that inputs would be for 3.5 man weeks of fish technologist inputs in the field with inputs from an economist in UK only. It was made clear to GTZ that NRI felt that there was a need for a field team approach to the work and that it would be difficult for one person to complete the work to a satisfactory level within the time available. Discussions with the Team Leader revealed that he felt that this was the case and it was agreed that a second follow-up visit was essential to complete the work on for instance:

- i Quality problems and the need for standards
- ii Processing other than chilling (fish smoking etc)
- iii Training and information needs
- iv Studies of the situation in Provinces other than Morobe such as Madang and the Sepik Provinces

It is suggested that this follow-up activity should coincide with a visit from the Economist contracted to the project to undertake periodic short visits. The likely timing for such a visit is March/April 1993 and it is strongly recommended that the next fish technologist visit should be at this time. Outline Terms of Reference for this visit are given in Appendix 3. It is estimated that the work involved would require 6 weeks in the field and 2 weeks for report writing and preparation in UK.

Summary of Recommendations and Action Points

GENERAL

Efforts are being made to increase the data available on the fish production and fishing effort in the project area. Similar efforts are required to collect data on the marketing of fish through the project landings so that a complete picture of the fishing industry can be built up and to assist in the future planning of project interventions. The recording of fish purchasers and ice sales to fishing groups has already begun and should be formalised so that monthly summaries can be produced and trends established.

Collaboration with the Department of Fisheries and Marine Resources fish technologists should be strengthened so that training and development activities can be coordinated.

A second visit by the primary author to coincide with the project economist must be undertaken so that the activities initiated by this report can be followed up and reviewed and further potential project activities can be identified in provinces other than Morobe. (Appendix 3)

MOROBE PROVINCE AND LAE

Ice Supply

Ice supply at village level is sporadic and unreliable, this is proving to be a major constraint to increased fishing efforts by the fishing groups. The general policy of providing block ice making facilities at strategic points where the necessary infrastructure exists to run a block ice plant is correct and should be followed through to other locations in the province where sufficient quantities of fish are caught - eg Siassi Islands. The siting of ice making facilities in remote villages should not be encouraged.

Action Points

Monitor and encourage the operation of the recently launched Kakota ice supply and fish collection operation to service the fishermen of the coastal communities.

Further discuss with fishermen groups their village level ice requirements and storage needs. Indicate to the villagers the likely costs and benefits of ice storage boxes (based on information from manufacturers). If reaction is positive have a number (say 3) boxes made at project expense and loan or lease them to fishermen groups on a trial basis. Monitor performance of boxes

over a six month period, measuring use for ice and for iced fish storage.

Further discuss with fishermen groups their requirements for fish and ice transport containers for use on dinghies. Indicate the likely costs and advantages and if positive reactions are obtained from fishermen have a number of boxes made for loan or lease to fishermen on a trial basis. Monitor performance as above.

Collect base line data on costs of fishing and fishing activities in target villages over a period of at least one year in order to assess the financial advantages of increased fishing activities brought about by more regular and certain supplies of ice.

Activities at Voco Point

The handling practices and the way in which fish is sold is leading to reduced quality of fish, possible conflicts between buyers and sellers and irregular practices on the part of market staff. The possibility of future major disputes over fish ownership and cash transactions cannot be ruled out and it is essential that control be exerted before these problems get out of hand. Demand for fresh fish from wholesale buyers in Lae and Goroka is strong and this has lead to the present irregular practices.

Action Points

Handling

Fish should be stored as chilled fish rather than as partially and slowly frozen fish.

"Fish in ice" storage and ice storage should be separated between the two stores on site.

The smaller of the two stores presently used as an ice store should be adapted to run at temperatures between 0 and +5°C. It should then be used just for storage of fish in ice not for blocks of ice.

The chill store should have a trapped drain fitted to allow melt water to escape.

Both stores should be fitted with door switches which cut out the evaporators when the door is open. This will result in more stable room temperatures by reducing loss of cold air, reducing the need for defrost and also save on electricity costs.

The plastic boxes should have holes drilled in their four corners to allow ice melt water to drain if they do not already have them.

Fish should be weighed, sorted, labelled and layered with crushed ice before storage in the chill room.

The chill room door should be kept closed and locked at all times when fish is not being put into or removed from the store.

The stores should not be used for any thing other than fish in ice or ice. The storage of beer and food stuffs such as skinned crocodile and fruit, which were found to be in the store on at least one occasion during this mission, should be strictly forbidden.

Sales System

Regular sales times for fish should be established at the Voco Point landing. It is suggested that two sales times per week would be appropriate taking into account the quantity of weekly landings and the demands of the buyers. Initially, Wednesday afternoon and Friday afternoon would seem appropriate but further discussions with fishermen and buyers are needed to establish this. The landing should only be used for wholesale transactions, thus reducing the entrance of members of the public and encouraging competition between buyers at wholesale level.

All wholesale buyers should be registered and identity cards issued. Complete records of fish purchases should be kept and computerised so that the strength of demand from the various buyers can be monitored.

An auctioning system for sales should be tried and tested. The restriction of sales to twice a week and the abolition of retail sales will accumulate sufficient fish for there to be enough fish for a reasonable auction to occur. Assistance from experienced auctioneers should be sought to train a member of fisheries staff to conduct auctions.

The involvement of fishermen's groups in the new marketing system should be explored with the possibility of cost recovery systems being introduced.

MADANG PROVINCE

Madang Fisheries Station Ice plant

The purchase and installation of the imported shell ice plant capable of producing 2 tonnes of ice per day seems inappropriate under present conditions at Madang. It was not possible to discuss this with the person who recommended this equipment but in spite of this the following recommendations are made.

The unused cold store adjacent to the ice plant should be used for ice storage rather than insulated top loading boxes which will require to be moved when full, be

difficult to unload and will require that the plant operations will be supervised on a continuous basis.

In order to achieve this the following actions are required:-

i. Turn ice machine through 180 degrees and raise it roughly 60 cm to bring the ice outlet level to the top of the adjacent store.

ii Move evaporator in the store to back wall from side wall.

iii Construct an insulated chute from the ice outlet of the ice machine through the wall of the store so that ice falls automatically into the store.

iv Fit a mechanical level sensing devise or thermo-static control to the store so that the ice plant will automatically cut in and out. Advice from a professional refrigeration company should be sought or "Berg" should be contacted concerning correct installation.

v It was also noted that the bolts used to secure the ice plant to the concrete plinth are very light duty and will be inadequate to hold the vibrating plant when running. Larger bolts and anti-vibration mountings would be more suitable.

MAIN REPORT

MOROBE PROVINCE

Area of Project Operations and Observations

1. For the purposes of statistics collection the project has divided the coast line of Morobe Province into a number of different areas as illustrated in Appendix 4. From records being collected at the Lae fish landing it is apparent that the majority of the fish being landed at Lae is from fishermen from villages in area 3, the coastline to the south of Lae as far as Lababia, approximately 2½ hours away by motorised dinghy. For logistical and operational reasons the project administration have decided that it will concentrate its development activities within this area and it is hoped to set up a field station at Laukano which will make coverage of the area 3 villages even more effective. Once innovations have been tried and tested at villages within the area 3 they will be extended where appropriate to villages in areas further afield.

2. For the above reasons and because of the very short duration of this visit the information collected and the recommendations made are based on the situation in the area 3 villages.

Fishing in Coastal Villages.

Background

3. There has been a tradition of fishing in most of the coastal villages of Momase region, probably ever since the communities were established. In Morobe province and probably elsewhere however the fishing was purely a subsistence activity with the men of the extended family unit using hand made hooks and lines and using dug-out canoes to fish for reef fish or amongst the shoals of skipjack and tuna which move along the coast line and are visible from the shore. Fish would be caught, taken to shore and distributed amongst members of the extended family or clan for immediate consumption. If there was too much fish for immediate use then the surplus would be smoked to preserve it, or perhaps bartered for other food stuffs.

4. It was not until about 20 years ago that the then Australian Administration introduced the concept of fishing for a profit. Until this time the fishing villages along the coast of Morobe province were more or less isolated from the main urban centres such as Lae and Finschafen because they were and still are only accessible by sea or on foot. In the early 1970's the first out board motors were introduced to the fishing communities along with aluminium dinghies. This not only allowed the fishermen to fish with other gears and to go

further for fish but also to transport their fish relatively fast to the urban centres for sale.

Fishermen Groups

5. Fishermen are normally organised into groups. A group consists a number of fishing units. Usually the group will have a motorised fibreglass or aluminium dinghy (19ft) plus 3 to 5 dug-out canoes. The fishing units will be owned by individuals in the same clan or at least from the same village but will operate communally as far as fish preservation and marketing is concerned. Often the canoe fishermen will fish at the same time with the motorised boat acting as a carrier boat to collect fish and ferry it back to shore for gutting cleaning and icing in a communal ice box. Often, to save on fuel costs, only the non-motorised dug-out canoes are used for fishing with the motorised dinghy being used solely as a transport boat. Further information on the operation of the fishing groups and the way in which the assets and rewards are shared can be found in the two project reports on the base line surveys conducted in Lababia and Busama villages. Once a fishing group has caught sufficient fish to fill the ice box or all the ice has been used the motorised dinghy will be used to transport the fish on ice to the Lae fish landing.

Fish Handling in Villages

6. The late introduction of the concept of fish as a means of earning money has led to a number of interesting developments. Firstly fishermen and fish sellers are very well aware of the value of chilling as a means of preserving fish, ice is widely used in villages for preservation, transport and distribution to the markets. Fishermen are well aware of how to use ice and will always get fish into crushed ice as soon as possible after capture assuming that they have ice available.

7. The second very unusual feature of the handling of fish is that as matter of course all fish are gutted and gilled as soon as possible after capture. This is done once the fish have been transported back to the village for icing and storage. The standards of gutting and cleaning of the gut cavity by the fishermen are extremely high, based on observation of fish being sold through the main fish landing in Lae.

8. These factors contrast with the situation in many other small scale fisheries in other parts of the tropical world where fishermen are often unaware of the use of ice, the value of gutting and the ways of maintaining quality which are illustrated in the PNG coastal fishery. These two factors (icing and gutting), coupled with the fact that fishermen attempt to sell all their fish within about 3 to 4 days of capture means that the quality of fish at first sale is extremely high.

9. The reliance on ice for preservation means that most fishermen and fishermen's groups in the villages will not go fishing unless they already have ice available. Talking to fishermen in a number of villages close to Lae revealed that they will not go fishing unless they have ice and they often have problems with ice supply which curtail their fishing activities. All fishermen interviewed in the villages visited indicated that they would fish more often and for longer periods if they had a reliable ice supply.

10. The groups usually have their own ice box which is an old domestic deep-freeze or refrigerator cabinet from which the mechanical parts have been removed. These are sited in the fishing village for conserving ice supplies and for storage of fish in ice until the fish is taken to the wholesale market in Lae. Fishing groups operating from villages more than an hour or so by sea from Lae may have a second smaller box for storage of fish in ice during transport to the landings. From villages closer to Lae fish may be transported in baskets with any remaining ice to assist in keeping it cool.

11. These old refrigerators or deep-freeze chests have in the past been given away to fishing groups by members of the clan or friends. Recently, however, the units have become scarcer and now have a resale value ranging between K20 and K50 depending on their condition and size. Apart from the fact that the units are now becoming scarcer and therefore more expensive they have a number of other problems. They do not last more than about one year before they become less effective in reducing ice meltage. Deterioration occurs because the linings of the units are light weight plastic which becomes easily damaged by blocks of ice being dropped, the exterior enamel cases rust quickly in the saline atmosphere in the coastal villages and because the units are often over filled the lids and their hinges become broken.

Ice Supply at Village Level

12. It is apparent therefore that the supply of ice is a very real constraint to further expansion of fresh fish supplies from the isolated fishing villages. There are various ways in which this constraint can be overcome:-

- i Siting of ice making facilities in fishing villages
- ii Providing better ice storage facilities in villages

The first of these two options is impractical for a number of reasons.

- a Lack of electricity in the Villages
- b Lack of access to spare parts, maintenance and man power for servicing of the machines.
- c No manpower for running the operation of an ice plant at village level.

d The demand from each village community would probably make it uneconomic to run even the smallest ice making unit.

13. It is recommended therefore that the policy of providing centralised ice making facilities at strategic points be pursued and the communications between the coastal fishing groups and the ice supply points be strengthened. This is already being tested by the trials of the leasing to the Kakota group of a boat equipped with two insulated boxes with a total capacity of 1.2 tonnes of fish and ice. This boat, being operated by a fisherman from Laukano village, only started operations in late July 1992. It is planned that the operator will buy ice from fisheries at Voco Point at K1.50, and transport it to fishing villages for sale. He will also purchase fish from fishing groups in the villages for transport back to Lae for sale through the fish landing. In addition the unit will undertake fishing activities in its own right. Complete records of the operation of the Kakota will be kept and a review of operations will be undertaken to ascertain the long term viability of the undertaking.

14. Supply and storage of ice in the villages could be strengthened by the provision of suitable ice storage facilities. Even within Area 3 ice requirements per fishing group vary depending on the number of fishermen in the group, the distance from Lae and the degree of activity of the fishermen. Discussions with a number of fishermen in Laukano, Lababia, Buakap and Busama indicated that they would require a box for their group capable of holding between 12 and 20 fifteen kilogram blocks of ice for a period of at least seven days.

15. There is also a less pressing need for insulated boxes for transport of iced fish between fishing villages and Lae, particularly from the more remote areas. These should be capable of carrying approximately 100 kg of fish and 100 kg of ice. Insulation thickness for these boxes should be 50mm and would need to have a capacity of about 250 to 300 lt.

16. Enquiries were made of a number of ice box manufacturers in both Lae and Madang as to the likely costs of various sizes of insulated boxes and the results at the time of writing are given in Table 1 below.

Table 1
Ice Box Quotations and Costs

Company	Capacity	Insulation	Type	Cost K
Luship	300 lt	50mm	FRP	380
Madang	300 lt	75mm	FRP	430
"	1000 lt	75mm	FRP	630
"	120 lt	75mm	FRP	120
Wong Tim	385 lt	50mm	FRP (Tapered)	425
Lae	290 lt	50mm	FRP (Tapered)	395
"	147 lt	50mm	FRP (Tapered)	220
SPM	224 lt	40mm	FRP (Exp Poly)	180
SPM	353 lt	25mm	FRP (Exp Poly)	270
SPM	630 lt	50mm	FRP (Exp Poly)	494
Dynoplast	170 kg	25mm	Plastic	355 App
Canada	225 kg	25mm	Imported	375 "
"	320 kg	25mm	"	425 "
"	455 kg	25mm	"	563 "
"	680 kg	25mm	"	594 "
"	770 kg	25mm	"	662 "

NB. The Dynoplast boxes referred to in the table have been imported for use at the Madang Fisheries Station

17. A box to hold twenty blocks of ice would have a capacity of roughly 580 litres and assuming a 75mm insulation thickness the likely costs are around K500, assuming the box is made of Fibre Reinforced Plastic inside and out. The box for carrying of fish and ice on board dinghies would cost approximately K400 as indicated by the quotations above. A number of other manufacturers of boxes have been asked to provide quotations. Cheaper options may be available and the possibility of setting up a village level production facility in Laukano should be explored. Training in manufacturing techniques would be required for villagers. This training may be possible from ex-employees of the major FRP manufacturers such as the village level boat builder, box manufacturer visited near Madang.

Village Ice Storage Box

18. Discussions with a number of fishermen in the villages to the south of Lae on their village ice storage requirements indicated that they would like a box that will store between 12 and 20 blocks of ice. The further the village from Lae the larger the number of blocks required. The 15 kg blocks of ice produced at Lae measure 70 cm long by 30 cm deep by 11 cm wide, with a slight taper to the bottom. It is proposed that blocks should be stored in a single layer resting on their long sides in two rows of ten blocks each. This will require that the box for 20 blocks will have internal dimensions of at least 30 cm deep by 140 cm long by 110 cm wide. To

allow ease of handling in the box an additional 2.5 cm all round should be added to give totals of 35 x 145 x 115 cm. A box with these dimensions, 75 cm of insulation, drainage holes at two diagonally opposite corners and drop in lid would seem to be appropriate as a first trial box for testing in the village situation.

Ice and Ice Fish Transport Box

19. A number of fishermen expressed interest in an improved box for the transport of ice on board their dinghy from the Lae landing and for the transport of fish in ice to market. Whilst there is technically a case to be made for a "better" box it has not been possible to ascertain whether such improved technology would be viable. It is suggested that the introduction of these boxes is much less of a priority than the village ice boxes discussed above or the other reforms suggested in this report.

20. Smaller boxes required for ice transport from the landing and fish transport to the landing are already made in suitable sizes by fibre glass manufacturers in Lae and Madang. The requirement seems to be for a box of roughly 250 to 300 litres. It is suggested that a number of boxes of different sizes and shapes be purchased from manufacturers, loaned to fishermen on a trial basis and their performance and suitability monitored.

The Voco Point Fish Landing - Lae

Facilities

21. The fisheries station at Voco Point in Lae is a focal point for fisheries activities in Morobe Province. It functions as a service centre for the fishing community and with the offices of the Provincial Government Fisheries Staff being on the same site should act as a centre for advice and assistance to the industry.

22. The facilities for servicing the marketing needs of the industry include the following:-

- a. Two approximately 5 to 6 tonne capacity cold rooms, one leased to Kum-Gie for ice storage, the other used by the department for storage of fish and ice.
- b. Weighing Scales
- c. Plastic boxes for fish handling and storage
- e. A landing point for motorised craft bringing fish for sale
- f. A buying point for customers to buy fish.
- e. A small flake ice plant (Liquid Carbonic model TE2) and ice store currently out of commission.

23. Until recently the landing also acted as an ice producer and seller for the industry. The ice production

facilities have recently (1/6/92) been contracted out to an NGO (Kum-Gie Consult) on the understanding that the Voco point landing has access to 40 blocks of ice per working day at K2.50/15kg block from the plant which it then sells on to fishermen at the landing at a subsidised rate of K1.50/block.

Sales System

24. The landing presently acts as a fish selling point for fishermen. Groups of fishermen from the coastal villages of Morobe Province bring fresh fish to the landing by motorised dinghies. The fishermen unload their catch into the plastic fish boxes belonging to the landing, the catch is then sorted into categories and weighed. The categories are those devised by the project in order to arrive at data from which catch per unit effort can be estimated. Other details regarding the catch are also recorded, such as fishing group, number of days fishing fish grounds etc.

25. Once the fish have been sorted and weighed they are ready for sale. If potential buyers are present then the sale may be made immediately, otherwise the fish in the boxes will be placed in to the cold store for storage. The fish is not purchased by the fisheries station, sales transactions being made directly between the fishermen and buyers.

Fish Buyers

26. The landing is presently acting as both a wholesale market outlet and a retail sales point. The major wholesale buyers are the supermarkets in Lae itself particularly Papindo and Steamships (through a middle man - James Yamali) and Gamesano Trading of Goroka.

27. Discussions were held with a number of the major buyers of fish that use or have used the Voco Point landing for fresh fish supplies. From these discussions it has been possible to compile the following list of their immediate requirements for fresh fish.

Table 2. Fish Requirments of Some Lae Buyers

Company	Weekly needs
Papindo	1000kg
Sullivans	1000kg
Steamships - wholesale	100kg
Steamships - retail	100kg
Gamesano	400kg
Pelgen's	70kg
Unitech Fresh Foods	60kg
Kwantung Restaurants	30kg
TOTAL	2760kg/week
	or potentially 11040kg/month

28. The above is by no means a fully comprehensive list of requirements from all potential purchasers but it does illustrate the fact that even within these few buyers there is unsatisfied demand. It can be seen by comparing the figures above with those in Tables 3 & 4 that none of the buyers demands were met buy their purchases in June and July 1992. These tables give breakdowns of the purchases through the landing for only June and July 1992. Purchases records for previous months are incomplete, because a system of recording has only recently been introduced.

Table 3 Major Purchasers of fish at Voco Point June 1992

Buyer	Days at landing	Total Purchase	% of monthly Landing
Papindo	14	2415.9	42.4
James Yamali	16	1245.6	21.9
Micheal	5	413.2	7.2
Samodai	4	348.0	6.1
Gamesano	2	184.6	3.2
Kamitu Trading	3	168.7	3.0
Andersons	2	95.0	1.7
Pelgen's	1	84.0	1.5
Unitech F F	1	37.4	0.6
Kwantung Rest	1	25.0	0.4
Hyundai	1	17.0	0.3
Retail		661.9	11.6
TOTAL		5696.3	

Table 4 Major Purchasers of fish at Voco Point July 1992

Buyer	Days at landing	Total Purchase	% of monthly Landing
Papindo	16	2092.1	40.5
Gamesano	5	540.6	10.5
James Yamali	11	461.8	8.9
Sullivan's	1	150.3	2.9
John Peka	3	130.2	2.5
Pelgen's	1	80.2	1.6
Retail		1779.3	34.4
TOTAL		5171.5	

Purchasing Practices

29. Tables 3 & 4 above disguise the fact that there is a potential to sell to other purchasers. Competition for good quality fresh fish in Lae is strong and this has lead to a number of practices by the major buyers which ensures them a more regular supply than others. For instance Papindo have made informal contracts with a

number of fishermen's groups to purchase fish at premium prices. For Red Emperor which is the most favoured reef fish they pay K0.30/kg above the normal market price and for less popular fish pay K0.10 to K0.20 above normal prices. In addition a number of buyers deposit cash with the government Fish Marketing Officer so that he buys fish on their behalf when they are not present at the landing, thus ensuring their supply. The Fish Marketing Officer will then telephone the purchaser to ask him to collect his fish. This practice is particularly useful to "out of Lae" buyers who cannot afford to come to the market without knowing that there is fish to buy. The main "out of Lae" buyer is Gamesano Trading from Goroka who in order to secure supplies deposits up to K400 with the Fish Marketing Officer against future purchases. This buyer's requirements are for up to 400 kg of fresh fish per week and presently he is unable to obtain this.

30. The practices outlined above have discouraged other potential purchasers from buying through Voco Point and led to some making arrangements direct with fishermen to purchase. It can be seen that even between June and July 1992 the number of buyers at the landing has gone down from 11 in June to only 6 in July. Discussions with a number of these buyers (Pelgen's, Kwantung Restaurants, Andersons, and Unitech Fresh Foods) revealed that they had more or less given up trying to buy fish from Voco Point because they did not want to get involved in, what they considered, underhand deals with market staff and therefore felt that they were unable to compete. They would welcome the chance to participate in regular sales at the market but were unwilling to use valuable staff time in visiting the market on spec.

Other Fresh Fish Supplies in Lae

31. Other means of obtaining fresh fish are available to buyers in Lae. In the time available it has been difficult to quantify the amount of fish passing through these other channels. These channels are as follows:-

i The main produce market in Lae acts as a retail outlet for some fresh fish. Women (relatives of fishermen, and shell collectors in their own right) from the nearby village of Labu bring fish for sale at the main market. They come on a regular (daily) basis to sell smoked fish, shells (cockles) and some garden produce. On Saturdays they also bring fresh fish for sale. About 15 ladies all from Labu village were at the market on 25th July 1992 selling fresh fish. The individual quantities were small varying between 5 and 20 kg. An estimated total of about 100kg were being traded and customers were many.

ii Fishermen themselves, particularly from Labu bring their fish and sell on a door to door basis. The proximity of Labu village to Lae (10 minutes by

motorised dinghy) means that most of the fishermen do not use ice but carry fish in baskets direct from the fishing grounds to their customers. Outlets for their fish include individual households, purchasers at their offices and restaurants. It has not been possible to quantify the amount of fish being sold in this way.

iii The Finschafen Fishing Industry (FFI) operates a fishing boat from Finschafen which until recently was used to collect and buy fish from fishermen in the Finschafen and Siassi Islands area. This fish would be brought to Lae and landed at Voco Point on a more or less weekly basis at the rate of up to 1 tonne per week. The company were contracted to Sullivan's Wholesale who take all the reef fish, freeze them and distribute to their wholesale outlets in Mount Hagen, Goroka, Mendi, Tari and Ramu Sugar. The fish destined for Sullivan's, although landed at Voco Point, does not pass through the market and records are not included in the monthly statistics. Fish in excess of Sullivan's needs or of the wrong types is however sold through the normal marketing channels to other purchasers. At the time of this visit FFI had run into difficulties in purchasing of fish and the collection system had been suspended. The owner of the boat was planning to use the boat for fishing.

iv The Wong Tim Company is a trading company supplying fishing gear, outboard motors, FRP boats and other goods based close to the Voco Point landing. Presently the owner has run down his fish buying and selling operations but he does have his own collector boat which is presently not operational.

Ice Production Systems at Voco Point

32. Ice supplies at Voco Point are used to cater for the needs of fishermen, fish traders and members of the public. The main demand however is from fishermen coming to the landing to sell their fish and returning to their fishing base with ice to conserve their future fish catches. Until recently the ice production facilities were owned and operated by the Fisheries Division, supplying ice at what proved to be a heavily subsidised price to the fishing community. Apart from the fact that the ice was being heavily subsidised it proved difficult for the Division to produce sufficient ice to satisfy demand from the fishermen. The short fall in supply resulted in the fishermen being rationed as to the number of blocks of ice they could buy at each visit to the landing, particularly those fishermen operating from villages close to the landing. The ice plant has the capacity to produce sufficient ice but because it was being operated on a non commercial basis it was not running at anywhere near full production. As a

Government operation the plant was run on a five day per week basis and producing at the most only one batch of ice per day. Whereas with a batch turn round time of roughly 20 hours there is potential to increase production by 20% each working day and by working over weekends a further three batches per week are theoretically possible. A seven day per week and 24 hour operation would therefore increase the throughput of the plant by over 65% as illustrated below.

	Maximum Potential from Government Run Operation	Maximum Potential from Continuous Operation
Blocks/batch	48	48
Batches/day	1	1.2
Days/Week	5	7
Total	240	403

33. Because of the difficulties outlined above, and in line with general government policy to privatise operations as much as possible the running of the ice plant was handed over to an outside organisation (Kum-Gie Consult) on a rental basis to run on a trial basis and along more commercial lines. One of the provisions of this arrangement was that Kum-Gie would provide ice on a regular basis and at a fixed price to the fisheries division who would then sell on to fishermen. Since this arrangement has come into effect (late May 1992) ice supplies have been more than sufficient to meet demand although the production does not seem to have reached the full capacity as estimated above. Records for production from the plant for June for instance show that 1130 blocks were produced. This is only about 280 blocks per week but this has been more than sufficient to supply the Division with its 40 blocks per working day as agreed in the contract between the Division and Kum-Gie. At the time of this assignment the fisheries division ice stock was rapidly increasing. This was probably due to a temporary drop in demand caused by reduced fishing efforts and catches. The system is to be tested for an initial period of six months and revisions made as and when necessary.

34. Prior to this partial "privatisation" of ice production the Fisheries Division were selling ice at K1.00 per block (15kg). It has been estimated by the project that ice production costs on a break even basis are roughly K2.20/block. The Division are currently purchasing ice at the rate of 40 blocks per working day at K2.50 and selling it to fishermen at K1.50 therefore incurring a K1.00/block subsidy. It is proposed that this subsidy should be phased out completely over the next year or so, the rate of doing so being subject to review. In the mean time the Division will continue to guarantee both purchase from Kum-Gie and subsidy to fishermen. Once the subsidy has been reduced to zero the Division will withdraw from ice sales and fishermen will

purchase direct from Kum-Gie. In the mean time Kum-Gie are free to sell excess ice to private individuals and are so doing to a limited extent. Their advertised price for private buyers is currently K4.50/block somewhat higher than the cost to fisheries.

Block Ice Production Units

35. Ice production units are locally fabricated block ice units which are probably unique to Papua New Guinea. They are based on insulated fibre glass tanks with drop in lids. The tanks are fitted with copper piping grids snaking back and forth on the inside of each of the vertical walls. These pipes are the evaporator of an external refrigeration system. The tank itself is filled with a eutectic mixture of ethylene glycol which acts as the refrigerant mixture. Each of these tanks is capable of holding 12 ice cans each with a capacity of 15kg. These units are the basic building units of the block ice production process developed in PNG. In Voco Point the facility consists of two pairs of these tanks each pair connected to a common refrigeration plant. There is thus capacity to produce 48 blocks of ice per batch. (ie 720 kg of ice). Present batch production time, based on record from Kum-Gie, is roughly 20 hours although turn round times of 16 hours for the units were mentioned to the mission in discussion with the plant manufacturers. It is possible that if the adaptations recommended below were introduced the batch freezing times could be reduced and thus the capacity of the plants increased.

36. These units have arrived at the present state of development through a series of prototypes and experimental designs mainly through New Guinea Motor Windings. There are however still a number of problems that if resolved may make the units more efficient and cheaper to run.

i. The glycol used as the refrigerant mixture is expensive. Its freezing point is relatively high but it does have the advantage of being non corrosive. In order to work efficiently it is important that the glycol remains liquid in the tank so that it can circulate and cause rapid cooling. In practice it was observed that the glycol freezes in the colder parts of the tanks causing reduced circulation and increased freezing times. This is probably because the glycol solution is not strong enough, having become diluted by water from the ice cans spilling into the tank on loading of the ice maker.

ii There is presently no forced circulation of refrigerant mixture in the tank. The transfer of heat between the ice cans and the refrigerant would be increased if the mixture was pumped around inside the tank or agitated. Presently there is uneven and

slow freezing in ice cans in the centre of the tank and furthest from the compressor.

37. The use of sodium or calcium chloride brine solutions for the refrigerant would reduce the costs but may cause corrosion problems with non stainless steel parts of the units. New Guinea Motor Windings have a programme to develop units using sodium chloride brine which should be encouraged and monitored by the project. In addition the fitting of a system to move the refrigerant around inside the tanks should be investigated and tests made to establish whether such systems will reduce the time taken to freeze a batch of ice blocks substantially. With a pair of tanks operating from one compressor, such as those in operation at Voco Point, tests on the effectiveness of different circulation systems could be made by adaptations to one of the pair of tanks. The performance of the experimental tank can then be directly compared with the non modified tank running from the same compressor.

Physical Fish Handling at Voco Point

38. The handling of fish at the landing is generally not well organised. There are a number of practices that are causing loss of quality in fish which is generally of excellent quality and still in chilled condition when landed. Firstly no ice is used at the landing itself. After sorting and weighing (as described above) fish in the plastic fish boxes are placed directly into the cold store without ice. The cold store is also used for the storage of ice blocks. The cold store runs at a minimum temperature of -30°C after the door has been closed overnight but is normally at between 0 and -10°C during the working day because the door is left open for prolonged periods whilst ice blocks are loaded and fish is being sold. This practice has two effects on fish quality:-

- i The fish surface rapidly dries out and the fish lose their glossy appearance. Prolonged storage under these conditions could lead to "Freezer Burn"
- ii The fish freeze but very slowly, so that although the outside of the fish may be chilled and frozen relatively fast the internal temperature may still be high enough for spoilage to be occurring. Because of this slow freezing the texture and flavour of fish will be badly affected resulting in excessive loss of water on defrosting and loss of fresh flavour constituents.

39. The end result is that, depending on how long the fish are kept in storage, some customers are buying badly frozen fish rather than good quality fresh fish which could be achieved by proper handling. The store was also observed to be used by staff members for storage of other

goods, such as beer and soft drinks, fruit and on one occasion a skinned small crocodile.

40. To overcome these problems, that will be more acute if fish is stored for longer periods, the following actions are recommended.

i. Separate the storage of ice and the storage of fish between the two cold rooms.

At present one of the two stores is used for ice block storage by Kum-Gie on a leased basis and the other for storage of ice blocks and fish by the Fisheries Department. The present store, used for ice by Kum-Gie should be converted to run as a chill room for fish in ice. At the time of this visit when ice stocks were relatively high it was never more than 60 % full and the second larger store could easily have accommodated all the ice. The store to be used for iced fish will require to be run at a higher temperature, between 0 and +5°C.

This will require the replacement of expansion valves and the adjustment of the speed of the compressor by changing the sizes of the gearing pulleys between electric motor and compressor. Discussions with New Guinea Motor Windings (NGMW) indicated that this work would cost approximately K1,000 although firm quotations from NGMW, Arcon Engineering Ltd (Daikins) and other refrigeration engineers in Lae should be obtained.

As well as these mechanical changes the store also requires to have a drainage pipe fitted to allow the release of ice melt water. Unfortunately the floor of the store does not slope so it will be necessary to regularly (at least once a day) sweep ice melt water towards the drain outlet to avoid water accumulation. The fitting of the drain must be done with care to ensure that water does not enter the insulation where the pipe is fitted. The drainage pipe must be trapped so that heat loss and ingress of animal pests (rodents, insects etc) is prevented.

The store presently used for storage of fish should have its running temperature raised to approximately -15°C so that it can be used as a block ice store. This modification should be possible simply by thermo-stat adjustment without any physical modifications to the refrigeration equipment. The effect of these changes to the running temperatures of both the stores will be felt in reduced electricity consumption and faster pull down times.

Whilst these modifications to the stores are being made it should be investigated as to whether a door operated switch can be fitted that will cut out the refrigeration units when the door is open. The

siting of the evaporators on the wall opposite the door means that under the present system and in such small stores the cold air is being pushed straight out of the top of the door opening and warm moist air is being drawn in at the bottom. With the evaporators switched off when the door is open the store temperatures should not rise so quickly, the need for defrosting should be less and the stores should be more economical to run. The fitting of plastic strip curtains across the inside of the door openings should also be investigated.

ii. Ice fish before storage in the chilled store.

Once the above modifications have been made it is recommended that fish received at the station are sorted and weighted before being layered with ice in the plastic boxes. A ratio of 0.5 ice to 1 of fish should be adequate since once iced the boxes will be placed in the chill store. It is recommended that trials are made to establish the most appropriate ice to fish ratio taking into account the costs of the ice and the need to ensure that the fish is still iced at point of sale. It is particularly important that ice is adequately distributed amongst the fish and the top layer of the box covered with ice. Before storage each box should be labelled with weight, fishing group, species category and date of receipt.

In order for ice melt water to drain from the boxes drainage holes should be made in the four corners of each of the boxes used for iced fish storage. It is noted that most of the boxes already have in built drainage holes or have had holes drilled in their corners.

41. A concerted effort should be made to recover from customers at least some of the plastic boxes that have been purchased by the project over the years. It is understood that the landing used to have at least 500 boxes, the stock is now down to less than 20. The boxes in future should not be allowed out of the landing without a hefty deposit being paid. The current level of K20 per box is apparently not enough since users are still not returning boxes. A daily charge rather than a single one off deposit may discourage prolonged "borrowing" but would be cumbersome and costly to administer. It would be simpler and probably more effective to completely ban the removal from the market of the boxes.

42. With the present throughput of fish at Voco point and for the foreseeable future it is very unlikely that fish will need to be stored at the landing for more than half a week and storage in ice in the above fashion will produce fish of excellent quality.

43. In addition to the modifications to the cold stores mentioned above the above system requires the provision of finely divided ice for in plant use. There are two options that should be explored here.

i. Purchase by the project of an ice crushing machine so that blocks of ice purchased from Kum-Gie can be used.

ii Reconditioning of the small ice making plant already owned by and installed in the Voco Point shed.

Lack of time has not allowed the investigation of the comparative costs of these two options.

44. The above proposals assume that within the near future the fisheries division stop ice sales and fishermen buy their ice directly from the ice plant at a non-subsidised price thus not needing to store ice. The speed with which transformation will occur is subject to review and at these reviews it may be possible for the division to re-negotiate terms so that Kum-Gie store ice that has been purchased by fisheries division rather than it being transferred to the fisheries store.

Sales System for Fish at Voco Point

45. As has been indicated above the system of selling fish at Voco Point is haphazard and disorganised. The demand from major buyers is such that Fisheries Staff are being used as unpaid brokers and cash is being deposited with staff for purchase of fish. This has the potential to lead to disputes over ownership of fish and corrupt practices as reported by one of the fish buyers. It has also discouraged some of the major potential customers from buying fish at the landing.

46. This system has developed for a number of reasons:-

i. The sporadic and unpredictable nature of the landings and the fact that fish are landed and sold at any time. Under the present system buyers would need to station a member of staff at the landing virtually full time to guarantee fish supplies unless they make arrangements with market staff.

ii The unsatisfied demand for fresh fish in Lae and the Highlands.

Proposed Sales System

47. To regularise and overcome these problems a number of actions are proposed. Firstly retail sales of fish at Voco point should be discontinued and the landing only be used for wholesale purchases. This will make more fish available to the main buyers, reduce the number of people

allowed access to the site and reduce the complaints of unfair competition which were received from a number of the wholesale buyers - particularly the supermarkets.

48. All wholesale buyers must be registered at the landing and records kept of their type of business and purchases. This process has already begun with the introduction of the Fish Sales Record cards and the computerised Stock Control Recording system introduced recently. From these records it is possible to extract information on the purchases by the buyers. At present this is only possible by manually re-entering the data from the stock control spreadsheet, a way of extracting the relevant information to give daily and monthly summaries of fish purchases directly from the spreadsheet should be explored.

49. At present the sales system at Voco Point is that, in theory at least, fishermen are selling direct to customers with no fixed price and on a cash basis. In practice there is a guide price of K2.50/kg for most reef fish with Red Emperor (Snappers) trading at higher prices and tunas and other fish in lower demand fetching lower prices. The actual prices paid are open to negotiation between the seller and the buyer on particular days but in practice these prices are fairly static with the exceptions being only when the informal contracts, referred to above, between buyers and fishermen have been made in advance. This system should be giving the fishermen the best possible returns on the fish, however since there is rarely more than one buyer at the landing at any one time there is little competition for the non contracted fish.

50. There are a number of proposals which if implemented will regularise the fish sales, increase income to fishermen and encourage more fishermen to use the facilities at the landing.

51. Fish sales should be conducted at set times only rather than on the present ad hoc basis. To begin with it is recommended that sales be held twice a week which should give sufficient quantities to attract potential buyers. Further discussions are required with fishing groups and buyers as to the best days for sales but it would appear that Wednesday and Friday would be most suitable. Most fishermen do not fish over the weekend but start on Monday accumulating fish from a number of days before coming to Lae for sale. The Wednesday sales therefore would cater for groups working close to Lae who can get to the market relatively easily. The Friday market would cater for fishermen from further away and should be convenient for buyers since the demand for fish is highest on Friday and Saturday. It is probable that the most suitable time of day would be in the afternoon, allowing fishermen to land their fish during the morning for it to be weighed and sorted ready for sale.

52. The sales system should be by open auction for registered wholesale buyers only. One of the objectives of the project is to assist in the development of coastal communities of Morobe Province. It is important, therefore, that any increased revenue created by auctioning the fish should be directly available to the fishermen's groups. For this reason it is recommended that fishermen should be present at the auction where ever possible and that no commission should be charged for the services of the fisheries department auctioneer and market staff. Where fishermen are unable to attend the auction and require immediate payment the project should have the option to pay for the fish at the prevailing floor price. The fish will then be stored and put up for sale at the next auction. Any "profits" from the sale of this fish will accrue to the department to offset some of the costs of fish storage. In this way fishermen will be encouraged to land their fish on auction days so that they can get full benefits of the auction system.

53. Professional advice on running and keeping records of the auction should be sought from experienced companies in Lae. Preliminary discussions were held with the Managing Director of "The Professionals" (Mike Quinn) on the possibility of his company assisting in the training of an auctioneer. He agreed in principle that they would be willing to supply an auctioneer to conduct auctions and to train a member of the department during the first month or so of operation. The charge for this would be 10% of the gross sales value of fish, this should be met from department funds so as not to reduce the sellers income. Contact was also made with Arthur Stachan Pty Ltd and discussions held with Oswald Duncan. The manager of the company and chief auctioneer is out of the country until 18th August and should be contacted by the project on return to discuss the possibility of assistance.

54. Floor prices would need to be set for each lot of fish and any unsold fish or fish that could not be sold at the floor price could either be held for the next auction after purchase by the department or taken by the fishermen for sale elsewhere.

55. The most suitable lot sizes and whether fish should be sold sorted into species or species groups is a subject for debate. Since the fish will be auctioned on behalf of individual fishermen in most cases it will be important that fish from each group are auctioned separately and that complete records are kept of weights and types of fish landed by each group and the prices that they realise.

Fish Quality Considerations

56. As has been said above the quality of the fresh fish landed at Lae is generally high with good cleaning, adequate icing and care having been taken in preservation. There are periodic reports however of consumers returning fish to sellers or to the landing because they were not satisfied with the quality. Time did not allow further study of this problem but reports suggest that the poor quality characteristics are associated with soft disintegrating flesh and off odours particularly in the belly cavity. It seems that the defects are not apparent in the whole fish and it is only during preparing the fish for cooking that these problems are revealed. It must be emphasised that these quality problems are very few and far between and no adequate explanation as to how these problems occur has been produced. Various people spoken to suggested that the problems may be occurring because fish had been dynamited from the reef, however from the reports received this seems unlikely. Dynamited fish are likely to show external signs of damage such as blood shot eyes, broken belly walls etc, and the fact that the problems can occur in non reef fish such as tunas and skipjack suggests that there must be some other cause. In addition it is unlikely that fishermen would resort to dynamite fishing or have access to sources of explosives.

57. A possibility is that the poor handling at the landing centre which has been discussed above which involves slow freezing and inadequate use of ice is causing these occasional quality problems. With the introduction of an ice fish storage and handling mechanism at the landing it may be that these problems will be diminished. Time did not allow further investigations in this area.

Fish Processing

58. As has been mentioned above the primary reasons for fishing are firstly to provide fresh fish for own consumption and secondly to provide cash income from the sale of fish. When ever possible fish are sold fresh, but there are occasions when this is not possible, either because there is too much fish caught at one time or there is not enough ice available for preservation. On these occasions the fishermen preserve the fish by smoking. The smoking operation itself is carried out jointly, it seems by both the male and female members of the family where as the marketing and selling of smoked fish is carried out by the women.

59. The smoking operation itself is a fairly standard procedure and is usually restricted to tuna or other pelagic species caught in larger quantities. Time did not allow details of the process to be obtained but the following notes are based on discussions with fishing groups and observation of the smoking equipment used.

Large fish such as skipjack (1 to 2 kg) are boiled in $\frac{1}{3}$ sea water for approximately 30 minutes whereas small fish are smoked without pre cooking. Smoking is done over a fire fuelled by forest timber for initial kindling and coconut husks for the main smoking process. For small quantities of fish a 200 litre oil drum is used as the smoker. The two end of the drum are removed and a small door approximately 30 cm square is cut into the lower side through which the fire is stoked. Fish are placed on a wire mesh rack placed over the top of the drum and then covered with metal sheet, matting or similar material. Fish are then smoked for between 2 and 10 hours depending on their size. Larger quantities of fish (more than 5kg) a different type of smoking apparatus is used. This consists of a wire mesh rack measuring roughly 1 meter by 2 meters which is suspended roughly 1 meter above the ground by wire attached to the rafters of an open sided hut. A fire is laid below the suspended rack on which a single layer of fish is made. The fish are covered in the same way as the smaller scale drum smoker.

60. Further studies as to the efficiency, fuel use, quality and other aspects of these traditional smoking operations are recommended. The Lae based Appropriate Technology Development Institute at UNITECH made some trials of the Chorkor smoker in 1988 and concluded that smoke/dried products with long shelf lives could be produced and that fuel efficiency was good. Unfortunately the report on the activities do not compare the traditional processes with the experimental work and the programme has not continued.

61. Collaboration with ATDI and with the fish technologists of DFMR in Port Moresby in pursuing the programme of alternative and improved process methods in the project area may be worthwhile. The emphasis, however, for the foreseeable future, particularly from fishing villages close to Lae will be on providing fresh fish to this market.

Financial and Economic Analysis of Proposals

Introduction

62. A full economic analysis for the fishing/marketing operation and the effects of the new technology was not attempted due to the unavailability of adequate data. However the openness of the Papua New Guinean economy, the strength of the exchange rate and the relative efficiency of the markets for the principal inputs and outputs of the Morobe Province fishing system all indicate that the financial prices used are not greatly distorted from true economic values.

63. Because the proposed changes are suggested as part of a consultative technology-testing process project, project-level financial and economic analysis is not

conducted. However the results of the rough budget analyses can be adapted and developed to extrapolate up the costs and benefits discussed in this report if need be. This would require much more detailed information on beneficiary groups if it were to be useful.

Financial Analysis

Methodology

64. In the absence of any previously established fishing group financial data a rough set of capital and operating costs were developed from available data on the fishing and marketing system, capital and operating input ratios and prices and returns from fishing. Whilst the data was sparse the objective was to establish a structure of relationships between inputs and outputs with which the proposed changes in ice-fish storage technology and marketing practises could be evaluated. With this structure the financial importance of ice, fuel, and time savings could be compared and the significance of added capital costs resulting from new technology could be evaluated.

65. Using the available landings data for 1992 for the area three villages (Appendix 5b) averages were developed for frequency of marketing trips to Lae and quantities landed. The more detailed landings data for July indicated a large variation in fishing activity between groups and also in the frequency of marketing trips made. The financial analysis attempts to take these factors into consideration by modelling a 'low-intensity' fishing group which lands reasonably low monthly quantities and a 'high-intensity' group which is landing larger monthly amounts.

Establishing low and high fishing level models

66. An analysis of the landings data for 1992 at Voco Point (summarised in Appendix 5a) and the socio-economic reports written on a number of fishing villages in the region (GOPA 1991; Tumonde and Wagner 1992) indicates overall averages for area 3 of about 36kg (29kg to 41 kg) being landed over 2 to 3 trips to lae per month giving a monthly landed catch per group of 94kg.

67. However using July 1992 data for area 3 it is evident that these averages mask the existence of two distinct types of fishing group (see appendix 5b). One type landed an average of only 15kg per marketing trip per month and carried out an average of only 1.5 marketing trips per month. However removing the effect of some very low landed quantities coming from the very closest villages to Lae would increase this average upwards.

68. The other category marketed an average of 33 kg per trip over an average 4.3 trips per month. Again allowing for the influence of the very frequent landings of the closest villages the average is pushed upwards to around 60kg/trip. The fishing groups analysed in area 3 fell in roughly equal numbers into the two categories. The average monthly landed catch of the latter group was approximately five times that of the former group (163 kg/mth compared to 30kg/mth). This phenomenon does not appear to be a function of the distance of the village from the landing station.

69. Allowing additionally for the fact that the July landings were relatively low for the year two basic fishing group models were developed. The low-intensity model was defined as landing roughly 60kg a month on average over 2 marketing trips. The high-intensity model was defined as landing an average of 244kg a month over 5 marketing trips (average of nearly 50kg/trip).

70. The models are only intended to serve as approximations for the extremely wide range of fishing and marketing systems which are known to exist in the region. They serve as reference points from which the impact of various changes in the resource use ratios, activity levels and fish outputs can be assessed.

71. The two models are likely to represent the two ends of the spectrum of fishing and marketing systems being currently practised.

Summary of findings of financial Analysis.

72. Whilst the data used for the analysis needs a lot more refining certain clear lessons emerge.

Current Technologies

- There is a wide variety in the level of 'intensity' of fishing operations for groups in the region.
- Fishing is generally a marginal to low profit activity. The further the village from Lae and the lower the 'intensity' of the fishing the more critical the problem seems to be.
- Fishing groups take off 25% to 50% of their catch for consumption and village-based trading so economic returns to fishing are substantially greater than financial returns.
- Fuel costs dominate the financial costs and marketing costs are very significant in these for villages more than an hour from Lae.

Ice-Storage Box Technology

- The new technology will permit substantial cost savings through reducing marketing costs. There will be a certain distance from Lae beyond which the benefits will justify the costs (probably half an hour's journey). For the models analysed the technology gave an incremental return of K40 to K90 (average K65) a month. This is equivalent on average to a payback period of 7.5 months. The returns are equivalent to 2 to 3 day's minimum wage per group member.
- Because of the quite high capital cost the technology is most likely to be adopted by the higher intensity fishing groups (probably those landing 120-150kg or more per month). However it may well encourage the intensification of fishing activity among some groups located at some distance from Lae for whom the extreme marginality of the activity was a disincentive to fishing.
- No expansion in fishing output (as a result of the new technology) is expected from those more 'intensive' groups. Some expansion in fishing levels is expected from the more marginal fishing groups.

Results of Budget Analysis.

Low-Intensity Fishing Groups.

Existing Situation

	Fish Marketed/mth	
	30kg/mth Kina	90kg/Mth Kina
Group Net Income	-130	-120
G.N.I /member	-26	-24
GNI (w/o depr.)	-79	-69
GNI p.p (w/o depr.)	-16	-14

From Appendix. 6a

73. The data above indicates that fishing activity when conducted at these low levels does not appear to be a financially viable enterprise. However whilst very little income is gained from the smoking of fish up to 50% of the village landed catch (in the case of low intensity fishing groups) does not find its way to the landing station. This is mostly either directly consumed by the

fishing families or is bartered for other goods. It therefore constitutes a significant return which is not monetised. The fishing system can therefore be described as semi-subsistence.

74. The capital investment necessary to maintain a fishing and marketing operation is very high (K 5835) and bulky, being the same for very low fishing throughputs as for much higher ones. It is known that in fact some fishing families are able to obtain extended family help in the acquisition of the dinghy and motor (K4500) and that some are able to earn income from non-fishing activities from these assets (eg ferrying). Hence the full capital cost may not in fact be attributed to fishing alone.

75. Additionally it is known that some of the more 'marginal' fishing groups sell their catch to the dinghy owners of other fishing groups and therefore do not necessarily incur the full marketing costs or the capital costs of owning a motorised dinghy.

However for the model analysed which represents a fishing group in a reasonably distant village from Lae (1.5-2 hours travelling) even removing depreciation costs does not render the fishing enterprise financially viable (though it halves losses), a financial loss of about K80 a month being made. Reworking the data for a 33% reduction in fuel consumption per month gives a roughly break-even result (K -40 to K 11 w/o depreciation). The net group return increase becomes greater for the 90kg/mth throughput under the reduced fuel-use scenario.

76. In fact one can say that this latter result is probably a closer approximation to the reality of the majority of low-intensity fishing groups of area 3.

77. Socio-economic data indicates that in fact many small groups are not able to cover their capital costs from their fishing activities as the Agricultural Bank has had problems with recovering loans made for fishing equipment.

78. It is known that whilst an average market price of K 2.5 prevails at Lae and does not appear to vary with fish quality, premium payments are made to some fishing groups by purchasers who negotiate for a regular supply. In some cases this can be at K3.00/kg. Also it is known that a minor proportion of the catch consists of higher value fish which can obtain up to K3.00/kg. Adding in the influence of these factors to the analysis improves the net return. However the result remains that for low-intensity fishing groups located some distance from the landing station the returns to labour are extremely low.

79. Ice and fuel constitute the two main cash operating costs to the enterprise where labour is remunerated on a percentage of group net returns basis. Fuel is by far the

more significant representing in the current situation some 58% of total monthly cash costs for the 30kg landed fish per month model. Of this the fuel use for marketing trips to Lae is nearly double the fuel use for fishing. Marketing costs in total amount to over 39% of total monthly costs.

80. The two inputs of ice and fuel are currently linked in a fixed ratio under the present technology of village-level ice storage (the traditional box). As this technology only allows ice to be stored for up to 3 days this means that a marketing trip must be made to Lae after every two or three day period of fishing activity. As fuel is the critical cost this obligation contributes substantially to the marginal financial viability of the fishing operation at these low levels of throughput. Obviously the further the village is from Lae the more marginal the enterprise.

81. It is interesting to note that for this 'marginal' type of fishing group relatively large increases in the quantity of fish caught and landed (eg from 30kg/mth to 90kg/mth) do not significantly change the financial viability of the operation. This is due to the ice-storage constraint obliging even small catches to be taken all the way to Lae thus incurring high marketing costs on low volumes of product. Whilst less distant villages operating a less fuel consuming fishing operation will experience healthier cash income figures the nature of the relationship still holds. This is due to the ice and fish storage technology currently being used at the village level.

82. This low-intensity ('marginal') fishing/marketing system could therefore substantially benefit from technologies which either reduce fuel use per kg of fish caught or fuel use per kg of fish marketed.

Introduction of Improved ice boxes

83. Although the improved ice box technology reduces the ice to fish ratio necessary for chilling by 25% its critical influence is in allowing the same ice to be kept for up to 7 days or more than double the period for the current traditional ice boxes. As ice costs to the fishing group are actually much lower than fuel costs the benefit of introducing the new boxes is principally in reducing monthly marketing costs.

84. Whereas a two or possibly three day fishing 'trip' (whether overnighing away from the village or in it) had to be followed by a marketing trip to Lae the improved box would permit two (and possibly three) fishing trips to be made before the marketing trip would have to be made. These fishing trips would of course have to be made in close succession with possibly a day's break between them.

85. At the very low levels of fresh fish currently landed by the low-intensity groups the new technology permits a 25% reduction in ice costs and a 33% reduction in fuel costs for a village some 1.5 hours or more from Lae.

	Fish Marketed/mth		
	30 kg/mth Kina	60 kg/Mth Kina	90 kg/mth Kina
Group Net Income	-89	-42	-34
G.N.I /member	-17	-8	-7
GNI (w/o depr.)	-30	16	25
GNI p.p (w/o depr.)	-6	3	5

From Appendix 6c

86. However the financial analysis reveals that for the range of throughputs analysed (30kg/mth to 90kg/mth from 2 and 4 fishing trips/mth respectively) the unit remains loss-making under full depreciation assumptions and only marginally profitable under more lenient assumptions (K 25/mth for a 90kg/mth throughput).

87. However at the current very low throughput the new technology gives an incremental monthly benefit of K 41.00 to K 49.00 for a marginal monthly depreciation cost increase of K 8.00 (ie an incremental net benefit of K 37 to K 41). It would seem therefore that the financial incentive is certainly present for the adoption of the technology. The initial extra capital cost is K 465 which represents an 8% increase in capital costs for the group enterprise (1 PIB per group). This is not a very

significant increase although capital availability may well be a constraint to adoption for such groups and special credit arrangements may well be necessary.

Intensive Fishing Group

Existing Situation

	Fish Marketed/mth	
	244 kg/mth Kina	374 kg/Mth Kina
Group Net Income	32	134
G.N.I /member	6.4	27
GNI (w/o depr.)	83	186
GNI p.p (w/o depr.)	17	37

From Appendix 6b

88. The available data indicates that currently a typical relatively 'intensive' (occupying a significant proportion of fishermen's time (10-15 days/mth on average) fishing group in the study zone is landing approximately 250 kg to 300 kg of fresh fish a month at Lae from 5 separate fishing trips . Taking the lower end of this range as a base-line position the enterprise achieves net returns to management, investment and labour of Kina 32 to 75 per month or K6 to K17 per fishing team member (although the group's income is not actually split in this way).

89. Allowing fully for asset depreciation therefore renders the enterprise only marginally profitable at this fishing level with current technologies. Returns to labour remain very low. Partly or completely removing depreciation costs leads to a significant increase in profits however (K83 per month). Ice constitutes 14% of total operating costs but this is still far outweighed by the fuel cost.

90. For groups landing larger quantities the per kg fuel, ice and depreciation costs are significantly lowered and the enterprise achieves healthier returns of about K150 a month for the model analysed.

91. It is expected that in addition some of the non-Lae landed fish will generate a cash return (61kg a month). Were this quantity to be fully monetised at K2.00/kg another K120/mth would return to the enterprise.

Introduction of Ice-Storage Technology

	Fish Marketed/(kg/mth)		
	244kg	309kg	374kg
	Kina	Kina	Kina
Group Net Income	122	220	292
G.N.I /member	24	44	58
GNI (w/o depr.)	181	279	351
GNI p.p (w/o depr.)	36	56	70

From Appendix 6d

92. At the current modelled throughput of 244kg/mth landed fresh fish from 5 fishing trips a group net income of K 122/mth is made. This represents an increase of K 90/mth for the group and generates a per capita return of K24/mth (assuming group asset ownership). Once again partly covering capital depreciation over other activities and reducing fuel usage improves these figures.

93. As the incremental cost of the technology remains the same as under the low-intensity case (K 500 for one unit) the monthly marginal cost is some K 8.00. In this case then the incremental net benefit of the new technology is K 87 a month.

94. Reworking the data for a 50% expansion in throughput (to 374kg landed/mth at Lae) a net return (after allowing for depreciation) of K 292/mth is earned. This represents more than a doubling of the return on the traditional technology for the model analysed. It also returns K 58 per fishing group member/mth which gives a daily return close to the K 4.1/day official minimum wage.

Analysis of Marketing Reforms

The Marketing System under Current 'Technology'

Fishermen

95. The current marketing system appears to be adequate for the needs of the fish suppliers (the fishing groups) at current output levels although demand is such that higher prices could be realised. Landings at Voco point are very low (6 to 7 tonnes/mth) and quite irregular. Fishermen appear able to dispose of their produce without much problem and with little apparent variation in price.

96. There appears to be little in the way of quality premiums at the moment. Losses appear to be very low and marketing costs to the fishermen once they are at Lae also appear to be very low apart from the opportunity cost of the time spent marketing.

97. Under the current marketing system Voco Point acts as both a wholesaling and retailing outlet. This benefits fishermen once again as the small quantity purchasers can be relied upon to compete with the larger quantity supermarket/wholesaler buyers for price (and therefore to keep prices favourable to fishermen) and to mop up those landings which can't easily find a quantity buyer on arrival.

Consumers and Small-scale Traders.

98. small quantity buyers at Voco point consist of both consumers and small-scale traders. Through having direct access to the Voco Point landing station they can purchase fish at its freshest and can market it without having to pay a wholesaler's margin on top of the K 2.50 purchase price. They therefore benefit in terms of having a higher mark-up than would exist if they were buying from a wholesaler somewhere in Lae (even allowing for some transport costs). They also benefit in being able to keep fish for marketing over a longer time-period due to its greater freshness. (mention value of benefit).

99. Consumers can achieve the same kinds of benefits by buying directly from the landing station.

Wholesalers/Supermarkets

100. The current marketing system is evidently an inappropriate one for the majority of larger quantity fresh fish buyers. They incur significant purchasing costs in having to monitor the landing point for potential purchases and in having to make frequent buying trips for relatively small quantities without a guarantee of finding the right kind of fish in any quantity when they get there. There are also potentially additional

hidden costs of using the sort of informal brokerage system which is operating at present.

101. The current inability of wholesalers to guarantee a regular supply of fish of a given type in a given quantity each week appears to be acting as a brake on the growth of demand for local caught fresh fish.

102. A process of sustained 'regional import substitution' where locally landed fish occupies a progressively greater share of the regional fresh, chilled and frozen fish market at the expense of fish from elsewhere can only be achieved by mechanisms to encourage regularity of supply.

103. It is in the longer-term interests of the local fishing economy to attempt to meet the purchasing requirements of the supermarket sector in terms of products, product quality and delivery systems. Price does not appear to be an issue in this process at the present time. Demand appears to be consistently greater than supply and the willingness of some supermarkets to pay substantial premiums for guaranteed supply is evidence of this.

Fisheries Division

104. At the moment a number of subsidies are being indirectly passed to both fishermen and fish purchasers by the Fisheries Department. Ice is being supplied on a partly subsidised basis; chill-room storage is provided free of charge, as is the fish weighing and handling equipment and a brokerage service is provided at no apparent financial cost.

105. Whilst this would appear to be an appropriate arrangement for current landing quantities under an adequately managed and financed system this may not always be the case. This system may well begin to work as an obstacle to both fish sellers' and buyers' interests in a future situation of greater throughput, less development project interest and reduced government financial support where the efficiency of the current system may well break down.

Effects of Introducing New Marketing 'Technology'.

The proposed changes are :

- to limit the sales of fresh fish to accredited wholesale purchasers only,
- to restrict selling times to limited periods (initially twice a week)
- to introduce a fish auctioning system.

Limiting sales to wholesale buyers only.

106. This measure will contribute to the regularisation of activities at the landing area thus permitting better management of the marketing process. However it will also have a negative impact on those individuals who are accustomed to purchasing there. It is likely that many of these are from poorer households and will therefore be less able to afford mark-ups which arise from buying further down the marketing chain (wholesaler's margins elsewhere in PNG for fish being of the order of 23%).

107. The initial effect of this measure on price is uncertain but will anyway be masked as a number of marketing changes are introduced concurrently. At current throughput the percentage of fish sold direct to petty traders/consumers is significant (11% to 34%). Removing this group from the market will significantly reduce the number of buyers in the market and initially this may leave room for the limited number of wholesalers to informally collude to pay lower prices. The existence of retail consumers at the landing point weakens wholesaler's bargaining strength to a certain extent.

108. The extent to which the petty traders/consumers suffer will depend on the eventual price differential between their new source of fresh fish and the previous Voco Point price of K2.50 that they were paying. Supermarket prices are currently between K3.50 and K4.00 in Lae. If it is the case that poorer groups derive some of their protein from this market then the nutritional implications could be quite large in the initial stages at least until a more sophisticated marketing system develops to meet their needs.

Restricting Selling Times to Limited Periods.

109. The intention here is to concentrate the low weekly quantities of fish marketed into one or two daily quantities. This should permit an auctioning system to become feasible but it should also encourage more wholesalers to purchase at the station by increasing their chances of finding the required type, quantity and quality of fish.

110. A number of problems are likely to be encountered in the initial phases of such a change. Fishermen may find it difficult to alter their fishing session pattern around the selling days due to the other factors which determine when such trips occur. Socio-economic studies conducted in certain villages mention the difficulties of coordinating fishing trips involving the male members of five or six different families and the importance of social and other economic(eg agricultural) obligations.

111. This is likely to lead to quite a large proportion of fishing groups continuing to land fish on non-market days. The suggestion that this fish could be purchased by the Fisheries Division is one proposal for coping with the problem over the period between the ending of the old system and the effective functioning of the new system.

112. This will however draw the Fisheries authority into being a major buyer and seller of fresh fish for which it would need to be properly structured. However this might have to occur if there is not to be a whole set of conflicts around the fairness and competence of the Fisheries Station in its marketing operations which in turn could lead to increasing levels of fish being landed outside of the landing station.

113. The inclusion of representatives from fishing groups and communities in an organizational structure to manage the new restricted period marketing system would seem to be an important element in effecting the change with minimum disruption. This structure could also slowly develop along the lines of a pre-cooperative structure (preferably introducing gradual cost-recovery mechanisms) so as to be able to maintain the functioning and relevance of the handling/marketing activities to the fishermen's needs.

114. The holding over of quite a large amount of fish until the marketing days will mean that storage costs to the authority will rise and may have a negative effect on price.

115. The twice weekly marketing sessions should see quantities traded increase from approximate current levels of 200-300kg a day to 750-800kg a trading day (for current average throughputs). This should attract more bulk purchasers to Voco Point and it is not unreasonable to expect that under the current conditions of excess demand prices may be pushed upwards whether or not a bidding process is used.

116. It is worth considering the supporting of the establishment of a private sector chill room which would store fish for a daily rate fee and which would permit the fish seller to personally sell his catch on the trading day. Alternatively the Fisheries Authority may provide this service on a fee-charging basis.

117. The introduction of improved village-based ice and fish-storage boxes would go some way towards allowing the fishing groups to delay their marketing trips to fit in with the trading days to some extent.

Introduction of Fish Auctions.

118. The general effect of introducing such a system will be to introduce an element of price volatility into the trading system. It should also eventually lead to the introduction of price differentials according to grades of quality of fish. Overall it is expected that fishermen will benefit from the system as the presence of excess consumer demand will be more efficiently converted into higher fish prices. The wholesalers with the strongest effective demand will purchase the product through paying the highest prices even when supply is very scarce.

119. However the introduction of price differentials by quality may have some negative impact on those fishing groups whose technology or distance from Lae means that their fish arrives in a poor state relative to competing supplier's fish. Also the effect of holding significant quantities over in a chill-room for two or three days may also lead to a lower price. If this produce is sold by the Fisheries Authority then it will adjust its' intervention price downwards accordingly.

120. Generally the development of a market to accord price premiums for higher quality produce is a positive development as it stimulates efficiency improvements along the production/marketing chain but in the shorter term lower technology groups may suffer.

121. The fish auctions will also spread price differentials through a marketing period such that sellers who have not had their fish purchased as the close of trading approaches will be obliged to sell at 'dumping prices'. Hence the price volatility can work in both directions. The ultimate net outcome will depend upon the attractiveness of the system to new wholesale buyers and the ability of the supply side to provide reasonable quality fish in sufficient quantities on the specified days together with the efficacy of the auction managing authority to run the system.

122. It is advisable that the system cover a proportion of its costs from a marketing tax system. This will constitute an extra cost to fish sellers and buyers but will encourage their participation in the management of the system and will help ensure the sustainability of the system under potential future conditions of low levels of government support.

Summary of Impact of Marketing Reforms

123. The proposed marketing reforms are necessary in order to prepare the system for future potentially substantial increases in quantities of fresh fish landed at the landing station. Whilst the system functions reasonably well at the moment it appears to impose a constraint on expansions of throughput.

124. The changes proposed are radical in relation to the current system and it is inevitable that in the early stages of implementation substantial disruption will occur particularly for fishermen. It seems essential that prior to implementation the proposed changes are fully discussed with all potentially affected groups so as to be able to draw up procedures that cause the least amount of avoidable disruption.

125. A number of possible variants of the changes exist, including those concerning chill-room access and status and management of the market management authority mentioned above.

126. Once the new system is fully established however (and this may take up to a year or more) the system is likely to generate an increased range of fish prices with quality considerations playing a more important role, but with average fish prices moving upwards towards the K2.75 to K3.00/kg mark (assuming fishing level increases are outstripped by the envisaged new buyers effect) as the strong demand becomes more effectively expressed and new buyers are attracted to the market.

127. On the consumer side certain groups will be net losers and various options could be explored by the Fisheries Authority to support a direct retailing outlet to deal with this.

128. On the supplier side it appears essential that the interests of the smaller, more marginal fishing groups are not ignored, and so the new system should be able to cope adequately with small quantities landed on non-trading days. In this context the fairness and transparency of the Fisheries Authority's activities in the eyes of the fishermen is paramount.

129. In an environment of decreasing active government participation in production and trading activities in favour of para-statal or private enterprise it would seem important to formally include fishing group's representatives in the design and implementation of the proposed new fish marketing (landing stage) structure. Investments made in this process at this stage should earn substantial payback in terms of increased efficiency of the market when throughputs increase.

130. It is advisable that the marketing changes proposed are introduced in a careful and gradual manner.

Substantial benefits could be gained from involving fishermen in discussions concerning the changes. There might be ways of encouraging the better scheduling of landings through introducing small landing handling fees on non-approved days. Trading could also be conducted on the scheduled days without the auctioning system being used at first. This would require much less direct involvement of the Fisheries authority and the trading could be monitored over several months.

Economic Analysis of Ice-fish Storage Technology

Increased Fishing Activity

131. The financial analysis shows that the effects of the introduction of improved ice storage technology are favourable to both 'intensive' and relatively 'marginal' fishing groups, and that adoption rates are expected to be high particularly amongst the intensive groups once supply is established and dissemination conducted (with credit where necessary).

132. However the effects of this improved profitability through cost reduction on overall fishing levels may not be very great. It will only lead to increased fishing in cases where the uncertainty of ice supply and/or the financial marginality of the enterprise were the binding constraints on increased fishing. This seems to apply more to the more distant villages from Lae and also to the more 'marginal' fishing groups.

133. Generally the more 'intensive' the group and the nearer it is to Lae the more unlikely it is that the new technology will stimulate greater fishing activity. It will however improve the profitability of the enterprise. Socio-economic studies of the zone have indicated that there are a range of socio-economic and cultural factors which prevent more time being dedicated to fishing by fishing groups. It is likely that these constraints are less binding on the more 'marginal' fishing groups though this needs further study.

134. With respect to the marketing reforms, the overall 10%-20% expected price increase effect may well encourage more fishing among the more 'marginal' groups though this is not certain. The combined effect of the marketing and ice-fish storage technology should lead to more fishing by these groups.

Economic Impact

135. The principal effect of these changes will be in terms of opportunity cost of the fisherman's labour. Studies have referred to the role of men in certain stages of the agricultural cycle (mainly land preparation) and the increased burdens placed on women by their dedicating more time to fishing. This is obviously a seasonal problem and it may only be a significant one for those participating in the fuller-time or more intensive fishing operations.

136. To summarize it would seem (though this needs further study) that the labour displacement effect would not be very great as it is not expected that the technology changes will substantially alter the fishing practises of those groups for which this factor seems critical.

137. Increased fishing and marketing activity among the more marginal and more distant groups will have a number of positive economic benefits which centre around the general effects of increased cash income entering into a low cash-income economy. As employment levels rise out migration of the young and able is restrained somewhat and the increasing shift from barter trade to cash-based trading together with increased family disposable incomes will stimulate the growth of small enterprise activity.

Increased marketed fish percentage.

138. The ice-fish boxes may reduce the percentage of the village landed catch that goes into village level consumption, barter trade and smoking. This is because where previously limited ice supply dictated that the fish surplus to ice availability was distributed in the village the improved box should release the ice constraint and permit greater percentages of the landed catch to be marketed through Lae.

Economic Impact

139. Whilst this effect is not expected to be very significant, where it does occur under conditions of no overall increase in village landed catches it will divert income away from those involved in village-based trade (cash or barter) and from those women who smoke fish and sell it. Smoking activity does not appear to be a very regular or financially significant activity , particularly for those villages not lying very close to Lae.

140. However reductions in the village-based trade in fresh fish may have a negative impact on some village members through reduced protein availability. This will also apply to those consumers living inland who rely on

this local trade for their fish supplies. Though this is not likely to be a very significant factor it is worthy of closer study. Where overall village-landed catches are increasing the problem will be less relevant.

Box Construction and Supply

141. Some degree of enterprise displacement will occur once improved box uptake became significant. Income losses will accrue to the traditional suppliers of the traditional boxes. Income gains will obviously be made by the suppliers of the new boxes. It is very unlikely that the traditional box suppliers will be able to supply the new boxes due the relative sophistication of the technology involved and the capital levels required. However as adoption of the new technology will probably be quite slow the two systems will coexist for quite a long time.

142. As the traditional boxes are simply discarded refrigerators finding a new use the economic multiplier effect of the shift in technology will be positive. Although the materials for the new boxes will be imported initially, local value-added is gained in Lae through assembly.

MADANG PROVINCE

Madang Fisheries Station

143. A very short visit was made to the Madang fisheries station in Madang to inspect facilities and to learn something of the activities of the Provincial Fisheries Office. Unfortunately the time spent in Madang was too short to make anything more than a preliminary assessment of the situation at the landing. It is recommended that during subsequent visits to the project the post harvest fish technologist should make a fuller study.

Facilities

144. The equipment available for the handling and preservation of fish at the Madang landing is as follows:-

- i. Two, approximately 5 tonne capacity, cold rooms. One used for storage of fish, the other presently out of use.
- ii Weighing scales
- iii Recently purchased imported insulated boxes
- iv One shell ice making machine with a capacity of 2 tonnes per day, recently imported and installed but, at the time of this mission, still awaiting commissioning from the electricity board.

145. The above are housed in a shed with access from the seaward end for deliveries of fish by boat and at the landward end for sales of fish to the public.

Ice Plant

146. The newly installed ice plant at the site was purchased from Provincial Government funds on the recommendation of a Canadian volunteer working with the Madang Fisheries Branch. Unfortunately the volunteer was on leave at the time of the mission and it was not possible to discuss with him the reasoning behind the choice of equipment or the way in which it is installed.

Type of Ice

147. There are a number of worrying aspects to the purchase and installation. The ice plant produces shell ice. The requirement of the coastal fishing and fish distribution industry of the Momase Region is for ice that can be easily distributed, is compact, melts slowly and is easy to handle. The obvious choice for this is block ice. There are available in PNG small capacity block locally fabricated ice makers such as those installed at Kum-Gie and other coastal fisheries stations. The shell ice that the imported machine at

Madang produces will melt more quickly than block ice, is bulkier, and more difficult to handle.

Capacity

148. The amount of fish passing through the fisheries station and the demand from out side users suggests that the plant has a much larger capacity than is required. The landings of fish at Madang fisheries station on a are given in Table 5 below.

Table 5 Fish Landings at Madang Fisheries Station

1990 Total Recorded landing 2.054 tonnes

1991 landings April - Dec

Month	Tonnes
April	1.593
May	1.624
June	1.042
July	0.829
August	2.492
September	1.254
October	2.446
November	1.813
December	0.799
Total	13.892
Average/month	1.543

1992 landings Jan -June

January	0.732
February	1.304
March	2.046
April	2.718
May	1.502
June	3.337
Total	11.639
Average/month	1.940

The above table 5 is for total landings of both marine and freshwater fish (Tilapia) from the Ramu River. From records of Tilapia landings for the first 7 months of 1992 the average per month is about 900kg, roughly 50% of the landings. It is interesting to note that marine fish landed through the Madang station and dominated by pelagic species such as tuna, skipjack and mackerel, with only the occasional landing of reef fish. The station staff explained that this was because the local traditional subsistence fishermen have traditional fishing rights to use the reefs adjacent to their villages and they only catch fish for home consumption and barter rather than for sale. The "commercial" fishermen tend to be outsiders and do not therefore have

access to the reefs and therefore only catch pelagic fish.

149. The amount of ice required for the 1.5 to 2 tonnes per month that currently pass through the landing is small compared with the amount of ice capable of being produced by the newly installed ice plant. Even assuming a 2:1 ice to fish ratio for the fish passing through the landing and an equal quantity of ice being demanded from other users the demand for ice is unlikely to be more than 8 tonnes per month, equivalent of 4 days production.

Installation

150. Shell ice plants such as the "Berg" unit are designed to be mounted either on top of or immediately along side a refrigerated store so that ice, which is produced continuously, can fall directly into the store through an insulated chute. The cold store would normally be fitted with a thermo-static control mechanism or an ice level sensor so that once the store is full the ice plant switches off automatically and will re start when ice is removed from the store. Thus a continuous and unattended ice production unit is available. The ice plant at Madang has been installed on a concrete block plinth raising it roughly 1.5 m above ground level with the ice outfall roughly 2 metres above the ground. The idea seems to be that ice produced will be collected in large insulated boxes purchased (from Canada) by the station. These boxes will need to have their lids left open whilst ice is being produced and will have to be moved once they are full (they will weigh over half a tonne at this stage). The above will lead to excessive ice meltage, very difficult handling of ice and the need for continuous supervision. It will also be very difficult to remove ice from these boxes for sale and distribution without excessive meltage and a great deal of handling.

151. The present siting of the ice plant is to one side of the cold store mentioned above which is presently not used. However the ice delivery from the machine is at the opposite end to the store. By turning the machine through 180 degrees and raising it roughly 60 cm the ice outlet would be on a level with the top of the side wall of the store. A sloping insulated chute could be constructed to direct the ice through a hole in the side of this store. The fitting of a thermo-static control in the store or a mechanical device for detecting ice level in the store which will switch the ice machine on and off automatically will produce a unit which will be much easier to manage, will require little attention and from which ice can be removed easily. The store will need to be run at roughly -5°C to prevent excess ice meltage.

152. In addition to the above recommended relocation of the ice machine it will be necessary to re-site the evaporator in the ice store so that it is not on the same

wall as the ice inlet chute. In re-siting and moving the machine attention should be paid to the bolts holding the machine to the concrete plinth. These are presently 4 (one at each corner) roughly 4mm diameter bolts which would appear to be totally inadequate to cope with the vibration of the machine when running. Larger bolts are required and the possibility of anti-vibration mountings being fitted should be investigated.

Handling at Madang Station

153. Marine fish is brought to the fisheries station in Madang either by fishermen landing their fish directly at the adjacent landing either on ice in boxes or without ice if they are based close to the town. Other supplies are transported by road from either marine fishing villages or from the Ramu river fishery for Tilapia and Fresh water prawns (*Macrobrachium spp*). The station staff also occasionally purchase fresh water prawns direct from fishermen at the Ramu River, transport it back to Madang in ice and sell it through the station. The transport by road is usually in ice in insulated boxes. Once the fish is brought to the station the department buys the fish from the fishermen or distributors at fixed prices from a revolving fund. The fish is weighed, sorted, placed in plastic fish boxes and into a refrigerated store running at about -10°C.

154. The station acts as a retail outlet for Madang consumers who come to the station on a regular basis. Buying and selling prices are given in Table 6 below.

Table 6 Buying and selling Prices of Fish at Madang Fisheries Station

Type of Fish	Buying	Selling
Reef Fish	K1.30/kg	K2.00/kg
Tuna/Skipjack	K1.30/kg	K2.00/kg
Tilapia	K1.30/kg	K2.00/kg
Red Emperor	K2.00/kg	K2.50/kg
Mackerel	K2.00/kg	K2.50/kg
Prawns	K0.50/piece	K7.00/kg

NB. The buying price of prawns is roughly K3.50 - K4.00/kg based on average sizes of 7-8 pieces/kg

155. The amount of fish handled by the station is relatively small (100kg/day) and usually all fish is sold out by the end of each day. Sales are conducted during normal government working hours (Monday to Friday 07.45 to 16.06hrs) with no sales over weekends or public holidays. If there is excess fish the station will take the fish to commercial companies, such as logging companies and agricultural estates where fish is sold at K2.50/kg.

156. As with the handling of fish at Voco point no ice is used on the fish once the fish have been landed. The station at the time of the visit did not have a working ice production unit. Once the unit is in operation the ice could be used successfully for temporary storage of fish using the store presently running at -10°C as a chill room.

Appendix 1

ITINERARY

16/7/92

LGW to Frankfurt BA

17/7/92

To GTZ
People met

Mr Kubitski Economist in South-East Asia and the Pacific
Division

Dr Dieter Fischer Head of Section South-East Asia and the
Pacific Division

Dr Rudolf Hermes Fisheries Biologist soon to be posted to
MCFCD

Read papers and documents in office and discussed project
with Hermes et al

19/7/92

Arrived Port Moresby

Met by Jörg Sorgenicht (Economic Advisor to PNG Aid
Ministry)

Evening Capt Peter Jarchau arrived

20/7/92

Meeting at Dept of Fish and Marine Resources

Met:

Rainol Gibson - Acting Assistant Sec for Resource Devel
Terance Yamelu - Planing Economist
Kenneth Pora - Coordinator for Momase Region
Welete Wararu - Women in Fisheries Officer
Tin Tin Myint - UNV Fish Marketing Specialist - Resource
Development
Leo K Aisi - Coordinator for Southern Region
N Rajeswaran - Senior Resource Devel Officer (Handling
and Processing)

PM To Lae with Peter Jarchau

21/7/92

To Voco Point office

Met Project staff

Collected project papers and reports

Reading and collecting info from reports in office

22/7/92

AM to Unitech

Library

Applied Sciences

Unitech Fresh Foods

Appropriate Technology Development Institute

PM to Supermarkets in Lae:-

Papindo

Pelgen's

Big C

Anderson Foodland

23/7/92

Public Holiday

To office to catch up on notes

24/7/92

Lae Main Market

Kwantung Village Restaurant

Sullivans - Russel Ikum

Steamships (ex Burns Philp outlet in town) - Mr Lee

25/7/92

To main Lae Market

Nuigini Freezers (Part of Steamships) - Willy Russ

Pelgen's Wholesale - Angelina Pelgen and Olisa.

26/7/92 (Sunday)

Tin Tin Myint arrived

27/7/92

By boat to:

Laukano Village - possible site of project out station

Lababia Village - Fishing Community

28/7/92

By boat to:

Buakap & Busama - fishing communities

29/7/92

To Madang

30/7/92

To Madang Fish landing station in morning

Thomas Amepou - Provincial Fisheries Officer

Max Balim - Rural Development Technician

To Fibre glass manufacturers:-

Luships

Bush Fabrications

Village level fibre glass maker

Visit to Provincial 1st Assistant Secretary - Pascal

31/7/92

To Ramu River fish landings

Stopped at Bogia spoke to Brian at Olama Trading

To market in Madang - Smoked Tilapia for sale

1/8/92

To Goroka - Goroka market no fish

2/8/92

Visit Goroka Seafood Market - Ben

Other fish outlets closed on Sunday

Return to Lae

3/8/92

Discussions with counterparts re project activities and conclusions to date.

Visit Wong Tim Company

Visit SPM - Aaron Clamp (Engineering and FRP manufacturers)

Visit New Guinea Motor Windings

Report writing

4/8/92

Report Preparation and Analysis of sales data

Tin Tin Myint leaves for Moresby

5/8/92

Visit Agriculture Bank - Mildred Raimo
Visit Labour Office - Minimum Wage Rates
Visit Elcom - Electricity Tariffs
Visit Daikin - Steve Tuckey (Refrigeration Engineers)

Report Writing

6/8/92

Visit The Professionals (Auctioneers)
Discussions with DPI Assistant Sec re wage rates in
Agriculture

Report Writing

7/8/92

Report writing and presentation of draft to PJ

Appendix 2

TERMS OF REFERENCE

1. The Technologist will:
 - 1.1 meet with DFMR officials in Port Moresby and establish the perceived priorities of the Government in respect of the project. Arrangement for a counterpart for the study will be discussed in the context of participation by the Provincial Fisheries Division (Morobe) and the Fisheries Branch (Madang)
 - 1.2 visit landing centres in the project area to document and evaluate existing methods and facilities for the processing, storage, distribution and marketing of fish.
 - 1.3 identify problems in the present systems and suggest ways of overcoming these problems for the present levels of throughput and to cope with projected increases. Discuss these suggestions with local authorities, project staff and the fishing community and thus identify options for the testing as "model facilities" at selected sites.
 - 1.4 assess means of fish handling/transportation from villages to fisheries stations (craft and equipment), assess and evaluate facilities and services of Luship and other boat operators to transport fish from certain areas to the main stations.
 - 1.5 assess the ice production and ice storage facilities and infrastructure needed for efficient movement of fish through the landing at Voco Point, Madang and district stations. Work out proposals to overcome existing problems and shortcomings. Make recommendations about more cost-efficient equipment to be used in the future. Prepare guide-lines for proper fish storage/handling. Estimate shelf life of iced fish according to specie.
 - 1.6 describe bottle-necks and shortcomings of existing marketing procedures, develop proposals for a formalised fish marketing system for landing sites in Lae (Voco Point) and Madang, taking into account the actual and potential future volume of fish landings, fluctuations in landings, present marketing and financing practices as far as information is available.
 - 1.7 present preliminary guide-lines of fish quality criteria and price categories to wholesalers' demands. Specify criteria for fish grading system (size, species, quality)

- 1.8 assess and evaluate existing mode of and facilities for transport and sale used down the marketing chain after the fish has been handed over to private traders. Develop proposals for information and/or training packages to improve handling and presentation of fish in regards to quality and efficiency.
- 1.9 describe concepts of fish processing and preservation taking into account consumption habits and the necessity of appropriate technology for processing and preservation.
- 1.10 prepare a rough cost-benefit calculation for all measure proposed from financial and economical points of view at different levels of throughput and for all alternatives proposed.
- 1.11 prepare an outline report for discussion with the Project Manager before departure from PNG.
- 1.12 prepare by 18/09/92 a final report which will provide a detailed analysis of current facilities and practices in the target areas, and will recommend appropriate solutions and approaches to key problems identified. The report will also provide a schedule and terms of reference for the second phase of the project aimed at implementing the key recommendations of the study.
- 1.13 liaise with the marketing economist prior to the study to ascertain the relevant field data to be collected for the proposed desk study into marketing economics. The technologist will collaborate with the economist during report preparation.
2. The economist carries out brief desk study in U K and upon return of the technologist from PNG, contributes to preparation of the final report with respect to economic implications of proposed trial systems.

Appendix 3

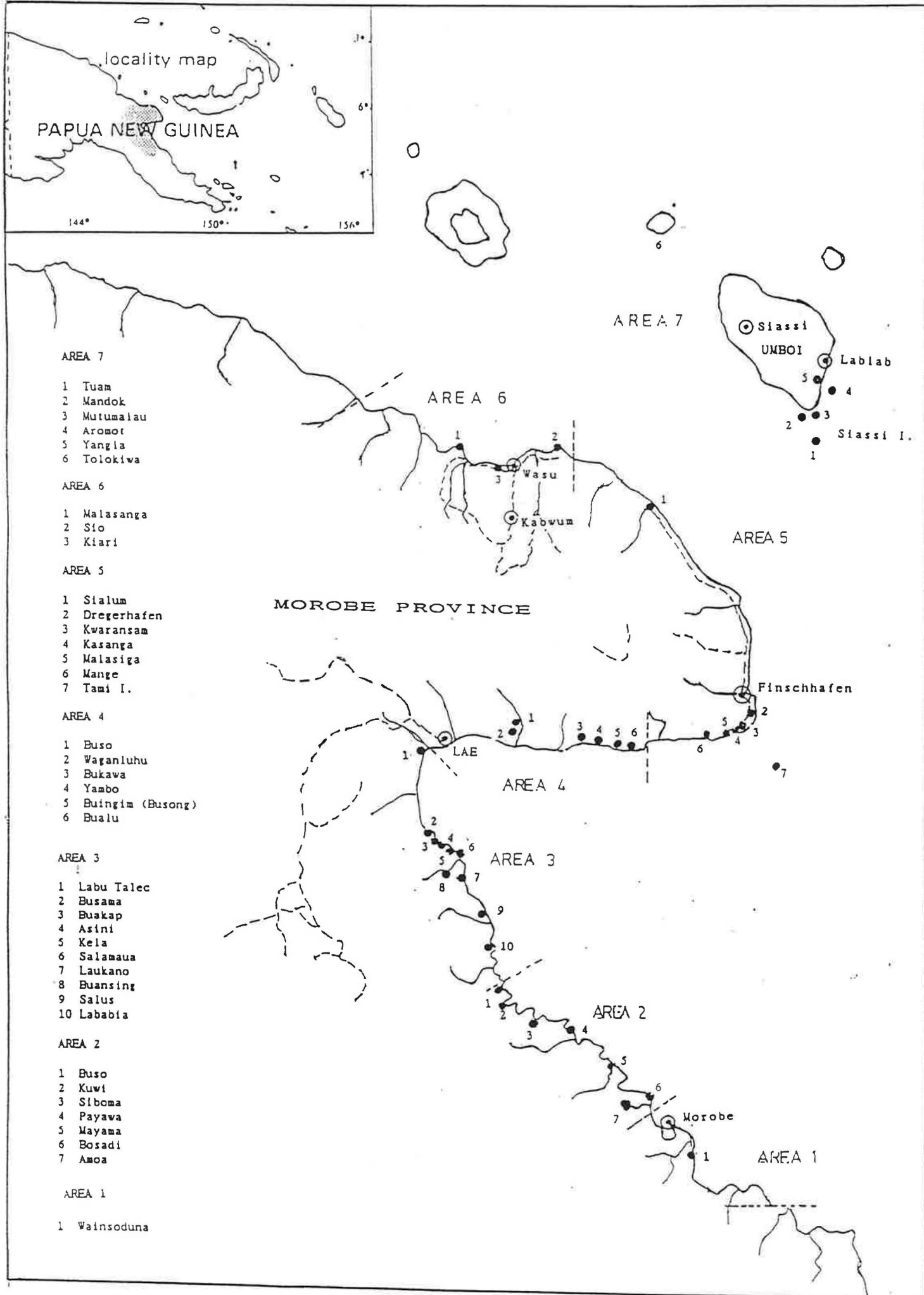
OUTLINE TERMS OF REFERENCE FISH TECHNOLOGIST -
APRIL/MARCH 1993

March/April 1993 (Length of visit 6 weeks plus 2 weeks UK report writing and preparation)

The Technologist will in collaboration with the project economist and the project social development adviser:

1. Review progress on the implementation of the revised sales system at Voco Point fish landing recommended in the report of September 1992.
2. Review progress on the introduction of ice storage boxes in fishing villages in the project area.
3. Review progress on the introduction of improved fish and ice transport boxes on dinghies.
4. Assess the needs for improving the village level processing of fish particularly smoking and the training or other requirements to assist in this area.
5. Review the operation of the Kum-Gie ice production operation and the Kakota fish and ice distribution service.
6. Visit Madang & East and West Sepik Provinces to ascertain project inputs on the post harvest side and make recommendations as to future project activities in these provinces.
7. Make further investigations into the sporadic quality problems that have been reported and recommend ways of overcoming these problems. If appropriate recommend a system of quality grades to used at fish landings.
8. In collaboration with the DFMR Fish Technologists review the training and extension needs for coastal fisheries activities in the project area.

Appendix 4 - MOROBE PROVINCE COASTAL VILLAGES BY AREA



Appendix 5 a

Project Zone Data

No. of Villages in Proj. Zone (Zone 3) :	13
Popn. in Proj. Zone :	5713
Fishermen : '(1)	553
Fishing Units :	79

1992 Voco Pt. landings (Zone 3):

Month	No. trips	No. Gps	Trips/Gp	kg/trip	kg/Gp
Jan	59.00	28.00	2.11	41.20	87.00
Feb	115.00	41.00	2.80	38.50	108.00
Mar	135.00	40.00	3.38	29.30	99.00
Apr	85.00	34.00	2.50	35.70	89.20
May	106.00	40.00	2.65	36.00	95.40
June	99.00	41.00	2.41	37.60	91.00
July	78.00	27.00	2.89	31.40	91.00
Avg	96.71	35.86	2.68	35.67	94.37

Source : Project data. (1992)

Appendix 5 b1

July landings analysis (Voco Pt.) (1992)

Village	No.Fish Gp	Fish land July 92'	No.Trips	No. Gps	Avg landin	No trips/G	Avg Kg	
		kg '91 '(1)	per villag	landing	per trip		/Gp'	
Asini	3.00	2331.00	16.10	2.00	1.00	8.05	2.00	16.10
Buakap	12.00	10749.00	759.80	23.00	8.00	33.03	2.88	94.98
Busama	14.00	14631.00	758.00	34.00	7.00	22.29	4.86	108.29
Kela	13.00	4498.00	48.60	2.00	2.00	24.30	1.00	24.30
Lababia	11.00	15810.00	417.00	6.00	3.00	69.50	2.00	139.00
Laugwe			21.80	1.00	1.00	21.80	1.00	21.80
Laukano	8.00	1802.00	427.20	10.00	5.00	42.72	2.00	85.44
Labu Talec	5.00	1608.00						
Labu Miti	2.00	592.00						
Kelkel	2.00	144.00						
Labu Butu								
TOTAL	79.00	55855.00	2448.60	78.00				
AVG				11.14	3.86	31.67	2.25	69.99

Source : Tumonde & Wagner - Zone 3 sample base
MCFDP landing data July 92.

Appendix 5b2

Group fishing intensity levels :

	Tot.no. of		Low Intensity		High Intensity	
	Groups	No.	Gps	Avg Catch kg/mth	No. Gps	Avg kg/mth
Asini		1.00	1.00	16.00		
Buakap		9.00	6.00	21.00	3.00	220.00
Busama		7.00	2.00	16.00	5.00	146.00
Kela		2.00	2.00	25.00		
Lababia		3.00	1.00	58.00	2.00	180.00
Laugwe		1.00	1.00	22.00		
Laukano		5.00	2.00	54.00	3.00	106.00
TOTAL		28.00	15.00		13.00	
Avg				30.29		163.00
No. trips				22.00		56.00
Avg trips/Gp */mth		*(1.5)		2.00	Rnd up	5.00
Avg Mkt Kg/ trip				15.14		32.60

Calc. from July landings '92 . Approx values.

Hence low fishing intensity groups (<80Kg/mth) and high intensity gps (>80Kg/mth) approx. equally divided in zone 3 with avg being :

Low Intensity : 30Kg/mth over 2 fishing (& landing)trips :
High Intensity : 165Kg over 5 trips

Appendix 6 - General Notes to Budget Analysis

- Fishing group = 5 members; 4 canoes, 1 dinghy with 20HP motor
 Assume 20% of non-marketed catch is smoked . Price=K1.5/Kg
 Value = 'best guess'
 Assume expanded output is 100% increase in no. fishing trips.
 1 2 day trip at 1 hr per day
 2 GOPA - Annex 18 p19 - 24 (1991)
 3 Clucas - July 1992
 4 Dinghy cost allocated : 50% fishing, 50% marketing .
 5 Aug '92
 6 Repairs = 5% Invest costs/Yr = .42% per month
 7 Clucas- Aug '92 (20-50Kina) Avg = K35.00
 8 See depreciation schedule below

Depreciation Schedule

Item	Cost	Life	Ann.Depr.	Mthly Depr
Canoe(*4)	800.00	10.00	80.00	6.67
Dinghy	2500.00	10.00	250.00	20.83
Motor	2000.00	10.00	200.00	16.67
Nets/Gear	120.00	2.00	60.00	5.00
Process Tools	20.00	5.00	4.00	0.33
Tradn Box	35.00	2.00	17.50	1.46
PIB	500.00	5.00	100.00	8.33
TOTAL(Tradn Box)				50.96
Tot with PIB				59.29

Notes		Current 30 kg/mth	Expanded 90kg/mth
Avg catch/trip : (Kg) :		30	30
Avg trips/mth :		2	4
Off-take for own consumption :		50%	25%
Total Catch : (Kg)		60	120
Consumption and smoking (Kg) :		30	30
Marketed : (Kg)		30	90
Ice to Marketed Fish Ratio :		'2:1	'2:1
Ice Use		60	180
Blocks		4	12
Fuel Use	Fishing:	1	2
	Hrs/Trip	2	4
	Trips/mth	2	4
	Total Hrs	4	8
	Lt/Hr	10	10
	Tot Lts	40	80
	Mkting	2	4
	Trips/mth	2	4
	Hrs/trip	4	4
	Hrs/mth	8	16
	Tot Lts	80	160
	Total	120	240

Budget Analysis - Low Intensity - Traditional Technology.

		Current (30Kg)			Expanded(90Kg)	
Note		Unit Price	No. Uni	Total	Units	Total
Investment	Canoes ' 2	200.00	4.00	800.00	4.00	800.00
Costs	Dinghy '2,	1250.00	1.00	1250.00	1.00	1250.00
Fishing	Motor	1000.00	1.00	1000.00	1.00	1000.00
	Nets/Gear '2	120.00	4.00	480.00	4.00	480.00
Marketing	Dinghy & Motor '2 ,4	2250.00	1.00	2250.00	1.00	2250.00
	Ice Box (Tradn.)'7	35.00	1.00	35.00	1.00	35.00
	Process Tools a			20.00		20.00
	TOTAL			5835.00		5835.00
Oper.Costs						
Fixed	Repairs '6			24.51		24.51
	Depreciati ' 8			51.00		51.00
	Total/Mth			75.51		75.51
	Per Kg			2.52		2.52
Variable	Ice -blck ' 9	2.50	4.00	10.00	12.00	30.00
	Fuel(Lt) ' 10	1.00	120.00	120.00	240.00	240.00
	TOTAL			130.00		270.00
	Per Kg.			4.33		3.00
Total Fixed + Variable Cost (A):				205.51		345.51
Total F+V/Kg				6.85		3.84
Fuel as % F+V cost				58.39		69.46
Fishing				19.50		23.00
Marketing				39.00		46.00
Ice as % F+V cost				4.87		8.68
Income from marketin Kg/Mth sold :				30.00		90.00
Price/Kg :				2.50		2.50
Tot. Income :				75.00		225.00
Income from fish processing :				0.00		0.00
Total Income /Mth (B)				75.00		225.00
Own consumption (Kg/Mth) :				30.00		30.00
Net mthly Group Income (B-A) :				-130.51		-120.51
Income per person (Net Income /5)				-26.10		-24.10
Group Income w/o depreciation				-79.00		-69.00
per person				-16.00		-14.00

Per Month	Current (244Kg)	Expanded (374Kg)
Avg gross catch/ fish trip :(Kg)	65.00	65.00
Avg fishing trips/mth :	5.00	7.00
Offtake for own consumption and smoking :	0.25	0.18
Total Catch : (Kg)	325.00	455.00
Consumption and smoking (Kg) :	81.00	81.00
Marketed : (Kg)	244.00	374.00
Ice to Marketed Fish Ratio :	'2:1	'2:1
Ice Use (Kg)	488.00	748.00
Blocks	32.53	50.00
Fuel Use Fishing: Hrs/Trip(d)	5.00	5.00
Trips/mth	5.00	7.00
Total Hrs	25.00	35.00
Lt/Hr	10.00	10.00
Tot Lts	250.00	350.00
Mkting Trips/mth	5.00	7.00
Hrs/trip	4.00	4.00
Hrs/mth	20.00	28.00
Tot Lts	200.00	280.00
TOTAL	450.00	630.00

Note	Current 244kg			Expanded 374 kg		
	Unit Price	No.Unit	Total	Unit	Total	
Invest. Costs						
Fishing	Canoes	200.00	4.00	800.00	4.00	800.00
	Dinghy	1250.00	1.00	1250.00	1.00	1250.00
	Motor	1000.00	1.00	1000.00	1.00	1000.00
	Nets/Gear	120.00	4.00	480.00	4.00	480.00
Marketing	Dinghy & Motor	2250.00	1.00	2250.00	1.00	2250.00
	Ice Box (Tradn.)	35.00	1.00	35.00	1.00	35.00
	Process Tools			20.00		20.00
	TOTAL			5835.00		5835.00
Operating	Repairs			24.51		24.51
Costs/mth	Depreciation			51.00		51.00
Fixed	Total/Mth			75.51		75.51
	Per Kg			0.31		0.20
Variable	Ice (blk)	2.50	33.00	82.50	50	125.00
	Fuel(Lt)	1.00	450.00	450.00	630	630.00
	TOTAL			532.50		755.00
	Per Kg.			2.18		2.02
Total Fixed + Variable Cost :(A)				608.01		830.51
Total F+V/Kg				2.49		2.22
Fuel as %				74.00		76.00
Ice as %				14.00		15.00
Income from marketing :						
	Kg/Mth sold :			244.00		374.00
	Price/Kg :			2.50		2.50
	Tot. Income :			610.00		935.00
Income from fish processing :				1.50	20.00	30.00
Total Income /Mth (B)				640.00		965.00
Own consumption (Kg/Mth) :				61.00		61.00
Net mthly Group income before financing (B-A) :				31.99		134.49
Income per person (Net Income /5)				6.40		26.90
Net Group income w/o depreciation				83.00		186.00
per person				17.00		37.00

Appendix 6c - New Storage Technology - Low Intensity Fishing Group

	Current	60 kg	90 kg
Avg vill. landed catch/trip : (Kg) :	30.00	30.00	30.00
Avg trips/mth :	2.00	3.00	4.00
Offtake for own consumption and smoking : 50%		0.33	0.25
Total Catch /mth: (Kg)	60.00	90.00	120.00
Consumption and smoking (Kg) :	30.00	30.00	30.00
Marketed : (Kg)	30.00	60.00	90.00
Ice to Marketed Fish Ratio :	'1.5:1	'1.5:1	'1.5:1
Ice Use (kg)	45.00	90.00	135.00
Blocks	3.00	6.00	9.00
Fuel Use Fishing: Hrs/Trip(b)	2.00	2.00	2.00
Trips/mth	2.00	3.00	4.00
Total Hrs	4.00	6.00	8.00
Lt/Hr	10.00	10.00	10.00
Tot Lts	40.00	60.00	80.00
Mkting Trips/mth	1.00	1.00	2.00
Hrs/trip	4.00	4.00	4.00
Hrs/mth	4.00	4.00	8.00
Tot Lts	40.00	40.00	80.00
Total	80.00	100.00	160.00

Note (b) : 2 day trip at 1 hrs/day

	Note	Unit Price	No.Unit	Total	Note	60Kg/mth Total	90Kg/mth Total
Invest. Costs							
Fishing	Canoes	200.00	4.00	800.00		800.00	800.00
	Dinghy	1250.00	1.00	1250.00		1250.00	1250.00
	Motor	1000.00	1.00	1000.00		1000.00	1000.00
	Nets/Gear	120.00	4.00	480.00		480.00	480.00
Marketing	Dinghy & Motor	2250.00	1.00	2250.00		2250.00	2250.00
	Ice Box	500.00	1.00	500.00		500.00	500.00
	Process Tools			20.00		20.00	20.00
	TOTAL			6300.00		6350.00	6350.00
Oper. Costs							
Fixed	Repairs			26.46		26.46	26.46
	Depreciation			59.30		59.30	59.30
	Total/Mth			85.76		85.76	85.76
	Per Kg			2.86		1.43	0.95
Variable	Ice(15Kg)	2.50	3.00	7.50		15.00	22.50
	Fuel(Lt)	1.00	80.00	80.00		100.00	160.00
	TOTAL			87.50		115.00	182.50
	Per Kg.			2.92		1.92	2.03
Total Fixed + Variable Cost :				173.26		200.76	268.26
Total F+V/Kg				5.78		3.35	2.98
Income from marketing :							
	Kg/Mth sold :			30.00		60.00	90.00
	Price/Kg :			2.50		2.50	2.50
	Tot. Income :			75.00		150.00	225.00
Income from fish processing : (6Kg*1.5Kina/Kg)							
				9.00		9.00	9.00
Total Income /Mth (B)				84.00		159.00	234.00
Own consumption (Kg/Mth) : '(23)				24.00		24.00	24.00
Net mthly Group income before financing (B-A) :				-89.26		-41.76	-34.26
Income per person (Net Income /5)				-17.85		-8.35	-6.85
Group income w/o depreciation				-30.00		17.00	25.00
				-6.00		3.00	5.00

Appendix 6d - New Storage Technology - High Intensity Fishing Group

	244Kg	309Kg	374Kg
Avg catch/fishing trip : (Kg)	65.00	65.00	65.00
Avg fishing trips/mth :	5.00	6.00	7.00
Offtake for own consumption and smoking :	0.25	0.21	0.18
Total Catch : (Kg)	325.00	390.00	455.00
Consumption and smoking (Kg) :	81.00	81.00	81.00
Marketed : (Kg)	244.00	309.00	374.00
Marketed/trip	49.00	52.00	53.00
Ice to Marketed Fish Ratio :	'1.5:1	'1.5:1	'1.5:1
Ice Use (kg)	366.00	464.00	561.00
Blocks	25.00	31.00	37.00
Fuel Use Fishing: Hrs/Trip(c)	5.00	5.00	5.00
Trips/mth	5.00	6.00	7.00
Total Hrs	25.00	30.00	35.00
Lt/Hr	10.00	10.00	10.00
Tot Lts	250.00	300.00	350.00
Mkting Trips/mth '(d)	3.00	3.00	4.00
Hrs/trip	4.00	4.00	4.00
Hrs/mth	12.00	12.00	16.00
Tot Lts	120.00	120.00	160.00
TOTAL	370.00	420.00	510.00

' (c) 2 days*2.5hrs.

2*2 day fishing trips/marketing trip

Note	Current (244Kg)			309Kg	374Kg	
	Unit Price	No.	Total	Total	Total	
Invest. Costs	Canoes	200.00	4.00	800.00	800.00	800.00
Fishing	Dinghy	1250.00	1.00	1250.00	1250.00	1250.00
	Motor	1000.00	1.00	1000.00	1000.00	1000.00
	Nets/Gear	120.00	4.00	480.00	480.00	480.00
Marketing	Dinghy & Motor	2250.00	1.00	2250.00	2250.00	2250.00
	Ice Box	500.00	1.00	500.00	500.00	500.00
	Process Tools			20.00	20.00	20.00
	TOTAL			6300.00	6300.00	6300.00
Operating	Repairs			26.46	26.46	26.46
Costs/mth	Depreciation			59.00	59.00	59.00
Fixed	Total/Mth			85.46	85.46	85.46
	Per Kg			0.35	0.28	0.23
Variable	Ice(15Kg)	2.50	25.00	61.00	77.50	77.50
	Fuel(Lt)	1.00	370.00	370.00	420.00	510.00
	TOTAL			431.00	497.50	587.50
	Per Kg.			1.77	1.61	1.57
Total Fixed + Variable Cost :				516.46	582.96	672.96
Total F+V/Kg				2.12	1.89	1.80
Income from marketin Kg/Mth sold :				244.00	309.00	374.00
	Price/Kg :			2.50	2.50	2.50
	Tot. Income :			610.00	772.50	935.00
Income from fish processing :('1)				30.00	30.00	30.00
Total Income /Mth	(B)			640.00	802.50	965.00
Own consumption (Kg/Mth) :	'(23)			61.00	61.00	61.00
Net mthly Group income before financing (B-A) :				122.00	220.00	292.00
Income per person (Net Income /5)				24.00	44.00	58.00
Net Gp Income w/o depreciation				181.00	279.00	351.00
Per person				36.00	56.00	70.00