

2. REVIEW OF PAST SECTOR PLANS AND PROGRAMS

2.1 Summary of Sector Development Plans and Programs

In 1990s three multi-sector studies are done in Palau. They are (1) Economic Development Plan Fiscal Year 1995-1999, (2) Palau National Master Development Plan, and (3) Sustainable Human Development in Palau, Progressing with the Past. The objectives of development, development strategies, development plans and programs are reviewed here.

2.1.1 Economic Development Plan

Economic Development Plan (EDP) was prepared by the Government of Palau in order to conclude the Free Compact Association with the US Government on May 1994. The fund of Capital Infrastructure Projects (CIP) supported by the Compact Fund was to be used according to an agreement upon plan. The report consists of two volumes. The first volume has an introduction of geography, history, and political structure in Palau, and a review of the national economy. The second volume has analyses of 15 sectors.

(1) National Development Objectives

The followings are positioned as national development objectives.

- National self-reliance;
- Development of natural and human resource with the protection of natural environment and culture;
- Balanced regional development.

(2) Development policies and strategies

Based on the national development objectives, the following development policies and strategies were set.

- Development of a self-reliant market economy;
- Reducing the weight of the public sector;
- Development of natural assets to generate income;
- Development of human resource;
- Balanced regional development and integration; and
- Conservation of environmental and cultural assets.

Economic development by the use of natural resource, infrastructure was considered, and economic development with vital private economic activities was also intended.

(3) Plans, projects and programs of major sector

With consideration of development policies and strategies, and current condition of each sector, the followings sector plans, projects, and programs were listed.

Tourism was positioned as leading sector of Palau, and the government was recommended to support tourism development by the improvement of access to Palau and access within Palau, the improvement of accommodation and attraction, and enhancement of tourism promotion.

Agricultural includes enhancement of subsistence production, diversification of agricultural production, research and development for agric-business, etc.

Land transportation includes building and maintenance of National Roads, access roads to communities, farming and others connecting with the Compact Road, the installation of traffic signals in Koror.

Sea transportation includes the improvements of harbor facilities channel dredging in islands, the improvement of small boat navigation aid, the completion of the unfinished graving dock at Malakal, and the study on new commercial dock at the west coast of Babeldaob, etc.

Air transportation includes the improvement of International Airport facilities, formulation of a civil aviation code, study on upgrading the International Airport, and allowing Japanese air carrier to provide direct freight service.

Communication includes the improvement of central office, electric equipment, outside plants, stations, and development of new central office in Airai.

Energy includes the establishment of Public Utility Corporation, the increase of power generating capacity in many areas, the upgrading power grid, the installation of electric consumption meters, etc.

Water supply includes the upgrade of Koror-Airai system, the installation of meters, and study on water source for Koror-Airai, etc.

Wastewater and solid waste disposal includes the expansion of Koror sewer collection system, the development of alternative public dumpsite, etc.

Environmental and pollution control includes the improvement of environmental review process, human resource development of Environmental Quality Protection Board (EQPB) staffs, the strengthening enforcement program, and the strengthening environmental education.

Health includes the new developments of Belau National Hospital and dispensaries, human resource development of medical professionals, the enhancement of the Ministry of Health, the establishment of national health insurance program, etc.

Education includes the renovation and maintenance of school facilities, and educational program such as adult education and vocational training.

2.1.2 National Master Development Plan

National Master Development Plan are prepared by Australian consultant, SAGRIC International Pty Ltd and submitted to the Government on April 1996. This is the first long-term national development plan after the independence. The report consists of three volumes. The first is main report, and the second and the third are sector report. The main report has 16 chapters, and describes development target setting, macro-economic framework, financial development, and brief sector development plans. The sector reports say the analysis of current conditions, identification of constrain and development potential, and formulation of sector development plan by each sector.

(1) Development vision and goals

The report says that the development vision of Palau is "to substantially enhance the quality of life of Palauans and future generations of Palauans." To achieve this vision, there are three development goals.

- Increase real economic growth per capita on a sustainable basis;
- Share the benefits of economic growth on an equitable basis, but in ways that still reward enterprise, risk taking and hard work, and allow foreign workers and investors genuine stake in development; and
- Enrich and enhance confidence in the Palau culture raise national consciousness,

and protect the natural environment of Palau.

(2) Development strategies of major sector

Development strategies in major sector are listed as follows.

Infrastructure

- Provide on a sustainable basis, the required infrastructure funding and services in an efficient manner and of a high standard throughout Palau to improve equitable access and underpin the expansion of economic activity;
- Improve the performance of the Government's corporate and service entity by creating a more commercial and competitive environment, formalizing the relationship with Government, clarifying objectives, improving pricing structures and performance measurement and establishing a prices' regulation function; and
- Enhance the performance of public sector investment programs and projects by improved evaluation, prioritization, and monitoring techniques incorporated in an investment program process.

Tourism

- Maximize the contribution of the tourism sector to the Palauan economy by developing a private sector framework conducive to tourism growth, promoting and monitoring tourism developments, and ensuring the necessary controls and charging systems are established to protect the natural environment and cultural interests.

Agriculture

- Maintain subsistence agricultural protection, but diversify and significantly increase the level of agricultural production both for import replacement and export, taking into account conservation practices.

Marine Resource and Natural Environment

- Achieve greater returns on a sustainable basis and increased local involvement from Palau's offshore and onshore marine resources, while maintaining adequate extraction levels for subsistence and the protection of the natural marine environment for tourism and cultural purpose;
- Improve the protection of the natural environment, or at least measure and make transparent the cost of degradation, through formalizing and streamlining environmental requirements and processes, integrating these into the decision making process, and improving management and education of environmental issues.

Human Resource Development

- Collect and analyze comprehensive population information to assist the development of policies and programs, particularly in relation to the labor market, education and health planning, disadvantaged groups, and family programs;
- In partnership with parents and the community, ensure that Palauan children, youth and citizens are educated and trained in a cost effective manner to achieve their maximum individual potential and become contributing citizens and productive workers in a changing world, while the same time protecting Palauan cultural attitudes and ways; and
- Provide improved health services to the whole populations to high standard in an equitable and cost effective manner, with a greater emphasis on the delivery of preventive and primary care and improved management of secondary and tertiary care.

2.1.3 Sustainable Human Development in Palau

Palau National Committee on Population and Children (CoPoChi) prepares this report with the cooperation of United Nations Development Program (UNDP) in March 1997. The characteristics of the report are focused on human development promoted by UNDP, and on development sustainability.

(1) The viewpoint of the report

The report evaluates that current development situation of Palau is moderate in comparison to other developing countries in the world. This is made possible by the combinations of (1) abundant natural resources, (2) a cultural tradition of sharing, caring, and respect, (3) the fortunes of history, which have recently bestowed by upon Palau significant monetary wealth. But, the report says, it is brought about the foreign aid, foreign labor, and the consumption of natural environmental resources, and Palauan people have to challenge some development issues.

(2) Strategies for sustainable human development

The report suggests the following strategies for sustainable human development. The purpose to set these strategies is to establish a balanced development plan for maintaining the natural environment as well as keeping Palauan tradition and culture.

- Balanced population growth with the carrying capacity of Palau's environment and infrastructure;
- Ensure that Palauans retain majority among the resident population;
- Reduce Palauan out-migration and encourage overseas Palauan to return to Palau;
- Stimulate controlled economic development in accordance with environmental and infrastructure carrying capacity;
- Achieve sustainable tourism development;
- Develop Palau's marine industry to provide a sustainable source of food and income for future generations;
- Increase sustainable agriculture production;
- Enhance production in the informal economic sector;
- Increase participation and earnings of Palauans from the construction industry;
- Preserve and protect Palau's environmental resources for future generations;
- Continue to improve the health of Palauans;
- Achieve universal education of a high standard in grades K-12 for all Palauans;
- Develop Palau's human resources in keeping with the requirement of nation building and enhance Palauan economic productivity; and
- Promote equitable distribution of income with special attention to narrowing the rural-urban disparity.

2.1.4 Sector Investment Plan and Programs

Table 2.1.1 summarizes the net investment and maintenance cost for social and economic infrastructure as estimated originally in Palau's first National Development Master Plan, 1994.

As has been observed before already, development targets outlined in this master plan have, for whatever reason, not been adhered to. It is, notwithstanding this fact, interesting the note for illustrative and comparative reasons the key features and outlays indicated in this well prepared document:

Total investment outlays for the decade 1995 to 2004 were estimated at \$582.61 million or roughly equivalent factor 5.5 the size of the ROP's 1995 economy of \$105 million.

The above estimate would translate into an annual average of \$58.3 million for both, net-investments and maintenance.

Total investment outlays for the decade 1995 to 2004 for net-investments alone were estimated at \$495.74 million or roughly equivalent factor 4.7 the size of the ROP's 1995 economy of U.S. dollar. Total maintenance cost was estimated at \$86.9, roughly equivalent to factor 0.8 of the ROP's 1995 GDP size; or 8.3 percent of 1995 GDP size on an annualized basis. Total maintenance expenditures were roughly 18 percent of total net-investment outlays.

Table 2.1.1 Investment & Maintenance Cost First Development Plan 1994

(Unit: \$ million)

Sector/ Sub-sector	Cost	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Water Supply	Capital Cost	0.79	2.75	11.50	8.50	2.95	3.00	0.00	0.00	0.00	0.00	29.49
	Maintenance	0.47	0.47	0.97	0.97	0.97	1.23	1.55	1.63	1.63	1.63	11.52
	Sub-total	1.26	3.22	12.47	9.47	3.92	4.23	1.55	1.63	1.63	1.63	41.01
Wastewater	Capital Cost	2.60	6.10	0.95	0.70	0.60	0.90	0.75	0.50	0.50	0.50	14.10
	Maintenance	0.50	0.50	0.65	0.70	1.05	1.01	1.14	1.14	1.14	1.14	8.97
	Sub-total	3.10	6.60	1.60	1.40	1.65	1.91	1.89	1.64	1.64	1.64	23.07
Waste Management	Capital Cost	0.45	3.82	1.17	0.22	0.07	0.00	0.00	0.00	0.00	0.00	5.73
	Maintenance	0.05	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.30	0.30	1.90
	Sub-total	0.50	3.97	1.32	0.37	0.27	0.20	0.20	0.20	0.30	0.30	7.63
Power Systems	Capital Cost	12.97	19.95	13.35	26.57	21.93	26.50	8.50	0.00	0.00	0.00	129.77
	Maintenance	0.00	0.32	0.60	1.48	1.88	2.92	4.32	3.37	4.13	4.13	23.15
	Sub-total	12.97	20.27	13.95	28.05	23.81	29.42	12.82	3.37	4.13	4.13	152.92
Telecommunications	Capital Cost	16.13	9.87	5.62	3.82	6.11	0.00	0.00	0.00	0.00	0.00	41.55
	Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sub-total	16.13	9.87	5.62	3.82	6.11	0.00	0.00	0.00	0.00	0.00	41.55
Road Construction	Capital Cost	0.50	1.80	9.10	10.00	12.60	11.00	7.50	10.00	10.00	9.38	81.88
	Maintenance	0.35	0.35	0.35	0.40	0.52	0.68	0.82	1.02	1.72	2.37	8.58
	Sub-total	0.85	2.15	9.45	10.40	13.12	11.68	8.32	11.02	11.72	11.75	90.46
Port & Marine	Capital Cost	2.25	7.40	22.65	18.50	15.50	6.00	0.00	0.00	0.00	0.00	72.30
	Maintenance	0.00	0.00	0.26	0.53	0.73	0.74	1.07	0.79	1.00	0.00	5.12
	Sub-total	2.25	7.40	22.91	19.03	16.23	6.74	1.07	0.79	1.00	0.00	77.42
Airport Facilities	Capital Cost	6.85	9.05	11.62	4.50	10.00	10.00	0.00	0.00	0.00	0.00	52.02
	Maintenance	0.25	0.26	0.73	0.72	1.05	0.94	1.46	1.47	1.50	2.52	10.90
	Sub-total	7.10	9.31	12.35	5.22	11.05	10.94	1.46	1.47	1.50	2.52	62.92
Transportation	Capital Cost	2.10	0.00	3.60	0.00	0.65	0.00	0.00	0.00	0.00	0.00	6.35
	Maintenance	0.00	0.20	0.20	0.27	0.27	0.61	0.33	0.33	0.41	0.39	3.01
	Sub-total	2.10	0.20	3.80	0.27	0.92	0.61	0.33	0.33	0.41	0.39	9.36
Government Buildings	Capital Cost	4.30	5.50	6.75	6.00	8.00	7.50	7.00	7.00	7.00	3.50	62.55
	Maintenance	0.30	0.30	0.46	1.15	1.47	1.72	1.82	2.02	2.24	2.24	13.72
	Sub-total	4.60	5.80	7.21	7.15	9.47	9.22	8.82	9.02	9.24	5.74	76.27
TOTAL	Capital Cost	48.94	66.24	86.31	78.81	78.41	64.90	23.75	17.50	17.50	13.38	495.74
	Maintenance	1.92	2.55	4.37	6.37	8.14	10.05	12.71	11.97	14.07	14.72	86.87
	Total	50.86	68.79	90.68	85.18	86.55	74.95	36.46	29.47	31.57	28.10	582.61

Source: Palau National Master Development Plan (First Draft, 29 July 1994)

2.2 Implementation Status of Selected Projects

Though the information is limited, Table 2.2.1 to 2.2.11 attempt to summarize the current implementation status of selected social and economic infrastructure projects.

Table 2.2.1 Status of Capital Infrastructure Projects (as of April 2000)

(Unit: \$ thousand)

Category	Project Name	Grant Amount	Status
On-Going Project	1. Koror-Airai Road Repair Project Phase I (T-227)	1,269	Completion
	2. Palau Rural Water Systems Project (T-209)	9,985	Completion
	3. Koror Sewage Treatment Plant Expansion (T-232)	3,500	Under Bidding
	4. Koror Wastewater System Improvements (T-224)	1,790	Completion
	5. Koror Wastewater System Deficiencies Repair (T-225)	554	Completion
	6. Koror-Babeldaob Bridge Repair (T-226)	2,380	Completion
	7. Koror-Airai Water System Improvements (T-231)	500	Completion
	8. Koror Wastewater System Pump Station Up-grade (T-233)	483	Completion
	9. Koror Electric Power System Improvements	1,452	Completion
	10. Babeldaob & Outer Island School Rehabilitation (T-230)	384	Completion
	11. Koror Jail Rehabilitation Project (T-246)	795	Completion
	12. Palau Classroom Construction Project (T-228)	1,310	Completion
	13. Koror School Complex Roofing Project (T-229)	646	Completion
	14. Palau International Airport Taxiway & Parking Apron Repair (FAA)	1,000	Completion
	15. Malakal & M-Dock Sewer Extension Projects (EPA)	870	Completion
	Total	26,918	23,418 had spent
Prioritized Projects	1. Koror Sewer Collection System Improvement	2,500	Completion
	2. Palau National Water Systems Improvement Project	5,000	Completion
	3. National Road Improvement/Repair Project and National Heavy Equipment Control Office and Asphalt Plant	7,885	Only Asphalt Plant (2,700)
	4. Palau National Power Plants Rehabilitation	8,500	Completion
	5. Palau National Gymnasium and Sports Facilities Project	3,500	Completion
	6. New Airport Terminal Construction	6,000	
	7. Palau National Education Facilities Renovation, Construction and Equipment Replacement	6,000	
	8. National Health Facilities Improvement Project	3,500	
	9. State Projects	4,000	
	10. Palau National Capital Construction Phase I	5,000	Completion
	Sub-total	51,885	27,200 had spent

Source: Economic Development Plan, Fiscal Years 1995-1999

Table 2.2.2 Status of Capital Infrastructure Projects (as of April 2000)

(Unit: \$ thousand)

Category	Project Name	Grant Amount	Status
Un-prioritized Projects	1. Babeldaob & Outer Island School Rehabilitation and Construction	1,450	
	2. Intra-Babeldaob Access Roads Project Phase I	7,700	
	3. Outer Island Electric Power System	3,600	Completion
	4. Koror-Airai Water Systems Improvements	3,750	
	5. Babeldaob Electric Power Transmission and Distribution Project	9,950	Completion
	6. Palau National Capital Construction Phase II	12,500	
	7. Palau National Museum and Library Complex	2,700	
	8. New Palau Prison Facility Project	2,500	
	9. Supreme Court Annex	1,400	
	10. Babeldaob & Outer Islands Police Substations Construction	900	
	11. Ship Purchase/Inter-Island Transportation	1,500	
	12. New Palau High School Construction Project	12,500	
	13. Palau Senior Citizens Center	1,500	
	14. Ministry of Administration Computer Center	2,500	
	15. Relocation and Expansion of Agricultural Station to Nekken, Aimeliik State	600	
	16. New Office Complex for Bureau of Natural Resources and Development, including Marine Resources Division, and Conservation/Entomology Office	200	
	Sub-total	62,250	13,550 had spent
Total		141,053	64,168 had spent

Source: Economic Development Plan, Fiscal Years 1995-1999

Table 2.2.3 Remaining Program/Project for Water Supply

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau Water and Waste Corporation (PWWC)	2.00
2	Detailed design of additional water storage dam	0.25
3	Construction of additional water storage dam, pipeline, access roads, power supply	15.0
4	Upgrade of existing State Water Supply Systems, Peleliu and Angaur	3.0
	Total Capital Cost of Program/Project	20.25

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.4 Remaining Program/Project for Wastewater

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau Water and Waste Corporation (PWWC)	Included in Water Supply
2	Modification and Expansion of the Malakal Wastewater Treatment Plant	7.35
3	Underlake the programs recommended in the Wastewater Facilities Plan for the 15 other States, including construction of package treatment plants in Angaur and Peleliu	1.25
4	Purchase of Sludge Handling Equipment	0.20
5	Sludge Processing by Vermiculture – Experimental Program (Airai)	0.30
6	Additional Maintenance funds for maintenance of pumping station in Koror	0.75
7	New Workshop, Store and Laboratory at Treatment Plant	0.25
8	General Capital Works – upgrading and extension of systems in Koror and States 2000-2005 due to population growth and movement	3.00
	Total Capital Cost of Program/Project	13.10

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.5 Remaining Program/Project for Waste Management

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau Water and Waste Corporation (PWWC)	Included in Water Supply
2	Construction of major new dump for Koror – Airai area, plus construction of improved dumping facilities in northern States of Babeldaob, Peleliu, Angaur and Kayangel	1.20
3	Construction of 3-4 Waste Transfer and Recycling Stations in Koror-Airai	0.50
4	Provision of Waste Collection Bins, Collection Vehicles, Heavy Equipment for dump management and maintenance facilities	2.50
5	Provision of Vehicle (Compactor)	0.80
	Total Capital Cost of Program/Project	5.00

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.6 Remaining Program/Project for Electric Power Development

	Name of Program/Project	Estimated Cost (\$ million)
1	Purchase of prime mover and complete the installation of the fifth 3.2 Mw unit at Aimelik Power Station	5.50
2	Feasibility study on conversion and overhaul of private power station at Airai	0.20
3	Overhaul of 2 x 7 Mw units and conversion to 60 Hertz Power	1.50
4	Purchase of 2 x 7 Mw units Power Station	On negotiation
5	Purchase and install new base load units with a capacity of 16 – 20 Mw at Malakal Station, including overhaul and relocation of serviceable "old" Malakal units to strategic locations on Babeldaob Island for emergency/standby purposes.	25.00
6	Planning and development of new 20 Mw (2 x 10 Mw units) coal fired base load station	35.00
	Total Capital Cost of Program/Project	67.20

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.7 Remaining Program/Project for Road Construction

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau Road and Port Corporation (PRPC)	2.00
2	National Highway on Babeldaob Island	41.00
3	National Highway in Koror State (Reef Road)	15.00
4	Reconstruction of Urban Road System Phase I	18.00
5	Reconstruction of State Roads (Main and Secondary Roads)	5.88
	Total Capital Cost of Program/Project	81.88

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.8 Remaining Program/Project for Ports and Marine

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau Road and Port Corporation (PRPC)	Included in Road
2	Master Plan Study of Malakal Harbor	0.25
3	Development of Malakal Harbor	20.00
4	Commercial Bulk Port at Gamliangle Bay	15.00
5	Ebaduf's Pier – Tourist and Transportation Center	10.00
6	Dry Dock Feasibility Study	0.15
7	Dry Dock Rehabilitation and Development	7.00
8	State Navigation Beacons and Markers	10.00
	Total Capital Cost of Program/Project	54.90

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.9 Remaining Program/Project for Airport Facilities

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau Airports Corporation (PAC)	2.00
2	Construction of Temporary Terminal building at Airai	1.50
3	Construction of New Terminal Building and Facilities at Airai	6.00
4	Extension of Aircraft Parking Apron and Additional Taxiway	2.00
5	Development of Air Cargo Handling Terminal and Taxiway	5.00
6	Airai Runway Improvement Study	0.15
7	Improvement of Water Supply and Emergency Power Supply to Airport	0.75
8	Second International Airport Design and Documentation Study	1.50
9	Construction of Second International Airport	20.00
10	Provision of Improved Terminal Facilities at Peleliu and Angaur Airports	0.20
11	Investigation, Design and Documentation of Domestic Airports in 3 States	0.60
12	Development of Kayangel Airport	2.50
13	Development of Sonsorol Airport	1.50
14	Development of Hatohebel Airport	1.50
15	Purchase of STOL Aircraft (Shorts 360 – 300)	3.50
	Total Capital Cost of Program/Project	48.70

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.10 Remaining Program/Project for Transportation

	Name of Program/Project	Estimated Cost (\$ million)
1	Institutional Strengthening of Transportation Division within the Ministry of Commerce and Trade	0.15
2	Feasibility Study of Bus Transportation	0.05
3	Bus Transportation Project	0.60
4	Feasibility Study of Marine Transportation	0.05
5	Marine Transportation Project	2.00
	Total Capital Cost of Program/Project	6.35

Source: Study Team (based on Palau National Master Development Plan and CIP Report)

Table 2.2.11 Remaining Program/Project for Government Buildings

	Name of Program/Project	Estimated Cost (\$ million)
1	Establishment of Palau National Building Corporation (PNBC)	2.50
2	Establishment of Palau National Insurance Office (PNIO)	0.75
3	Palau National Education Facilities Project (\$3.40 million of \$6.00 million had been spent for projects)	2.60
4	Palau National Health Facilities Improvement Project (\$0.90 million of \$3.50 million had been spent for projects)	2.60
5	Government Building Development Project (\$1.04 million of \$25.80 million had been spent for projects)	24.76
6	National Capital Development Project (\$5.00 million of \$17.50 million had been spent for phase I)	12.50
7	Housing Development Loan	3.00
	Total Capital Cost of Program/Project	6.35

Source: JICA Study Team (based on Palau National Master Development Plan and CIP Report)

2.3 Infrastructure Development Project up to 2020

It is estimated that a total of \$473.7 million will be needed over the 20-years period 2000 to 2020, in order to maintain all the intended projects. Among the cost, 56 percent of that total is needed for the implementation of net-investments, and the balance of \$206.8 million, or 44 percent of the total for maintenance expenditures.

It is furthermore estimated that total outlays before 2009, the year in which COMPACT funding is to end, will have to be around \$335.7 million, equivalent to around 71 percent of the 20-years total. The split of the pre-2009 expenditure outlay is \$266.89 million for net-investments (80 percent of that total), and \$68.8 million for maintenance expenditures.

Net-investment outlays are programmed to realize by 2006, with the largest outlays to be implemented in 2002 (\$62.70 million) and 2003 (\$68.10 million).

Table 2.3.1 Schedule of Remaining Infrastructure Development up to 2020

Category	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL	(Unit: US\$ million)	
Water Supply	Capital Cost	0.00	0.75	0.50	8.00	5.80	5.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.25	
	Maintenance	0.00	0.73	0.73	0.73	0.73	1.49	1.59	1.59	1.59	1.59	2.00	2.05	2.05	2.05	2.05	2.46	2.51	2.51	2.51	2.51	2.51	34.20	
	Sub-total	0.00	1.48	1.23	8.73	6.53	5.93	1.49	1.59	1.59	1.59	2.00	2.05	2.05	2.05	2.05	2.46	2.51	2.51	2.51	2.51	2.51	54.45	
Wastewater	Capital Cost	0.00	5.30	5.05	0.95	0.90	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.10	
	Maintenance	0.00	0.50	0.80	0.80	0.80	0.97	1.07	1.07	1.07	1.07	1.24	1.34	1.34	1.34	1.34	1.51	1.51	1.51	1.51	1.51	1.51	23.10	
	Sub-total	0.00	5.80	5.85	1.75	1.70	1.70	0.97	1.07	1.07	1.07	1.24	1.34	1.34	1.34	1.34	1.51	1.51	1.51	1.51	1.51	1.51	36.20	
Solid Waste	Capital Cost	0.00	0.00	0.00	1.25	3.60	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	
	Maintenance	0.00	0.05	0.05	0.05	0.15	0.15	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.40	0.40	0.40	0.40	0.40	0.40	4.95	
	Sub-total	0.00	0.05	0.05	1.30	3.75	0.30	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.40	0.40	0.40	0.40	0.40	0.40	9.95	
Road Construction	Capital Cost	0.00	5.30	19.10	20.00	19.48	11.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.88	
	Maintenance	0.00	0.42	0.58	0.87	1.12	1.67	2.22	2.72	3.12	2.72	2.72	2.72	3.12	3.12	2.72	2.72	2.72	3.12	3.12	2.72	2.72	46.16	
	Sub-total	0.00	5.72	19.68	20.87	20.60	12.67	9.22	2.72	3.12	2.72	2.72	2.72	3.12	3.12	2.72	2.72	2.72	3.12	3.12	2.72	2.72	128.04	
Port & Marine	Capital Cost	0.00	11.15	19.00	18.75	5.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.90	
	Maintenance	0.00	0.53	0.02	0.44	0.28	0.42	0.54	1.15	0.65	0.85	0.96	1.13	1.03	1.82	1.08	1.44	1.59	1.45	1.48	2.29	1.51	20.66	
	Sub-total	0.00	11.68	19.02	19.19	5.78	0.92	0.54	1.15	0.65	0.85	0.96	1.13	1.03	1.82	1.08	1.44	1.59	1.45	1.48	2.29	1.51	75.56	
Airport Facilities	Capital Cost	0.00	4.20	8.70	11.30	4.50	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.70	
	Maintenance	0.00	0.25	0.25	0.81	0.70	0.98	1.10	1.38	1.55	1.45	1.40	1.45	1.60	1.72	1.65	1.72	1.65	1.94	1.90	1.99	1.90	27.39	
	Sub-total	0.00	4.45	8.95	12.11	5.20	10.98	11.10	1.38	1.55	1.45	1.40	1.45	1.60	1.72	1.65	1.72	1.65	1.94	1.90	1.99	1.90	76.09	
Transportation	Capital Cost	0.00	5.60	0.00	0.10	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.35	
	Maintenance	0.00	0.00	0.27	0.27	0.35	0.27	0.33	0.41	0.33	0.33	0.47	0.39	0.39	0.47	0.39	0.39	0.47	0.39	0.39	0.47	0.39	7.17	
	Sub-total	0.00	5.60	0.27	0.37	0.35	0.92	0.33	0.41	0.33	0.33	0.47	0.39	0.39	0.47	0.39	0.39	0.47	0.39	0.39	0.47	0.39	13.52	
Governmental Buildings	Capital Cost	0.00	11.11	10.35	7.75	4.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.71	
	Maintenance	0.00	1.57	1.77	1.99	1.99	1.99	2.24	2.34	2.24	2.24	2.24	2.24	2.34	2.24	2.24	2.24	2.24	2.24	2.34	2.24	2.24	43.21	
	Sub-total	0.00	12.68	12.12	9.74	5.99	5.49	2.24	2.34	2.24	2.24	2.24	2.24	2.34	2.24	2.24	2.24	2.24	2.24	2.34	2.24	2.24	79.92	
TOTAL	Capital Cost	0.00	43.41	62.70	68.10	43.78	31.90	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	266.89	
	Maintenance	0.00	4.05	4.47	5.96	6.12	7.01	9.09	10.76	10.45	10.65	11.47	11.67	13.16	11.77	12.20	13.04	13.16	13.65	14.13	14.13	13.18	206.84	
	TOTAL	0.00	47.46	67.17	74.06	49.90	38.91	26.09	10.76	10.85	10.45	10.65	11.47	11.67	13.16	11.77	12.20	13.04	13.16	13.65	14.13	13.18	473.73	

Source: JICA Study Team

Note: Modified schedule based on the NMDP and study recommendation

3. AGRICULTURE

3.1 Existing Condition

Farm Households

The total number of the farming household in Palau is reported 2,844 in 1994. Among them, however, only 16 of them are full-time farm household. Women of the families take care of most part of their agricultural work, when they have a time to spare from their housework.

Table 3.1.1. Shows that almost half of the holdings have less than 0.29 acreages.

Table 3.1.1 Holdings by Size

Size	Holdings (Acreage)	Ratio	Accumulated
0.01-0.09	144	0.15	0.15
0.10-0.19	208	0.22	0.37
0.20-0.29	108	0.11	0.48
0.30-0.39	104	0.11	0.59
0.40-0.49	64	0.07	0.66
0.50-0.74	128	0.13	0.79
0.75-0.99	56	0.06	0.85
1.00-1.99	100	0.11	0.96
More than 2.00	40	0.04	1.00
Total	952	1.00	2.00

Source: Agricultural Census in 1994

Agricultural Products

Table 3.1.2 shows the values and the quantity of the major agricultural products in Palau.

Table 3.1.2 Major Products

(Unit: Pound)

Fruits		Vegetables		Staple Crops	
Banana	96,325	Watermelon	100,319	Cassava	101,665
Coconut Drink	82,310	Cucumber	67,625	Taro	91,440
Lemon	56,548	Pumpkin	51,256	Cytosperma	63,157

Source: Statistical Year Book in 1998

Fruit Flies

Oriental Fruit Fly was first recorded in the ROP in September 1996 under the auspices of Regional Management of Fruit Fly in the Pacific, FAO. According to the surveillance, the spreading level of the Fruit Fly is epidemic and guava, star fruit, banana, soursop and papaya are particularly heavily infested. In addition, the flies also damage on citrus, avocado and capsicum as well as various vegetables of eggplant family.

Land Suitability Potential for Agriculture

According to the "Soil Survey of Island of Palau" and Land Use Inventory of Babeldaob", there are seven major soil categories, Nekken-Ollei complex, Ngardock silt loam, Ngaptang silty clay, Ngedebus sand and Palau Aimeliik complex. This category of land accounts for around 5.2% of the total area of Palau. One of them is Potential High Intensity Use, which is indicated as suitable land for clean-tilled crop production.

Slope is another important factor to examine for the suitability of Palauan agricultural industry. Given the condition of less than 6% of slope, the areas are confined to 717 hectares.

Consumption Characteristics

As tabulated below, the agricultural output in Palau is far less for the self-sufficiency. Table 3.1.3 sets forth the estimation of staple food consumption in 1997/98.

Table 3.1.3 Estimation of Staple Food Intakes

Kinds	Intakes (pound)	Per Capita (lbs/ann)
Taro	725.6	39.3
Cassava	834.4	45.2
Other Roots	616.8	33.4
Sub-total	2176.8	117.9
Rice	2418.3	131.0
Potato	248	13.4
Wheat Flour	142.3	7.7
Sub-Total	2808.6	152.2
Total	4985.4	270.1

Note: Population is estimated at 18,459 in 1998

Source: JICA Study Team

All major staple food is currently imported though small volume of local products is consumed for subsistence purpose. Taro and cassava are the major staple food before but it is now more common to eat rice, especially among the youth.

3.2 Problems and Issues**Food Security**

The enhancement of subsistence is one of the national issues with a view to reduce food import and to improve the balance of payment. It is the first step to increase the domestic subsistence.

Inadequate Market System

There is no stable market system even in Koror State. This is consequently discouraging the farmers to produce surplus products.

Unification of Products

Every household is growing almost the same products such as taros and cassavas. Expanding the variety of the products should be encouraged.

Primitive Technique

There is no large-scale agricultural farm in Palau at the present and no public broadcasting service to inform the weather forecast. In order to improve the domestic subsistence, the government has to inform the public the recent agricultural technique, such as better nursery plants or harmful insects. Also utilizing the public service to exchanging information about local farm management, such as organizing small markets, announcing any information about planting or input fertilizer, would be helpful and encourage the domestic agricultural activities.

3.3 Projects and Programs

In order to improve and develop the current agricultural sector, implementation of elaborated and phased plan is indispensable.

3.3.1 Promotion of Food Production**(1) Improvement of plant nursery****Findings**

Presently, those seedlings are distributed to farmers without charge. Despite a large demand for seedling in the lumber, fruit trees and vegetables, supply is very limited. It

is hindering the sound development of agriculture, forestry and horticulture. For instance, seedlings for lumber are grown at the Forestry Experiment Station located in Nekken. The products for scale are, however, rather small and far less to meet the annual demand in this country for 60,000 forest trees.

A Nursery Station for fruit trees is under construction adjacent to above station under Division of Agriculture and & Mineral Resources of the Ministry of Resource & Development. However the nursery have no services for delivery and farmers and/or persons entrusted by state government have to carry them to other farmers and there is no nursery specialized for vegetables. The following seeds would have demands:

Timber Trees: Swietenia mahogani (Mahogany), Pterocarpus indicus(Nara), Calophyllum inophyllum, Calophyllum cholebtaches, Serianthes kenahirae for timber industry, and Acacia (auriculiformis, mangium) for land preservation, and Rhizophora (apiculata, mucronate) for the conservation of Mangrove.

Fruit Tree: Avocado, Soursop, Guava, Rambutan, Mangosteen, Tangerine, Shakatou, and Betelnut.

Vegetables: Grafted seedling for eggplant family like Tomato, Eggplant, etc., and Watermelon, Head cabbage, Green Onion, Radish, Pumpkin, Shallot, Asparagus, Celery, Chinese kale, Cauliflower, Chive, Chinese parsley etc. for improved variety of seedling, Lemon Thyme, Chervil, Basil, Marjoram, Sage, Rosemary, Parsley, Ornamental Plants.

Recommendations

To increase the production scale of the Forestry Experiment Station from current production of 25,000 to targeted production of 60,000 seedlings per annum. To increase the production scale of seedling nursery for fruit trees from 2,000 to 20,000 per annum. In order to increase efficiency in the multiplication of seedling, a laboratory room related to Tissue Culture and some equipment for examination of various diseases should be provided in the nursery. To establish a new Supply Center for to improve vegetable seedlings particularly grafted seedlings of eggplant family. To provide temperature-controlled vehicles at about 15°C in order to deliver the seedlings produced at the nurseries to each state under the responsible of the Center.

The investment cost required for the above four components are roughly as follows:

- Extension and strengthening of seedling nursery of Forest Experiment Station;
- Extension of seedling production of new nursery for fruit tree;
- Establishment of vegetable seedling nursery;
- Vehicle; and
- Total tentative estimated costs for Nurseries.

(2) Extension of organic farm in Palau

Findings

Morita Farm in Ngeremlemgui State makes 400 tons of compost a year and grow vegetables on 2ha of land without using chemical fertilizers and agriculture chemicals. They are practicing genuine organic agriculture and shipping various kinds of vegetables like Chinese cabbage, cucumber, green onion and okra to markets in Koror. The vegetables have high reputation in their quality, good test and long durability even though the price is 20 to 30% higher.

Wild grass collected for material of compost is mainly Ishumum, which are grassing 20-30cm high, grown everywhere in the Babeldaob Island. The farm employs 29 Palauan workers, about 10 are exclusively engaged in cutting and collection of grass and are making of compost. It is beneficial to the areas where employment opportunity is limited.

Palauan people are traditionally used to preparing compost. It is common practices to dig down the root and put some organic matter when they grow taros or yams.

Recommendations

The above mentioned organic agriculture practiced in Morita Farm should be extended and spread into other states to contribute to the increase of production and to promote local employment opportunities. Presently many vegetable growers purchase compost made in the United States and put in their seedbed or between the ridges of the vegetable field. If organic farm will succeed, it would enable many more farmers to use large quantity of organic fertilizer with a low price. However, it is desirable to carry out this program with prudent considerations on the following two points. Cutting and collection of grasses required a vast land, hence the preliminary arrangement for the grass harvest is necessary. Also grass vegetation differs by area and state, hence it is necessary to select a vast land where the Ishmum grass can be collected. Necessary equipment, material and facilities for this project are as follows:

- Machines: 2 cutters, 1 forklift for mixing and turning over, and 3 of 5 tons trucks for work;
- Shed: Working shed (100m x 50m x 3m) and compost store spaces (100m x 20m x 2m); and
- Estimated cost of investment: US\$ 200,000 per 1 unit.

(3) Promotion of agricultural processing industry

Findings

Around \$1.5 million is spent to import these products. If the products can be substituted by domestic product, part of the balance of the payment in Palau will be improved. These products are as follows;

- Fruit related products: canned, juice and dry fruits;
- Edible oil; and
- Alcoholic beverage.

In terms of vegetables and fruits, Oriental Fruit Flies is a serious problem. Even if the fly were exterminated, many countries would not import vegetables and fruit produced in Palau until they are sure about its safety and there is no possibility of dissemination. If Palau delays to take proper counter-measure against Oriental Fruit Fly, she will not be able to export her products for a long time, 5 to 10 years or more. On the other hand, vegetables and fruits indicate an increasing trend. They would eventually overflow from the small Palauan markets and prices of those would slump sharply. The Government of Palau should seriously think the processing of fruits like fruit juice, canned fruits and dry fruits as a counter-measure of treatment of overflowed products.

Coconut is a good material for edible oil. Also it is possible to produce the edible oil in a large quantity by growing peanuts in the suitable places like Peleliu Island. If the production is developed and the oil is extracted, not only the oil for edible but also protein feed for piggery and poultry can be produced. Self-sufficiency in edible oil should easily be achieved by coconut and peanut.

As to alcoholic beverage, rum can be made from sugarcane, brandy from pineapples, yet both materials are abundant in Palau. One could produce a specialty product in Palau from material of rootstock abundant presently.

It implies that processing of food products, Agro-Industry may possibly become the motive to lead the agricultural economy in this country. A government's role is to prepare for a favorable environment and to assist smooth operation of the private

sectors. In other words, the Government should arrange proper business environmental conditions so that enterprises can overcome the obstacles. Fundamental business preconditions such as banking arrangement should be arranged immediately.

Recommendations

The government should arrange good business environmental conditions in the following aspects and try to induce private sectors;

- Offer convenience in financing mainly with low interest;
- Assist in solving problems related to land ownership; and
- Assist in technology transfer, such as provision of market information and well developed marketing facilities, and developing domestic markets as well as overseas markets.

The following agriculture processing industries have potentials.

- Business related agriculture: Production of food (rice) and feed (corn), Processing fruits (juice, canning, dry fruit, etc.), Production of local brand distillation;
- Utilization of existing resources: Utilization of coconut for feed of pig and poultry; Utilization of wild taro for feed
- Development of new source of agricultural production: Extraction of medicines from various herbs, Lemon grass and young papaya, Culturing edible frog and snails, Raising buffalo and ducks, and Noni juice.

In terms of Noni juice, the Noni juice production industry has already started in Fiji and other Pacific islands according to an article of Pacific Magazine in 1999. Since the Noni plants grow naturally in the ROP, there is high potential of Noni juice production industry in ROP. Also, the Noni fruit does not seem to be affected by the Oriental Fruits Fly.

In order to promote above business and the inducement of investors, it is necessary to strengthen the material supply system. For that purpose, it will be effective to unify the farming technology, marketing (sales), financing (capital) and other information in the form of cooperative societies. Forming of agricultural cooperative means the formation of a group of collaborators and driving forces of local development. Early realization of agricultural cooperative fit to the social and economic condition of this country is earnestly desired.

(4) Study on production of domestic animal feed

Findings

Frozen meat imported by the Republic of Palau from October 1998 to September 1999 and the pork and eggs domestically produced in one year from October 1997 to September 1998 are shown in Table 3.3.1.

Table 3.3.1 Volume of Frozen Meat

Kind	Unit	Import (1998)	Domestic Production (1997)	Total
Beef	lbs	955,995	-	955,995
Pork	lbs	716,791	41,000	757,791
Chicken	lbs	989,389	-	989,389
Fish	lbs	277,625	-	277,625
Eggs	doz	107,596	284,265	391,861

Source: JICA Study Team

Among the meats mentioned above, price of imported pork and eggs and the prices of domestic products are shown in Table 3.3.2.

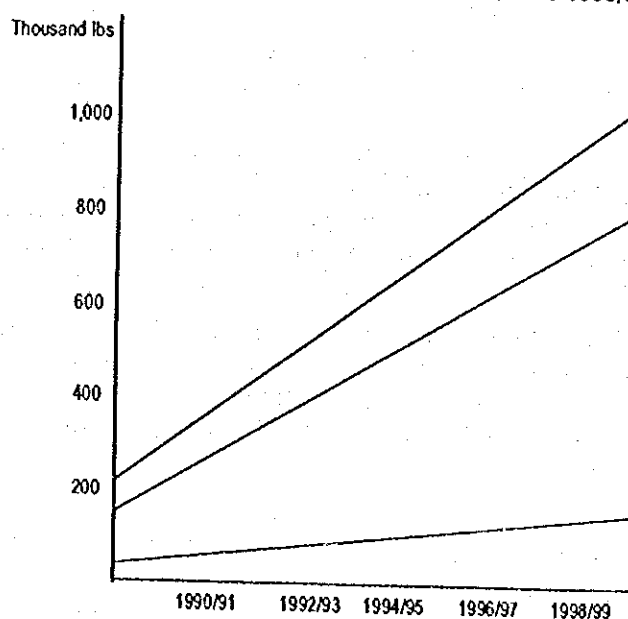
Table 3.3.2 Value of Pork Meat and Eggs

	Domestic Production	Imported	Price in 1997 (\$)	Total Value (\$)
Pork	41,000/lbs	716,791	1.5/lbs	1,136,186
Eggs	284,265/doz.	107,596	1.75/doz	685,757

Source: JICA Study Team

In other words, Palau imported about 70% of animal products and spent \$1.3 million. If such import were replaced by domestic product, there was no need of import equivalent to \$1.3 million worth.

In the Republic of Palau, imported food and food products flourished the markets. In addition, people's dietary life changed abruptly in recent years. Figure 3.3.1 shows the trend of pork consumption during 1990/91 to 1998/99.

Figure 3.3.1 Pork Consumption from 1990/91 to 1998/99

Source: JICA Study Team

As shown in above diagram, consumption of pork increased from 150,000 lbs in 1990/91 to 758,000 lbs., about five times, in 1998/99. This sudden increase of consumption was done by imports of frozen meat.

Table 3.3.3 shows the condition of domestic pig breeding. 819 head pigs were raised at 14 piggeries, from which 665 head pigs could be shipped to market this year. The quantity of meat to be shipped to the markets is 104,800 lbs. (665 head times 200 lbs. times 0.8). Presently, domestic pork is supplied to only about 1/6 of the total demand in this country.

Table 3.3.3 Condition of Domestic Pig Breeding

Name of farmers	Boars	Sows	Growers	Piglets	Total
John Tarkong	2	6	30	0	38
Nino Enichi	1	8	10	11	30
Lebal Renguul	0	0	37	0	37
Rubeang Ngiruchelbad	2	8	31	0	41
Henry Arbedul	1	4	26	0	31
Evergreen Farm	1	4	20	15	40
Yano's Farm	1	2	25	10	38
Lucky's Farm	1	11	96	14	122
Kenjiro Dengokl	3	17	227	3	250
Frank Malsol	2	8	21	3	34
Raymond Aktwo	0	4	29	0	33
John Rechucher	2	5	68	0	75
Keibo Ridep	0	2	16	0	18
Carp Island	1	5	19	7	32
Total	17	84	655	63	819

Note: Beside the above, some quantity is consumed at village level for ceremonial occasion. But its quantity is unknown.

Source: JICA Study Team

In Palau, management of piggery is not easy. The reason is high cost of feed. Since a feed price in Palau is nearly twice of that in the U.S.A., business will be profitable. Most of the above piggeries are located in Koror and Airai State. And they get majority of the feed from leftover foods of restaurants, hotels, markets, schools, etc. However, leftover foods are not stable supplies and can only provide less balanced nutrition and it is also problematic for the hygienic condition. For the same reasons, it is not recommended to use left over food for the poultry breeding.

Recommendations

It is necessary to supply hygienic and nutritious feed to livestock farmers with low prices. To establish the domestic feed production, it is vitally important to analyze the possibility of the following factors through feasibility studies;

- Setting optimum scale such as required quantity per annum of feed to raise pig and poultry in attaining self-sufficiency, and required quantity of feed materials;
- Scale of feed manufacturing plant such as building and necessary sheds and machinery for washing, cutting, drying, hammers milling, mixing, packing, and etc., and temperature controlled warehouse to store finished products;
- Setting a standard nutrition formula to feed pig and poultry at various stages of growing;
- Quality control especially on prevention of mold on materials and other facilities;
- Prepare "Feed Manual in case of fresh raw starch such as taros, cassavas, and local fish meal etc. are used;
- In case of materials such as taros, cassavas, maize, etc, are produced in its own fields. Selection of project area, and Required area, and necessary machines and equipment for cultivation;
- Establishment of operation and management manual; and
- Investment cost and economic analysis.

(5) Reinforcement of research and extension activities

Findings

The engaging in agricultural works is regarded as unpleasant and undesirable. As seen in their daily conversation "Let you take to Taro Patch", the words spoken when they scold their children, the prestige of agriculture is generally low. In such society, the

agriculture would not develop soundly. They do not expect income from agriculture. Productivity remains stagnant, and the people are contented with favorable natural environment that promises subsistence. In this background, the situation of this country is that farmers are still contented with primitive cultivation practices and on the other hand, markets in consuming areas are flourished with imported foods. Even in this adverse situation, the government authority is making efforts to strengthen researches, experiments, education and extension works:

- To introduce suitable varieties,
- To study on the factors restricting agricultural production and set up proper countermeasures,
- To transfer technology to farmers, and
- To foster youth who will shoulder the future agriculture of Palau.

The organization engaged in the researches, experiments, education and extension in this country and their activities are as follows:

- Division of Agriculture & Mineral Resources (DAMR), Ministry of Agriculture and Mineral Resources,
- Palau Community College, Academic Program/Agricultural course,
- Palau Community College, Cooperative Research and Extension (CRE),
- Informal Employment Sustainable Livelihood (IESL), and
- Agricultural Technical Mission of the Republic of China.

There are 11 extension workers in Palau. They belong to different organizations and work for same purpose. Three are disposed to the DAMR, Four to Agricultural Course of PCC, two to CRE of PCC, and two to Agricultural Technical Mission. The number of farming households in Palau is 2,844 according to Agricultural Census conducted in 1994. There is one extension worker in every 260-farming household, which is reasonably better than other developing countries. However, they seldom visit farmers lived in state and islands where transportation is not so convenient. This situation will improve when the Compact Road is completed.

The agricultural course in PCC is not so popular among Palauan students. This seems to be caused by their contempt to agricultural work. The school authority should encourage the Palauan students to comprehend that the agriculture is a science and it involves more business chance than other office works.

Recommendations

Palauan tradition that the agricultural work like the practice of cultivating products at taro patch should be carried out by the housewives is still deeply rooted in the society. The renovation of village people's awareness is important, through public education or short time workshop. A Key for this village based project. First priority is placed on diversification and increase of farmer's income. Persons engaging in research, experiment and education should give pertinent advice to farmers after studying and experimenting characteristics of the areas such as soil, vegetation, etc. and directly assist farmers through following activities.

- Assisting farmers in their production by introducing technical know-how on farming management, insect and disease control etc.
- Giving optimum market information and facilitate smooth and fair transactions,
- If possible, realizing a merit of group production and group shipment through cooperative activities.

Expectations to the various organizations;

- DAMR: Unification, centering upon DAMR, of the extension services,
- CRE: They have rather good achievements in research works particularly in marketing, in preventing pests (weeds, mites, and insects). Research Center is under construction at Ngaremlengui State supported by USDA and ROP,
- PCC: Strengthening the present functions for agricultural education, and
- IESI: Further strengthening of activities for subsistent farmers' group.

The following equipment should be provided for the agricultural research works.

- Equipment for Tissue Culture: Analytical balance (0.1mg accuracy), Top Loading balance (0.01g), Glass Distilling Apparatus and Collection System (4 to 10 liter/hr), Clean Bench (24 x 48 HEPA Filter), Research Stereo Microscope with Photomicrographic Attachment, Exposure Meter and Fiber Optic Illuminator, Filter Sterilization Equipment, Glassware, three units
- Soil Analysis: Oven, Laboratory Furnace, pH Meter, Electric Conductivity Meter, Kjeldahl Digestion, Distillation and Titration Apparatus for Nitrogen Analysis, Atomic Absorption Spectrophotometer and Attachment for Analysis of other Soil Element
- Food Processing Equipment: Model-typed food processing units for performing manufacturing test and trial on production of canning, juice, dry-fruit and oil extraction is considered through the Research Center at Ngaremlengui to promote food-processing industry. CRE of Palau Community College is recommendable organization in operation and maintenance for equipment.
- Equipment for extension workers: Vehicle for traveling in duty, One each for DAMR, CRE, PCC, IESI/Four pick-ups, Soil tester for technical guidance to farmers/4 sets, and Video related equipment/photographing, editing, duplication.

For the consolidation of facilities, in the high temperature and humidity of the area, anti-mold function is required and adding lamps for observation are recommendable. The processing equipment is not used for production but for testing and tentative production, therefore, small-scale equipment would be sufficient. It is preferable to arrange the experiment individually rather than single continuous system.

Technical assistance by foreign expert is essential until the locals are practically learned to operate and maintain the equipment.

3.3.2 Establishment of Marketing Facilities for Agricultural Produce

(1) Establishment of hygienic slaughter house

Findings

Presently, in Palau 600 to 700 head pigs are slaughtered annually in commercial based and another 150 to 250 heads for various ceremonies at village every year. Totally nearly 1,000 heads are disposed per annum. This disposal is not conducted at their backyards without any concern to the public hygiene. This may cause the prevalence of epidemic diseases. For example, the recent contagious disease killed more than 200 people in Malaysia. The troops were dispatched and tens of thousands of pigs were shot to death.

The proper disposal facility should be implemented urgently and constant examination on the meat safety must be carried out under the supervision of the public sectors.

Recommendations

If the self-sufficiency were attained in supplying of pork, about 1,500 heads of pigs

would be expected to be disposed annually, i.e. four heads pigs daily. However, it is impractical to dispose only 4 to 5 heads everyday, hence the management of the disposal facility should operate the facility within limited time, two days a week. This will allow about 15 heads disposal in the limited time and would increase the efficiency.

After slaughtering, the meat must be arranged into standard cutting sizes and stored in refrigerator storage. Then, the meat is delivered by using refrigerator car directly to customers (supermarkets, restaurants, hotels, etc.)

The slaughterhouse should be located about 10km away from Koror City for the hygienic reason. The basin of Ngerikill River, Airai State, would be a desirable location.

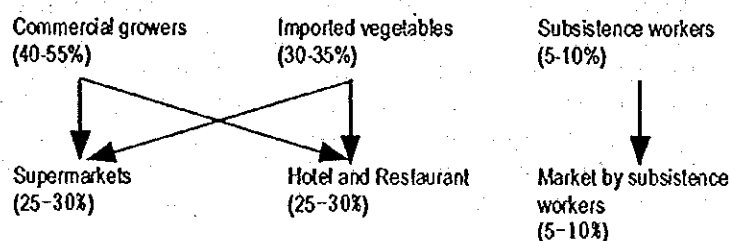
As for estimated costs for the facility, Building (5m x 10m x 20m), tools and equipment for slaughtering, refrigerator (2 ton capacity), refrigerator car (500kg capacity) and waste disposal facility, etc are estimated to be about US\$ 150,000 in all.

(2) Establishment of a Central Market and Market Information

Findings

The outline of the marketing of vegetables in Palau is shown in Figure 3.3.2, although it differs somewhat by the kind of vegetables and the seasons.

Figure 3.3.2 Demand and Supply of Vegetables



Source: JICA Study Team

Presently 180-220 tons of vegetables are sold in Koror City annually. Commercial growers supply the majority and farmers' group supplies part of them and the rest is supplemented by imports.

As mentioned above, about half of vegetables are shipped to supermarkets and farmer's groups bring the rest into small markets.

The commercial growers and importers often deliver the vegetables to supermarkets, hotels and restaurants on the base of their contract. Whereas the farmer's group can not afford to give such convenience and, therefore, sell a small size of vegetable at small markets.

Housewives mainly run the market of farmer's group. Besides the vegetables, they produce and sell various kinds of tuberous roots, fruit and other products. Their daily sales can sometimes reach \$300 to 500. Most products are shipped from states of southern part of the Babeldaob Island and very little come from the northern part of the island, where transport condition is not so good.

The vegetables grown and sold in various marketing channels in Palau, and their prices are shown in Table 3.3.4.

Table 3.3.4 Sales Quantity and Unit Price of Vegetables

Kind of Vegetables	Sales Quantity (lbs)	Unit Price (\$/lbs)
Watermelon	100,319	0.84
Cucumber	67,625	0.80
Pumpkin	50,256	0.66
Chinese cabbage	42,521	1.06
Squash	42,483	-
Radish	35,005	1.08
Eggplant	30,455	0.98
Kang kong	27,584	-
Okra	20,550	0.88
Yard-long bean	17,885	0.99
Bitter gourd	9,966	-
Melon	3,995	0.87
Green onion	3,185	2.49
Bean sprout	3,065	-
Sweet pepper	2,561	1.81
Corn	2,035	1.61
Hot pepper	1,486	1.44
Cabbage (trop. var.)	395	0.77
Tomato	255	2.79
Ginger	148	-
Lettuce (trop. var.)	97	-

Source: Data from DAMR and CRE

Note: Data of sales quantity is sampled from October 1998 to September 1999 otherwise data of unit price is sampled from March to December 1998

The kind of vegetables mainly consists of tropical varieties such as cucumber, pumpkin, chinese cabbage (nappa) and eggplant are sold throughout the year at the market. Yet the vegetables are shipped in the rainy season as farmers cannot work during the rainy season. Temperate vegetables such as lettuce, head cabbage and green peas are imported from the U.S.A. and sold mainly to hotels, restaurants and supermarkets. Generally, vegetables displayed in supermarkets for sale are lack of quality and have poor freshness but their prices are 50 to 70% higher than imported products. There is a considerable loss of value of products, especially vegetables, during a time from harvest to consumers. This loss is supposed to be over 50% in cabbage, lettuce.

Recommendations

At the front of OEK, there is a small market, in which each state sells their products. This market is located in between the Central Post Office and Upper House Assemble. However, there are many disadvantages in the sales setting. Sometimes the food brought in damaged condition. It would be painful for housewives to be exclusively engaged in marketing since they do not work for any housekeeping work.

Although the new market, which is expected to build in Koror City, may be small, it has profound meaning from viewpoints of social development in the future and challenge by village people rather than economic benefits. Rough concept of the market is shown in Table 3.3.5.

Table 3.3.5 Concept of the Central Market

Concept of Market	Specialize in local products Value added by farmers them themselves Collected and shipped by state cooperative societies
Place	At the front of OEK (1ha)
Building	Traditional Abai style (30m x 100m)
Shop	16 booths for each state (general dishes, lunches, smoked fish, bottled processed vegetables, etc.)
Equipment	Refrigerators, Kitchen, water and fuel supply, garbage pits

Source: JICA Study Team

3.3.3 Eradication of Oriental Fruit Fly

(1) Eradication of oriental fruit fly

Background

Four species of fruit flies now exist in Palau. The Oriental Fruit Fly (*Bactrocera dorsalis*) is a major pest, while Caroline Fruit Fly is also serious pest within the remaining three. Oriental Fruit Fly is regarded as a very serious pest species and is categorized in the top ten worst fruit fly species in the world. The infestation usually results in the complete loss of fruits and vegetables. Oriental Fruit Fly occurs in Hawaii, French Polynesia, Taiwan, Vietnam, Cambodia, Laos, Hong Kong, Sri Lank, Nepal, Bhutan, Myanmar, Northern Thailand, Southern China, Part of India, and Mauritius. Oriental Fruit Fly was recorded in the Republic of Palau in September 1996, following the reestablishment of a quarantine surveillance trapping system for exotic fruit fly by DAMR under the auspices of the Regional Management of Fruit Flies in the Pacific (RMFFP), the Secretariat of the Pacific Community (SPC), FAO. The upgraded quarantine surveillance, using traps has been operating since May 1999. 110 traps were built covering many islands of Palau. The combination of these trapping programs revealed that there were four species of fruit flies throughout Babeldaob, Koror, the Rock and Angaur Islands. Catch by trap in Koror and Airai State is relatively high. The average numbers of Oriental Fruit Fly from the 13 traps in Koror State ranges from 518 per trap during two weeks in late June to 95 per trap during two weeks in late July 1999. This level is epidemic. The reports show that about 90% of guavas and starfruits are infested, while banana, soursop, papaya are heavily infested, with significant economic losses. Also the flies cause considerable damage to citrus, avocado, capsicum and various vegetables of eggplant family. The Government of the Republic of Palau formally requested RMFFP an assistance to investigate and report on the feasibility and cost of eradication of Oriental Fruit Fly in early 1999. AusAID, UNDP and New Zealand Government funded this project and the report was submitted in August 1999.

The goals identified to eradicate Orient Fruit Fly include:

- Minimizing losses caused by Oriental Fruit Fly;
- Facilitating diversification of fruits and vegetables for domestic consumption that would be attacked by Oriental Fruit Fly.
- Improving balance of payment in Palau by development of agriculture to reduce fresh fruit and vegetable import; and
- Fostering potential export markets on tropical fruits that have been restricted or inaccessible because of the presence of Oriental Fruit Fly in Palau.

Recommendations

The most appropriate method for eradication of species of fruit flies is male annihilation by methyl eugenol. Methyl eugenol is a very powerful male attractant, which is combined with an insecticide in blocks of fiberboard. Distribution over large areas

either by ground team or from a helicopter is an effective tool for eradicating fruit flies. The principal technique is that the male flies are attracted to the treated blocks, which are densely distributed 250-300 blocks per km². The male flies will be reduced to the number to which no mating occurs. The fly population will eventually crash and the species attracted to methyl eugenol will be eradicated. This method has been successfully used for eradication of Oriental fruit fly in Okinawa and Rota Island and in the northern Australia for the eradication of Asian papaya fruit fly. The male annihilation technique is currently being used for eradication of Oriental Fruit Fly and Pacific Fruit Fly in Nauru and for the eradication program for Oriental Fruit Fly in French Polynesia as well.

One immediate action to open potential export markets that would be restricted or inaccessible because of the presence of Oriental Fruit Flies, should be considered on agricultural products such as cut or potted flowers and foliage plants that can be exported without a quarantine treatment. Secondly, pre-exportation quarantine treatment may be considered as well. Fortunately, numerous technologies have been developed for use of quarantine treatment against Oriental Fruit Fly and other fruit fly species. Some examples are:

- Cold Treatment;
- Heat Treatment;
- Hot Water Immersion Treatment; and
- Forced Hot Air and Vapor Heat Treatment.

(2) Strengthening of quarantine control

Findings

A variety of agricultural products is imported in large quantity and marketed everywhere in Palau. Palau however seems to be not pre-cautious about the danger of new noxious diseases and insects from foreign importation. As an example, Oriental Fruit Fly propagates all over Palau, especially epidemic level in Koror and Airai State showing considerable damage to vegetables and fruits. Also, Rhinoceros beetle, which attacks coconuts, makes the growth of coconut industry difficult.

Quarantine rules enforced up to the present was enacted when Palau was under trust territorial administration. Various deficiencies however have been pointed out since and Palau needs to be responsible for the quarantine administration. Under such circumstances, the Palauan Government promulgated the new Plant and Animal Quarantine Regulation in June 1999. This new law specifies the rules and regulations related to application of the laws and enforcement, and penalties in details in compliance with quarantine inspections when plants and animals are exported or imported from/into Palau.

Presently, six quarantine officers carry out the quarantine inspection. A team consists of three officers attend day and night shifts. They perform their duties at airport and seaport where foreign ship and freight arrive and/or depart. Since the work is too heavy by this staff, other two more office should be join this work immediately.

The quarantine operation is now receiving technical assistance from the Pacific Community. The assistance contains the following;

- By the request from Palauan Government, they have guided technical advise on the enactment of "Plant and Animal Quarantine Regulation" and "Rules relative to Application of the Law";
- Giving technical helps and guidance by making regular visiting (three time a year);
- Engaging in consultation in identifying diseases and insects, and its

extermination; and

- Other recent prominent activities were to set up a Project team within this organization in order to take measures against Oriental Fruit Fly. "Regional Management of Fruit Fly in the Pacific" and started full-scale activities in this region. In Palau, the investigation was started in May 1999 according to the request from Palauan Government and a report called "Feasibility Study on Eradication of Flies Attracted to Methyl Eugenol in Palau" was submitted.

Recommendations

The above are the outline of the quarantine administration in Palau. However, there are many problems and constraints in actual implementation.

- Qualification of quarantine officers: From interview and observations, the technical capability and qualification do not seem high enough to conduct inspection in international standards. Therefore, proper training by Secretariat of the Pacific Community should support them by giving more technical guidance and assistance.; and
- Lack of Equipment for quarantine operation: Necessary equipment and materials to perform quarantine inspection are deficient. There are almost no equipment in their offices, inspection site and laboratory. It is very disappointing that there cannot be seen any serious attempt of the institution to fulfill even their basic works, the preparation.

These situations are due to tight financial budget. However the following equipment is urgently required: Small type fumigation chamber for treatment of infested materials;

- Providing quarantine services of pre-treatment and certification for agricultural products such as flowers and fruit which are carried out by tourists as souvenirs.
- Fumigation treatment for small but expensive materials such as imported vegetable seeds and seedlings.
- Using in various experiments for the purpose of conducting quarantine treatment.

Fumigation sheet with safety equipment for marine container and timber (3 sheets and necessary protectors): these fumigation sheets are used for conducting fumigation of ship containers and import/exporting timber. It should include safety equipment such as gas masks in using toxic fumigants

Vehicles for moving in duty (2 station wagons: one for seaport duty and one for airport duty): there is only one vehicle belonging to the quarantine group and this brings about extreme difficulties in the quarantine work. At airport, it requires only a short time but at seaport the duty takes a longer time, at least two more cars for day and night shifts are required.

Incinerator (1 set at Laboratory): there are many cases in which the goods were rejected in the quarantine inspection. Those goods must be abandoned after proper treatments. The incinerator is required for this purpose.

Inspection equipment (6 sets belonging to each quarantine officer): Present inspection is conducted with naked eyes, so that accuracy can not be expected. Sometime it may yield individual differences. In order to improve this situation, inspection equipment such as magnifier, probe, sieve, spring-type weight and helmet must be supplied to each quarantine officer.

Laboratory equipment (One set for laboratory use): Microscope (x20x100/stereo),

lamps for microscopic observation, fixed temperature box dissection kit for insect, etc.

Computer for Inter-net communication with digital camera (one set for office): Whenever quarantine officers encounter problems, they communicate information to the Plant Protection Officer, at Secretariat of the Pacific Community, Palikir, and Pohnpei through inter-net. In other words, this equipment is used in the emergency cases when they find noxious insects and cannot identify them. They take photographs of the diseases or insects with the digital camera and send them to Pohnpei through inter-net and ask for identification and guidance in order to take proper actions.

4. FISHERY

4.1 Fishery in Palau

According to the recent statistics by the Division of Marine Resources (DMR) in the Ministry of Resources and Developments in 1998, there are approximately 350 fishermen in Palau. This figure includes part-time fishermen who simultaneously engage in other occupations and also who go fishing on rare occasions.

In fact, the number of full-time fishermen in Palau is assumed as about 40 to 50 persons. The present number of full-time fishermen, which is estimated most severely, is only 30 in the entire country. Besides, these full-time fishermen are all aged over thirty and some are even over sixty. This tendency for range of age can be applied to the part-time fishermen.

It is observed that the successors for fishermen (particularly for full-time) are hardly found at present, and the situation will never be better in the future.

On the other hand, it could say that all the people, who live nearby the sea or who own motorboat(s), are fishermen, since almost all of them go fishing sometimes or go to shore to capture fishes, crabs and shellfishes.

This is a sort of typical life pattern of sustenance, and it is not only for the fisheries aspect, but also for the agriculture in Palau.

4.2 Catch of Marine Products and Fish Flow

4.2.1 Catch Volume and Value of Marine Products

Table 4.2.1 shows fish catch from the sea by domestic fishing boats in Palau according to the statistics of DMR.

Table 4.2.1 Domestic Catch Volume and Value

Year	Weight (kg)	Value (\$)	Ave. Unit Price (\$/kg)
1990	236,620	-	-
1991	341,715	-	-
1992	307,291	-	-
1993	354,118	1,029,214	2.91
1994	250,570	642,381	2.56
1995	280,161	713,914	2.55
1996	256,592	667,099	2.60
1997	156,993	413,454	2.63
1998	151,438	390,131	2.58

Source: Division of Marine Resources, Ministry of Resources and Development

In this decade, the maximum catch volume was recorded in 1993. This is due the big catch volume of reef fish (193 tons) and crabs (14 tons) in that year. But in recent years, 75 to 150 tons of reef fish and 1 to 5 tons of crabs had been caught annually.

Poor catches of assorted reef fish, parrotfish and rabbit fish of the inshore fishing by domestic fishing boats had caused the gradual drop of catch volume since 1994.

Other considerable factors for the drastic decrease in catch after 1997 might be the reformation by adopting new method of collecting the data and/or might be change of routes of fish flow, which does not appear, on the data.

In 1998, 83 tons (55% of total fish catch in Palau) of fish were produced in Ngeremlengui State, 26 tons (17%) in Peleliu State, 15 tons (10%) in Ngarchelong State. These three states produce more than 80% of total catch in Palau, most of them to be

transferred to Koror by sea and the other are by land. Ngatpang, Kayangel and Koror produce 22 tons (14.5%) in total. Ngaraard and Aimeliik together produce 4 tons (2.6%). In 1998, this top high fish catch six states produced almost 97% of the total catch in Palau.

The figures that appeared on DMR data do not include fish volume of self-consumption of fishermen's family and fish which are given to neighbors and which are sent to friends in Koror and Guam, etc. as gifts. The volume of these fish is no little in quantity.

Therefore, most of the catch on the data prepared by DMR is the fish volume that is concentrated in Koror area to meet the demand of its population. In other words, only the handling volume of fish from fish landings from other states to Koror appears on the statistics of DMR.

4.2.2 Fish Flow in Palau

Fish flow in Palau fresh markets can be drawn quite simply. The actual total fish catch in 1999 was estimated to be about 730 tons according to DMR.

The following basic number are assumed:

- Number of Fishermen: 810 persons (includes part-time fishermen);
- Number of Fishing Boats: 270 boats (3 fishermen on board per each fishing boat);
- Average catch per boat per day: 18 kg (40 lbs); and
- Number of operation days per year: 150 days.

Estimated total catch in 1999 was:

270 boats x 18 kg x 150 days = 730 tons.

Out of the 730 tons, approximately 350 tons of fish are traded commercially at fish catch states, and are transported to the Koror area for the urban residents. Only this figure (350 tons) might appear on DMR data of fish catch statistics.

Outlet and/or movement of the rest about 380 tons of fish (this is more than one half of the total estimated catch volume of the year) are assumed as follows:

- For home consumption of fishermen
- Given to neighbors
- Given to friends/family
- Sent to kin in Koror (gift)
- Sent to the children's lodging houses (gift) ¹
- Aired to friends/kin in Guam and Yap, etc. (gift)

This outlet of fish is as much as nearly 400 tons will be not shown on DMR data of fish catch as stated above.

This is an actual fishing activity and the actual fish catch volume and the fish flow in Palau.

¹ Hi-school, private school and college students in Koror stay mostly at their relatives' houses without paying any fee.

4.3 Fishing Industries in Palau

4.3.1 Inshore Fishing

There are approximately 1,450 vessels in Palau. Among of them, about 1,400 are motorboats with their length ranging from 5 to 9 meters.

It is presumed that motorboats of that number between 250 and 300 are engaged in fishing as full-time or part-time operation as aforesaid. Most of them are fishing only inside of the reef. Fishermen fishing inshore generally utilize hand-spears or spear guns. Professional and semi-professional fishermen use gillnets and shallow-water seine nets (a mesh size of fishing nets laws prohibit less than 3 inches).

Permission for inshore fishing is presently given only to Palauan fishing boats. This is an ideal policy for Palauan fishermen in the sense of being advantageous to them. At the same time, it is significant for conservation of natural inshore marine resources in this country. This policy should be continued to be effective from now on.

The present regulations and restrictions on the marine lives such as giant clams, groupers, crustaceans, invertebrates, etc. also should be continuous.

These regulations and restrictions might as well get stricter than the current ones in order to protect the Palauan nature and creatures inside of the coral reef as well as outside.

It is observed that some of marine lives are not sufficiently utilized by inshore fishing Palau.

Shellfish (bivalves and snails)

Housewives who live nearby seashore capture shellfish, and they are consumed only by housewives' folks and inside the villages. Shellfish can be studied to transport to Koror for trade in the forms of processing such as cooked, salted or dried.

Squid, octopus

Although the volume is not so abundant, squids and octopuses are found inside the reef in Palau. However, fishermen seldom get these cephalopods, since their demand in the market is low in their fresh form. Moreover, in the fish markets in Palau, marine products are dealt by their weight, and fish prices are almost the same regardless of their species and size. Therefore fishermen catch the large size of heavy demersal fish instead of light boneless cephalopods.

Squids and octopuses can be taken as sashimi when they are fresh. It is also recommended that these cephalopods be to be gutted and dried in the sun. The processing is quite simple and the product is ready to eat (as is or slightly broiled). Dried products of the cephalopod suit the tastes of Palauans and the tourists in Palau.

Fishermen catch demersal fish sometimes in large quantities at a time. It causes not only the sharp decline in the fish price also brings a status of the fish in stock. These stocked white flesh fishes are to be processed to *surimi* (ground fish meat), which is an ingredient of *kamaboko*, *chikuwa* and *hanpen*. They are all Palauans' favorites. These kinds of fishes are also processed as "smoked fish".

Completion of the COMPACT Road under construction in Babeldaob will be helpful for transportation of the fish catches from fish producing states to the Koror area by land.

Existing fishing ports and their facilities on shore at each fish-landing site nationwide are well provided. Careful maintenance of them is required even more continuously. Ice plants installed at main fish landing are exceedingly helpful to not only fish-related people, also to the residents there. Fishermen and fish dealers are to pay more

attention to keep the fresh quality of the fish catch by utilizing the flake ice or crushed ice. Soaking fish in ice chilled water with big blocks of ice for the long time even for few days is prevailing among almost all the fish dealers in Palau. By soaking fish catch in chilled water; they are able to hold the fresh of the fish only and that is nothing but for one or two days. However, the quality and the flavor and the flesh color of the fish are deteriorated tremendously in hours with this method.

This should be converted to a method, which holds the fish covering with flake ice, or crushed ice in the insulated boxes having the drainpipes for melted water to keep the catch quality.

Mobile telephone system currently studied is helpful for fishermen and the passengers for their communication and security purposes. Carrying the phones with boats for fishing, recreating and cruising shall be mandatory for fishermen and/or motorboat operators in the future.

4.3.2 Offshore Fishing

(1) Palauan Fishing Boats

Offshore line fishing in progress

At least four Palauan fishing boats are operating outside of the reef in Palau since 1996. They are all Japanese built FRP boats loaded with onboard marine diesel engines. They engage in daily line fishing (handline fishing, and pole and line fishing) operation, and go to and from Malakal harbor as their base.

In their first stage of operation, Japanese fishing technicians had stayed in Palau to instruct the fishing to local fishermen (Palauan and foreign fishermen in Palau).

Japanese who are stationed in Palau are still involved in these several fishing boats in their financial and operational aspects,

Handline fishing (hook and line fishing)

Three boats engage in catching demersal fish at shelves in outside of reefs where about 200 meters in the depth. They are ranging from 10 to 13 meters in their length and from 4 to 5 tons in their gross tonnage, 7 to 12 crewmembers on board. They use hook and line to catch sea breams (Tai family) and snappers (hamadai family) and also napoleon fish, etc.

These species of fish are suited to sashimi and their market value in Japan is quite high in their fresh condition.

Pole and line fishing

One of the rests of the boats is a pole and line fishing boat for skipjacks. She is 17 meters in length-LOA. Live baits for the fishing are caught by crewmembers using mojiami (small triangular net) near the mouth of Malakal harbor.

They go fishing early in the morning with 12 crew members on board and reach the fishing ground within hours (the nearest major skipjack fishing ground in the Palauan waters is area of N 7°30' and E 134°30'). They fish for skipjacks using pole and line with sprinkling water and live baits, then call back to Malakal harbor in the afternoon of the same day.

Prospect of offshore fishing in Palau

The above four fishing boats go fishing always with a sufficient volume of crushed ice kept in their insulated space installed on the boats, or in the well-insulated boxes placed on the deck.

Certain techniques and fishing equipment and gear are needed for the above fishing; nevertheless they are not very sophisticated. The line fishing gear is relatively simple

and easy to be maintained compared with that of net fishing (trawling, drift net, trap nets, etc.).

They have a daily operation, and though they fish offshore, they operate just close to outside of the reef. They can go fishing almost every day except before and after full-moon days and their catches are rather stable and marketable. Besides, their operation cost for fishing boat maintenance, fishing gears, ice, and fuel oil is low compared with their catch income.

For the reasons said above, offshore line fishing is quite suitable to Palauan fishermen's habit of mind and it is the most recommendable to the present fishing industries in Palau.

Another important reason for development of offshore fishing in Palau is that, though the inshore fishery resources is sufficient, there is no large room for expansion in inshore fishing, and inshore fishermen have to switch their present fishing to bigger and farther fishing. Resources of demersal species offshore in Palau have no question.

Offshore fishing in Palau develops fish-related industries on shore such as hull and engine industries, fishing gear industries, etc. To catch the high quality fish by Palauan fishermen in offshore Palauan waters also improves the fish handling technique for post-harvest and transportation system of fish catches by sea or by land as well.

(2) Foreign fishing boats in Palau (Malakal based tuna fishing boats contracted to joint venture company)

Taiwanese and Chinese and some Japanese fishing boats are operating in 200 nautical miles EEZ (outside of 12 n. miles) of Palauan waters using Malakal harbor as their fishing base. They are tuna long line fishing boats.

Taiwanese boats are 17 to 22 meters in length (LOA) and 70 to 90 G/T, and they are steel or FRP built boats, 7 to 8 crews' members on board. Chinese boats are about 24 meters in length (LOA) and about 100 G/T; all of them are wooden boats with 8 to 10 crewmembers. Japanese boats are like Taiwanese ones. Japanese boats seldom call at Malakal harbor at present.

The number of the boats is 10 to 50 for Taiwanese and 30 to 100 for Chinese. It fluctuates by season of tuna. Tuna lean season is November to March, and May to September is peak season for yellow fin and big eye tuna in Palauan waters. April is the highest season for marlins. Fishing ground of tunas in Palauan waters is located in the area of N 5° and E 134° to E 135°.

In tuna lean season in Palau, fishermen go fishing in other countries' waters or go back to their homelands for docking and relieving the crewmembers.

Foreign fishing boats have to obtain a fishing license for operation in Palauan waters, and also to get the permission to operate basing at Malakal. Accordingly, they are able to operate in Palauan EEZ water raising Palauan flags. And, they can enter Malakal harbor at any time.

The boat owners have to pay the fishing license fee, which fluctuates every year with reference to size of fishing boat, also to pay port fee for every call at Malakal harbor. Payment of fees for immigration entry permits and work permit for each fisherman is also required. At present, the exporters of tuna have to pay export tax for US\$0.25 per one kilogram of fish.

The Government of Palau should open the door wider to foreign tuna boats, and encourage them to operate in Palauan waters basing at Malakal harbor, since Palauan EEZ water is abundant in certain migratory pelagic species, which are stable in their volume for long-term basis.

At the same time, the Government of Palau should provide the improvement and expansion of the port facilities, and also investigate the increasing the means (air flight) of exporting tunas; this is described later.

Migratory fishes in Palauan waters are literally migrating in the Western Pacific. If they are not caught in Palauan waters, they might be caught in other countries' water; i.e. tuna and tuna-like fish should be caught in Palauan waters either by Palauan or by foreign fishing boats with license.

On the grounds of increasing foreign fishing boats operating in Palauan waters, the Government will derive more revenue from fishing license fees and port fees. Entry permit fee and work permit fee for crewmembers of fishing boats should be reduced or they should even be exempted. Because foreign fishing boats contribute greatly not only to the Government revenue from license fees, but also to the derivative industries on shore, such as fuel oil, marine engines and machineries, ice, stevedore, transportation, etc.

1,454 tons of tuna and other fishes were transported from Palau to Japan by air and sea in 1998. Also, approximately 650 tons of tuna were shipped to Asian countries by trampers for canning. Foreign boats that operate in Palauan waters with their fishing license catch these fish.

Unloading volume of sashimi tuna to Malakal is not expected to be more than the present volume. Limit of air-cargo space restrains the volume of sashimi exportation to Japan, and that is a big bottleneck of limitation for the business.

An increase of number of air flights from Palau to Japan either direct or transshipping is expected in the future. It relies on the tourism promotion in Palau and on the extension and mending of Palau airport, i.e. upgrade of the airport and the consequent increase of tourists to Palau from Japan and Taiwan induce the increment of participation of foreign tuna long liners to Palau based fishing. (Sashimi tuna are also transshipped at Taiwan for Japan)

Table 4.3.1 shows the import fish from Palau to Japan in 1998.

Table 4.3.1 Import Fish from Palau in 1998

	Quantity (kg)	Value (thousand yen)	Value (\$)
Fresh			
Yellow fin Tuna	548,789	408,618	3,027,886
Big eye Tuna	807,673	741,112	5,569,021
Marlins (except Swordfish)	4,706	3,443	26,190
Swordfish	6,985	6,267	47,671
Sub Total	1,368,153	1,159,440	8,670,768
		@¥847/kg	@\$6.33/kg
Frozen			
Yellow fin Tuna	68,485	5,648	47,808
Big eye Tuna	17,480	1,441	12,197
Sub Total	85,965	7,089	60,005
		@¥82/kg	@\$0.70/kg
Total	1,454,118	1,166,529	8,730,773
		@¥802/kg	@\$6.00/kg
Other fishes (Frozen)	62,236	28,982	210,218
		@¥466/kg	@\$3.38/kg
Grand Total	1,516,354	1,195,511	8,940,991

Source: Data from Japan Marine Products Import Association

Fish imported from Palau to Japan shares only 0.05% in volume of total import of marine products of Japan. Total marine products imported to Japan (1998):

- Quantity: 3,102,565,900kg
- Value: 1,741,238,084 thousand yen (\$13,275 million)

(3) Foreign deep sea fishing boats in Palau EEZ

Tuna long liners, skipjack pole and line boats, tuna purse seine from Japan/Korea/Taiwan/China/Philippines/USA and many other countries are operating in the Western Pacific water the whole year round.

They operate there fishing in the high sea of the Western Pacific and/or within 200 nautical miles EEZ of the Pacific countries. They bring their catch back to their homelands or to tuna canneries in other countries, or they transship the catch to large reefers (fish carriers) at Guam or Tinian.

These deep-sea fishing boats are operating by obtaining fishing licenses (yearly basis or trip basis) from certain countries in the Western Pacific. Though they obtain the fishing license, they do not make a call at these issued-issued countries. They call mostly at Guam for replenishment or for emergencies due to its superior port facilities in the area.

Areas of 200 nautical miles EEZ of Palau and the adjacent countries in the Western Pacific are shown in Table 4.3.2.

Table 4.3.2 Exclusive Economic Zone of Western Pacific Countries

Country	Exclusive Economic Zone
Palau	629,000
Federated States of Micronesia	2,780,000
Marshall Is.	2,131,000
Kiribati	3,550,000
Papua New Guinea	3,120,000
Solomon	1,340,000
Tuvalu	900,000
Fiji	1,290,000

Source: JICA Study Team

These countries offer diverse systems and conditions of the fishing license according to the fishing and the country of fishing boats.

The conditions change every year or every season.

The Government of Palau should study the system and rate of her fishing license forms to be more efficient and more lucrative to Palau, and more attractive to fishing boat owners and skippers who are operating in the Western Pacific Ocean. The system and fee rate of fishing licenses in Palau should be competitive to these of adjacent countries. And, it is to be executed and revised every year harmonizing with other Pacific countries. Revenue from the fishing license fees contributes greatly to this country (refer to Table 4.3.3).

Table 4.3.3 Conditions or Agreement on Licensing for Fishing for Japanese Purse Seines in the Western Pacific

Palau	EEZ 200 mile	3,550,000
License system is option to per trip or yearly. Not mutually consented yet for year of 2000. In 1999, 1,041,900 yen for per trip basis, 1,449,600 yen for yearly basis.		
Federated States of Micronesia (FSM)	EEZ 200 mile	3,550,000
Volume \times Price \times 5% = License fee per Trip Volume: Average catches volume per trip in the previous year Price: Fish price in the last 3 months in Japan (changes monthly) Estimated to be 2 to 3 million yen per trip in 2000.		
Marshall Is.	EEZ 200 mile	3,550,000
Yearly basis only, 800,000 yen per boat. Whole payment to be done in the beginning of the year. In case of 5% of the sales of catch from this area exceeds 800,000 yen, the excess amount to be paid to Marshall Is. for an additional license fee.		
Nauru	EEZ 200 mile	3,550,000
Yearly basis only, 1,000,000 yen per boat. Whole payment to be done in the beginning of the year. In case of 5% of the sales of catch from this area exceeds 1,000,000 yen, the excess amount to be paid to Nauru for an additional license fee.		
Kiribati	EEZ 200 mile	3,550,000
Yearly basis only, 1,500,000 yen per boat. Whole payment to be done in the beginning of the year. In case of 5% of the sales of catch from this area exceeds 1,500,000 yen the excess amount to be paid to Kiribati for an additional license fee.		
Tuvalu	EEZ 200 mile	3,550,000
Yearly basis only, 900,000 yen per boat. Whole payment to be done in the beginning of the year. In case of 5% of the sales of catch from this area exceeds 900,000 yen, the excess amount to be paid to Tuvalu for an additional license fee.		
Fiji	EEZ 200 mile	3,550,000
500,000 yen per trip per boat.		

Source: JICA Study Team

4.3.3 Aquaculture

(1) General

Operation of aquaculture in seawater or in fresh water is neither simple nor easy. Generally speaking, techniques for fish, shellfish and seaweed cultivation are rather complicated, and almost all these aquacultures need quite meticulous maintenance. Extremely delicate care and bothersome labor should control some maricultures.

Besides, most of aquacultures require considerable expenses in their initial investment, as well as high costs for running of the operation.

In particular, the products from which aquaculture is operated under the intensive manner should be dealt with in quite higher price at the local markets or for foreign markets, because of their high operation costs of culturing.

It is to be understood that either produce or products for export, processed foodstuffs of marine products especially export to Japan, require extraordinary high quality in their fresh, taste, flesh color, uniform size as well as their hygienic facilities in the factories.

Also it is to be perceived that the importers (Japanese and others) of foods want a quite large quantity in one shipment, and also require of commodities arrival on time at destination.

Besides, fluctuation in the exporting prices of marine products is at a large range in a short period. The price is according to the foreign market of the goods and that is what the exporters cannot control ever.

The difficulties for exportation of marine products to foreign countries are not applied only for aquaculture marine products, but also for all marine fishes and shellfishes in their fresh or frozen forms and their processed products.

(2) Unsuitable aquaculture fishes in Palau

Aquacultures that require a large scale of investment and the complicated techniques are not recommended in Palau.

Cultivating prawn (*Penaeus monodon*) for commercial base, either intensive or semi-intensive, needs constructing of fishponds, dikes canals and numbers of watergate. It needs also daily care and feeding. Extensive prawn culture does not need feeding, however, the initial cost for operation is almost same as that of semi-intensives, and it requires also daily cautious maintenance.

Cage-culture of marine fish in the sea is not recommendable in Palau, due to its burdensome maintenance and the frequent occurrence of natural disasters and man-made disasters.

In the season (around April), fry of milkfish approach the coast of Palau. The fry are gathered and captured by people living near shore.

The fry of milkfish shall be used only for the milkfish fishponds in Palau. There is no opportunity of fry exporting to milkfish producing countries in Southeast Asia, since milkfish fry are being produced artificially in the Philippines and Indonesia also in Taiwan at their hatcheries since several years ago.

(3) Suitable and recommended aquaculture fishes in Palau

Milkfish

To culture milkfish in seawater or in brackish water is the most recommendable among the all aquacultures in Palau.

Milkfish, mullet, tilapia are being imported to Palau from Taiwan in their frozen forms. Besides from Taiwan, many other kinds of frozen fish, mollusks and crustaceans and their processed marine products, such as canned, dried and frozen-ready-to-serve foods are also imported to this country from Japan, Korea, China, the Philippines, Thailand, Malaysia, Indonesia, U.S.A., EU countries and even from South Africa.

Importation of marine products in their various forms to Palau from other different countries amounts to quite a huge sum considering the size and population of this fish producing country.

This is beyond the comprehension that Palau is importing frozen milkfish together with other frozen fish and many other marine products from Taiwan, since milkfish are cultural in this country, and retail prices of imported frozen milkfish in Palau are extremely dear.

Culturing milkfish in the extensive method is rather simple compared with the culture of other fish. Milkfish are being cultured in Peleliu and Ngatpang, though the method is very primitive.

The most important factor to be studied for milkfish culture is selection of the location of pond. Soil of the pond should be muddy. The bottom level of the pond should be at least 20cm higher than low tide sea level, and at the same time, it should be about 150cm lower than the sea level of spring tide (the range of spring tide in Palau is about 210cm).

Coasts or inlets suitable for the culture will be found in Airai, Ngatpang, Aimeliik and Peleliu.

Fishponds of milkfish need to be divided into several production ponds (size of each pond shall be 600 m² to 10,000 m²), and one (1) or two (2) nursery ponds (50 m² to 200 m²) shall be prepared in accordance with the size of total area. One (1) watergate for each pond shall be also constructed.

Once the fishpond is completed, the milkfish culture is simple. Fishpond operators get milkfish fry from shallow water off the coast, and put them into the nursery ponds. Feeding for milkfish is unnecessary. Only adjustment of water level and controlling of salinity² of the ponds are required. Milkfish will be harvested after four (4) months from their fry period. Tilapia will be by-product of milkfish, if their fingerlings are obtained.

Cultured milkfish should be supplied for only human consumption in Palau. Milkfish for bait of tuna longline fishing are cultured with stocking high-density population in Indonesia. Bait milkfish are also undersized milkfish come from caught accidentally with consumable size of milkfish, or from prematurely harvested fish to avert the natural disasters such as typhoons or floods or to avoid the steep fall of milkfish market due to a rich harvest. This happens frequently in the Philippines and Indonesia. Such undersized milkfish are utilized for fishing baits of tuna fishing boats. Milkfish are the sort of substitute baits for Pacific saury (sanma) or roundscad (muroaji) of tuna longline fishing.

Abalone

Culturing of abalone (*Haliotis ovina*) is also recommendable in Palau. Among shellfish commodities, the economically important is abalone. The most interesting feature of this species is the meat of high protein and low fat content.

An experimental abalone culture has being done at the west coast of Babeldaob.

To obtain the seeds of abalone is not difficult. The seeds will be spread over in some areas in the sea. They grow in the natural condition. Abalone's will be served locally to Palauans and the tourists, or exported to Asian countries in dried form or soaked in brine.

Experimental cultivation

Hatching and cultivation, which are in progress at Malakal, is meaningful in a sense of experiment, and this will forward the culture of giant clams and grouper culture to business at commercial bases in the future.

4.3.4 Fish Processing Industry

(1) General

Fish processing includes all marine processing in this chapter. As mentioned above, Palau is importing numbers of kind of general foods and beverage as well as marine products in their various forms from Asia, U.S.A. EU and other Oceanic countries, and the volume is quite big for the scale of this country. Frozen whole or cut open fish, canned fish, dried and salted fish and ground fish from all over the world rushes to this fish producing country.

To study how to preserve the fish and other marine produce with simple ways and to study how to practice the processing is the urgent subject in Palau.

On occasion to select the type of processing industries in Palau, those which need a big scale factory, complicated and sophisticated machinery's, advanced technology and imported materials, which used together for the processing, should first be omitted.

² Pond water should be adjusted to suit to grow seaweed (algae), which is the food of milkfish.

(2) Unsuitable fish processing in Palau

Fish canning

The canning industry requires a large quantity of material to be packed, numbers of laborers having skill with their hands, an abundance of clean, chilled fresh water, and imported empty cans which rust easily during the conveyance and custody.

Particularly, tuna-canning industries which make use of fish either its fresh or frozen form as the material, requires extraordinary meticulous attention with labor and time. Moreover, the market of canned tuna fluctuates always in a big range.

Manufacturing canned tuna (not only tuna, also all kinds of canned foods) in Palau is extremely costly, and will never be able to cope with imported canned goods in Palau's market, and it is not necessary to consider the possibility of exportation of Palauan made canned foods to foreign countries.

However, there is an interest by a major American canning company in order to establish a tuna cannery in Palau. Also, the ROP thinks to renegotiate certain provisions of the Compact of Free Association between the ROP and the USA to allow total duty free access of canned tuna from Palau to the U.S. market.

Frozen tuna loins

Loin of tuna is the product of halfway of process of canned tuna. Material for tuna loins is from the reject of sashimi quality, and this is also for canning. Volume of the rejected tuna is much less than that of for sashimi.

Packing machine is not necessary for loin manufacturing (other machinery's for canning are all needed for loin factory). Instead, a freezing system is required for loin production. To transport the frozen loins for exporting, reefer cargo vessels are also needed to call at Malakal harbor.

(3) Suitable and recommendable fish processing in Palau

Salted and/or dried fish opened or gutted

Fish will be preserved by solely dried or dried with salt when the catch is abundant and excessive for daily consumption.

Preservation by the means of drying or curing is of use to transport the processed fish at lower in price and easier, because dried or cured fish can be conveyed in lightweight without ice and insulated boxes.

Half dried or light salted fish last a few days, well dried or deep salted ones last quite longer; as much as several months without refrigeration.

Dried or salted fish should be taken more often to Palauans dietary habits instead of the imported frozen and canned fish, and even fowl and meat.

Squids, octopuses, bivalves and small anchovies, which are half or well dried, will be favorites to every Palauan and foreigners living in Palau.

Salted fish/squids/guts in bottle (shiokara)

Followings will be made to salt down deeply in bottles with the caps close tight;

- Chopped small meat of fish with red flesh (sardine or mackerel);
- Small size of fish with red flesh (anchovies);
- Guts and meat of squids; and
- Guts of skipjacks.

The contents shall be stirred up once a week, and be served after several weeks. The products will last long, and they are good for appetizers or as a side dish with rice, taro or cassava.

Smoked fish products

- Smoked fish (whole or opened) is the most popular means of fish processing in Palau. Smoked fish produced by prevailing means among the people in Palau can be kept only for few days without refrigeration.
- By adopting the new smoking techniques, the fish will be well preserved and last longer, and the commercial value will be much higher.
- Smoked skipjack loin (*namaribushi*) is also popular in Palau. The quality and taste will be also improved by new techniques from Japan.
- Fish jerky also deserves to be studied in Palau. The material should be from large sized fish with red flesh. The meat will be cut into thin pieces and smoked. Skipjack from local inshore fishing, tuna from rejected *sashimi* and canning quality will be material of fish jerky. Marlins are also shipped to Japan in the form of fresh or frozen; therefore catches of marlins (billfish) of tuna fishing cannot be used for fish jerky. Fish jerky produced in Palau shall be consumed in this country. The exportation of fish jerky to Truk (Chuuk) and Guam is worthy of being studied after the production gets going.

Boiled down fish in soy (*tsukudani*)

The same material as for fish jerky will be also processed to *Tsukudani*. By cooking red flesh fish, which cut into small cubes with sugar added soy, *Tsukudani* can be easily processed. The product lasts long without refrigerating. This is not only good for side dish with the staple food; also it could be taken for emergency provisions for Palauan people. Bivalves and snails are also used to make *tsukudani*.

4.3.5 Tourism related Fishing Industry

We have to study how to make the divers and non-diver tourists have a joy of marine recreations in Palau at least one day during their visit.

Fishing at shore Sports fishing by motorboats Swimming at beach Skin-diving Snorkeling Boarding on glass-bottom boats Holding beach barbecue (seafood) parties and camping at beach Experiential fishing village life, etc.

In Palau, reinforcement of the marine recreation business is worth considering, and this is also to be discussed earnestly, so as to increase the income of fishermen and people live nearby the beach. Marine recreation creates more opportunity of jobs for residents including the women of the houses.

The more foreign tourists come to Palau, the more income will be derived to fishermen and fishing villages in Palau.

The amount of foreign tourists to Palau who are carried by aircraft's naturally depends on the number of flights coming to Palau. Frequent flights from Japan and Taiwan contribute the most to this country.

The number of flights coming and going Japan/Taiwan is also an important factor for the marine-related industry, because the transportation of *sashimi* tuna relies on air delivery. Chartered cargo flights are utilized at times during tuna peak season; nevertheless *sashimi* tunas are principally conveyed by regular service flights from Palau to Japan.

4.4 Future Fishing Industries in Palau

4.4.1 On Shore Facilities for Fisheries Activities

Facilities for fishing boats and fish landing on shore are provided amply at dock(s) constructed in every state. Those who do inshore fishing using motorboat land their

catch on the docks prepared for traffic and leisure motorboats.

At least one dock is provided in every state, which has sufficient space for the number of the boats utilizing it, and some docks are installed with an ice plant. Ice plants (flake icemaker) are found in seven states, which are Kayangel, Ngarchelong, Ngeremlengui, Melekeok, Koror, Peleliu and Angaur. Large and medium size (over 2 G/T and/or over 8 meters in length) fishing boats engage in offshore fishing in Palauan waters. The foreign fishing boats utilize only Malakal harbor for discharging their catch and for lying in.

The only facility, which is deficient for on shore in this country, is "Fish Keeping Storage". Every fish-landing site needs that Storage. This is a well-insulated building with an adequate space to keep the iceboxes. The space of the building and number and size of boxes will be studied and determined to match to volume of the fish catch in the area. This is an insulated storage and not a cold storage. The storages shall be located near the ice plant built at the dock. The storages and boxes in Babeldaob will be more useful after the planned Compact Road is completed.

The insulated building has a space of about 20 to 35 m² installed with 3 to 15 pieces of insulated boxes having drainpipes. Each box can hold about 100 kilograms of fish and the same weight of crushed ice or flake ice. This manner of keeping the fresh fish, "keep in well insulated box with drainpipe together with crushed ice of same weight to the fish" should be adopted also during the fish transportation, and at the wholesalers and retailers in Koror. The cost of the building and insulated boxes will be US\$8,000 to \$15,000 according as the size of building and the number of boxes.

The construction of ice plants will be studied for Ngardmau, Ngirwal, Ngatpang and Ngchesar. The ice plant will be the same type as the present plants in Ngaraard or Angaur.

More shellfish (Bivalve and Snail) and cephalopods (Squid and Octopus) shall be caught by fishermen, and they will be transported to Koror for processing.

Also exceeded catches of some fish shall be processed as smoked fish at fish producing states, or to be sent to Koror to be salted, dried or cooked as preserved marine foods for mainly local consumption.

4.4.2 Offshore Fishing for Palau Fishermen

Those which hand-line (hook and line) fish for the demersal species in the outside reef, and pole and line fish for skipjacks offshore in Palauan water shall be taken into account for future Palauan fisheries. This is new fishing to local fishermen and for the future fisheries in Palauan offshore waters.

The line fishing is a daily operation, which is suitable for Palauan fishermen, and the fishing gear and the techniques are rather simple, and also less maintenance of fishing boats and gear is required.

The fishing boats and the gear and the fishing technicians from Japan are needed for this fishing.

An approximate cost for one fishing boat 6 to 8 G/T) with complete set of hook and line fishing gear is US\$100,000, and for one pole and line skipjack boat 15 to 20 G/T) with full set of fishing gear is US\$1,300,000.

4.4.3 Aquaculture

(1) Milkfish in brackish water area

Suitable coasts or inlets for milkfish culture are in the west coast in Airai, the southern

part of Aimeliik, mouth of Ngeremeduu Bay of Ngatpang and northeast coast of Peleliu. Fry of milkfish can be caught along the coast of islands in certain seasons of the year.

Scale of a total fishpond of one unit will range between one half (0.5) ha. to ten (10) ha. Small-scale fishponds will be composed of 1 nursery pond and 2 to 4 production ponds. Large scale will be 2 to 3 nursery ponds and 8 to 15 production ponds. Developing cost for fishponds is very diverse according to the site location and soil condition.

Technician(s) for milkfish cultivation shall be sent to Palau from Japan or the Philippines.

In case of developing the coast or swamp to fishpond, always take notice of the existing nature, and pay special attention not to destroy the coral area and forest of mangroves.

(2) Abalone's for Mariculture

Abalone (*Haliotis ovina*) is being cultured experimentally in Babeldaob, though its system and manner of culture is not finalized yet.

The culture of abalone is worth studying on a commercial basis in Palau, since the techniques of culturing abalone are not sophisticated and the value of abalone in its dried form is quite high in Asian countries.

4.4.4 Marine Product Processing

Study and enforcement for preservation of fish are needed in this country. This is the countermeasure for rich hauls and also for the preserving of the catches with or without refrigeration.

The products processed in Palau are all for the local market, and never should be for exporting purposes.

(1) Salted and/or dried fish

Any species of demersal and pelagic fish could be salted or dried in their gutted or opened forms.

- Dried fish with a small quantity of salt for the short period (2 to 4 days) of preservation,
- Soaking in deep salt or well-dried fish for the long period (weeks to months) for preservation.

Cephalopods (squid and octopus) are also to be gutted and opened, and dried in the sun. The products will be delicacy for Palauans and for the tourists from Asia.

The techniques of fish drying and curing from Japan are needed.

(2) Salted down fish/squids/guts in bottle (*shiokara*)

Whole fish of anchovies, chopped red flesh fishes, squids and the guts and skipjacks guts are able to be made into *shiokara* with a lot of salt (better with coarse salt). The processing needs 3 to 6 weeks, and the fish should be stirred up several times before be taken.

(3) Smoked fish

Smoked open fish are being produced in the traditional way in Palau.

The Japanese technique of manufacturing smoked fish and smoked skipjack loin (*namaribushi*) will improve the local smoking manner to make the products last longer

and make the taste better.

Fish jerky made from sashimi-rejected tuna and tuna-like fish shall be studied simultaneously with other smoked fish.

(4) Ground fish meat (*surimi*) for *Kamaboko*, *Chikuwa* and *Hanpen*

White flesh fish of almost all kinds of demersal species abundant inside the reef are caught sometimes in large volume at once.

These fish shall be processed into *surimi*. The *surimi* will be made to *Kamaboko*, *Chikuwa* and *Hanpen*, etc.

These products are the favorites of local people, and they purchase these commodities paying a high cost for imported *Kamaboko* and others from Japan and fish balls from Taiwan.

(5) Boiled down fish in soy (*tsukudani*)

Tsukudani will be made from pieces of red flesh fish by simmering with soy and sugar. The product lasts quite long outside the refrigerator. Table 4.4.1 shows proposed fish processing facilities.

Table 4.4.1 Proposed Plan for Fish Processing Facilities

	Kayangel	Ngarchelong	Ngeremlengui	Koror	Peleliu
Salted and Dried Fish	●		●	●	
Salted down Fish in Bottle (<i>shiokara</i>)				●	
Smoked Fish	●	●	●	●	●
Ground Fish Meat (<i>surimi</i>)				●	
Boiled down Fish in Soy (<i>tsukudani</i>)				●	

Note: ● indicate Proposed Processing Workshop in State

Large size of workshop (150m²) in Koror, Medium size of workshop (100m²) in Kayangel, Ngeremlengui, Small size of workshop (40m²) in Ngarchelong, Peleliu

Japanese techniques and simple machinery (grinding machine) are needed for the processing.

Source: JICA Study Team

Improvement of fish processing industries in Palau contributes greatly to the international revenue of Palau.

Table 4.4.2 shows main suitable fisheries by fields.

Table 4.4.2 Summarized Table of Suitable Fisheries by Field

	Suitable Elements	Suitable Work	Unsuitable Work
Offshore Fishing	Simple fishing gear Simple techniques Less maintenance One day operation	Hand line for demersal fish Pole & line for skipjack	Several days operation Net fishing
Aquaculture	Needless for Large investment Complicated techniques Daily maintenance Anxiety for fry or seed Anxiety for mortality	Milkfish (brackish water) Abalone (marine)	Intensive culture w/delicate care Prawn Earls Fresh water fish Marine fish
Processing	Needless for Mass Production Big scale factory Complicated and sophisticated machineries Special skill	Salted and dried Salted & bottled Smoked Ground fish meat Boiled down	Canning Frozen lion Processed foods for export

Source: JICA Study Team

(6) Fishing license fee for revenue

There are two types of fishing licenses for foreign fishing boats that operate in Palauan waters.

Fishing license for fishing boats based at Malakal harbor

Taiwanese/Chinese/Japanese: Tuna longline boats.

Fishing licenses for deep sea fishing boats operating in 200 mile EEZ of Palauan waters

Japanese/the United States/Taiwanese/Korean: Tuna longline boats/skipjack pole and Line boats/tuna purse seines.

The present system for fishing license fees of this country should be studied and examined to be more efficient and lucrative. The Government should always study ways of taking advantage of the migratory fishes in Palauan 200 mile EEZ, and pay more heed to the systems of fishing licensing of the adjacent countries.

Palau should select the right and best system for every season and every year adapting to the demand of skippers of fishing boats and also a trend of international markets for tunas and skipjacks. The license fee of Palau should harmonize with the other Western Pacific countries. Fishing license fees are the most efficient revenue source to this country.