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19 November 1987
ENGLISH

ASSISTANCE TO THE PALAU FISHING AUTHORITY IN THE REHABILITATION OF FISH SMOKING PLANT

SI/TTR/87/801/11-01

TRUST TERRITORY - REPUBLIC OF PALAU

Technical report: Assistance to fish processing industry *

Prepared for the Government of the Trust Territory - Republic of Palau by the United Nations Industrial Development Organization, acting as executing agency for the United Nations Development Programme

Based on the work of Munehiro Shimada,
fish processing expert

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United Nations Industrial Development Organization

Vienna

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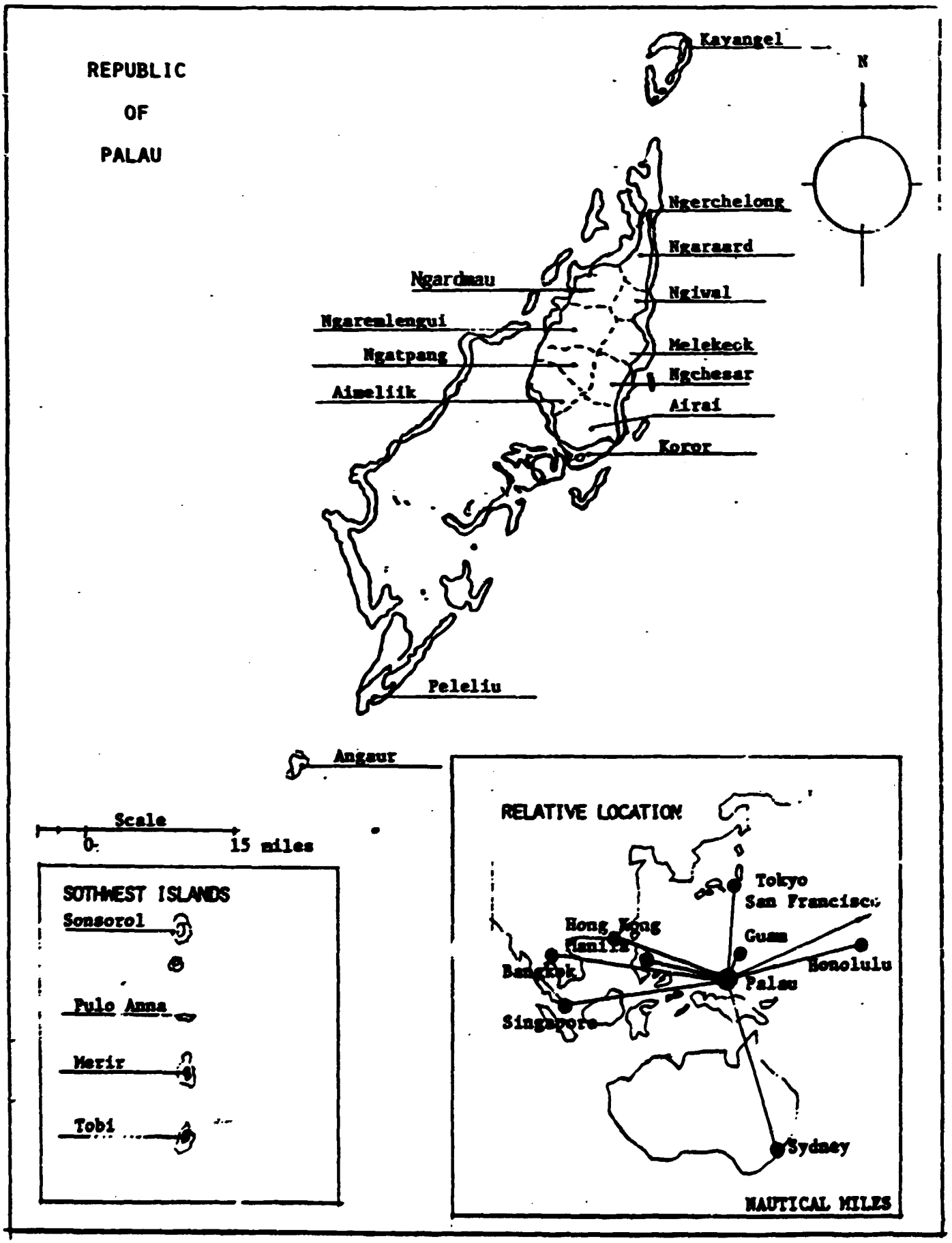
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NAUTICAL MILES

Symbols, units of measurement and abbreviations

Symbols:

#	=	Number
-	=	Nil or less than half the unit used
$	=	United States Dollar
..	=	Not available
%	=	Percentage
$'000	=	In Thousands of U.S. dollars
°F	=	Degrees Farenheit
°C	=	Degrees Celcius

Units of Measurement

Weight:

1	ounce	=	0.028350	kilogram	=	28.350	gram
35.27396	ounce	=	1	kilogram	=	1,000	gram
1	pound	=	0.453592	kilogram	=	453.592	gram
2.20463	pound	=	1	kilogram	=	1,000	gram
1	short ton	=	0.907184	metric ton	=	907.184	kilogram
1.102311	short ton	=	1	metric ton	=	1,000	kilogram
1	long ton	=	1.016047	metric ton	=	1,016.047	kilogram
0.984207	long ton	=	1	metric ton	=	1,000	kilogram

Length:

1	inch	=	2.54	centimeter	=	0.0254	meter
0.3937	inch	=	1	centimeter	=	0.01	meter
1	foot	=	30.48	centimeter	=	0.3048	meter
3.28084	feet	=	100	centimeter	=	1	meter
1	yard	=	90.44	centimeter	=	0.9144	meter
1.093613	yard	=	100	centimeter	=	1	meter
1	statute mile	=	1,609.344	meter	=	1.609344	kilometer
0.621371	statute mile	=	1,000	meter	=	1	kilometer
1	nautical mile	=	1,853.184	meter	=	1.853184	kilometer
0.539612	nautical mile	=	1,000	meter	=	1	kilometer

Area:

1	square foot	=	.0929	square meter	
10.7639	square feet	=	1	square meter	
1	acre	=	0.4047	hectare	= 0.004047 square kilometer
2.4710	acre	=	1	hectare	= 0.01 square kilometer
1	square mile	=	259.0	hectare	= 2.590 square kilometer
0.38610	square mile	=	100	hectare	= 1 square kilometer

Capacity:

1	gallon (U.S.)	=	3.7854	liter
0.26417	gallon (U.S.)	=	1	liter

Temperature:

° Celcius = $\frac{(°\text{Farenheit} - 32) \times 5}{9}$

° Farenheit = $\frac{(°\text{Celcius}) \times 9}{5} + 32$

Abbreviations:

Av.	=	Average
CIP	=	Capital Improvement Project
Cont.	=	Containers
DOI	=	Department of Interior
DUI	=	Drunk Under Influence of Drugs
DWI	=	Driving While Intoxicated
Dz.	=	Dozens
Ea.	=	Each
F	=	Female
FCL	=	Full Container Load
Fy	=	Fiscal Year
Gals.	=	Gallons
Gn	=	Graduate Nurse
H/hold	=	Household
Lb.	=	Pound
LCL	=	Less than Full Container Head
M.	=	Male
Max.	=	Maximum
Micro.	=	Micronesian

Min.	=	Minimum
MOC	=	Micronesian Occupational College
N.e.s.	=	Not Elsewhere Specified
No.	=	Number
N.s.	=	Not Specified
Pass.	=	Passengers
Pcs.	=	Pieces
POL	=	Petroleum, Oil and Lubricant.
Qty.	=	Quantity
r	=	Revised
Rn	=	Registered Nurse
SDA	=	Seventh-Day Adventist
SITC (Rev. 2)	=	Standard International Trade Classification, Revision 2
Sq. Miles	=	Square Miles
Temp.	=	Temperature
TT/TTPI	=	Trust Territory of the Pacific Islands
U.S.A.	=	United States of America
Vol.	=	Volume
spp	=	species
PFA	=	Palau Fishing Authority
PFFA	=	Palau Federation fo Fishing Associations
MNR	=	Ministry of National Resources
MMDC	=	Micronesian Mariculture Demonstration Center
PMA	=	Palau Maritime Authority

ACKNOWLEDGEMENT

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To all these individuals and others who contributed warmest assistance for this work but are not mentioned here, my sincere appreciation is expressed.

Munehiro Shimada

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I. Introduction

The Republic of Palau is situated within an area recognized as rich fishing grounds for pelagic fish, bottom fish, and shellfish. Coastal fisheries in Palau supply abundant fish to its local market. Palau Fishing Authority and Palau Federation of Fishing Associations play key roles in fish marketing to local consumers and also fish export. However, mainly due to limited local market and concentrated fish landings in good fishing periods/seasons, there occurs excess fish unsold in PFA/PFFA. PFA/PFFA usually store these excess fish in frozen form, some of which must be disposed of after long storage. PFA/PFFA has seeked the ways to utilize these excess fish as processed fish such as smoked fish, dried fish, etc. with using its existing smoking machine.

The Government of Palau has requested UNIDO to provide technical assistance to assist PFA to rehabilitate the existing fish smoking machine and to identify the appropriate forms of fish processing for excess fish stock.

Consequently, UNIDO fielded fish processing expert, Mr. M. SHIMADA for these purposes. He stayed in Palau from 30, Aug. to 22, Sep., 1987 and reviewed fisheries sector especially in fish processing, assisted rehabilitation of the existing smoking machine, assisted trial fish processing and studied viability for fish processing. This report includes those review, summary of his activities, viability study, conclusions, and recommendations.

II. BACKGROUND

2.1 General

2.1.1 Geography

The Republic of Palau comprising more than two hundred islands forms an archipelago in the far western corner of the north Pacific Ocean between 2 degrees and 8 degrees north latitude and 131 degrees and 135 degrees east longtitude. The islands covering an area of 170.4 square miles include four types of geological formation; volcanic, high limestone, low platform, and coral atoll formations. Babelthaup, the largest island occupying four-fifths of the total land area, Arakabesang, Malakal, the west part of Koror, as well as a number of small neighboring islands in the northern half of the Palau reef are of volcanic origin. The Rock islands consist of limestones. Peleliu and Angaur are low platform and reef islands. The Southwest Islands are made up of reef flats resulting from geological uplift. Kayangel, located 28 miles north of Babelthaup, is a classic coral atoll. The climate in Palau is maritime tropical characterized by little seasonal and diurnal variation with annual mean temperature of 82°F. Diurnal variation in temperature is about 10°F. Heavy rainfall occurs from May to January, with June and July maximum. A slightly drier period extends from February to April. The short but torrential nature of the rainfall results in over 150 inches of precipitation annually.

2.1.2. Population

The population in Palau increased rapidly in the 1950's and 1960's from 7,726 in 1957 to 12,473 in 1973. Since 1970's a decline in the annual population growth rate occured. A preliminary count based on a census carried out in March 1986 shows that the current population of Palau is 13,772, reflecting annual population rate of 0.7% since 1973. (Table 2-1-1 and 2-1-2)

2.1.3 Economy

The economic structure in Palau indicates a high level of private and GOvernment consumption relative to gross domestic product, a high propensity to import and a low propensity to export. The economy is characterized by a small production base and a weak productive capacity, primarily due to limited natural resources, shortage of skilled manpower, and limited domestic market growth. Gross domestic product (GDP) of Palau in 1983 is measured as $31,580,000

in terms of money values of all goods and services produced by resident individuals, business enterprises, cooperatives, government and non-government organizations with including estimation of non-market production in the subsistence economy based on a detailed analysis of the 1980 Agriculture census of the Trust Territory of the Pacific Islands. The predominant sector of the economy is the services sector which contributes 64% of the GDP in 1983. Within the services sector the Government Administration dominates with a contribution of 36.9% to GDP, followed by trade, 16.6%. Agriculture and fishing are mainly of subsistence nature and contributed 9.8% and 7% respectively. The contribution of manufacturing in the industrial sector is almost negligible, and most of the activities in this sector are construction activities. (Table 2-1-3 and 2-1-4)

2.1.4 Trade

External trade in Palau is dominated by imports of merchandise goods ranging from foodstuffs to construction materials and equipment. Total exports amount to a negligible proportion of external trade, resulting in a large negative trade balance.

Table 2-1-5 shows private commercial sector merchandise imports and exports, which indicates a large negative trade balance. The export of goods did not change by any significant amount between 1979 and 1984 except for fish exports which probably declined by about $2.0 million in 1983, following the closure of Van Camp Company's fishing operations in 1982.

Fishery products including fish and trochus shell play an essential role in the external exports of Palau even after closure of Van Camp operation. In 1984, exports of fresh or frozen fish recorded $125,000 and $173,000 for trochus shell exports. Export destinations of fresh and frozen fish concentrated to Guam and Saipan. Trochus shell is mainly exported to Japan. The other major export item is wooden handicraft. (Table 2-1-6)

Imports are demarcated into private commercial sector imports and Government imports. The private commercial sector imports comprise goods that are imported for use by both households and the Government. Its structure shows that foodstuffs, beverages, and tobacco dominate the import bill, accounting for 40.2% of commercial imports in 1983 and 27.8% in 1984. Almost half of the imported foodstuffs comprises meat and cereals. However, fishery products such as canned fish are also included in the major imported items. (Table 2-1-7)

Other than private sector imports, the Government directly imports goods such as fuel for power plants, the Government own vehicles/boats for non-commercial purposes. (Table 2-1-8)

2.2 Fisheries Sector

2.2.1 Fisheries

Fisheries in Palau are mainly demarcated into coastal fisheries and offshore fisheries. The coastal fisheries are commonly conducted on the fishing grounds in the lagoon area of about 1,455 Km^2 surrounded by the long reef of about 400 Km. Artisanal coastal fishing is also conducted in Peleliu and Angaur Islands and South West Islands. These coastal fisheries based on subsistence or semi-subsistence activities in the villages, however fish marketing to Koror through fishermen's cooperatives has been developed.

Offshore fishing for pelagic species, especially tuna kinds fish, is conducted primarily by foreign vessels which must pay the Republic of Palau for fishing licenses. Revenues realized from this source totaled about $375,000 in 1983 and $365,000 in 1984. In addition to these foreign vessels, one locally owned and operated pole and liner (23 gt, 200 HP) supplies fresh tunas for domestic consumption.

Fishing for commercial button shell, trochus, is a seasonally significant source of revenue for many local fishermen. Average annual catches during June collecting season range from 100 to 300 tons, with a dockside value of $60,000 to $180,000.

2.2.2 Fishery related organizations

National Government agencies concerned with marine resource exploitation and development include the Ministry of Natural Resources and the Ministry of State.

Within the Ministry of State, the Palau Maritime Authority is responsible for negotiating and issuing fishing licenses to foreign entities, and also responsible for development, conservation and management of migrating species of fish within both the territorial seas and the 200 mile fishing zone.

The Ministry of Natural Resources includes the Bureau of Resources and Development, which directs the activities of the Division of Marine Resources and the Micronesian Mariculture Demonstration Center. The main functions of the Marine Resources Division includes transfer of fisheries technology, advisory services, statistical monitoring and technical support to fishermen.

A fishermen's cooperative, the Palau Federation of Fishing Associations, was established in 1975 to offer shoreside facilities and services to local fishermen. PFFA suffered financial losses and was declared insolvent in 1982. In 1983 the PFFA was taken over by the National Government, and is currently managed as a quasi-government agency by the Palau Fishing Authority, a non-profit corporation.

2.2.3 Fishery Production

Precise data on total landings and marine products are generally lacking mainly due to incompletion of data collecting system for subsistence fishing and direct landings to private retailers/processors/consumers other than the Palau Federation of Fishing Association (PFFA). According to the existing fish landing data, PFFA's fish purchase records, 215 tons of fish of value of $199,000 was purchased and landed at PFFA and in 1984 this increased to 287 tons, or $272,000. (Table 2-2-1 ,2-2-2) There is another estimation of fish production which indicates that about 2,000 tons of fish is yielded by coastal fisheries inside reef, 700 to 800 tons of the catch are marketed in domestic market and for exports and the remaining 1,200 to 1,300 tons of the catch are consumed by the fishermen and in their villages.

Numbers of fishermen is estimated 400 to 500 persons including 195 of full-time fishermen and other part-time fishermen. Their major target species are bottom fish such as snappers, groupers, parrot fish, rabbit fish, unicorn fish and pelagic fish such as skipjack, yellowfin tuna, dolphin fish. Mangrove crabs and lobsters are also their valuable targets.

Inland or brackish water fisheries are not well developed in Palau. Some quantity of milkfish is landed to PFFA by fishermen from Ngatpang.

In aquaculture, the Micronesian Mariculture Demonstration Center (MMDC) plays a key role in mariculture research and development especially for giant clams and turtles. MMDC also conducts trial hatching of fresh water prawn, Macrobracum. Two culture ponds for Macrobracum are constructed by private investors. Since its establishment in 1973, MMDC has produced 700,000 pieces (equivalent 30 tons of biomass) of seed clams, which have been distributed to twelve countries in the South Pacific area for experimental culture activities.

2.2.4 Fishing Activities

1. Fishing Fleet

Major part of fishing fleet of Palau consists of outboard engine fishing boats which are of 5 to 8m in length and equip 50 to 120 HP of outboard engines. These boats are usually used for fishing and transpoctation purposes. GRP or wooden inboard engine fishing boats equipped with 12-70 HP engines also play key roles in coastal fisheries in Palau. Total number is less than that of outboard engine boats. These boats include eleven GRP boats (11m in length, 70 HP, 3.2 gt) supplied by Japanese fisheries grant aid project in 1982. The Palau Fishing Authority (PFA) holds property of these GRP boats and lends them to local fishermen. Fish landing by these boats to PFFA contributes much to PFFA total fish purchase.

In addition, there is one big fishing vessel in operation, GRP made pole and liner of 23 gt and with 200 HP engine. The Marine Resource Division (MRD) estimates totally 120 fishing boats and vessels in operation for fishing activities. Other than these motor powered fishing fleet, fishing by bamboo rafts and traditional canoes still exists, but its roles are getting smaller. However, in Angaur bottom fishing by canoes is recognized as a suitable way in comparison with fishing by motor powered boats because canoes are easier to be settled at good fishing point by paddling rather than anchoring in motor powered boats.

2. Fishing Technique

Fishing techniques in Palau use for substantial level fishing range from simple collecting of sea cucumbers, sea urchins, clams, and other species at low tide, often by women and children, to hook and line fishing, underwater spearfishing, cast net fishing and trolling conducted almost exclusively by men. Skipjack pole and line fishing is conducted in offshore fishing.

2.2.5 Infrastucture

Malakal fishing port located in Malakal island adjacent to Koror island is the biggest landing place with relative facilities of block ice and plate ice plant, fish wholesaler area, cold storage and freezing plant. PFA and PFFA main office locate in this port.

Major local landing sites locate in Peleliu, Kayangel, Ngatpang, Ngeremlengui, Ollei and Ngaraard. These landing sites generally consist of landing jetty, fuel supply facility and flake ice plant (1 ton/day). However, most of those flake ice machine are in trouble.

2.2.6 Fish Marketing

Palauan fish consuming styles are based on common customs seen in a tropical area. They take fish as baked form, smoked form, dried form, and fish soup. However, they also take sashimi style fish (raw fish eating) with soy sauce and some seasonings such as kinerau and horse radish. This style is seemed to be originated from Japanese customs in Japanese mandate period.

Mainly because of lack of retailers' facilities for frozen fish, sashimi eating customs and limited marketing range both in village and town area, fish is marketed in fresh form basically in a domestic market. Some frozen fish is marketed to small scale processors for fried and smoked fish processing in poor fishing seasons. In Palau, there exists no fish wholesale market. PFFA plays an important role in fish marketing as wholesaler cum retailer in Koror and adjacent islands, where more than 60% of population is concentrated. PFFA purchase fish both from its member fishermen and the others. However, undersize fish (less than about 12cm), damaged fish, and non-marketable fish species are rejected for purchase. PFFA sells purchased fish in its retail space to local consumers, private fish processors, processors cum retailer, retailers, hotels, and restaurants mainly in fresh form. In poor fishing season and period, PFFA sells its frozen stock of good fishing season or period mainly to fried fish processors, restaurants and hotels. Fish handling of PFFA has been growing since its establishment. In 1986, PFFA purchased 295 tons of fish and sold 155.5 tons in a local market. (Table 2-2-1, 2-2-2 , 2-2-3). Though PFFA's fish purchase and sales prices have beer adjusted in its management, at the time of this study PFFA marketed fish by demarcating fish into three groups in accordance with Palauan preference and marketing conditions. (Table 2-2-4, 2-2-5). Major fish purchased by PFFA are snapper, parrot fish followed by rabbit fish, grouper, unicorn fish, jack and skipjack. These are also common fish in coastal fisheries in Palau. Market preference exists on most of these fish species. However, preference for some species of red snapper and grouper seems to be relatively low. As fish is sold by weight, customers select larger size of fish in consideration of ratio of edible portion against whole fish weight. PFFA's fish stock remained unsold amounted to 84.5 tons in 1986. According to PFFA, major portion of this stock consist of grouper (mainly Epinephelus sp., Plectropoma sp.), red snapper (mainly Lutjanus bohar), small size (less than 25cm) of blue parrot fish and white snapper. Skipjack is also included in this unsold stock because its production is concentrated seasonally due to its migrant habit and availability of bait fish for fishing. Other than PFFA fish marketing,

fishermen sell fish directly to their customers such as retailers, restaurants, hotels, fish processors, etc. There are around five fish retail shops in Koror. Some of them deal fish occasionally. Retail spaces of these shops are smaller than that of PFFA. Including PFFA, these retailers commonly display fish in ice slurry water.

In local islands, fishermen distribute fish in their village ranges. Detailed fish marketing data by these private retailers and local fishermen are not available.

PFFA also plays a key role in fish export. PFFA exports fish by himself and often assists persons who buy fish in a PFFA retail shop for export. PFFA export handling including these two dealings amounted to 74 tons or 77% of total fish export of 95.8 tons in 1984. (Table 2-2-6). Exported fish is put in a plastic bag and packed in an insulated polystylene container with covering ice. Destinations of export are concentrated to Guam and Saipan. In 1984, 61.7% of total export were for Guam and 33.2% for Saipan. (Table 2-2-7)

2-2-7 Fish Procesing

Fish processing in Palau is conducted in small scale. There are one smoked skipjack processing factory and freezing facilities of Palau International Traders Incorporated. However, the former is not well operated and the latter has just iniated re-operation. Other than fish processing plant, trochus shell processing factory is operated periodically.

Fish is mainly processed at a retail stage in fried and smoked form by small scale processors or retailer cum processors. For smoking fish, processors use hand made traditional smoking kiln and small smoking house. The smoking kiln is commonly made by second-hand drum cans, steel nets and galvanized iron plate. Typical kiln has smoking capacity of 15 to 30 lbs. per one process cycle. Large size smoking house affords to smoke 90 lbs. of fish per cycle. Local pine trees and mangroves are prefered as smoking wood. However, the other woods are also used because smoking wood is not marketed and processors often feel difficulty and time-consuming to get wood by themselves. Various species of fish are smoked. According to one of major processors, market preference exist on grouper, snapper, blue parrot fish, unicorn fish and yellow fin tuna. Processors usually smoke larger size of fish mainly because smoked fish is sold by weight at retail price from $1.75 to 2.50/lbs. Smaller size fish is utilized in frying processing considering difference in weight loss by processing. However, many processors mention that there is good preference to smoked fish and one of the major processors mentions that at least 50 lbs. of smoked fish can be sold to his

customers. He also processed 100 to 150 lbs. of fried fish daily when material is available. Thre is good smoked fish sales in the evening and in the morning just before international flights departure to Guam area because people prefer to take smoked fish as good souvenirs.

As typical smoking procedures, skipjack and tunas are boiled in seawater or solution of salt and smoked in 3 to 4 hours in a hot smoking way probably more than 175°F. This processing procedures seem to be originated from Japanese arabush processing (one kind of forms of smoked skipjack processing). Small size (about 25cm in length) of skipjack is smoked in gill & gutted form. Large size of skipjack and tunas are filleted into two or four blocks and smoked. The other species are commonly slightly salted and smoked in 3 to 4 hours in a hot smoking way. Small size is split open and smoked and larger size is cut into several blocks. The smoked products are of hard dried products probably with moisture contents less than 30%. The processors generally don't use any kinds of food preservatives, additives, and colorants.

Some processors continue this processing throughout the year and many ones join this business when good material for smoking is available easily. Total smoked fish production cannot be estimated due to limited data available.

III. Summary of Activities

3.1 The existing Smoking Machine

The existing smoking machine, Enviro-Pac Type CSU-1E, was installed in 1980 by MRD. This machine is designed for total processing from steam cooking, water rinsing, drying or smoking by combination processing the attached smoke generator and boiler. The processing procedures are designed to be controlled by manual and automatically. Main component is a drier/smoker of electric heaters and air blowers. Attached boiler supplys steam for material cooking through connection lines. Attached smoke generator supplys smoke made by electric smoking wood chips or sawdust (Appendix I)

The machine was used in 1985 by PFA for simple smoking fish. However, usage before 1985 was not confirmed due to no report remaining.

In respect of present conditions of the machine, the major components of the machine such as drying machine and smoke generator are still useful in fish processing operation if adequate repair and check/test are conducted. (Appendix II) However, steam supply boiler may not be used. Much corrosion damaged its body inside and outside. Many electric connection points seem to be damaged. Detail points of damage were not inspected. Considering original design of the existing machine, it may have been better used for total processing with cooking, rinsing, and drying/smoking. However, at present it seems to be difficult to use this machine for that purpose. Total processing from cooking to smoking will be suitable for processing enough quantity of the same kind and size of material fish to uniform quality of products automatically and in manpower saving manners. However, total processing system seems to become ineffective and uneconomic in processing various kinds and sizes of fish in fluctuated quantities.

At present in Palau, local smoked fish processors based on wood fuel supply hard dried smoked fish to local consumers. Production of same kinds of traditional smoked fish by using the existing machine based on electricity seems to be non feasible. This kind of modern equipment should be used for processing modern and less dried products with less electricity consumption.

3.2 Trial Processing

Small scale trial fish processing was conducted with using the existing smoking/drying machine by the UNIDO expert and Palauan counterparts. The purposes of trial processing are 1) to study the products processed from Palauan fish, 2) to try processing frozen fish of PFFA stock, and 3) to transfer fish processing methods, fish processing techniques including modern processing methods, usage of additives and presevative, etc.

It is reported that PFFA held much amount of excess fish unsold. In 1985, 25 tons of unsold fish had to be disposed of. In 1986, 80 tons of fish are remained unsold in its sales activities. Some of them may be sold to the other customers. Major part were disposed of or still stocked in its storages. In 1987, these unsold excess fish seem to be accumulating. According to PFFA, major portion of unsold excess composed of small white snapper (less than 25cm, Lutjanus spp, Lethrinus spp), small parrot fish (less than 25cm, Scarus spp, Scarops spp), red bass (Lutjanus bohar) and grouper (Cephalopholis spp, Plectropara spp). Skipjack is also included in this excess stock.

In consideration of the excess fish conditions, same or similar kinds of fish are selected for this trial processing. In addition, some other species such as spanish mackerel, which will be good process material but less familiar to local consumers, are also selected. Frozen fish stock is maily used for studying the products conditions from frozen stock.

With respect to processing procedures in trial processing, processing was conducted based on drying with using the existing machine as a hot air drier. This is because smoking based on a smoke generator with wood chips and sawdusts needs more frequent operation management and the products will similar to the traditionally processed ones. However, a modern method of smoking by drying the material soaked in a smoke liquid solution also produces smoked fish. Processing procedures of soaking material in a smoke liquid solution and simple drying are simple and easy to be understood and handled. As smoky flavor can be controlled easily by changing content ratios of smoke liquids, some attractive products such as soft smoked fillets seem to be processed easier than by traditional ways. When various kinds of fish are smoked in the same operation for various levels of products such as hard, medium, soft drying, strong smoky and soft smoky, smoking in combination with drying and smoke liquid may present a flexible operation.

In trial processing soft and medium smoked fillets and bar blocks, hard and medium salted dried split open fish are processed. Detail processing records are shown in Appendix III. Considering that preservatives are often used for keeping quality of soft and medium smoked/dried products, some preservatives are tried to be used in trial processing. Detail of the smoke liquid and preservatives used in trial processing are shown in Appendix IV.

Note: Fish jerky bar processing is also tried in the final stage.

3.3 Case study for fish processing

A case study was carried out with respect to utilization of excess stock of PFFA's fish sales and the existing smoking/drying machine.

1) Production plan

In 1986, PFFA held 80 tons of fish stock unsold, which compose of small parrot fish and white snapper, grouper and red bass as mentioned before. Utilization of these stocks is essential material for PFFA. In consideration of species construction of fish landings to PFFA in 1985 (Table 3-3-1), the case study is carried out as to 67 tons of material fish in total. The material composes of small parrotfish, white snapper, red bass, and grouper mainly. Spanish mackerel and skipjack are also included. (Appedix V-1)

Projected products are split open salted dried fish, medium and soft smoked fish and fish jerky. The existing machine is used as a hot air drier and smoked products are produced with smoke liquid and a drier. Preservatives are used for keep quality of the products in storage, transportation and display.

Total weight of treated material before drying is estimated as 57,450 kg. Considering that the existing machine has a production capacity of 200 kg per one lot according to trial processing experiences, processing is conducted based on 300 days operation per year. The drier will be operated for twelve hours per day for one processing cycle.

2) Sales plan

a. Target market

Products weight of salted-dried split open fish is 40,280 kg. These products will be distributed to local consumers in Koror area including Airai. Against persons in Koror and Airai, these products supply increase around 5 kg per person, year of fish consumption. Considering estimated fish consumption 33.9 kg in these areas (Appendix V-2), fish consumption will be increased by 5 to 10 kg. by developing processed fish other than traditional ones.

Products weight of medium and soft smoked fillets and fish jerky is 3,625 kg. In consideration that 6,129 non-Micronesian tourist/visitors visited Palau in 1984 (Table 3-3-2), these products will be absorbed in their market as souvenirs, delicacy food in hotels and restaurants, etc.

b. Sales price

Price of salted-dried fish is planned considering that traditional smoked/fried fish are sold at 1.75 $/lbs. to 2$/lbs. However, it had better be sold at 2$/lbs. considering conversion ratio from raw material.
With respect to medium and soft smoked fillet and fish jerky, reasonable buying prices are estimated. In Phillipines, soft smoked spanish mackerel is sold at 1.8$ per 80g vacuum pack through Ruston's supermarket chain. In Seychells, Marlin is smoked and sold at around 20$/kg. to European tourists. These products are planned to be marked in a vacuum sealing packages considering quality keeping, products appearances and utilization of the existing vacuum packing machine, (Appendix V-3)

3) Viability

a. Profit and loss

Sales income	207,481 $	(Appendix V-3)
Operation cost	148,036 $	(Appendix V-4)
Sales charge (10% of sales income)	20,748 $	
Bank interest (15% of operation cost and sales charge)		
Plant depreciation	10,000 $	
Net income	3,380 $	
Tax	135 $	(Table 3-3-4)
Profit	3,245 $	

b. Viability

Projected operation will make a profit of 3,245 $ per year. Considering total amount of sales income and potential risk of operation, this value of profit doesn't seem to be enough. However, considering utilization of excess fish stock in PFFA and the existing machine and equipment, operation is considered to be viable.

VI Conclusions and Recommendations

1) Fish processing

Palauan people take fish in various kinds of forms such as baked fish, fried fish, smoked fish, fish soup, sashimi style and canned fish as people of the country surrounded by water of abundant marine resources. However, the share of imported canned fish consumption (approx. 20%) is relatively high while local fish production is exceeded in good fishing periods/seasons. This is mainly come from shortage of storage capacity of excess fish and under-developed fish processing industries. Palauan people seem to have flexible tastes to fishery products. Newly developed processed fish will encourage local fish consumption and prevent foreign currencies to flow out by importing canned food. Development of processed fish based on a small scale operation without a big initial investment is required. Salted-dried split open fish as a main dish for rice food and fish ball for noodle food are recommended as these products.

Some processed fish such as soft and medium smoked fish and fish jerky will be suitable for souvenirs or delicacy food for tourists and also Palauans. Smoked shellfish also has good potential. However, considering high transportation cost based on air flight and an export handling lot, development of export of these products still needs time and trials in tourists market. In consideration of development of processed fish suitable for foreigners' taste and preference, usage of additives and/or preservatives is one of convenient ways. However, a long term of training for processing theory and techniques is required for further development.

Though modern processing machine often present easier processing operation, energy saving type equipment should be developed for wide development of utilization of processed fish. Agro waste fuel smoker/drier has been developed in Phillipines for effective smoking/drying in rainy season. As one of rainfall countries, further study on the equipment is recommended.

Fish processing often supplys processing waste in its procedures. Utilization of the waste as some kinds of feeds are recommendable. Considering supposed quantity of processing waste, fish silage has more advantages than fish meal. However, considering low international prices of fish meals, fish silage production in Palau has less feasibility in a industrial scale.

2) The existing smoking/drying machine

The machine is still useful with necessary repair and check/tests. In consideration of various kinds and sizes of fish to be excessed in sales, the

machine is recommended as a multi-purpose drier/smoker. Considering limited manpower in PFA and PFFA and busy works in much fish landings, some kinds of additives such as smoke liquid is recommended to be used for special purposes. For smooth operation of processing, processing space under adequate low temperature is recommended to be prepared adjacent the building where the existing machine is installed. Price adjustment between small and large size fish may be required for preventing fish from remaining unsold and also reasonable fish processing management.

Table 2-1-1 Resident Population of the Republic of Palau by Sex, 1920, 1925, 1930, 1935 and 1954-1980

YEAR		MALES	FEMALES	TOTAL
1920	Micro	3,143	2,611	5,754
	Other	571	36	607
	Total	3,714	2,647	6,361
1925	Micro	3,315	2,642	5,957
	Other	727	346	1,073
	Total	4,042	2,988	7,030
1930	Micro	3,305	2,704	6,009
	Other	1,279	813	2,092
	Total	4,584	3,517	8,101
1935	Micro	3,390	2,840	6,230
	Other	4,337	2,231	6,568
	Total	7,727	5,071	12,798
1954		3,893	3,833	7,726
1955		3,845	3,811	7,656
1956		4,050	3,949	7,999
1957		4,373	4,190	8,563
1958		4,502	4,382	8,884
1959		4,604	4,468	9,072
1960		4,703	4,617	9,320
1961		4,865	4,809	9,674
1962		5,010	4,955	9,965
1963		5,221	5,059	10,280
1964		5,323	5,305	10,628
1965		5,543	5,289	10,832
1966		5,757	5,468	11,225
1967		5,853	5,512	11,365
1968	r	5,987	5,564	11,551
1969	r	6,132	5,647	11,779
1970	r	6,270	5,745	12,015
1971	r	6,402	5,850	12,252
1972	r	6,518	5,955	12,473
1973		6,618	6,055	12,673
1974	r	6,693	6,138	12,831
1975	r	6,734	6,196	12,930
1976	r	6,740	6,222	12,962
1977		6,703	6,208	12,911
1978	r	6,618	6,144	12,762
1979	r	6,478	6,023	12,501
1980		6,279	5,837	12,116

r=revised

Source: Data for the years 1920 to 1967 from Quarterly Bulletin of Statistics, Vol. III, No. 2; Office of Planning & Statistics, TTPI/Saipan; Data for the years between 1967 and 1980 is interpolated using the 1967, 1973, 1977 and 1980 census results.

Table 2-1-2 State Distribution of Population and Population Density, 1958, 1967, 1977 and 1986.

State	1958	1967	1977	1986	Percent Change 1957-1986	Pop. Density (Pop./sq.mi.) 1958	1986
Aimeliik	412	364	295	282	-31.6	20.8	14.2
Airai	442	538	616	1021	131.0	25.3	58.3
Melekeok	310	356	240	255	-17.7	29.0	23.8
Ngaraard	773	770	576	471	-39.1	55.6	33.9
Ngarchelong	558	615	434	272	-51.3	136.1	66.3
Ngardmau	201	227	171	155	-22.9	11.2	8.7
Ngaremlengui	316	436	320	299	-5.4	12.6	12.0
Ngatpang	88	119	267	219	148.9	5.0	12.4
Ngchesar	450	449	302	271	-39.8	27.4	16.5
Ngiwal	366	381	257	218	-40.4	35.5	21.2
Babelthaup Pop.	3916	4255	3478	3463	-11.6	25.6	22.6
Koror	3585	5667	8298	9419	162.7	504.9	1326.6
Peleliu	679	682	637	545	-19.7	144.5	116.0
Angaur	428	429	258	221	-48.4	129.7	67.0
Kayangel	181	199	136	113	-37.6	258.6	161.4
Hatohobei	108	72	66	n.a.	n.a.	180.0	n.a.
Sonsorol	90	61	38	n.a.	n.a.	100.0	n.a.
Rock Islands	-	-	-	11	-	-	-
Total Population	8987	11365	12911	13772	53.2	52.7	80.8

Source: Abstract of Statistics - 1984, Office of Planning and Statistics, Government of Palau.

Note: 1986 population is based on a preliminary count of the census undertaken in March 1986 by the Government's Office of Planning and Statistics, and it excludes Sonsorol and Hatohobei because their population had not been enumerated.

Table 2-1-3 Gross Domestic Product, 1983 (In current prices by kind of economic activity/sectoral origin)

Sector	GDP ($'000)	Percentage Share
Agriculture and Fishery	5299	16.8
Agriculture	3080	9.8
Fishery	2219	7.0
Industry	4099	13.0
Manufacturing	117	0.4
Construction	3982	12.6
Infrastructure	1898	6.0
Electricity	594	1.9
Transport	402	1.3
Communications	327	1.0
Ownership of Dwellings	575	1.8
Services	20250	64.1
Trade	5247	16.6
Hotel and Restaurant	539	1.7
Finance & Insurance	549	1.7
Real estate & Business Services	260	0.8
Government Administration	11651	36.9
Other Services	2004	6.4
GDP at factor Cost	31546	99.9
Indirect Taxes	2702	8.6
Less Subsidies	-2668	- 8.5
GDP at Market Prices	31580	100
Population (Mid 1983) (Number) :	13,46	
Per capita GDP at current prices:	2345	

Source: Abstract of Statistics, 1984; Office of Planning and Statistics, Government of Palau.

Table 2-1-4 Value to Non-Market Production, 1983 (in current market prices)

Activity	$'000	Percent
Agriculture	2960	50.9
Fishery	2120	36.5
Construction Labor & Boat Building	157	2.7
Imputed Rental Value of Owner Occupied Dwellings	575	9.9
TOTAL NON-MARKET PRODUCTION:	5818	100

Source: Abstract of Statistics, 1984; Office of Planning and Statistics, Government of Palau.

Table 2-1-5 Private Sector Commercial Commodity Exports & Imports (in Current Value), 1979 - 1984 ($'000)

Commodity Exports & Imports	1979 Value	1979 Per Cent	1983 Value	1983 Per Cent	1984 Value	1984 Per Cent
EXPORTS						
Fish (fresh and frozen)	-	-	97.0	31.0	125.0	26.9
Fish (Smoked)	-	-	-	-	22.0	4.7
Copra	-	-	6.0	1.9	-	-
Trochus Shell	-	-	64.5	20.9	173.0	37.3
Scrap Metal	-	-	40.5	13.2	6.0	1.3
Wooden Handicraft	-	-	100.0	32.5	138.5	29.8
TOTAL EXPORTS	-	-	308.0	100	464.0	100
IMPORTS (FOB)						
Food	2947.1	35.2	3382.3	25.0	4280.8	18.6
Beverage & Tobacco	1347.0	16.4	2065.0	15.2	2105.5	9.2
Crude Materials (inedible)	16.6	0.2	402.3	3.0	585.6	2.5
Mineral Fuel, Lubricant	15.7	0.2	2143.0	15.8	2143.0	9.3
Animal & Vegetable Oils, Fats	36.0	0.4	66.1	0.5	97.1	0.4
Chemicals & Related Goods	529.1	6.3	716.1	5.3	762.5	3.3
Manufactured Goods Classified by Materials	1163.3	13.9	1744.3	12.8	6071.0	26.4
Machinery & Transport Equipment	1434.5	17.2	2053.8	15.2	5238.6	22.8
Misc. Manuf. Goods	848.0	10.1	978.6	7.2	1605.9	7.0
Unspecified	-	-	-	-	135.8	0.5
TOTAL IMPORTS(FOB)	8364.2	100	13551.5	100	23025.8	100
TOTAL IMPORTS (CIF)	9219.4		15313.2		26019.2	

Source: Abstract of Statistics, 1984; Office of Planning and Statistics (OPS), Government of Palau, and other detailed import data collected by OPS.

Note: (i) 1984 import data for petroleum, oil & lubricants (POL) are not available, but it is likely that import value in 1984 was not lower than in 1983, hence the 1983 figure may be assumed for 1984 import of POL. (ii) CIF import value for 1983 has been calculated on the basis of 1984 CIF/FOB ratio in which year CIF import value represented 113% of FOB import value.

Table 2-1-6 Quantity and Value of Exports by SITC Item and Destination for 1983 and 1984

SITC Rev. (2)	1983 Description	Destination										Total	
		Guam		Saipan		Japan		U.S.		Other			
		Qty.*	Value ($)	Qty.*	Value ($)	Qty.*	Value ($)	Qty.*	Value ($)	Qty.*	Value ($)	Qty*	Value ($)
034	Fish, Fresh, Chilled or Frozen	32.6	59,000	17.6	32,000	-	-	-	-	3.3	6,000	53.5	97,000
081.37	Copra	-	-	-	-	39.4	6,000	-	-	-	-	39.4	6,000
288.23	Scrap Metal	-	-	-	-	..	40,000	-	-	-	-	..	40,000
291.15	Trochus Shell	-	-	-	-	60.1	65,000	-	-	-	-	60.1	65,000
635.40	Wooden Handicraft	-	-	-	-	..	57,900	..	25,800	..	16,300	..	100,000
	Total (Value)	n/a	59,000	n/a	32,000	n/a	168,900	n/a	25,800	n/a	22,300	n/a	308,000
	1984												
034	Fish, Fresh, Chilled or Frozen	41.5	75,000	24.1	44,000	-	-	-	-	3.0	6,000	68.6	125,000
035.04	Fish, Smoked	-	-	-	-	11.2	22,000	-	-	-	-	11.2	22,000
288.23	Scrap Metal	-	-	-	-	..	6,000	-	-	-	-	..	6,000
291.15	Trochus Shell	-	-	-	-	119.2	173,000	-	-	-	-	119.2	173,000
635.40	Wooden Handicraft	-	-	-	-	..	72,000	..	37,000	..	29,000	..	138,000
	Total (Value)	n/a	75,000	n/a	44,000	n/a	273,000	n/a	37,000	n/a	35,000	n/a	464,000

* Quantity - Short Ton

Source: Outbound Cargo Manifest provided by Airlines & Shipping Line; Palau

Table 2-1-7 Import Quantities of Selected Fresh/Prepared Agricultural Products
1975-1984
(short tons)

Items	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Beef, Frozen	19.5	36.3	16.8	28.9	21.3	37.2	52.9	48.1	62.8	53.1
Pork, Frozen	16.7	21.8	19.9	30.4	34.6	31.2	42.0	38.2	32.0	43.0
Chicken, Frozen	71.4	116.6	80.1	82.4	119.9	119.2	119.4	240.9	241.3	196.1
Fish, Frozen	-	5.4	1.8	0.8	0.4	-	1.0	6.8	3.6	5.0
Eggs (Dozen '000)	27.8	117.6	55.1	29.1	39.8	85.4	117.3	247.0	115.7	116.8
Beef/Pork, Canned	184.3	139.4	73.1	81.9	150.0	115.9	149.5	83.1	151.6	158.0
Fish, Canned	99.4	88.3	152.2	59.3	107.9	128.8	63.9	119.7	76.9	108.3
Chicken, Canned	118.7	32.3	23.6	30.5	18.2	37.7	94.7	80.0	38.9	46.9
Vegetables, Frozen	51.8	138.7	78.5	47.2	57.2	73.0	127.2	107.9	54.4	140.2
Fruits, Frozen	20.2	38.3	63.4	64.2	66.1	80.2	105.3	103.8	44.3	98.2
Vegetable, Canned	11.1	54.0	15.4	1.0	26.6	34.4	34.4	23.8	11.6	23.6
Fruits, Canned	43.7	45.7	36.5	0.3	64.2	30.0	66.9	50.0	25.8	33.4
Rice	838.2	589.3	267.9	513.6	768.0	921.5	879.2	820.0	1,209.9	747.0
Potatoes	7.4	12.2	28.6	10.1	8.2	23.9	15.0	4.5	57.1	11.3
Flour	128.4	143.2	174.6	202.1	158.5	209.2	179.5	215.6	178.9	178.2
Biscuit/Cookies	108.7	85.4	459.5	21.6	33.0	61.5	28.9	46.2	72.6	34.1

Note: Unit is gross weight as indicated on Bill of Lading (B/L)

Source: Division of Agriculture; Palau

Table 2-1-8 National Government Merchandise Imports, 1984 ($'000)

Items	FOB Value	FOB Per Cent	CIF Value	CIF Per Cent
Food	0.4	-	0.5	-
Crude Materials (inedible)	35.6	1.2	43.8	1.3
Petroleum Fuel & Lubricant	1896.3	62.6	2142.8	63.5
Animal & Vegetables, Chemicals & Related Products	208.9	6.9	224.5	6.7
Manufactured Goods Classified by Material	249.7	8.2	282.1	8.4
Machinery & Transport Equipment	477.0	15.8	508.7	15.0
Miscellaneous Manufactured Articles	160.8	5.3	172.9	5.1
Total Government Imports	3028.7	100	3375.3	100

Source: Abstract of Statistics, 1984, Office of Planning and Statistics, Government of Palau. Data for fuel import obtained from the Bureau of Public Works, Government of Palau.

Table 2-2-1 Palau Federation of Fishing Associations: Fishing Purchases By Taxonomic Group 1976 - 1981

Species	1976		1977		1978		1979		1980		1981	
	Lbs.	$	Lbs.	$	Lbs.	$	Lbs.	$	Lbs.	$	Lbs.	$
Snapper	43,332	13,813	23,504	7,749	8,002	2,624	56,477	22,057	113,886	55,565	42,138	22,692
Parrot Fish	25,095	8,901	25,667	9,508	12,070	4,628	54,117	22,762	68,620	37,246	46,510	27,926
Rabbit Fish	25,371	8,867	19,062	7,341	26,207	11,094	36,513	17,705	46,261	28,209	17,069	10,914
Unicorn Fish	18,204	6,165	19,260	7,477	16,251	7,167	24,345	12,650	72,223	46,193	31,980	20,616
Grouper	3,397	1,026	20,152	5,069	15,319	3,872	28,335	8,441	27,796	9,155	21,102	8,520
Mullet	7,122	2,648	4,433	1,663	1,757	874	5,833	3,285	6,944	4,605	4,349	3,027
Jack	6,619	1,677	2,815	926	2,146	688	11,166	3,525	9,944	3,982	3,502	1,514
Surgeon Fish	743	247	436	153	1,141	351	7,826	2,845	7,434	4,047	2,413	1,441
Goat Fish	2,225	680	1,631	551	943	330	2,441	1,111	5,109	2,860	2,667	1,571
Wrasse	1,255	414	918	334	957	335	3,836	1,659	3,366	1,834	2,578	1,545
Silver Fish	4,430	1,543	1,935	666	208	73	2,673	870	1,790	701	976	450
Squirrel Fish	40	12	257	90	20	7	584	257	287	164	3,470	2,082
Sweet Lips	-	-	95	14	335	111	973	278	1,511	469	390	150
Other Reef Fish	4,114	1,280	1,906	835	2,373	916	5,914	2,279	11,451	6,003	1,370	779
Assorted Reef Fish*	61,174	20,035	135,498	44,442	47,828	16,740	23,752	8,421	1,133	446	-	-
Pelagic Fish	19,381	4,311	56,059	8,175	159,324	26,232	201,118	38,160	68,985	18,440	28,233	10,489
Invertebrates	3,150	2,818	3,529	3,874	2,324	2,333	9,288	3,395	6,202	5,680	8,695	3,016
Reptiles	-	-	-	-	995	303	1,135	99	5	1	-	-
Total	225,646	74,437	317,157	98,867	298,200	78,678	476,326	149,799	452,947	225,600	217,442	116,669

* Classification by species improved during the period resulting in a declining part of the Assorted reef fish group.

Source: The Palau Reef Fish Production Study; Division of Marine Resources, Palau, November 1983.

Table 2-2-2 Palau Fishing Authority:
Fish Purchases By Taxonomic Group
April-December 1983 and 1984

Species	1983				1984			
	Quantity		Value		Quantity		Value	
	Pounds	%	Dollar	%	Pounds	%	Dollar	%
Snapper	98,923	22.9	59,583	30.0	100,540	17.5	64,051	23.6
Parrot Fish	47,756	11.1	24,533	12.4	93,206	16.3	44,968	16.5
Surgeon Fish	5,834	1.4	2,612	1.3	4,023	0.7	1,954	0.7
Rabbit Fish	15,896	3.7	9,830	5.0	36,913	6.4	31,895	11.7
Goat Fish	2,444	0.6	1,456	0.7	4,353	0.8	3,523	1.3
Grouper Fish	34,083	7.9	13,742	6.9	42,315	7.4	18,625	6.9
Sweet Lips	1,224	0.3	452	0.2	1,546	0.3	469	0.2
Wrasse	4,645	1.1	2,065	1.0	3,712	0.6	2,323	0.9
Squirrel Fish	1,022	0.2	693	0.4	1,761	0.3	839	0.3
Jacks	10,754	2.5	5,423	2.7	21,106	3.7	10,754	4.0
Mullet	1,331	0.3	797	0.4	1,209	0.2	836	0.3
Silver Fish	325	0.1	176	0.1	639	0.1	390	0.1
Unicorn Fish	47,173	10.9	22,577	11.4	30,432	5.3	15,714	5.8
Other Reef Fish	12,428	2.9	5,581	2.8	7,812	1.4	3,535	1.3
Assorted Reef Fish	2,819	0.7	1,409	0.7	47	-	24	-
Pelagic Fish	139,731	32.4	44,130	22.2	218,025	38.0	63,987	23.5
Invertebrates	3,587	0.8	2,997	1.5	5,977	1.0	7,965	2.9
Reptiles	890	0.2	661	0.3	-	-	-	-
Total	430,865	100.0	198,716	100.0	573,616	100.0	271,852	100.0

Source: Division of Marine Resources

Table 2-2-3 Fish marketing of PFFA in 1986, 1987 (lbs.)

Month	Fish Purchase	Domestic Sales	Export	Stock
1986				
Jan.	30,822	18,598	5,084	7,140
Feb.	45,915	25,196	11,046	9,673
Mar.	61,811	27,091	18,477	16,243
Apr.	91,716.5	26,092	15,974	49,650.5
May	96,335	29,581	19,465	47,289
Jun.	64,763	30,374	11,916	22,473
Jul.	56,915	35,001	6,317.5	15,596.5
Aug.	32,142.5	37,034	3,793	-8,684.5
Sep.	15,546	25,681	6,024	-16,159
Oct.	49,538	28,305	7,862	13,371
Nov.	52,805	27,101	9,979	15,725
Dec.	51,918	32,881	4,812	14,225
(Subtotal in 1986)	(650,227)	(342,935)	(120,749.5)	(186,542.5)
1987				
Jan	17,587	25,598	7,817	-15,828
Feb.	62,322.5	31,393	16,000	14,929.5
Mar.	62,222.5	35,416	10,020	16,786.5
Apr.	91,062.5	26,017	11,008	54,037.5
May	53,275,5	24,335	3,346	25,594.5
Jun.	47,582	23,785	353	23,444
Jul.	40,345	25,322		

Quantity of domestic sales is estimated by dividing monthly total sales value by average sales price.

Source: PFFA, PFA

Table 2-2-4

Fisherman's Buying Price List
(Cents per lb.)

Fish (Species)	1983				1984			
	Feb	May	Aug	Nov	Feb	May	Aug	Nov
Erangel (Unicorn Fish)	60	60	70	60	50	60	70	80
Um (Unicorn Fish)	55	45	45	30	35	40	60	70
Ersuuch (Dolphin)	30	30	-	-	-	-	-	-
Kelsebuul (Rabbit Fish)	60	60	70	60	75	100	100	100
Meyas (Rabbit Fish)	50	50	60	60	60	60	70	80
Kemedukl (Parrot Fish)	50	30	50	40	60	50	50	60
Mellemau (Parrot Fish)	50	30	30	20	50	20	40	60
Ngyaoch (Parrot Fish)	60	60	70	60	60	50	60	70
Kedesau (Snapper)	50	45	45	35	35	40	40	45
Keremlal (Snapper)	55	60	70	50	50	40	60	70
Nechur (Snapper)	60	60	70	60	60	60	60	70
Melangmud (Snapper)	60	60	70	60	60	60	60	70
Metengui (Snapper)	60	80	150	100	50	60	50	70
Sebus (Snapper)	60	80	150	100	100	125	125	125
Udech (Snapper)	50	50	60	50	50	60	70	80
Temekai (Grouper)	50	45	45	35	35	40	40	50
Tiau (Grouper)	50	45	60	50	50	50	50	60
Maml (Wrasse)	60	50	60	50	50	60	70	80
Orewidel (Jack)	50	50	60	50	50	50	50	60
Katsuo - Grade I (Pelagic Fish)	35	32	42	25	25	20	20	20
Tekuu (over 7 lbs. - Pelagic Fish)	60	60	70	50	50	40	40	55

Source: Monthly Price-list, Palau Fishing Authority.

Table 2-2-5 Price groups for purchase and sales of PFFA

	(English name);	(Local name)
Group A	Rabbit Fish;	Meyas, Kelsebuul, Bebael, Beduut
	Parrot Fish;	Mellemau (large), Ngyaoch, Otord, Ngesngis
	Snapper;	Metengui, Sebus Udech
	Dolphins;	Ersuuch
	Jacks,	Orwidel, Wii
	Goat fish;	Bang, Dech
	Mullets	Kelat, Uluu
Group B		
	Unicorn fish;	Erangel, Um, Mesekuuk
	Parrot fish;	Kemedukl, Mellemau (small)
	Snapper;	Kedesau, Keremlal, Mechur, Melangmud
	Grouper;	Temekai, Tiau
	Wrasse;	Maml
	Tuna species;	Tekuu (large)
	Jacks;	Terekrick, Desui
	Barracuda;	Meai, Aii
	Mackerel	Ngelngal, Keskas
Group C	Tuna species;	Tekuu (small)
	Skipjack;	Katsuo
	Frigate mackerel;	Soda

Price in September, 1987 Cents/lbs.

	Purchase	Sales
Group A	70	80
Group B	60	80
Group C	35	50

Note: Some valuable fish such as Etelis species is occasionally sold by more than 80 cents/lbs.

Source: PFFA, PFA

Table 2-2-6 Palau Fishing Authority: Quarterly Fish Exports by Taxonomic Group

Fish	1983		1984									
	2nd-4rd Quarter		1st Quarter		2nd Quarter		3rd Quarter		4rd Quarter		Total	
	Qty. (lbs.)	Value ($)	Qty. (lbs.)	Value ($)	Qty. (lbs.)	Value ($)	Qty. (lbs.)	Value ($)	Qty. (lbs.)	Value ($)	Qty. (lbs.)	Value ($)
Invertebrates	384	651	932	717	564	1,268	484	1,251	146	430	2,126	3,666
Snapper	24,848	25,796	11,138	10,565	14,396	13,019	11,988	10,930	6,708	6,010	44,230	40,524
Parrot Fish	3,779	2,645	5,556	3,760	5,103	3,753	3,867	3,124	2,848	2,404	17,374	13,041
Surgeon Fish	466	317	867	686	1,076	504	1,024	468	181	138	3,148	1,796
Rabbit Fish	3,971	3,423	4,345	4,756	6,915	6,982	5,958	6,404	3,343	3,665	20,561	21,807
Goat Fish	765	589	1,376	1,574	1,621	1,404	1,193	1,022	640	565	4,830	4,565
Grouper	5,169	3,106	2,349	1,442	2,254	1,545	1,854	1,393	1,247	925	7,704	5,305
Wrasse	95	48	23	14	-	-	-	-	-	-	23	
Squirrel Fish	376	369	228	222	269	125	-	-	-	-	497	347
Jack	841	625	739	547	2,105	1,650	1,928	1,567	837	657	5,609	4,421
Mullet	166	116	341	285	110	94	145	123	145	123	741	629
Silver Fish	285	176	82	57	251	191	166	131	166	131	665	510
Unicorn Fish	6,892	4,363	3,960	2,249	7,818	5,340	5,508	4,135	2,326	1,864	19,612	13,588
Other Reef Fish	3,990	3,195	1,344	1,059	887	713	776	660	678	577	3,685	3,009
Asst. Reef Fish	509	418	791	475	-	-	-	-	-	-	791	475
Pelagic Fish	1,036	904	5,170	2,847	3,497	1,715	3,106	1,608	321	255	12,094	6,425
Prepared Fish	4,312	5,972	5,481	8,550	11,410	15,481	2,169	3,265	801	1,329	19,861	28,625
Total	57,884	52,713	44,722	39,805	58,276	53,784	40,166	36,081	20,387	19,073	163,551	148,743

Source: Palau Fishing Authority

Table 2-2-7 Quantity of Fish Export by Month and Destination
1983 - 1984
(short ton) (1)

Month	1983 Destination					1984 Destination				
	Guam	Saipan	Hawaii	Other	Total	Guam	Saipan	Hawaii	Other	Tot.
January	2.4	1.5	-	0.2	4.1	3.8	3.2	-	0.2	7.2
February	8.1	2.1	-	0.1	10.3	2.8	3.2	0.1	0.5	6.6
March	6.6	1.0	-	0.1	7.7	10.7	7.4	0.5	1.3	19.9
April	5.8	1.3	-	0.5	7.6	10.9	4.3	0.4	0.1	15.7
May	4.2(2)	2.3(2)	-(2)	0.4(2)	6.9(2)	5.3	2.8	-	-	8.1
June	5.0	3.5	-	-	8.5	2.2	2.6	-	0.6	5.4
July	2.5	3.4	-	-	5.9	2.5	1.4	-	0.4	4.3
August	2.8	1.6	-	-	4.4	4.2	2.3	-	0.1	6.6
September	4.4	4.2	1.2	0.1	9.9	5.8	1.2	-	0.7	7.7
October	4.7	2.8	1.6	0.1	9.2	4.6	1.6	-	-	6.2
November	3.4	2.3	1.0	0.1	6.8	1.6	0.9	-	-	2.5
December	7.2	4.9	0.3	0.1	12.5	4.7	0.9	-	-	5.6
Total	57.1	30.9	4.1	1.7	93.8	59.1	31.8	1.0	3.9	95.8

Note: (1) Quantities in gross weight;
(2) Estimates;

Source: Out-bound Cargo Manifest provided by Airlines.

Table 3-3-1 Fish landings to PFFA for some selected species in 1985

		Qtys (tons)
Snapper	Lutjanus spp	34.0
Snapper	Lethrinus spp	36.4
Parrot fish	Scarus spp, Scarops spp Ypsiscarus spp	42.5
Grouper	Cephalopholis spp	22.0
	Plectropoma spp	
Spanish mackerel	Scomberomorus spp	
	Acanthocybium spp	9.0
Skipjack tuna	Euthynnus spp	25.6
Other		163.1
Total		332.6

Note: Some of important species for local market such as rabbit fish are not included.

Table 3-3-2 Non - Micronesian Visitor Entries by Country of Citizenship and Purpose of Entry: 1984

Citizenship	Tourist/ Visitor	Business	Religion	Employment	Other *	Total	%
U.S.A.	1,659	445	54	134	240	2,532	28.1
Japan	3,195	136	1	455	182	3,969	44.0
Philippines	318	95	2	475	197	1,087	12.1
Europe	389	69	1	56	25	940	6.0
Other	568	101	4	120	93	886	9.8
Total	6,129	846	62	1,240	737	9,014	100.0
(%)	68.00	9.38	.69	13.75	8.16	100.00	

*Other includes Seaman, Airline Crews, Peace-corps Volunteers and dependants.

Source: Division of Immigration; Palau

Table 3-3-3 Employment & Earnings in the Commercial Sector by Occupational Group, Citizenship and Sex as at 6/30/84

S.O.C.	Description of Occupations	T.T. Citizen		Non T.T. Citizen		Total	(1) Average Annual Wage
		Female	Male	Female	Male		
11 - 14	Executive, Administrative & Managerial Occupation	13	24	2	33	72	14,428
16 - 21	Engineers, Surveyors, Architects & Lawyers	3	7	1	41	52	17,938
22 - 25	Teachers	29	4	2	-	121*	4,082
26 - 30	Medical Occupations	2	1	-	-	3	5,824
32,37-39	Musicians & Technicians	5	14	-	3	22	5,472
40 - 44	Marketing & Sales Occupations	70	13	3	1	87	3,137
45 - 47	Administrative Support Occupations including Clerical	95	53	7	6	161	4,494
50 - 52	Service Occupations	62	53	23	17	155	3,402
55 - 58	Agriculture & Fishing Occupations	1	6	-	2	9	2,475
60 - 61	Mechanics & Repairers	-	22	-	37	59	4,823
63 - 65	Construction & Extractive Occupations	-	74	-	285	359	6,027
67 - 78	Precision Production & Production Working Occupations	1	11	6	21	39	4,019
81 - 83	Transportation & Material Moving Occupations	-	89	-	9	98	3,818
85 - 87	Handlers, Cleaners & Helpers	31	228	-	2	261	2,644
	Occupations not Classified	-	-	-	-	412	-
	Total	312	599	44	457	1,910	5,314

Source: Employment Survey; Division of Labor, Palau

(1) Based on a 40 hour workweek

* Including 86 Teachers not classified according to citizenship and sex for Emmaus & Bethania High School, MOC, SDA School and Belau Modekngei School (estimated from educational statistics).

Table 3-3-4 Structure and Rates of Taxation, 1985

Taxation Categories	New Rates(introduced in FY1985)
Income Tax	
Personal Income Tax	a. 5% on gross income up to first $8,000 p.a., with tax exemption on first $2,000, but full tax deductible on income above $2,00 p.a.
	b. 12% on Salaries & Wages above $8,000 p.a.
Indirect Tax	
Gross Revenue Tax (Business Tax)	a. 4% tax on the total revenue less salary and wages of employees
Profit Tax (on Financial Institutions)	a. 4% on net income (ie. income less operating expenses, financial expenses, and depreciation)
Import Tax	
-Cigarettes	$0.14 per 20 cigarettes 60 per cent ad valorem
-Tobacco	
-Perfumery, Cosmetics, toiletries, etc., except goods having intrinsic medicial properties	25% ad valorem
-Soft Drinks and Non-Alcoholic beverages	$0.10 per 12 fl. oz.
-Beer & Malt Beverages	$0.15 per 12 fl. oz.
-Liquor	$ 3 per 1/5 gallon or $0.10 per oz.
-Wine	$2 per 1/5 gallon or $0.08 per oz.
-Foodstuff	Nil
-Liquid fuel	$0.05 per gallon
-All other imported products, except those mentioned above	3% ad valorem
Excise tax	
Gasoline & Diesel Fuel	$ 5. per gallon

Source: Bureau of National Treasury, Ministry of National Administration.

Appendix I Specifications of the existing smoking machine

1) System; Multi-purpose drier/smoker available for drying, smoking, steam cooking, product showering and their combination.

2) Major component

a) Smoking/Drying room; approx. 1.5 m Lx 1.5 m Wx 1,8 mH
Capacity ; 20 stairs x 2 drying nets (75 cm x 120 cm)
Drying heater; three electric heating coils
Air flow; automatic or fixed strength, 20 CFM
Water· 10 GPM/60 PSI
Steam; 20 psi at 75#/hr.
Air; 5SCFM/50 PSI
Electric Consumption; 31.5KW, 240V, 3phase, 50Hz

b) Smoke Generator; electric heating system

c) Boiler; Weil Mclain made
steam; 1500 sq. feet
water; 417.4 MBH, 50 psi

d) Control panel
Temperature controller, indicator, and recorder combination
processing controller

Appendix II Required repair and check/test

A) Points for repair

1) Corrosion

Corrosion must be cleaned up and protected for long span life of machine operation. Especially, corrosion on the processing space such as drying nets, net stays, etc. must be cleaned up in order to realize good quality products by preventing product from adhering the nets in process and also corrosion dusts from covering the products. Corrosion on the movable parts of the machine must be cleaned up to realize smooth operation.

2) Rubber packings of the door

Rubber packings of the door must be renewed or repaired in order to prevent air flow from leaking for efficient and economic machine operation.

3) Side wall panels

Side wall panels must be fixed correctly in order to realize proper air flow inside. At present, air flow strength inside fluctuates due to air leaking through unfixed wall panels and/or mal-adjustment of air flow control panels.

This unbalanced air flow will disturb smooth processing operation and uniform quality production.

B) Points for check/test

1) Control panel

Operation control system and sequence must be checked for normal operation. Especially, temperature indicator and controller must be checked by being compared with actual temperature measured in operation. Then, it must be adjusted and repaired if it's not operated correctly. Emergency system must be tested and adjusted if required. All indication lamps must be checked and renewed if required.

2) Electric lining

Dusts and dirts on the electric lining and connections must be cleaned up and the connections must be checked to find short-linings, unfixed points, etc.

3) Air flow control

Air flow strength must be checked, for example, by putting thin string at the air flow holes. If air flow is not adjusted evenly up and down inside, it must be adjusted by adjustment of air flow control panels, controlling air flow with taping the holes, etc.

Note: These points for repair and check are only the major and basic points for re-operation of the machine. All the things surrounding the machine must be arranged neatly and cleaned up. All the parts of the machine must be cleaned up, checked and repaired if required.

Appendix III Trial processing record

(A) Case A: Medium smoked fillet

1. Material

	(Scientific name)	(English/local name)	(length)	(weight)
1)	Scarops rubroviolaceus	Blue parrotfish/Mellemau	35cm x 1 pc	0.8kg
2)	Lutjanus bohar	Red bass/Kedesau	35cm x 1 pc	0.8kg
3)	Lethrinus miniatus	Longnose Emperor/Melangmud	40cm x 1 pc	1.1kg
4)	Plectrorhynchus spp	Sweet lips/Bdui	45cm x 1 pc	1.6kg
			total	4.3kg

Condition; material is of three months frozen stock of PFFA

2. Processing procedures

1) To thaw frozen fish in fresh water (ambient temp.; 25°C)

2) To treat fish in skinless and boneless fillets
(Treated weight is 1.8kg. Conversion ratio from whole weight is 42%)

3) In addition, to cut into jerky bars of fillets of Melangmud and Bdui
(Size of jerky bar is 10mm x 20mm x 80-150mm L)

4) To prepare smoking sauce

water	1,900cc
smoke liquid (SP-3)	100cc (5%)
salt	50g (2.5%)
seasoning (Sodium gultaminate; Aginomoto)	some (about 0.5g)

5) To soak material in the smoking sauce for 15 hours. (From 16:30 on 10, Sep. to 7:30 on 11, Sep.)

6) To dry soaked material

7:30 - 8:30	1 hour	Drip off smoking sauce by laying material on steel nets
8:30 - 9:30	1 hour	Drying by blowering with heating (ambient temp. 25°C or 75°F)
9:30 - 10:30	1 hour	Hot air drying with heating at 55°C (130°F)
10:30 - 13:00	2.5 hrs.	Hot air drying with heating at 80°C (175°F)
13:00 - 15:00	2 hours	Equalize moisture between surface and inside by staying products on nets without blowing and heating.
15:00 - 16:00	1 hour	Hot air drying with heating at 80°C (175°F)

Note: A. Air flow strength inside drying room is not adjusted due to damage of fixing bolts of the side wall. Air flow is strong in lower side (probably approx. 4.0 m/s) weak in upperside (probably approx. 1.5m/s) Strong air flow is suitable only for blowing out smoking sauce drops in the beginning stage of drying (30 mins. to 1 hour in the beginning). Then, drying nets were shifted up to the upper side because too strong

air drying will cause unbalanced drying between inside and surface due to rapid drying on surface.

B. Temperature of hot air drying is measured by the temperature indicator of the existing dryer/smoker. However, actual temperature seems to be lower than indicated.

3. Final product

Products were of medium dried ones of approx. 40% of moisture content. Final weight was not measured, but conversion ratio from fillet block is estimated as more than 60%. (Then, from whole weight the ratio is 25%)

4. Panel taste

Slight storage smell was felt. According to Palauan panelists, slightly more salty taste was required. Though these medium dried products were strange to Palauan panelists, they seemed to be pleased with its flavor and texture.

(B) Case B: Soft smoked fillet

1. Material

	(Scientific name)	(English/local name)	(Length)	(Weight)
1)	Scomberomorus commerson	Barred spanish mackerel/ Ngelngal	100cm x 1 pc	4.1kg

Condition; material is of three months frozen stock of PFFA

2. Processing procedures

1) To thaw frozen fish in fresh water (ambient temp. is 25°C)

2) To treat fish into skinless and boneless fillets
(Treated fillet weight is 2.3kg. (Conversion ratio from whole weight is 55%)

3) One side of fillets was cut into two pieces, the other side of fillets cut into jerky bars and small fillet blocks.

4) To soak material in the smoking sauce for 16.5 hours (From 15:00 on Sep. 13 to 7:30 on Sep. 14)

Smoking sauce;	water	1,840cc
	smoke liquid (SP-3)	160cc (8%)
	salt	85g (4.3%)
	seasonings (Sodium gultaminate)	some (about 1g)
	preservatives (TE-20)	8cc (0.4%)

5) To dry soaked material

7:30 - 8:00 (0.5 hour) Drip off smoking sauce

8:00 - 8:30	(0.5 hour)	Drying only by blowering without heating in lower side of drying room.
8:30 - 9:30	(1 hour)	Hot air drying with heating at 55°C (130°F)
9:30 - 11:30	(2 hours)	Hot air drying with heating at 80°C (175°F)
11:30 - 15:00	(3.5 hours)	Equalize moisture
15:00 - 16:00	(1 hour)	Hot air drying with heating at 80°C (175°F)

Note: In the initial stage of drying fillets, it is essential to check drying conditions and to turn over fillet block on the nets because fillet material tends to adhere to the nets in this stage.

3. Final product

Products were of medium dried ones of more than 50% of moisture content. Final weight was 1.8kg, then conversion ratio from fillet block was 78% and that from whole weigh was 43%. Surface color light is very light brown and inside color is light pink.

4. Panel taste

Very slight storage smell was felt to limited panelists. Salty and smoky conditions are suitable to Japanese and European people's taste and also acceptable for Palauan people as delicacy food. Some Palauan panelists may still require much more salty taste. The product seemed to be suitable for food served in hotels and restaurants and for souvenir purposes. Storage in a refrigerator will keep quality for a week. Frozen storage is highly recommended.

(C) Case C: Hard dried split open fish

1. Material

(Scientific name)	(English/local name)	(Length)	(Weight)
Lethrinus spp	White snapper/Mechur, Udech	10-25cm x 9 pcs.	-
Scarops spp	parrot fish/Mellemau	25cm x 3 pcs.	-
		total	3.6kg

Condition: Material is of four months frozen stock of PFFA. Some portion of flesh had been burned in light red color.

2. Procesing proedures

1) To thaw frozen fish in fresh water

2) To treat fish gill & gutted and split opened from back side. (Treated weight is 3.4kg. Conversion ratio is 94%)

3) To prepare salt solution

water	4,700cc
salt	300g (6%)

seasonings (sodium glutaminate)	some (about 1g)
preservatives (TE-20)	5cc (0.1%)

4) To soak material into salt solution. Slight salt was powdered on the flesh when soaking. Soaking is conducted for 1.5 hours.

11:30 - 13:00	(1.5 hours)	Soaking
13:00 - 14:00	(1 hour)	De-salting by dipping material in fresh water for controlling salty condition.
14:00 - 14:30	(30 mins.)	Drip off by laying material on steel nets
14:30 - 7:30 (next day)	(17 hours)	Hot air drying with heating at 65°C (150°F)

Note: Material is not necessary to be turned over while drying because fish skin side does not adhere the nets.

3. Final product

Products were of hard dried ones of less than 25% of moisture content. Final weight was 680g, then conversion ratio is 20%.

4. Panel taste

Storage smell is hard to be felt. Salty condition is suitable for Palauan and Japanese panelists. The products seemed to be familiar with Palauan panelists. Products are able to be stocked under ambient temperature.

(D) Case D: Medium dried split open fish

1. Material

(Scientific name)	(English/local name)	(Length)	(Weight)
Lethrinus spp	White snapper/Mechur Udech	15cm - 25cm x 12pcs.	3.2kg

Condition: Material is of four months frozen stock of PFFA

2. Processing procedures

1) To thaw frozen fish in fresh water .

2) To treat fish gill & gutted and split opened from back side (Treated weight is 3.0 kg. Conversion ratio is 94%)

3. To prepare solution

Water	4,750cc
Salt	280g (5.6%)
Seasonings (sodium glutaminate	some (about 1g)

4. To soak material into solution with slight salt powdering on it. Then de-salt and dry them by hot air blowing.

9:40 - 11:00	(100 min)	Soaking
11:00 -12:00	(1 hour)	De-salting

12:00 - 12:30	(30 mins.)	Driff off
12:30 - 15:30	(3 hours)	Hot air drying with heating at 65°C (150°F)
15:30 - 16:30	(1 hour)	Hot air drying with heating at 80°C (175°F)
(next day)		
9:30 - 11:30	(2 hours)	Hot air drying with heating at 80°C (175°F)

3. Final product

Products were of medium dried ones of more than 40% of moisture contents. Final weight was 2.3kg. Conversion ratio from treated matrial is 77%.

4. Panel taste

Storage smell is slightly felt. Salty condition is suitable for Palauan panelists. The style of baking the products again and seasoned by soy sauce seems to be strange for Palauan people. However, the products seem to become new dishes in their home. The products must be kept in refrigerators, frozen storage is also recommended.

(E) Case E: Medium smoked split open fish

1. Material

(Scientific name)	(English/local name)	(Length)	(Weight)
Plectropoma Leopardus	Grouper/ ---	25-30cm x 4 pcs.	----
Epinephelus spp	Grouper/ ---	25-30cm x 3 pcs.	----
		(Total)	5.9 kg.

2. Processing procedures

1) To thaw frozen fish in fresh water

2) To treat fish gill & gutted and split opened from back side. (Treated weight is 5.6kg. Conversion ratio is 9.6%)

3) To soak material in the smoking sauce for 17.5 hours. (From 16:00 on Sep. 16 to 9:30 on Sep. 17)

Smoking sauce;	water	4,750cc
	salt	250g (6%)
	smoke liquid (SF-2)	200cc (4%)
	seasonings (sodium glutaminate)	some (about 1g)

4) To dry soaked material

9:30 - 11:00	(1.5 hour)	Drip off and sun drying (weather condition was slightly cloudy)
11:00 - 15:30	(4.5 hours)	Hot air drying with heating at 65°C (150°F)
15:30 - 16:30	(1 hour)	Hot air drying with heating at 80°C (175°F)

(next day)

9:30 - 12:00 (2.5 hours) Hot air drying with heating at 80°C (175°F)

3. Final products

Products were of medium dried ones of more than 40% of moisture contents. Final weight was 4.5kg. Conversion ratio from treated material is 80%.

4. Panel taste

Storage smell seems to be controlled by smoky smell. Salty condition is suitable for Palauan panelists.

The product needs to be kept in refrigerators or freezers.

Appendix IV Additives and Preservatives used in trial processing

1. Smoke liquid

Smoke liquid is one of additives used for smoked fish, smoked chicken, etc. Smoke liquid is produced by dry distillation of natural smoke at around 700°C and refining. Smoky flavors are blended according to usage and required specifications. In this trial processing, three types of smoke liquids including light flavor liquid (SF-2) suitable for smoking shellfish, white fish, medium flavor liquid (SF-3) suitable for white fish and hard flavor liquid (SF-5) suitable for red fish such as skipjack and tuna are tried.

2. Preservatives

Various kinds of preservatives are use in food processing industries. There are also many reports with respect to accidents and influence by using chemically synthenic preservatives. In this processing, preservatives made from natural Vitamin E is used. (TE-20)

Appendix V - I

Prodution plan

Material	Whole weight (kg.)	Target Product	Treatment
Red bass (S)	3,000	S.S.S.	split open
Red bass (L)	2,000	M.S.	fillet
White Snapper (S) (Lutjanus spp, Lethrinus spp	30,000	S.S.D.	split open
Parrot Fish (S)	15,000	S.S.D.	split open
Grouper (S)	5,000	S.S.D.	split open
Grouper (L)	2,000	M.S.	fillet
Spanish mackerel	2,000	S.S.	fillet
Skipjack & Tuna	8,000	F.J.	jerky bar
	67,000		

NOte: (S) = small size, (L) = large size

S.S.D. = split open, salted dried fish

S.S. = soft smoked fish

M.S. = medium smoked fish

F.J. = fish jerky

Conversion Rate A	Treated weight (kg.)	Conversion Rate B	Product weight (kg.)
0.95	2,850	.08	2,280
0.5	1,000	0.7	700
0.95	28,500	0.8	22,800
0.95	14,250	0.8	11,400
0.95	4,750	0.8	3,800
0.5	1,000	0.7	700
0.55	1,100	0.75	825
0.5	4,000	0.35	1,400
	57,450		43,905

Appendix V - 2 Estimation of fish consumption in Koror area

In 1986, 155.3 tons of fish is distributed mainly to local consumers in Koror area by PFFA. According to fish marketing status in Koror area, PFFA seems to supply about 60% of total fish supply to people in Koror and in Airai partly. At least 50% of people in Airai get fish from fish landings in Koror. Population in Koror and Airai in 1986 are 9,419 and 1021 respectively. Then, fish consumption of local fish in Koror area is estimated as 26.1 kg. per year per person.[1] Including imported canned consumption,[2] total fish consumption is estimated 33.9 kg. In comparison with estimated fish consumption per year per person in 1980 in various countries such as 21 kg in Tonga, 60 to 80 kg in Tuvalu, 20 to 40 kg. in Solomon Islands, 6 kg in U.S.A, 70 kg in Japan, 11 kg in Indonesia, and 32 kg in Phillipines, this value of 33.9 kg seems to be in a Pacific level as a country surrounded water with abundant marine resources. However, shortage of facilities to store excess fish in good fishing seasons and underdeveloped fish processing may still disturb increase of fish consumption in Palau.

1) $155{,}300^{kg} \div 0.6 \div (9{,}419 + 510) = 26.1$ kg./person

2) Imported canned fish is 108.3 tons in 1984. This shows its consumption per person as 7.8 kg.

Appendix V - 3 Sales plan

Material	Product	Sales foam
Red snapper (S)	S.S.D.	sales by weight
Red snapper (L)	M.S.	500 g vacuum bag
-------ditto-----		80 g vacuum bag
White snapper (S)	S.S.D.	sales by weight
Parrot fish (S)	S.S.D.	sales by weight
Grouper (S)	S.S.D.	sales by weight
Grouper (L)	M.S.	500 g vacuum bag
------ditto------		80 g vacuum bag
Spanish mackerel	S.S.	500 g vacuum bag
		80 g vacuum bag
Skipjack	F.J.	200 g vacuum bag
		50 g vacuum bag

Product weight (kg.)	Number of Product	Target price (US$)	Sales income
2,280	---	3.85$/kg (1.75$/lbs.)	6,498
500	1,000 bags	6$/bag	5,000
200	2,500 bags	1.25$/bag	3,125
22,800		3.85$/kg.	87,780
11,400		3.85$/kg.	43,890
3,800		3.85$/kg.	14,630
500	1,000 bags	6$/bag	6,000
200	2,500 bags	1.25$/bag	3,125
700	1,400 bags	8$/bag	11,200
125	1,562 bags	1.5$/bag	2,343
1,000	5,000 bags	3$/bag	15,000
400	8,000 bags	1$/bag	8,000
43,905	22,962 bags		207,481

Appendix V - 4 Operation cost estimation

1) Material purchase 1) 90,638 US$

Skipjack; 35¢/lbs x 8,000 kg ÷ 0.454 = 6167

Other; 65¢/lbs x 59,000 kg ÷ 0.454 = 84,471

2) Utility 2) 10,295 US$

a. Electricity 31.5 kw x 12 hrs/day x 300 days/year x 0.09$/kwH = 10,206

(288 days are required to dry total treated weight of 57,450 kg by the existing drier of 200 kg/day capacity).

b. Water 670 tons x 50¢/1000 gals ÷ 3,785 = 89

3) Manpower 6,000$/year x 3 persons 3) 18,000 US$

(Table 3-3-3)

4) Processing material 4) 23,807 US$

a. Smoke liquid (used for medium and soft smoking and fish jerky)

7,100 kg x 8% x 110$/20kg = 3,124

b. Salt

57,450 kg x 5% x 1$/kg = 2,873

c. Seasonings (sodium glutaminate, etc)

57,450 kg x 0.1% x 10$/kg = 575

d. Preservatives

57,450 kg x 0.3% x 100$/kg = 17,235

5) Packing material 5) 2,296 US$

Vacuum sealing bag 22,962 bags x 10¢/bag = 2,296

6) Maintenance 6) 3,000 US$

Total —— 148,036

Addendum to: Appendix III

[F] Case F ; Medium smoked fillet

1. Material

(scientific name)	(English/local name)	(length)	(weight)
-	gruoper / Tiau	80 cm(head off)	

condition; Material was of four months frozen stock of PFFA.
Fish was cut off head and stored.

2. Processing procedures

1) To thaw frozen fish in fresh water.

2) To treat fish into fillets block. Treated weight is 3.4kg. Convertion ratio is not measured because material was not whole fish.

3) To soak material in the smoking sauce for 17.5 hours.

Smoking sauce; water	4,600 cc	
Smoke liquid (SF-5)	400 cc	(8%)
Salt	280 g	(5.6%)
Seasonigs(Sodium gultaminate)	some	(about 1g)
Preservatives (TE-20)	5 cc	(0.1%)

4) To dry soaked material

9:30-10:30 (1 hour)	Drip off smoking sauce
10:30-15:30 (5 hours)	Hot air drying with heating at 65°C(150°F)
15:30-17:00 (1.5 hours)	Hot air drying with heating at 80°C(175°F)

3. Final product

Final product was medium smoked one. Final weight was 2.7kg. Convertion ratio from treated material is 79%.

4. Panel taste

Hard type smoke liquid seemed to little bit strong for grouper. Medium type (SF-3) is better for this product.Salty taste seems to be acceptable for Pplauans and foreigners.

[G] Case G ; Fish jerky

1. Material

(scientific name)	(English/local name)	(length)	(weight)
Thunnus albacares	Yellowfin tuna/Kerengab	80 cm	3.2 kg

Condition ; Material is fresh one in good preservation.

2. Processing procedures

1) To treat fish into fillet and cut into jerky bars. Treated weight was 1.8kg. Convertion ratio is 57%.

2) To soak material in the smoking sauce for 15.5 hours.

Smoking sauce ;	water	1,880 cc
	smoke liquid (SF-5)	120 cc (6%)
	salt	100 g (5%)
	seasonings(sodium gultaminate)	some (about 1g)
	preservatives (TE-20)	3 cc (0.15%)

3) To dry soaked material

9:30-10;00 (30 min.)	Drip off
10:00-19:00 (9 hours)	Hot air drying with heating at 65°C (150°F)

3. Final product

The product was hard dried fish jerky bars. Final weight was 630g. Convertion ratio from treated material is 35% and 19.7% from raw material.

4. Panel taste

Taste and texture are accepted by Palauan panelists who also feel that the product is acceptable for foreign turists as survenirs.