FI:TCP/PNG/6611
Technical Report 4

TECHNICAL COOPERATION PROGRAMME

STRENGTHENING NATIONAL CAPACITY FOR
FISHERIES CONSERVATION AND MANAGEMENT

PAPUA NEW GUINEA

Technical Report:

FISHERY QUALITY CONTROL AND INSPECTION REQUIREMENTS IN PAPUA NEW GUINEA

Report by
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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Bangkok, November 1996

FISHERY QUALITY CONTROL AND INSPECTION REQUIREMENTS IN PAPUA NEW GUINEA

1.0 INTRODUCTION

1.1 CONSULTANCY INPUTS

The consultant in Quality Control and Inspection was assigned to the team of international consultants for a period of one month. He arrived in Port Moresby on 25th August and departed on 25th September. His counterpart officer was Mr N Rajeswaran, Principal Fisheries Inspector, Inspection and Enforcement Branch of NFA. Mr John Timothy, Principal Fisheries Inspector, also assisted the consultant in collection of data and arranging meetings with various government departments.

1.2 TERMS OF REFERENCE

Under the terms of reference of the consultancy the consultant was expected to evaluate the current practice and policy with respect to fishery quality control and inspection and recommend appropriate measures to strengthen control and inspection. Specific terms of reference for the consultancy were:

- review existing practice and policy with respect to fishery quality control and inspection and assess their adequacy in the light of minimum and international standards;

- identify the nature and extent of constraints that inhibit the strengthening and improving of quality control and inspection requirements;

- propose reasonable and realistic measures and options that might be adopted, including an assessment of their costs and relative advantages and disadvantages, for strengthening quality control and inspection requirements.

The consultant and his counterpart travelled to Lae, Wewak and Goraka to inspect the Coastal Fisheries Stations in Lae and Wewak, University of Technology (UNITECH, Lae), National Analysis Laboratory (Lae), Mackerel cannery (Lae), GTZ Project (Lae), Trout Farms (Mt Willehm and Goraka), Transhipment Centers (Wewak), East Sepik Youth Fisheries (UNDP) Project (Wewak), Sepik Coastal Agencies Pvt. Ltd. and several other centers important in fish handling, processing and marketing.

In Port Moresby, while stationed at the NFA Town Office, visits were undertaken to National Institute of Standards & Industrial Technology (NISIT), National Chemistry Laboratory, Agriculture Protection Division, Veterinary Laboratory and Quarantine Division of the Department of Agriculture and Livestock, Customs Operations Unit (Internal Revenue Commission), New Guinea Marine Products Pty Ltd. Meetings were also held with senior staff and field staff of various branches of NFA and chairman, Fishing Industry Association.

Primary data/information were collected through interviews with fishermen/traders/processors/various government staff etc secondary data, through recorded literature and other documents.

2.0 PRACTICE AND POLICY

2.1 GENERAL

The fisheries sector of Papua New Guinea is characterised by an expanding domestic sector and a large foreign fishing ventures operating in its EEZ of 2.4 million sq km. Fishing activities in the domestic sector are undertaken by around 100,000 coastal dwellers out of a total coastal population of around 600,000 spread over a coastline of around 13,200 km (Table 1). Domestic production of fish and other marine resources in 1995 is estimated at around 47,500 mt, consisting of around 26,000 mt of coastal subsistence production, and an inland/highland production estimated at 13,500 mt. Domestic commercial/artisanal production accounts for balance 8,000 mt. Fishing in coastal waters is undertaken by a wide range of canoes and dories. These crafts are generally multi-purpose, being used for transporting people and products to markets, as well as fishing, and transporting fish. Craft types range from single hull and outrigger wooden canoes powered by paddles, sails or motor, to outboard powered fibreglass and aluminium dinghies. Higher in the range are inboard powered wooden dories with cabins and fish holds.

Table 1: Profile of Coastal Population Spread in PNG (1990 estimates)

Province	Population		(%)	No. Coastal Villages	Coastline (km)	Population km Coastline
	Province	Coastal				
Western	110 000	16 000	14.5	71	1 058	15
Gulf	80 000	23 000	28.9	106	746	31
Central	320 000	89 000	27.9	99	748	119
Milne Bay	170 000	107 000	63.1	305	2 624	41
Oro	110 000	13 000	11.5	80	650	20
Morobe	375 000	35 000	9.3	92	752	46
Madang	270 000	28 000	10.4	118	628	45
East Sepik	241 000	14 000	5.9	66	304	46
Sandam	139 000	17 000	12.3	49	278	61
Manus	27 000	14 000	53 6	99	568	25
N. Ireland	87 000	66 000	75.8	388	1 650	40
ENB	185 000	50 000	27.1	155	774	65
WNB	135 000	58 000	43.2	188	1 640	35
N. Solomon	165 000	38 000	23.0	128	806	43
Total	***2 414 000***	***568 000***	***23.53***	***1 944***	***13 226***	***43***

Source: UNDP Fisheries Sector Review (1989)

There is a growing domestic commercial sector, consisting of about 30 boats in operation (1995), out of a total of 49 licensed boats (Table 2), employing around 370 people. The largest fleet is composed of prawn trawlers. In addition there are several freezer boats which are associated with lobster fishery. The trawlers and freezer vessels operating in the prawn, lobster and barramundi fisheries carry out limited processing and freezing at sea. The general fishing vessels and dories held fish in (ungutted) frozen or iced form for offloading ashore. The domestic commercial/artisanal production of around 8,000 mt consists of prawns and lobster (1,900 mt), reef fish and large pelagics (4,000 mt), shark, shells and beche-de-mer (2,100 mt). Expansion of the domestic tuna fleet is expected in the near future.

Annual catches of the foreign fishing fleet has been estimated at 200 - 300,000 mt. These vessels are mainly tuna longliners and purse seiners (Table 3). The foreign fishing fleet in 1995 consisted of about 261 licensed vessels, mostly from US, Korea, Japan and the Philippines, licensed to fish inside PNG's exclusive economic zone. The fleet employing a crew of around 4,000 persons caught an estimated 220,000 mt of tuna in 1995, mainly consisting of skipjack (160,000 mt), yellowfin (50,000 mt) and sashimi quality tuna (10,000 mt).

Table 2: Licensed domestic fishing vessels in the PNG fishery - 1995

Fishery	Length (m)				
	<10 m	10-20 m	20-30 m	>30 m	Total
Prawn Trawlers	1	1	16	-	18
Collection Vessels	3	7	1	-	11
Live Fish	-	-	3	2	5
General Fishing	3	2	-	-	5
Tuna Longline	-	1	-	5	6
Tuna Seiner	-	-	-	2	2
Shark Lining	-	1	-	-	1
Gillnetting	-	1	-	-	1
Total	***7***	***13***	***20***	***9***	***49***

Source: DFMR data base (Final Report of the ADB Project TA No. 2258 PNG)

Imports account for nearly 60 per cent of the domestic consumption of fish and fishery products. Annual imports of fish, mainly canned mackerel and sardine, is estimated at around 35,000 mt and valued at around 30 - 35 million kina (Table 4) which includes around 2,000 - 3,000 mt of whole or processed fish and fishery products.

Table 3: Licensed Foreign-Owned Fishing Vesels Operating or Licensed to Operate, in PNG waters, 1995

Vessels	Length (m)				
	<10 m	10-20 m	20-30 m	>30 m	Total
American Seiners	-	-	-	44	44
Korean Seiners	-	-	-	29	29
Taiwanese Seiners	-	-	-	42	42
Philippines Seiners	-	-	4	22	26
Philippines Lightboatts	-	34	53	1	88
Philippines Motherships	-	-	-	31	31
Philippines Tankers	-	-	-	1	1
Total	***0***	***34***	***57***	***170***	***261***

Source: DFMR data base (Final Report of the ADB Project TA No. 2258 - PNG)

Exports mainly consist of block frozen prawn, dried beche-de-mer, chilled/frozen fish and frozen lobster. In 1995 the total exports were around 1,880 mt, valued at around Kina 22 million (Table 6). Imports mainly consists of canned sardine and mackerel, fresh fish (mainly barracuda) and some dried/smoked fish. Canned fish imports in 1989 has been estimated at 52,000 mt. However, present imports are lower, as a considerable amount, around 40 per cent of the domestic market, is produced locally using imported raw material.

Table 4: *Seafood imports (1990)*

Item	Value of imports (kina)
Fish, crustaceans etc prepared (canned)	33 078 000
Fish, fresh, chilled or frozen	774 000
Crustaceans etc, fresh, dried etc.	344 000
Fish, dried, salted, smoked etc.	34 000
Total	***34 230 000***

Source: Extracted from "International Trade Statistics" National Statistical Office

Consumption pattern shows variation among coastal and inland communities. Studies undertaken in late 80s, which excluded molluscs and crustaceans, suggest a consumption of around 1 kg/person in inland areas and 20 kg/person in coastal areas (UNDP, 1988). A summation which included imports, estimated at 52,600 mt in 1989 (Agrodev, 1991) has suggested a national average per capita consumption of around 22.3 kg (ADB,1995). There has been a drop in direct imports of canned fish since the commencement of production of canned fish locally.

Based on an available annual fish supply of 98,500 mt, and a population of 4.2 million, the present annual average fish consumption can be estimated at around 23.5 kg (Table 7), a slight increase over earlier estimates.

Table 5: Seafood and other marine exports (1985-1995)

Year	Quantity kg	Value (FOB) kina
1985	9 912 662	13 978 062
1986	1 787 416	10 925 523
1987	1 704 165	11 210 211
1988	1 199 287	8 674 690
1989	1 148 911	7 558 121
1990	2 166 704	10 256 628
1991	2 384 328	13 307 677
1992	2 076 223	13 132 584
1993	1 982 649.4	12 835 544
1994	1 498 464.5	12 911 355
1995	1 878 275.2	21 759 519

Source: 1985-1991 - National Statistical Office of Papua New Guinea
1992-1995 - Export Declaration NFA

This is a welcome sign of the local market and consumers gradually weaning off from heavy dependency on imports. From a health angle, the trend of increased fish consumption, if maintained, could also help to reduce the dependency of the population on high fat meat diets, blamed by medical personnel to be the cause for heavy incidence of heart problems among the population. In view of the nutritional values of fish as a healthy diet, more campaigns for fish-eating habits should be encouraged by both the government and the industry, especially to the inlanders/highlanders.

Table 6: Seafood and other marine exports (1995)

Item	Quantity kg	Value (FOB) kina
prawn	691 938	9 145 633
beche-de-mer	440 843	4 474 986
fish	181 268	711 529
lobster	122 728	3 038 955
trochus	311 931	3 362 210
shark	98 007	294 823
processed prawn	13 167	422 474
shell	11 078	143 123
crab	7 596	78 587
clam	1 000	20 000
Total	***1 879 556***	***21 692 320***

Source: Compiled using NFA data

Table 7: Fish Consumption Estimates - 1996

Domestic production	coastal subsistence	26,000 mt*	
	inland/highland	13,500 mt*	
	commercial/artisanal	8,000 mt*	
			47,500 mt*
Direct Imports			35,000 mt+
Imports processed locally (canned)			20,000 mt
Exports (wet fish equivalent)			4,000 mt+++
Total available			**98,500 mt**
Population			4.2 mill
Per capita consumption			**23.45 kg**

* Kolkolo, 1996
\+ Customs - personal communications
\+ \+ Back calculated using NFA statistics

2.2 STATUTORY BODIES ASSOCIATED WITH FISH MARKETING AND INSPECTION

National Fisheries Authority (NFA), a non-commercial statutory body, was formed in 1994 as per a decision taken by the National Executive Council (NEC), to take over the functions of the Department of Fisheries and Marine Resources (DFMR) and the provincial fisheries departments. The Fisheries Act of 1994, in providing for the establishment of NFA, defines its objectives and lists eleven key functions. Functions d) and e) listed in para 6 (Part II, Division I) of the act, which relate to quality control and inspection functions to be undertaken by NFA read as follows:

d) subject to the *Pure Foods Act* and any other relevant law, to control and regulate the storing and processing of fish and fish products; and

e) subject to the *Commerce (Trade Descriptions) Act*, the *Customs Act*, the *Customs Tariff Act*, and the *Exports (Control and Valuation) Act*, to control and regulate the export of fish and fish products;

Under the newly approved organizational structure of the National Fisheries Authority (NFA), Inspection activities are undertaken by the "Inspection and Enforcement Branch" of "Licensing, Surveillance and Enforcement Division". The budgetary allocation for the whole division was around 10% of the total DFMR budget in 1992, out of which nearly 85% was apportioned to physical surveillance and inspection activities. The amount appropriated for the division in the 1994 budget stood at nearly 12% of the total DFMR budget of K6,830 million. At present "Inspection and Enforcement Branch" has an approved cadre of 10 staff (Appendix 1).

The Fisheries Sector Policies lay adequate emphasis on fish inspection and quality control. The major elements and strategies of the Fisheries Sector Policies related to roles and functions of Inspection Services, as approved by the National Executive Council in 1993, can be summarised as follows:

- to ensure that fisheries products meet Papua New Guinea and international standards with respect to identification, grading, handling and product quality;
- to maintain a healthy, productive, constructive interaction with industry;
- develop programmes to monitor industry compliance with regulations;
- designated and random inspection of licensed vessels and premises;
- annual inspection and approval of vessels, linked to export-approved onshore establishments, for processing and packing products at sea for export, ensuring they maintain required quality standards for export;
- regular monitoring of export-approved establishments to ensure that satisfactory conditions are employed in handling, processing and storage of products for export. As appropriate, conduct sensory. physical, laboratory tests etc. as well as checks on product, to assess product quality;

- export-approved facilities where significant lapses are noted during inspection and/or testing of products, more frequent visits/testing to be carried out until the problems are resolved to the satisfaction of the authorities;

- if product continue to be substandard, or the product integrity is not satisfactorily maintained the inspection services may withhold export approval;

- inspectors to be stationed at all export approved processing facilities to facilitate accurate grading, the maintenance of product quality standards and other requirements at the time of packaging;

- on-board processing of prawn, lobster will be permitted only if the relevant grading, handling and processing standards are complied with; otherwise such activities have to be conducted at an authorised shore facility;

Other government bodies responsible for fish marketing include Department of Trade and Commerce, Department of Customs and the Consumer Affairs Council (CAC). CAC, coming under the Ministry of Finance, is responsible for handling consumer complaints regarding products marketed in PNG. Customs is basically involved in the collection of tariff on imports and exports. Imported frozen fish and canned sardine is subjected to a duty of 40 per cent. Other canned fish varieties such as mackerel and tuna, is subjected to 100 per cent duty. Duty on all seafood exports is a flat 5 per cent.

2.3 DOMESTIC PRODUCTION, MARKETING AND QUALITY CONTROL

Traditional trading of fish in PNG has been in the smoked form. Today fish is traded mostly in the fresh or frozen form. Fresh fish is mostly sold at informal markets or at municipal markets. Such facilities can be seen in many parts of the country, every town, municipality and sub-center. Sale of frozen fish is confined to private outlets. Municipal markets are run under Council supervision or under the supervision of a government approved body.

2.3.1 HANDLING AND MARKETING OF FRESH FISH

Fish marketing systems and infrastructure serving artisanal and small-scale commercial fisheries are not well developed. The cash market for fish is confined to urban centers. In the coastal areas much of the fish is sold fresh in local markets, by fishermen themselves. Government owned coastal fisheries stations have provided market outlets for artisanal fishermen in the past. However, at present most of these facilities are defunct.

Municipal marketing

The two major municipal markets in the country, Koki market and Gordon market, are located in the capital Port Moresby.

Koki market has for long been one of the largest fish markets in the country. It is supplied mainly by fishermen from Hula (south-central), Motuan and Koitabu villages around Port Moresby, and peri-urban settlers from Gulf province. Most of the fish sellers are women coming from villages. The market has a sheltered area for fish vendors. However, often fish vendors prefer to sell fish on the ground outside, where they have bigger space to display their fish on plastic sheets or on temporary display

arrangements made of wooden planks supported by a wooden box. The sanitary conditions at the market, when compared to status reported few years back, has shown a significant improvement over the last few years.

At Koki market, though inadequate there is some access to potable water. The beach adjacent to the market is polluted by discharges from hundreds of houses built on stilts in shallow beach waters. Mindful of the contaminated nature of beach water, fishermen refrain from using beach water for washing fish, a practise common in some developing countries. There is very little usage of ice at the market. However, fishermen use ice for holding fish after catching and transporting fish to the market. At the end of the day they buy ice from the only ice vendor in the market, and carry the ice back to the fishing villages in insulated, lidded, plastic containers. Normally, they take one or two blocks of ice daily, at K5.50/15 kg block. The vendor located at Koki market sells around 48 blocks of ice daily. He has his ice machine at a location outside the market and transports ice daily to the market, where he stores the ice in a deep freezer. The chill room and the block ice plant at the market are defunct. At both Koki and Gordon market there are no designated areas for various fish and fishery products. The product mix consists of reef fish, coastal demersal species such as mackerel tuna, Spanish mackerel, mangrove crabs, shellfish, smoked fish, freshwater fish and even turtle flesh.

The more recently established Gordon market has well serviced fish selling areas with concrete walkways. The enclosed area, designed for sale of fish, has two rows of concrete tables to display fish and wooden benches behind the tables for fish sellers. However, there is no access to fresh water or ice at the market. Fishermen and fish transporters buy ice from a vendor located outside the market.

The two markets also receive some of the high value species in the by-catch of shrimp trawling in the Gulf waters. Most of the by-catch is often discarded at sea due to limited freezing and holding capacity on board. However, towards the end of the fishing trip, based on the availability of storage onboard, some of the high value species in the by-catch are set aside to be sold at the Port Moresby markets or at various private outlets in and around Port Moresby. Some trawl operators also sell high value by-catch fish to coastal people or subsistence fisherman from the coastal belt, who visit the trawlers in the fishing grounds.

Lae fish landing and marketing center

Fish landing and wholesaling in Lae, the second largest city in PNG, is carried out at the fisheries wharf, located at the Coastal Fisheries Development Center (GTZ project) premises. In addition to fish caught in Lae area, the station also serves as the main fish landing point for fish caught in Morobe, Finchhaven, Wasa and Siasi waters. The station also has a fish sales outlet, where fish purchased from fisherman are sold to the public (Table 8). As a result of insistence by quality control staff of the fish landing center, all the fish landed in Lae has to be gutted and iced by the fishermen prior to delivery. Fish caught by fishermen at landing points outside Lae, are gutted and held in iced fish boxes, sometimes for several days till the stocks built up, awaiting transport to Lae. In addition to the two fisheries inspectors stationed at the center in Lae, there are also fish inspectors stationed at Morobe (1) and Finchhaven (1).

The station has a steady supply of both block ice and flake ice. Block ice is supplied to fisherman at a subsidized rate of K1.50/15kg block, where the same is sold for K4.50/15kg for non-fish or party use. In return, fisherman are expected to supply fish, gutted and iced, to the station. Fish are thoroughly checked for quality after landing, and any poor quality fish is rejected. The station sells the fish to retailers and at the time of selling also provide an adequate quantity of flake ice to chill the fish, free of charge.

Table 8 : Fish prices at the Central Fish Landing Center, Lae (prices noted on 9th September 1996)

Variety	Price Kina/kg
Lobster (head-on)	7.30
Lobster tails	10.50
Prawns	6.20
Octopus	6.20
Squids	6.20
Crabs	7.30
Clam meat	6.20
Spanish mackerel	5.30
Red snapper	5.30
Assorted reef fish	4.60
Rainbow runner	3.70
Freshwater prawn (Machrobrachium)	10.00
Indian mackerel	3.80
Skipjack	2.40

The total block ice production capacity at the center is around 1 to 1.5 mt/24 hours, while the supply in Morobe and Wasa is around 300-400 kg. In Finchhaven and Siasi it is around 700-800 kg/24 hours.

Fresh fish marketing at informal markets

In most of the smaller towns and coastal villages fish is sold at informal markets, often on the beach itself, or at a point close to the beach. Fish is caught in coastal waters and is washed on the beach and sold ungutted or uniced to consumers or traders. Fish bought by traders may be sold at town markets and other informal markets or may be sold to a food store with freezer facilities. Alternatively food store owners may buy fish direct from the fisher folk. Fish landed in locations like Lae, Wewak, Medang etc are transported on ice by road to interior areas and the highlands. This fish is meant for major highland market centers like Mount Hagen and Goraka and other smaller sales points dispersed in the interior areas and the highlands. Some traders keep the fish in 12-18 cu ft capacity chest freezers till they build up adequate stocks prior to transport or sale to buyers or traders from highlands.

Availability and usage of ice

Usage of ice is not wide spread in domestic marketing of fresh fish. Generally fish is sold either fresh, un-iced, or frozen. Both fresh and frozen fish is sold at supermarkets and food stores located in urban areas. However, mostly as a result of encouragement and insistence of ice usage by some fish traders who supply hotels/resorts and the chilled fish export trade, demand for ice has shown a gradual increase in recent times. As a result of growing consumer awareness of fish quality and the expected expansion of chilled fish exports from PNG, the demand for ice can be expected to continue to further increase in the future.

Ex-factory price of block ice can vary from K4.50 to K6.00 for a 15 kg block of ice reconstituted block of flake ice. Block ice machines popular among ice producers in PNG are normally of small capacity, brine cooled and producing twelve, 15 kg blocks per shift. Depending on the demand for ice, suppliers may operate several such units. Such production methods are more economical rather than using larger units, as they can be operated or shut down depending on the demand. Surplus ice is stored in a chill room or a chest freezer. It is difficult to quantify ice usage in fish marketing as it is split on party use and fish use. During the weekends and festival times most of the ice is used for chilling beverages whereas during the fishing season the production is mostly geared to fish use. In most instances ice producers are linked to coastal or provincial fisheries service stations which are involved in the fish trade. Such bodies have arrangements with fishermen to supply ice at a concessionary price ranging from K1.50-K2.50 per 15 kg block, in return to supply of fish.

In mid-late 80s with the establishment of coastal fisheries stations ice production capacity in the fisheries sector increased to around 23 mt per day; 16 mt of block ice and about 7 mt of flake ice (Table 9, Fig 1). Some of these units are not in operation at present. However, the supply of ice by private suppliers to the fisheries sector has shown an increase over the last few years. Total ice requirement of Port Moresby for both party use and fish use has been variously estimated at around 15-20 mt per day whereas in Lae, the second largest city in PNG, which has a relatively low fish production from its coastal waters, the demand is estimated at 3-4 mt. On a conservative estimate, based on the present ice usage pattern (very low ice: fish ratio), the daily demand for ice for the entire fisheries sector can be estimated at around 20-25 mt. However, factors such as improved quality awareness among consumers/traders and resulting increase ice usage in domestic fish marketing, the envisaged growth of fish production, export and domestic marketing by small scale sector etc can substantially increase the demand for ice in the future. Apart from the demand, an important consideration in any future investment in ice plants should be the availability of a steady supply of potable water. In some locations the sources of water has been reported to be heavily polluted. Low water pressure and interruption in supply has affected the operation of flake ice plants in some locations.

Fish production and marketing in Inland/Highland areas

Inland and highland areas receive their fish from coastal centers such as Medang, Wewak and Lae. Fish from these centers are transported by private traders in plastic boxes with some ice. Relatively small quantities of fish, frozen or partially frozen in chest freezers, are transported and delivered to food stores in inland areas.

Supply of fish from inland/highland capture and culture fisheries are low and has been estimated at around 400-500 mt per annum. As a result of introduction of exotic species for pond culture in highland areas in early seventies, carp in particular, has become well established in many highland waters. Carp provides the bulk of the small amount of fish actually produced in highland areas followed by tilapia and rainbow trout, latter at altitudes above 2000 meters. Small quantities of fish are also collected from man made reservoirs such as Yonki.

Fishing is carried out at subsistence level and very little enters the local market. If there is any surplus it may be smoked. Impact of animal husbandry and use of agro chemicals on quality and safety of fish caught is not clear. However, the use of agricultural chemicals in stunning fish prior to capture has been reported. Discussions held with medical/public health authorities and environmental study groups did not reveal any direct impact of such practises on safety of food fish, or any ill effects as a result of consumption of inland/highland fish on humans. However this can not be taken for granted, as future expansion of agricultural activities in inland/highland areas, and the corresponding anticipated increase in usage of agrochemicals would inevitably have an impact on fish extracted from these waters. Furthermore, population expansion and corresponding growth of animal husbandry is bound to create contamination of these water with sewage and faecal matter.

2.3.2 FROZEN FISH

Both imported and locally produced frozen fish are marketed and traded in PNG. Most of the imported frozen fish (except for imports of frozen mackerel for canning) is frozen barracuda used mostly by "fish and chips" sales outlets, followed by some frozen fish blocks and individually wrapped or packed fillet imported for supermarket sale and for hotel use.

Only a small quantity of fish is frozen locally. In the mid-late 80s, when the DFMR coastal fisheries stations were in operation, the daily freezing and total frozen storage capacity in coastal fishing operations was estimated at 33 mt and 147 mt respectively (Table 8). However, most of the freezing/cold storage facilities are now non operational. As a result, most traders resort to freezing fish in chest freezers, often the process resulting in a poor quality partially frozen product. This method is especially unsatisfactory, and unsafe, with tuna species due to the possible built up toxic histamines. Hence any future expansion in domestic tuna production should take into consideration the need for efficient freezing/cold storage facilities. Present land based freezing and cold storage capacities for fisheries use has been estimated at around 17 mt and 70 mt respectively. Private land based fish freezing and cold room facilities are located in Daru and Alotau.

2.3.3 SMOKED FISH

Traditionally, smoked fish has been an important item of trade in Papua New Guinea. Even today, smoked fish is produced and sold at many coastal market centers, including municipal markets in Port Moresby and Lae. Fish smoking involves grilling of fish for a short period over an open fire and then drying and smoking the grilled fish over a smoking fire, often for several days. The operation is often geared for Saturday markets, fisherman starting the smoking operation around mid-week. Thus the market will have fish of various grades of smoking. Larger fish are eviscerated prior to grilling whereas the smaller species are grilled and smoked ungutted. Tuna and spanish mackerel may be cut up into steaks prior to smoking.

Fish smoked in this fashion may keep for 4-5 days depending on the level of smoking/drying, initial quality of fish and method of storage. Fisheries authorities have made efforts to introduce improved fish handling and smoking practises through women's groups with limited success. It is interesting to note that there is a steady demand for locally smoked rainbow trout in the supermarkets. Use of quality raw material and improved smoking technology, improved packaging and presentation could help even other species of smoked fish to have better market access.

2.3.4 CANNED FISH

Fish canning in PNG commenced in mid 1995 with the opening of the mackerel cannery (International Food Cooperation Ltd) in Lae. The cannery was meant to reduce the dependence of PNG on imported canned fish. However, due to the preference for canned mackerel among the local population, a species which is not caught in local waters, the factory has to depend on imported raw material. At present most of the raw material is imported, mainly blue mackerel (Besta brand) and jack mackerel (Ace and Supreme brands). The imported block frozen raw material is subjected to a satisfactory process controlled canning under careful supervision of qualified QC staff. The laboratory has basic equipment for routine quality control work. The laboratory is now been upgraded to undertake routine microbiological tests as well. At present the microbiological examinations on canned products from the cannery are carried out by the UNITECH National Analysis Laboratory, Lae. The company is now in the process of developing its own quality manual with the view to achieving international quality certification

Table 9 : Coastal Fishing Operations and Refrigeration, Cold Room and Ice Plant Capacities - 1985 and 1996 ( )*

Plant Location	Freezing Capacity (mt/day)	Freezer Storage Capacity (mt/day)	Ice		Chiller Capacity (mt)
			Block (mt/day)	Flake (mt/day)	
Aitape	-	10 (-)	-	0.3 (-)	-
Balmuru	3 (-)	15 (-)	4 (-)	1 (-)	6 (-)
Daru	10 (10)	2.5 (-)	-	-	-
Kavieng	2.5 (2.5)	15 (15)	0.8 (0.8)	-	-
Kieta	-	5 (-)	0.4 (-)	-	-
Kimbe	2.5 (-)	20 (-)	-	-	5 (-)
Kupiano	-	10 (10)	0.8 (0.8)	-	5 (5)
Lae	-	5 (5)	1.2 (1.2)	-	-
Madang	-	10 (-)	0.8 (0.8)	- -	-
Manus	2.5 (2.5)	15 (15)	0.8 (0.8)	-	5 (5)
Rabaul	-	3.5 (3.5)	-	0.3 (0.3)	-
Samarai	2 (2)	21 (21)	5.6 (5.6)	-	18 (18)
Tufi	0.6 (-)	5 (-)	-	5 (-)	5 (-)
Wewak	10 (-)	10 (-)	1.6 (-)	0.6 (0.6)	3.5 (-)
Total	**33.1 (17)**	**147.0 (69.5)**	**16.0 (10)**	**7.2 (0.9)**	**47.5 (28)**

( ) 1996 estimates by NFA

W.B. Data on freezing/cold room facilities at private fish processing plants in Alotau, Daru and Lae cannery and ice production facilities not dedicated to fisheries sector has been excluded.

2.3.5 INSPECTION AND QUALITY CONTROL

Out of around 47,500 mt of domestic fish production, only around 8,000 mt is traded, mostly in coastal urban areas where there is a good demand for fresh fish. The fish sold at municipal markets is priced in such a way to facilitate the disposal of fish by the end of the day. Any surplus fish is smoked. Part of the coastal landings are also transported by traders to inland/highland market centers by road. There are several factors which could affect quality and safety of fish produced in PNG. These include possible quality deterioration of fish due to inadequate ice usage, use of contaminated surfaces and containers, slow freezing of fish in chest freezers, use of contaminated water/ice, heavy metal/agrochemical contamination, use of harmful additives in processed products, use of high levels of preservatives or unpermitted additives etc.

In spite of these possibilities, fish and fishery products processed and marketed locally are not subjected to any regular, systematic quality testing. Any consumer complaints regarding products, including fish and fishery products, marketed locally are handled by the Consumer Affairs Council (CAC), coming under the ministry of finance.

2.4. EXPORT TRADE AND QUALITY CONTROL OF EXPORTS

Major items of export from PNG are frozen prawn, beche-de-mer, frozen lobster and fresh/frozen fin fish, mainly tuna and barramundi. The total quantity exported is around 1,590 mt (1995) valued at around K22 million. In addition to this around 200,000-300,000 mt of tuna collected from PNG waters are transhipped annually from several centers in northern PNG. The main transhipment centers are Wewak, Kavieng and Manus and Rabaul (Table 10). Transhipped tuna are inspected by fisheries officers/inspectors at these locations to collect statistics on export for the purpose of revenue collection. There are no quality tests or sampling carried out on tuna transhipments.

Inspection and quality control of exports

The exports subjected to laboratory testing are mainly frozen prawn, lobster and fresh fish (barramundi). Prawn/lobster fishery is mainly carried out in Gulf of Papua, Torres Strait and Western Provinces. Prawn exports in 1995 stood at around 690 mt tail weight or around 1,300 mt gross weight. The maximum sustainable yield of the resource has been estimated to be around 2,400 mt. Landings mainly consists of banana prawn (*Penaeus merguiensis*) and to a lesser extent black tiger (*Penaeus monodon*) and brown tiger (*Penaeus semisulcatus*). The fishery is carried out by a fleet of around 18 domestic trawlers, most of which is around 20-30 meter range (Table 2).

Inspection and certification of exports, other than live fish (crabs and lobster/crayfish), is conducted by the Inspection Unit of Surveillance and Inspection Division of the National Fisheries Authority. Live products are inspected by the Quarantine Division of the Department of Agriculture and Livestock (DAL). Sample collection is done by Fisheries Inspectors, in response to a formal application made by the prospective exporter (Fig.2).

At present, an exporter has to fill a total of six forms with respect to each consignment (Appendix 2), two forms initially; "Notice of intention to move marine products" and the "Fish Sampling Certificate" followed by four more forms; Notice of intention to move frozen fish" (Form 3), "Notice of intention to export fish" (Form 4), "Application for an export permit" (Form 5) and "Certificate of fitness for the export of fish" (Form 6).

Shrimp are graded and frozen onboard the trawlers. Some trawlers have size grading equipment while in others size grading is carried out manually. Once the trawler arrives in port, five samples are collected by the inspector from each container; in the case of prawn this amounts to five, 2 kilo packs. After sampling is complete, the products are transferred to refrigerated containers awaiting shipment.Generally sample collection is done by field inspection staff. However, in some instances laboratory staff also undertakes analysis of samples submitted by the processor.

Table 10: Major ports/locations of seafood export and products exported

Location/Port		Products exported
POM	-	Shrimp, sashimi tuna, beche-de-mer, barramundi fillets, crayfish
Daru	-	lobster, barramundi fillets
Alotau	-	shrimp, crayfish, beche-de-mer
Lae	-	sashimi tuna, beche-de-mer, fish meal, canned fish
Medang	-	beche-de-mer,
Wewak	-	tuna transhipment, sashimi tuna, beche-de-mer
Rabaul	-	tuna transhipment, beche-de-mer
Kevieng	-	tuna transhipment, beche-de-mer
Manus	-	tuna transhipment, crayfish, beche-de-mer, live fish

There are no land based storage facilities in Port Moresby. However, land based freezing and storage facilities are available at two processing facilities, one in Daru and the other in Alotau. After transfer of frozen products to the container they are sealed. The containers with the product may be left at the wharf or may be towed to a yard outside the harbour, to be kept awaiting clearance of shipment for export.

The sample cartons are taken by vehicle, often packed in a carton box, to the microbiology laboratory at Kilakila for laboratory analysis. Samples collected from locations outside Port Moresby, ex Daru and Alotau, are sent to the laboratory by air, in a carton box, sealed in a polythene cover or in an insulated container. In addition to those attached to NFA's Fish Inspection branch, there are 10 fish inspectors attached to major landing centers who are involved in sampling operations, out of which eight are located outside the national capital district. However, under the revised NFA cadre, none of these officers are listed as Surveillance Officers and there is an ambiguity in the role of these officers in future fish inspection activities.

Sample analysis

Sample analysis is carried out by the fish microbiology laboratory of NFA. It handles around 15-20 samples a month, mostly shrimp and lobster samples. They are mainly from trawl processed export shipments (Port Moresby), shrimp and lobster processed by two land based facilities in Daru and Alotau. The frequency of receiving samples from other locations is very low. Samples are analyzed for weight, size/grade specifications, decomposition, blackspot, filth/foreign matter etc. Sampling and reporting procedures are discussed elsewhere in this report. The laboratory is equipped with basic facilities for microbiological analytical work and it conducts routine analysis of samples for total plate count, total coliforms, faecal coliforms, *Salmonella* and *Staphylococcus*.

The laboratory testing may take place up to two weeks, after which the results are intimated to the Inspection Branch in the Head Office for necessary processing of documents, which may take an additional three days. At the Inspection branch, the product price indicated in the export documents are cross checked with average global/regional market prices for the product to avoid under invoicing.

The Fish Microbiology laboratory has no provision for chemical analysis of fish samples on a routine basis. At present such analysis is conducted with the assistance of the National Chemistry Laboratory (NCL) of the Department of Agriculture and Livestock located at the Kilakila complex. NCL has facilities for advance chemical analysis. Studies have shown that levels of mercury in some species such as barramundi (*Lates calcarifer*) collected from certain localities exceeds WHO recommended limit of 0.5 micro gram per gram wet weight of fish. Fresh/frozen barramundi is an important item of export from PNG and hence it is important to strengthen provision for such analysis, independently or in collaboration with NCL. Considering the growing expansion of tuna exports, it is also important to build up provision for analysis of tuna samples for histamine.

Registration of processing facilities

Inspection and approval of onshore and onboard facilities for processing fish and fishery products for export is carried out by NFA inspection staff as per the provisions in Part VI (Storage, Processing and Export) para 43 (Fish Export Facilities) in the Fisheries Regulations (Appendix 3). At present there is no systematic inspection of facilities for their compliance with Good Manufacturing Practises (GMP) or adequacy of other basic health and hygiene requirements. Annual licensing of vessels/plants are done on the recommendations of the field staff. The relevant documentation is given in Appendix 4.

The inspection arm of the National Fisheries Authority has developed factory/vessel hygiene inspection audit schedules to be used by inspection staff, based on Australian schemes and documentation.

Inspection of seafood imports

Total annual seafood imports are estimated at 40,000 mt, consisting of about 37,000 mt of canned fish and around 3,000 mt of frozen finfish, mainly barracuda imported for catering trade. In 1993 the role of inspecting fish and fishery product imports was transferred to fisheries authorities from the quarantine division of the Veterinary Department. However, at present there is no systematic inspection of imports.

There has been reports of non-conformity of some imported brands of canned fish to international standards. Low drain weight, species substitution and inclusion of mixed species, use of sub-standard poor quality raw material, poor can integrity, lack of product information, shelf-life data etc has been cited. Such products not only cause economic losses to the consumer, and the country as a whole, but also put the consumer at risk. Hence the urgent implementation of an import inspection scheme is of great importance. Implementation of such a scheme can be carried out with minor expansion of existing staff in the inspection branch, with relatively small extra investment on equipment.

2.5. LABORATORY FACILITIES ASSOCIATED WITH ANALYSIS OR MONITORING OF SEAFOOD QUALITY

Fisheries Microbiology Laboratory

The laboratory is located in the Veterinary Laboratory Complex at Kilakila, and shares a building with the veterinary microbiology laboratory. The laboratory has a staff of three, comprising of a Senior Food Technologist, Senior Fisheries Inspector and an assistant Food Microbiologist (seafood microbiologist) all with first degrees in food science/microbiology. It is responsible for conducting analysis of all seafood exports, imports and domestically marketed products, other than live exports and imports. Latter function is carried out by the Quarantine Division of Department of Agriculture and Livestock (DAL).

The laboratory handles around 15-20 samples a month, mostly shrimp and lobster samples. They are mainly from trawl processed export shipments (Port Moresby), shrimp and lobster processed by two land based facilities in Daru and Alotau (Fig. 3). The frequency of receiving samples from other locations is very low. Samples are analyzed for weight, size/grade specifications, decomposition, blackspot, filth/foreign matter etc. Sampling and reporting procedures are discussed elsewhere in this report. The laboratory is equipped with basic facilities for microbiological analytical work and it conducts routine analysis of samples for total plate count, total coliforms, faecal coliforms, *Salmonella* and *Staphylococcus*.

The laboratory is in the process getting accredited under joint National Institute of Standards and Industrial Technology (NISIT)/National Association of Testing Authorities, Australia (NATA) scheme of national laboratory accreditation. The laboratory seeks the assistance of the microbiology laboratory of the Department of Health for detailed microbiological analysis and serotyping. Chemical analysis such as proximate analysis and heavy metals are conducted with the assistance of the National Chemistry Laboratory also located at Kilakila in an adjoining premises.

Even though the number of samples referred to the laboratory for chemical analysis at this stage is relatively low, a significant increase in demand for such analysis could be expected with the expected expansion of exports of tuna, reef fish and processed products such as fish fillet by domestic sector.

Veterinary microbiology laboratory

Veterinary microbiology laboratory, located at Kilakila, is a division of the veterinary laboratory complex of the Department of Agriculture and Livestock (DAL) set up in 1960s. Other divisions coming under the complex are parasitology, histology, pathology and haematology. The complex has a staff of 3 scientists and 7 technicians. The complex is mainly geared for veterinary histological and pathological studies.

Due to budgetary limitations, the complex has not been able to develop its analytical capabilities. The microbiology laboratory conducts routine analysis of animal samples. The veterinary microbiology laboratory is located next to fish microbiology laboratory and collaborates efficiently and effectively in microbiological analytical work. The laboratory is approved by the National Association of Testing Authorities, Australia (NATA) and uses a NATA accredited laboratory in Cairns as a reference laboratory.

Quarantine Division of the Department of Agriculture and Livestock

Quarantine Division of the Department of Agriculture and Livestock is responsible for clearing export and import shipments of live fish, such as crab, crayfish, ornamental fish, brood stock, ova and fingerlings of various species (Appendix 5). The division is accredited by the Office of the International Epizootics (OIE). Until 1993 Quarantine Division also undertook analysis of all fish imports. In 1993 the role of inspecting fish and fishery product imports was transferred to fisheries authorities. However, at present there is no systematic inspection of imports.

National Analysis Laboratory

National Analysis Laboratory (NAL) in Lae is the premier privately run chemical analysis facility in the country. It is now run by Unitech Development and Consultancy Pty Ltd. - the commercial arm of the PNG University of Technology in Lae. NAL carries out routine analysis of water, foods, stock feed, coconut products, fish, spices etc. Chemical and microbiological analysis, pathological examinations and trace metal content determinations (mercury, cadmium, arsenic, lead, manganese etc) are some of the analysis conducted at the laboratory.

NAL has a staff of 14 with degree qualifications, mainly in analytical chemistry. NAL is accredited under the Papua New Guinea Laboratory Accreditation Scheme (PNGLAS) which comes under the guidance of National Association of Testing Authorities, Australia (NATA). The laboratory, which has a satisfactory internal and external validation schemes, is equipped with UV spectrophotometers, atomic absorption spectrophotometers (Varian SpectraAA and Perkin Elmer PE-3100), HPLC etc. The laboratory conducts heavy metal analysis on fish, and microbiological analysis on locally produced canned fish on a routine basis.

National chemistry laboratory

National Chemistry Laboratory of the Department of Agriculture and Livestock at Kilakila is well equipped with facilities for a wide range of analytical work related to agriculture sector. At present the facility is mainly involved in testing samples of soil, plant material, rubber, spices etc submitted by various regional agriculture centers and individuals. Analytical equipment at the laboratory includes microwave digestion units, UV spectrophotometers (Cary), Atomic Absorption spectrophotometers, high pressure liquid chromatograph (HPLC-Varian) etc capable of carrying out most of the chemical analytical work including heavy metal and pesticide analysis. The laboratory has an internal and external test validation scheme and is linked to the Agriculture Laboratory in Waganingan, Netherlands for this purpose.

National Institute of Standards and Industrial Technology (NISIT)

National Institute of Standards and Industrial Technology (NISIT) was set up under Act No. 21 of 1993, to provide for the establishment and use of uniform measurement and technical standards or integrated standardization for the promotion and undertaking of technology development. The act empowers NISIT with establishment of national technical standards as well as pre-shipment inspection and quality control of a commodity or a product. However, this does not apply in respect of a commodity or a product for which a pre-shipment inspection procedure is provided by under any other law.

When fully operational, the institute will have a cadre of 126, while at present the cadre strength is 25. NISIT has no laboratory facilities of its own at present but enjoys services by NATA (Australia) for special analytical work. It is now in the process of identifying national laboratories to be accredited for routine analytical work in the fields of agriculture, mining and medical sectors. The laboratories under the Department of Agriculture will form the nucleus of the proposed National Agricultural Research Institute (NARI). There is also a proposal to launch a NISIT mediated PNG laboratory accreditation scheme (PNGLAS).

The institute has set up special committees to draft/adopt suitable standards for various sectors. It has adopted codex standards for fishery products. NISIT also empowered with pre-shipment inspection of commodities if the products are not covered by any other government approved inspection system.

3.0 PRESENT CONSTRAINTS AND STRATEGIES FOR STRENGTHENING QUALITY ASSURANCE

The large resource base is the major criterion which gives scope for future expansion of the sector. With an annual sustainable yield of around 650 000 mt per annum, PNG maintains its status as one of the largest fisheries resource base in the Pacific region (Table 11). Tuna fishery offers largest potential for growth. Other areas with good prospect for growth are coastal pelagics, deepwater fish and deepwater crustaceans. Thus, considering increasing global demand for fish, a considerable expansion of the fishery sector, both catch sector (especially the domestic fleet strength) and processing sector (including processing for export), in PNG can be expected. This would most likely involve, or would necessitate a wide range of industry developments, which would mainly include:

Table 11 : **Comparison of present production of selected fishery resources with indicative estimates of potential annual sustainable yields**

	Estimated Present Production Range (mt)	Potential/Yields (mt/yr)
Skipjack Tuna	160 000 - 260 000[1/]	250 000
Yellowfin	55 000 - 86 000[1/]	100 000
Other Tunas	100 - 200	5 000
Billfishes	-	5 000
Sharks	800 - 1000	15 000
Coastal Pelagics	2 000	130 000
Inshore and Shelf Demersal Finfish	12 000	130 000
Deep Demersal Finfish	-	25 000
Deepwater Shrimps	-	2 000
Prawns	700 - 800[2/]	1 500
Lobster	100 - 120[2/]	200
Crabs	500 - 600	1 500
Shellfish	200[3/]	800
Beche de Mer	500[4/]	1 000
	231 000 - 363 000	**667 000**

[1/] Foreign catch
[2/] Tail weights
[3/] Shell weights
[4/] Dried weights

Source: Final Report of ADB Project TA No. 2258 - PNG)

3.1 IMPROVED ON-BOARD HANDLING FACILITIES

This would primarily apply to the domestic commercial fleet and the coastal fishing fleet. Fishing in coastal waters is undertaken by a wide range of canoes and dories available in the coastal communities. These boats are multi-purpose, being used for transporting people and products to markets, as well as fishing and transporting fish. Craft range from single hull and outrigger wooden canoes powered by paddles, sails or motor, to outboard powered fibreglass and aluminium dinghies. Higher in the range are inboard powered wooden dories with cabins and hold space.

Over the past few years there has been some positive developments such as increased use of insulated containers and ice in holding and transporting fish. With the growing quality awareness among fishermen, traders, exporters as well as consumers developments such as better use of ice on-board, introduction of ice/fish holds to larger boats etc can be expected, and should be promoted. In some countries such developments are encouraged through credit schemes.

The growing domestic commercial sector, presently consisting of about 30 boats in operation in 1995, would also need to improve on-board handling facilities if they were to satisfy the industry needs for quality fish. The prawn trawlers and freezer vessels operating in the prawn, lobster and barramundi fisheries carry out limited processing and freezing at sea. The prawn trawlers often block freeze the product at sea. Most of the vessels in domestic fleet are relatively old, and needs upgrading of most facilities including sanitary facilities.

3.2 IMPROVED LAND BASED FACILITIES SUCH AS COLD ROOMS, ICE PLANTS, FREEZER FACILITIES ETC.

Expansion in fish landings would inevitably need improved facilities to handle, chill and store the fish, including freezing facilities. Availability of ice is a necessary pre condition for all activities in the production sector. Most of the ice plants/cold rooms presently located at coastal centers are defunct. In this context, the present network of ice plants/cold rooms would need refurbishing (depending on the economics) and expansion. There has also been recommendations to lease the facilities at costal centers and lease money to be used to subsidize ice price for the small scale fishermen. and other ice users. Even at present a two tier system of pricing ice is being used at some costal plants; K1.50-2.50/15kg block for fishermen and K4.50-5.50/block for party use. However, it is interesting to note that even at centers where there is no such price difference, ex Koki market, the use of ice by fishermen is on the increase.

The expansion of the sector will also need improved transport/bulk handling and wholesaling facilities. Introduction of insulated trucks/reefer trucks would help efficient, safe transport of products to market centers and processing facilities. Present urban/municipal markets would need upgrading and the introduction of wholesale markets at suitable locations would need consideration. Previous studies have recommended that present fish wholesale markets (municipal markets) should be operated by private sector. These studies also have recommended that government owned coastal/municipal fish marketing sheds and equipment should be leased out and operated commercially.

In some countries, governments have taken a major role in providing investment for fisheries sector infrastructure expansion, with limited success. Alternatively, as recommended by some previous studies, this could be done by providing the suitable framework conditions that motivate the private sector to invest and be involved in the production, transporting and marketing, as well as providing supplies and services to the fishing industry.

3.3 EXPANSION OF THE PROCESSING SECTOR

Studies have forecasted a steady expansion of the domestic demand for fish and fishery products, exceeding 90,000 mt by the turn of the century (Table 12). This would inevitably involve a considerable expansion of the domestic processing sector which would involve setting up of new processing operations (ex. Madang tuna cannery) and expansion of existing facilities. On a conservative estimate the domestic commercial sector can be expected to create nearly 1,000 extra jobs in the processing sector over the next five years. Such jobs are expected to be created in new canneries to be set up, and in shore based operations in long line/purse seine fisheries and in prawn processing.

Considering the large amount of foreign exchange used in the import of fish and fishery products to supplement domestic production, import substitution has become one of the major policies of the government. Such action would not only curtail imports but would also provide employment. High raw material cost is a factor which makes domestic processing not so attractive, thus making the domestic market more dependent on imports. At least a partial solution for this situation could be seen in improved use of by-catch species.

Table 12 : Future Fish Demand Estimates for PNG 1990 - 2000 (mt)

Year	Subsistence	Traded	Total
1990	59 550	13 300	72 850
1991	60 750	18 850	74 600
1995	65 750	16 350	82 100
2000	72 600	20 100	92 700

Source: Agrodev (1991)

In Gulf of PNG waters, by-catch could be as high as 6-10 times the prawns caught in the trawl. Thus annual by-catch can be estimated at 10,000-15,000 mt. In the tuna fishery by-catch has been estimated to be over 5,000 mt per annum (Table 13). Most of the by-catch is often discarded at sea due to limited freezing and holding capacity on board. Mindful of the poor utilization of by-catch species (presently only 4 per cent is used), the authorities have taken steps to encourage improved utilization of the same through encouraging the recovery of relatively high valued marketable species and exploring methods of using other low-valued species for food/feed purposes. Certain by-catch species such as croaker, bream and some other white fleshed species can be used in the production of fish mince products such as fish ball, fish cake/sausage, fish burgers etc (Table 14).

Domestication of the fisheries sector would undoubtedly increase landings of high value species (prawn, lobster, tuna, barramundi, spanish mackerel etc) leading to an expansion of shore based operations in long line/purse seine fisheries and in processing.

Table 13 : By-catch Estimates in Tuna Fishery

projected tuna catch	=	**200 000 mt**
number of vessels in fishery	=	151
estimated number of sets	=	7 672
average no. sets per vessel	=	51
average catch per set	=	26.07 mt
average by-catch per set	=	0.73 mt
average by-catch per vessel per year	=	7.23 mt
projected total by-catch	=	**5 622 mt**

Source: Final Report of the ADB Project TA No. 2258 - PNG)

Table 14 : Potential for value addition and product development

Species	Products
skipjack/yellowfin (local market), tuna fillet (fresh/frozen), tuna burgers and tuna cakes (local market), smoked tuna, katsobushi, extractives etc.	sashimi, loining, canning, canned with black meat
shark (export and local market), shark cartilage, shark skin.	dried fins, canned shark fin products, shark meat fillet
fin fish	live, fillet/steak portioned and vacuum packed, dressed shrink wrapped.
shrimp and breaded (local market).	cooked and peeled, P&D, consumer packs, battered
lobster	head-on, popsicle pack.
by-catch meat	sausage, cake, fish fingers (local market and export).

3.4 HIGHER SKILL LEVELS IN THE PROCESSING SECTOR

Technical training needs of the fisheries sector should be adequately addressed to satisfy future industry requirements of trained manpower. In the past, National Fisheries College in Kavieng, which offered a two year course leading to a Certificate in Tropical Fisheries, figured prominently in catering for sector needs in trained manpower. Seafood Technology is one of the fifteen subjects taught under the certificate programme. NFC has produced about 30 certificate holders annually, out of which many have got gainful employment in the fisheries sector. However, with the proposed termination of regular programs at NFC, provision for obtaining advanced training in fish technology in the country will be limited.

Various private sector fisheries projects planned to be implemented during the next three year period are expected to create around 1,200-1,500 land based processing jobs, out of which at least 5 per cent (60-75) would need some advanced training in fish technology. Thus, re-introduction of a fish technology component into Food Technology courses at UNITECH (Applied Science Department) or University of PNG should be considered.

3.5 APPLICATION OF QUALITY ASSURANCE PROGRAMMES AND STRENGTHENING INSPECTION ACTIVITIES

Major importing countries have recently imposed on fishery products the requirements of a system called **"Hazard Analysis Critical Control Point"** (HACCP) which is presently recognized as the best system for ensuring safety and quality of food products. HACCP is internationally recommended by the Committee on Food Hygiene of the CODEX ALIMENTARIUS COMMISSION, a Joint FAO/WHO Food Standards Programme. HACCP is being disseminated worldwide through a number of training programmes and publications developed by FAO for its application by government and

fish industry of developing countries. When applied to fish production, the system is based on the recognition that health hazards (biological, chemical, physical) exist at various points of the fish production/distribution chain, but measures can be taken to control (prevent, eliminate, reduce) these hazards at specific points in the chain - the so-called "Critical control points" (CCPs).

Through the application of HACCP principles it is possible to cover a comprehensive range of safety, quality and economic integrity hazards. Additionally, HACCP may be used to reduce failure costs in the fish industry, including the reduction of post harvest losses. HACCP-based systems should be developed and applied by the industry and rely heavily on proper monitoring and record keeping by the industry, under government close supervision. HACCP-based quality management systems are unique: for each product, for each plant (fishing vessel, fish farm, fish retail shop, etc.), a different HACCP-plan, specifically designed and applied for that plant and that product should be implemented.

HACCP is now being introduced as a regulatory approach for the control of fish and fishery products in several industrialized countries including USA, Canada, European Union and Japan, as well as in leading fish producing and exporting countries such as Thailand, New Zealand, Chile, Norway and Iceland. Once established, the main effort of quality assurance is directed towards the Critical Control Points (CCPs) and away from endless final product testing. This will assure a much higher degree of safety and quality at lower cost.

The pending new sanitary and quality requirements of major fish importing countries, including the application of the HACCP concept by the government and industry sectors are already being enforced by the European Union since the first half of 1996 and will be imposed by USA from December 1997. For Papua New Guinea economy, this matter is extremely crucial and urgent and requires prompt action on the part of Government and Fish Industry. Therefore, this necessitates awareness of such developments and concerted action by government and industry to satisfy these foreign requirements and national needs. On the other hand, the matter would also require action and involvement of all groups, starting from the fishermen, fish suppliers/traders, factory operatives, factory supervisors, junior/senior management to planners and policy makers, both in government and industry.

With the expected introduction of HACCP-based quality assurance programmes by industry, government regulatory bodies would need to be prepared to perform their new role in a national seafood quality assurance programme. The new activities to be carried out by government inspection would concentrate in ensuring the correctness and efficiency of industry HACCP-based quality assurance plans, to guarantee that Good Manufacturing Practices (GMP) are used by processors, and the products exported are safe and wholesome.

Under the revised organizational structure of National Fisheries Authority, which has resulted in a total reduction of the staff strength from 222 to 168 as per the governments structural adjustment plan, Inspection and Enforcement branch will have a staff strength of ten. This would include seven technical posts; Fish Inspection (05 posts), Food Technology (2 posts) (Appendix 1). However, the sector needs for inspection has to be kept under constant review and appropriate measurers taken to strengthen inspection cadre if such action is felt needed.

4.0. CONCLUSIONS AND RECOMMENDATIONS

Aiming at strengthening quality control and inspection of fish and fishery products in Papua New Guinea, particular attention should be given to international recommendations made by the CODEX ALIMENTARIUS COMMISSION and the specific sanitary requirements imposed by major fish importing countries. Accordingly, there is an urgent need to design and implement a HACCP-based national quality assurance programme to be applied at government and private sector (industry) level.

Therefore, as a first step it will be necessary to review the existing rules dealing with inspection and quality assurance of fish and fishery products with the objective of making them at least "**equivalent**" to those of major fish importing countries - a basic request of those importing countries. In parallel with this work it will be needed to organize a national training programme mainly directed to transfer the HACCP-concept to all those involved in fish as food. The planning and implementation of these measures would require further international assistance.

Within this framework, some areas for prioritary actions were identified and a number of recommendations are made to be implemented in these areas. Follow-up action on recommendations given below needs efficient coordination and interaction with various government departments and international agencies. At the same time government staff would need constant guidance and direction in implementing the new programmes and activities. Hence priority should be given to filling the vacant post of NFA manager (Inspection and Enforcement) with a suitable candidate.

AREAS FOR PRIORITY ACTIONS

4.1 IMPLEMENTATION OF AN IMPORT INSPECTION SCHEME

At present there is no inspection of seafood imports. It has been reported that some of the imported brands of canned fish do not conform to international standards. Economic fraud (low drain weight) and poor product integrity (species substitution and inclusion of mixed species, use of sub-standard poor quality raw material, poor can integrity, lack of product information, shelf-life data etc) has been reported with some brands. Such products not only cause economic losses to the consumer, and the country as a whole, but also put the consumer at risk.

Hence speedy implementation of an import inspection scheme is of great importance. This inspection scheme should be based upon the HACCP-concept through the concentration of efforts in problem areas, i.e. those products imported from companies/countries with a past history of being of unsatisfactory quality and/or safety nature. Particular attention should be given to specific products that may represent a potential hazard to the health of consumers, e.g. mollusc bivalves, cold smoked fish, etc. The implementation of such a scheme can be carried out with very little expansion of the present cadre of inspection staff with some minor additional investment on equipment. It may be necessary for inspection staff to be gazetted as food inspectors under provisions in Food Sanitation Act No. 29, 1991 for the purpose. A charge may be levied on sampling and inspection to cover the costs involved.

(Vide Table 15 for basic cost breakdown).

4.2 STANDARDIZATION AND DOCUMENTATION OF SAMPLING AND TESTING PROCEDURES

There appears to be some flaws and ambiguities in the sampling and testing scheme presently adopted for seafood exports. Lack of documented information on guidelines and test methods to be adopted, can result in the application of incorrect, inconsistent practises of sampling and sample handling by field staff, resulting in loss of exporter confidence in the inspection scheme as a whole. The practise of occasionally allowing an exporter to submit his/her own samples to the laboratory for analysis could seriously compromise validity of test results.

The proposed stardization should once more be based on the HACCP-concept, i.e. concentrating efforts in problem areas. Therefore, sampling and testing procedures must be organized giving priority to those products which may represent a potential hazard to consumer's health. The frequency of product sampling and testing should also take into account the efficiency of the quality management programme of the producing establishment, i.e. those establishments with a HACCP-based quality management programme considered as efficient by NFA would have their products sampled and laboratory tested less frequent thant those considered less efficient by NFA.

Moreover, it is important to clearly identify and document information on method of sampling, quantity of samples to be collected for laboratory analysis, method of handling/transport of samples, standard test methods to be used etc to avoid malpractises and use of incorrect sampling and testing methodology.

4.3 IMPLEMENT A SCHEME FOR REGULAR INTERNAL AND EXTERNAL VALIDATION OF ANALYTICAL PROCEDURES

Internal and external validation of analytical procedures is a standard practise adopted by established testing laboratories to ensure reliability, consistency and validity of test methods used. Implementation of such a scheme linking the NFA Fish Laboratory with suitable national and international laboratories is recommended.

In this respect, accreditation of NFA Fish Laboratory under the proposed NISIT/PNGLAS (PNG laboratory accreditation scheme) laboratory accreditation plan can be recommended. Alternatively, the NFA laboratory may consider developing an independent laboratory validation scheme with suitable national laboratories such as Veterinary laboratory and National Chemistry Laboratory of the Department of Agriculture, Medical laboratory of Department of Health, National Analysis Laboratory (UNITECH) etc. National Association of Testing Laboratories (NATA), Australia could serve as a suitable foreign reference laboratory for the scheme.

4.4 IMPLEMENTATION OF A VESSEL/PLANT INSPECTION PROGRAMME

The present system of vessel/plant licensing relays on recommendations made by the inspector in charge of the area where the facility is located. There are no standard guidelines for use in the evaluation of the facility with respect to basic plant hygiene and sanitation requirements. The inspection arm of the National Fisheries Authority is now in the process of developing vessel and plant audit inspection schedules, based on Australian schemes and documentation. This is a necessary first step towards implementation of a satisfactory factory/vessel inspection programme. It is important for the scheme to be transparent, practical and constructive, in order to win the confidence and acceptance of the industry. However, it should be noted that

for plants/vessels already in operation, and for vessels in particular, falling in line with any new requirement/requirements will take time, and often, additional investment.

In order to strengthen the licensing scheme, it is recommended that an annual inspection scheme for licensing of the plant/vessel be followed by quarterly inspections, to ensure adherence of the facility to Good Manufacturing Practises and other specific hygiene and sanitation requirements. This is a necessary prerequisite for implementation of HACCP based production. Annual inspections should ideally be carried out by a team of (at least two) inspectors. It is also advisable to include a gazetted food inspector (*Food Sanitation Act*, para 8) in the team, at least in the initial stages of launching the revised programme, to give wider authority and acceptance for the scheme in industry circles.

(Vide Table 15 for basic cost breakdown)

4.5 SPEEDY RELEASE OF EXPORT CLEARANCE DOCUMENTATION

There appears to be a considerable delay in the release of export clearance documents, specially those related to shrimp and lobster shipments. Under the present scheme there are almost 6 documents to be perfected by the exporter, and a waiting period of anything up to 3 weeks to get clearance for export. Such delays would not only be an economic loss to the exporter, but could also result in the deterioration of product quality during prolonged storage.

It is necessary to speed up the process by minimising the documentation and reducing the time taken for the release of test reports. If properly organized, sample collection and conduct of basic microbiological tests and release of test report can be completed within 4 continuous working days. If there is parallel processing of export clearance documentation the whole process could be completed within one week, or a maximum of 10 days, even if there is an interruption of laboratory work due to intervening holidays. However, this will necessitate proper coordination of various activities undertaken by field/laboratory staff and HQ staff. Duties undertaken by laboratory staff during holidays could be compensated financially or by the provision of lieu leave.

4.6 ESTABLISH CLEARLY DEFINED ROLES FOR INSPECTION STAFF

The specific roles and functions of NFA inspection staff based in Port Moresby, NFA inspection staff in the provinces, and inspection staff appointed by provincial administration has not yet been clearly established. This has to be addressed early to enable smooth implementation and coordination of inspection activities in the country.

It is recommended that at each of the major centers of seafood export, an officer be identified to be fully responsible for inspection and quality control activities, in addition to normal duties entrusted to him. In locations where there are no officers from the center, an officer from the provincial set up may be appointed for the purpose. Centers such as Daru, Alotau, Lae, Wewak and Manus, from where highly perishable fresh/frozen products and live products are exported, should receive priority in this respect. Inspection staff should also work in close cooperation with surveillance staff in the collection of accurate data related to production, processing, exports, prices, infrastructure facilities etc. Such data and information would be important for identifying and planning strategies for quality assurance of seafood exports as well as domestic marketing.

4.7 IMPROVED LABORATORY FACILITIES

At present inspection branch seeks the assistance of the National Chemistry Laboratory for chemical analysis of fish samples. However, with the planned expansion of inspection activities, and the diversification and expansion of exports, it is necessary for the fisheries sector to build up its own capability to conduct at least some basic chemical analysis such as histamine, TVN/TVB, free chlorine, peroxide value etc. On the other hand, the planned expansion in by-catch utilization and domestication of the fishing industry, may require NFA to assist industry in product development/diversification activities.

These industry developments, and NFA's plan to set up a Pilot Plant for product development, would thus necessitate expansion of laboratory facilities to provide for sensory examinations and conduct storage trials on a wide variety of products. Due to high equipment and operational costs involved, it may not be feasible for NFA to set up its own facilities for advanced chemical analysis such as heavy metals, pesticides/agrochemicals, antibiotics etc, at this juncture. However, with the growth of export sector, and growing impact of agrochemicals and heavy metal contamination on the aquatic environment and its resources, it may become necessary to seek government or donor funding to set up and operate an advanced testing facility in the future, an issue which needs periodical evaluation.

(Vide Table 15 for basic cost breakdown)

4.8 NATIONAL TRAINING PROGRAMME IN FISH INSPECTION AND QUALITY CONTROL

Since the training activity undertaken by FAO in Kavieng in late 80s, there has not been any training programme dedicated to processing, inspection and quality control in the country. Several NFA staff who have got short term foreign training in fish technology are no more involved in related activities. Only limited exposure to fish technology is provided under annual JAICA programs conducted at UNITECH/UPNG.

Hence there is an urgent need to provide satisfactory training in fish technology to NFA inspection staff, with special emphasis on fish inspection and quality assurance. This could be done by a national training programme also open for participation by industry. In this respect a seeries of one/two weeks workshops with the participation of a maximum of 25 trainees, both from government and industry, can be recommended. The programme should be tailormade to satisfy specific training needs of NFA inspection staff and to set the stage for implementation of HACCP based production processes by industry. The programme should also address the training needs of provincial staff who play an important role in fish inspection and conducting extension activities.

This opportunity could also be used to conduct a one day industry seminar to introduce modern concepts of quality assurance and product marketing to policy makers, planners, senior government officials and industry. Regional and international bodies such as SPC, FAO/INFOFISH, USFDA (US), NMFS (US), EU (Brussels), DFO (Canada) could provide guidance and technical assistance for such programmes.

(Vide Table 15 for basic cost breakdown)

OTHER AREAS NEEDING ATTENTION

4.9 ADOPTION OF STANDARDS FOR IMPORTS AND EXPORTS OF FISH AND FISHERY PRODUCTS

At present there is no guidance on standards/specifications to be adopted for imports/exports of fish and fishery products. Regarding exports, when there is no specific quality requirements or product specifications from foreign importers, the inspection branch check seafood quality based on relevant Australian standards.

It is advisable to make necessary steps to identify specific,realistic national standards for fish and fishery products, starting immediately with major items of export/import to avoid the present ambiguity in standards to be used. For such an exercise there should be satisfactory participation from relevant government institutions such as National Institute of Standards and Industrial Technology (NISIT), National Fisheries Authority, Department of Health, Veterinary Laboratory as well as industry. Such a committee may decide to adopt an existing foreign standard in toto or decide to adopt such a standard with appropriate modifications, or to develop own national standards.

4.10 FACILITATE IMPROVED INTERACTION OF INSPECTION STAFF WITH INDUSTRY

At present there is limited interaction of inspection staff, especially those based in Port Moresby, with industry. Most of the land based processing facilities are located outside Port Moresby while sampling and inspection of vessels are done by the field staff. As a result there appears to be lack of indepth knowledge and understanding of industry practises among the inspection staff based in Port Moresby.

It is recommended that all inspection staff be given industry exposure through special field assignments, rotation of staff in vessel/factory inspection panels, rotation of duties/duty stations where practical etc.

4.11 IMPROVED ACCESS TO INFORMATION AND PUBLICATIONS

Access to even basic information related to handling, processing, marketing and quality control is lacking in the country. Even the fisheries library at Kanudi has very little information in these areas. Most of the material at Kanudi too is research/management in nature. Same applies to libraries at UPNG and UNITECH, where most of the material is academic and research oriented, and does not serve as a source of information on modern technical/industry developments.

Hence, either upgrading the Kanudi facility, or preferably setting up a separate central repository of processing/marketing information is of great importance to keep the NFA staff aware of global industry developments. The facility should take the form of a reference library, with a continuous supply of magazines, journals, periodicals, news letters, project documents etc. Regional and international agencies such as SPC, FAO, INFOFISH, NMFS (US), USFDA (US), DFO (Canada), ODNRI (UK), ITC (GENEVA), EU (Brussels), ISO, UNIDO (Geneva), NATA (Australia) etc are good sources of valuable information on inspection and quality control.

Good accessibility is an important criterion (hence location at NFA office) to be considered in identifying a suitable location for the proposed facility. Ideally, it should also be open to industry, academia, students and interested members of the public.

The unit should have an efficient record keeping system for receipts of publications from various national/international sources, as well as staff lendings/returns. Useful material often get misplaced or mis-directed. Lack of an efficient scheme has limited staff/industry access to some valuable sources of information.

(Vide Table 15 for basic cost breakdown)

4.12 INCLUSION OF A FISH TECHNOLOGY COMPONENT IN DEGREE PROGRAMMES

Fish technology has been a component of degree programme in fisheries at Agriculture University (UNITECH), Lae up to 1985 and at UPNG during from 1985-1989. It is also included in the two year diploma course of the National Fisheries College (NFC), Kavieng. With the proposed termination of regular programs at NFC, there will not be provision for obtaining advanced training in fish technology in the country. Various private sector fisheries projects planned to be implemented during the next three year period are expected to create around 1,000-1,500 land based processing jobs, out of which at least 5 per cent (60-75) would need some advanced training in fish technology.

Thus, re-introduction of a fish technology component in to Food Technology courses at UNITECH (Applied Science Department) or University of PNG should be considered.

The main cost components of such an exercise would be staff cost and equipment/operational costs. Basic practical work could be undertaken jointly at UNITECH food technology pilot plant/laboratory, Fish Microbiology lab at Kilakila and NFA pilot plant to be set up at Kilakila. UNITECH has contributed significantly in the past in fish technology programmes and product development work. It is recommended that fish processing equipment idling at UPNG (worth over K250,000) be transferred to Kilakila for pilot production work. Alternatively, if fish technology is reintroduced at UPNG degree programmes, facilities at Kilakila could be used for practical work.

Industry needs of junior management/supervisory staff with training in processing technology could be addressed by the introduction of a short-term (6-9 month) certificate programme at NFC.

4.13 COLLECTION OF STATISTICS ON PROCESSING AND MARKETING

Access to even basic information related to domestic production (products/quantities/seasonality), marketing(prices/buyers/markets), services and infrastructure (ice plants, freezing/cold room facilities/shore based facilities and staffing), etc are lacking or limited. This is a serious constraint in planning strategies for sector development and quantifying investment needs. Most of the limited documented information needs updating.

Hence it is important to take necessary steps to build up a data basis on such information. Such an exercise could be carried out using a carefully structured questionnaire, to be perfected by provincial NFA staff, with inputs from industry where applicable.

4.14 DEVELOPMENTAL RESEARCH AND SURVEY ACTIVITIES

Technically qualified staff in the inspection branch should be encouraged to conduct developmental research/survey activities, where necessary, in association with local or foreign universities, without compromising their official duties. The studies on heavy metal contamination of fish, microbiology of coastal waters, impact of agrochemicals on safety of inland fish, appropriate fish smoking technology, product development using by-catch species, packaging of fishery products etc are some study areas relevant to PNG industry.

It is recommended that such studies be encouraged. This could be used as project work in registering for post-graduate programmes at local/foreign universities (split programs), providing career development prospects for staff.

Table 15 : BASIC COST BREAKDOWN WITH RESPECT TO IMPLEMENTING RECOMMENDATIONS
(capital cost + operational costs for three years)

NB: Assessed based on present industry requirements

RECOMMENDATION 4.1 *(Import Inspection)*

Item	**Cost**
Minor equipment*	5,000
Expendables	5,000
Additional staff (01) X 36 months	75,000
Testing charges - regional laboratory (1000 samples)	21,000
Travel and transport	5,000
Documentation, reporting and secretarial (apportioned)	30,000
Miscellaneous	10,000
Total	***151,000***

* vacuum gauge, can cutter, seam tester, strainer, magnifier weighing scale etc.

RECOMMENDATION 4.4 (Factory/vessel inspection)

Item	Cost
Minor equipment*	4,000
Consumables	5,000
Travel/transport cost	15,000
Documentation, reporting and secretarial (apportioned)	20,000
Miscellaneous	8,000
Total	***52,000***

* digital temperature probes, chlorine tester and other minor equipment

RECOMMENDATION 4.7 (Improved laboratory facilities)

Item	Cost
Equipment*	30,000
Consumables	15,000
Travel/transport cost	9,000
Documentation, reporting and secretarial (apportioned)	15,000
Miscellaneous	15,000
Total	***84,000***

* muffle furnace, homogeniser, grinder, screw press, digestion and distillation unit, Conway's unit, spectrophotometer, vacuum pump, measuring equipment, vacuum packing/nitrogen flushing machine etc.

RECOMMENDATION 4.8 (National Workshop and Industry Seminar)

Item	Cost
International resource persons (03)	
Travel (@ 2200 X 2; @1200 X 1)	5,600
DSA (US$ 207 X 3 X 12 days)	7,450
Internal travel	2,100
Industry seminar	5,000
National resource persons, field visits, venue etc	7,000
Documentation, reporting and secretarial	5,000
Miscellaneous	3,000
Total	***35,150***

***RECOMMENDATION 4.11** (Information center)*

Item	Cost
Subscription/purchases (3 years)	45,000
Computer and software	15,000
Communication/postage	5,000
Documentation, reporting and secretarial (apportioned)	20,000
Miscellaneous	6,000
Total	***91,000***

PERSONS MET

NATIONAL FISHERIES AUTHORITY

1. Mr Dennis Renton
   Executive Director
   National Fisheries Authority

2. Mr Tatek Buraik
   Executive Manager
   Planning & Corproate Services
   National Fisheries Authority

3. Mr Joel Opnai
   Executive Manager
   Fisheries Management and Industrial Supplies
   National Fisheries Authority
   Kanudi

4. Mr Kenny Leana
   Executive Manager
   Licensing, Surveying & Enforcement
   National Fisheries Authority

5. Mr Louis Aitsi
   Manager
   Provincial Liason
   National Fisheries Authority
   Kanudi

6. Mr N Rajeswaran
   Principal Fisheries Inspector
   (Food Technologist)

7. Mr John Timothy
Principal Fisheries Inspector
National Fisheries Authority

8. Ms Aquina Kango
Senior Food Technologist
National Fisheries Authority

9. Mr Ambrose Andre
Senior Food Technologist
National Fisheries Authority

GOVERNMENT DEPARTMENT

1. Mr Ronald Paita
Principal Quality Assurance Officer
National Institute of Standards & Industrial Technology

2. Ms Mary Karo
Technical Officer
National Chemistry Laboratory
Ministry of Agriculture and Livestock
Kilakila

3. Mr David Kanawi
Chief Agriculture Quarantine Officer
Agriculture Protection Division
Department of Agriculture and Livestock

4. Mr Paul Iramu
Manager, Revenue Operations
Customs Operations
Internal Revenue Commission

5. Prof. K Patil
Pathologist
Government Hospital
Lae

6. Mr Ian Onaga
Acting Chief
Veterinary Laboratory
Kilakila

7. Dr Ilagi Puana
(Pathologist)
Acting Chief Veterinary Officer
Quarantine Division
Department of Agriculture and Livestock

PRIVATE SECTOR ESTABLISHMENTS & REGIONAL FISHERIES CENTERS

1. Mr Maurice J Brownjohn
Chairman
Fishing Industry Association

2. Mr Kazuaki Hidaka
Managing Director
New Guinea Marine Products Pty Ltd
Port Moresby

3. Mr Fred Grieshaber
Chief Chemist
National Analysis Laboratory
Papua New Guinea University of Technology
Lae

4. Mr Buckley Kaupa
Provincial Fisheries Officer/Fish Inspector
Coastal Fisheries Development Project/GTZ Project
Lae

5. Mr K P Pradeep
Production Manager
International Food Corporation Pty Ltd
(Mackerel cannery)
Lae

6. Ms Didia
Quality Control Officer
International Food Corporation Pty Ltd
(Mackerel cannery)
Lae

7. Mr Kaukesa Sawanga
Marketing Manager
Coastal Fisheries Development Project/GTZ Project
Lae

8. Ms Betty Higgins
Lake Piundi Fish Farm
Mt Willhem (Chimbu)

9. Manager
Nupaha Fish Farm
Goroka

10. Mr Dennis Wallong Kalinau
Project Manager
East Sepik Youth Fisheries (UNDP Project)
Wewak

11. Mr Nick Artekain
Project Manager
Wewak Coastal Fisheries Project
Wewak

12. Mr Mathew Watson
Shipping Manager
Sepik Coastal Agencies Pty Ltd
Wewak

13. Me Casper Kwuaindu
Boarding Officer
Sepik Coastal Agencies Pty Ltd
Wewak

14. Mr John Brugman
General Manager
Sepik Coastal Agencies Pty Ltd
Wewak

15. Master Fisherman
Jih Yu 812 purse seiner
Taiwan

REFERENCE DOCUMENTS

Agrodev(1991), Fisheries and Coastal Resource Management and Development Project, PNG. Final Report. Technical Assistance No.1306-PNG, Asian Development Bank, Manila, Philippines.

ADB Technical Assistance No.2022-PNG, Working Paper No.2 - Report of the Training Specialist (February 1995).

ADB Technical Assistance No. 2022-PNG, Working Paper No.4 - Report of the Organization and Management Specialist (February 1995).

ADB Technical Assistance No. 2258-PNG, Fisheries Management Project Feasibility Study, Final Report (December 1995).

Circular No. 7/96 of National Fisheries Authority, Office of the Executive Director.

Food Sanitation Act, Independent State of Papua New Guinea, Act No. 29 of 1991.

Fisheries Act, Independent State of Papua New Guinea, Act No. 21 of 1994.

Fisheries Regulations, Independent State of Papua New Guinea, Statutory Instrument No. 2 of 1995

Ian Ini Onaga (1993), The total mercury concentration in fish from certain southern coastal waters and North Solomons province of Papua New Guinea, Papua New Guinea Journal of Agriculture, Forestry and Fisheries, 1993, Vol. 36 No. 2 pp 22-28.

International Trade Statistics (Imports), National Statistical Office, 1990.

Kolkolo, U. (1996), Papua New Guinea Country Statement presented at the Investment Seminar, INFOFISH AQUATECH '96, Kuala Lumpur, Malaysia.

National Institute of Standards and Industrial Technology Act, Independant State of Papua New Guinea, Act No. 21 of 1993.

UNDP (1989), Fisheries Sector Review. Papua New Guinea Final Report, January 1989. Project: PNG/88/004/A/01/31. UNDP Report for Government of PNG, 110 p.