

NATIONAL FISHERIES AUTHORITY  
THE INDEPENDENT STATE OF PAPUA NEW GUINEA

BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT FOR CONSTRUCTION  
OF  
WEWAK MARKET AND JETTY  
IN  
THE INDEPENDENT STATE OF  
PAPUA NEW GUINEA

MAY 2008

JAPAN INTERNATIONAL COOPERATION AGENCY  
(JICA)

OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD.  
(OAFIC)

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## PREFACE

In response to a request from the Independent State of Papua New Guinea, the Government of Japan decided to conduct a basic design study on the project for construction of Wewak market and jetty and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Papua New Guinea a study team from 15th day of October to 11th day of November, 2007.

The team held discussions with the officials concerned of the Government of Papua New Guinea, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Papua New Guinea in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Independent State of Papua New Guinea for their close cooperation extended to the teams.

May, 2008

Masahumi Kuroki  
Vice-president  
Japan International Cooperation Agency

May, 2008

### Letter of Transmittal

We are pleased to submit to you the basic design study report on the project for construction of Wewak market and jetty in the Independent State of Papua New Guinea.

This study was conducted by Overseas Agro-Fisheries Consultants Co., Ltd., under a contract to JICA, during the period from September, 2007 to May, 2008. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Papua New Guinea and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Munehiro Shimada  
Project manager,  
Basic design study team on  
the project for construction of  
Wewak market and jetty  
Overseas Agro-Fisheries Consultants Co., Ltd.

## **SUMMARY**

## Summary

The Independent State of Papua New Guinea (hereinafter referred to as “PNG”) has a total population of 6.187 million (source: The Secretariat of the Pacific Community, as of FY2006) and consists of a total land area of 462,000km<sup>2</sup>. PNG is located right on the equator, approximately 160km north of Australia, comprising the eastern half of the Island of New Guinea and over 700 large and small islands. The target region of the Project is the East Sepik Province, which is in the northeast of its territory in the Island of New Guinea, and the PNG’s longest river, the Sepik (1,126km), runs through the Province. The East Sepik Province has a total population of 343,000 and a total land area of 43,000km<sup>2</sup>. PNG’s GNI per head per year was 660 US dollars in 2005 (source: the World Bank) and PNG’s economic growth was 2.4% in the same year (source: the Central Bank of PNG). Furthermore, PNG’s GDP in FY 2005 was approximately 3.03 billion US dollars, consisting of 49% primary industries, 26% secondary industries and 25% tertiary industries. PNG has natural resources in abundance (natural gas, crude oil, gold, copper, nickel, cobalt, timber, fishery products etc.) and 70% of PNG’s export earnings are from mineral resources. Meanwhile, PNG’s economy has a two-tier structure comprising monetary economy in urban areas and self-sufficient economy in rural areas, and approximately 85% of the population are self-sufficient gardening & fishing villagers. These self-sufficient gardening & fishing villagers are largely impoverished members of society, making up approximately 37% of PNG’s population thereby, PNG is one of the poorest countries in the world.

PNG’s five-year development scheme, the Medium Term Development Strategy 2005 – 2010, projects budgets are strategically demarcated to meet seven development priorities (expenditure priorities) so as to achieve highly cost-effective development. These seven priorities are the rehabilitation and maintenance of the transport infrastructure; the promotion of income earning opportunities; basic education; development-oriented informal adult education; primary health care; HIV/AIDS prevention; and law and order. This Project relates to two of the above priorities, i.e. the rehabilitation and maintenance of transport infrastructure and the promotion of income earning opportunities, as the Project is carried out to improve the Wewak Market, the base of retail activities by the gardening & fishing villagers of Wewak, and the Wewak Jetty that serves as part of the transport infrastructure. PNG’s ten-year fisheries development scheme (2006-2016) defines that tuna, shrimps, sea cucumbers, button shells and sharks constitute the backbone of PNG’s fisheries industry while pointing out the importance of the promotion of small-scale coastal fisheries in the light of sustaining food supplies to the people of PNG.

With regards to Wewak in the East Sepik Province, the Project’s target region, the Wewak Market provides the economic base for local gardening & fishing villagers who sell their products. During the busiest hours, the Market accommodates 850 vendors (on average) and becomes packed with shoppers. The half-destroyed Wewak Jetty once provided the main access by sea to the Wewak Market, serving as part of the transport infrastructure. The channels for distributing key products,

which are available at the Wewak Market, are consisted of fishing communities (gardening also supports their livelihoods in these areas but fishing is more actively operated) of the inland areas, eastern coasts and Wewak islands and, as well as agricultural products, fresh fish and smoked fish are distributed. However, the following issues have been raised:

- ① The Wewak Market is in a lowland area and the premises become contaminated with mud at the time of high tide and heavy rain, creating too unhygienic a condition to use. The 27 years old market buildings are at risk of collapse because of their decrepit state.
- ② The Wewak Jetty is 47 years old and was partially destroyed by the earthquake in 2002. The remaining parts are also in a decrepit state and are feared to collapse. The Jetty has therefore been out of use. Due to this condition, vendors who access the Wewak Market by sea have no choice but to operate landing and loading at the water's edge, which is rather inconvenient and inefficient.
- ③ After over 20 years of use, the old ice block making machines have been removed, which has disabled the supply of ice blocks to fishing operators for storing harvested fish as well as storing ice prior to fishing.

This condition has entailed problems such as the loss of income earning opportunities, inadequate landing and loading of products by banana boat, and inadequate fresh fish preservation.

Under such circumstances, the PNG government formulated “The Project for Construction of Wewak Fish Market and Jetty” with the aim of reconstructing the Wewak Market and the Wewak Jetty as well as re-establishing the ice supply system. The PNG government also requested grant aid cooperation from the Japanese government in support of the rebuilding and extension of the Market, the renovation of the Jetty, plus the provision of an ice making facilities.

In response to the request, the Japanese government dispatched a preliminary study team to carry out evaluation work between April 29 and June 2, 2007. The following outcomes were reached:

- ① The Wewak Market lacks space and is unhygienic. Renovation is urgently required.
- ② The Wewak Jetty is collapsed and out of use. Renovation is urgently required in the light of the regeneration of local fishing communities.
- ③ The PNG government states that an ice making plant is much needed but it is necessary to identify the actual demand.

Subsequent to the above preliminary study and considering its results, the Japanese government decided to conduct a basic design study and an expert team was dispatched according to the following schedule:

Basic Design Study	: Oct. 15 – Nov. 11, 2007
Explanation of the Draft Basic Design	: Feb. 28 – Mar. 5, 2008

From the field survey and analysis, the basic design study team identified and examined the background and details of PNG's project, natural conditions, operation and management planning, plus conditions of building construction and material procurement. The results led to the conclusion

that, in order to increase income earning opportunities for gardening & fishing villagers in the target area of the Project, it would be necessary to reconstruct the Wewak Market and the Wewak Jetty as well as re-establishing the ice-supply system with the goal of restoring the retail system, enabling the villagers to sell their products, and the transport infrastructure to reopen the sea access thereby resolving the above issues. It was decided that during the course of the Project, the Requested Japanese Assistance, by means of grant aid cooperation, would realise the construction of Market Building, Administration Office Building (including Products Storage), Kiosk, Public Toilet, Refreshment Space, Corridor, Standby Rubbish Bays, and Pavement on the Premises for the Wewak Market, the construction of the New Wewak Jetty and the construction of Ice Making Building and Ice Making Plant (including Ice Making Machine, Ice Storage, Emergency Generator and fixtures such as Maintenance Tools for Ice Making Machine, Ice Boxes, Scale etc.). The basic design is outlined as follows:

Facilities		Detail / Scale
Wewak Market	Market Building	3 buildings, 304 places for on-the-table sales, 296 places for on-the-floor sales, total floor area of 2,170m <sup>2</sup> , steel structure, one storey
	Administration Office Building	Market manager's room, market clerk's room, staff room, office toilet, storage room etc. total floor area of 90m <sup>2</sup> , reinforced masonry construction, one storey
	Kiosk	Sales of drinks and snacks, sink, total floor area of 44m <sup>2</sup> , reinforced masonry construction, one storey
	Public Toilet	Gents', ladies', pay counter, total floor area of 46m <sup>2</sup> , reinforced masonry construction, one-storey building
	Corridor	2 sections between the market buildings, total floor area of 125 m <sup>2</sup> , steel structure, one storey
	Pavement	Common aisles/outdoor sales sections, paved area of 2,206 m <sup>2</sup> (approx.), interlocking type.
	Outdoor Facilities	Refreshment space (accommodating benches etc.), drainage trenches, retaining walls, standby rubbish bays
Ice Making Plant	Operation office, office toilet, machine room, ice handling area etc., ancillary equipment (500kg/day ice block making machines, 1.8 t (approx.) ice storage, 10kVA emergency generator), total floor area of 77 m <sup>2</sup> , reinforced masonry construction, one-storey building, and fixtures (ice boxes, scale, maintenance tools etc.)	
New Wewak Jetty	Access section (W: 3.5m, L: 14.0m), Section connected to the shore (W: 6.0m, L: 13.5m), jetty structure directly attached to the seabed, steel pipe piling, (pipe length: 17.4m), reinforced concrete upper section, fender system (rubber fender type.), ancillary equipment (bits, ladders etc.)	



When implementing this Project by means of grant aid cooperation which is provided by the Japanese government, it requires a total implementation period of 16.0 months consisting of approximately 5.5 months for the details design and approximately 10.5 months for the actual construction. The project cost borne by the PNG side is estimated as 1,985,400 PNG Kina.

Subsequent to the implementation of this Project, the cost incurred by the operation and maintenance of the Wewak Market is estimated to be approximately 17,208 Kina per month whereas the income gained from facility fees is estimated to be approximately 22,000 Kina per month. The cost incurred by the operation and maintenance of the New Wewak Jetty and the Ice Making Plant is estimated to be approximately 4,354 Kina per month whereas the income from ice sales is estimated to be approximately 5,287 Kina per month. The above financial estimation therefore ensures the healthy operation and maintenance of the Wewak Market, the New Wewak Jetty and the Ice Making Plant.

By implementing the Project, the following outcome are expected:

As direct effect,

- ① The Wewak Market will be able to accommodate more vendors, increasing the number from approximately 150 to approximately 600.
- ② The market premises will be well drained, thus improving hygiene.
- ③ The daily number of banana boats, which can use the Jetty, will increase from 0 to 10, as the New Wewak Jetty can be used for transporting agricultural and fishery products to the Wewak Market for sale.
- ④ The weekly supply of ice blocks, which are needed for the fresh fish for sale at the Wewak Market, will increase from 0t to approximately 2.5t.

As indirect effect,

- ① Income earning opportunities will increase for vendors (gardening & fishing villagers) who use the Wewak Market.
- ② The sea transport infrastructure will be restored and improved, revitalising the distribution of agricultural and fishery products especially from the fishing communities of Wewak islands.
- ③ The supply of ice blocks will be reinstated, which will revitalise fishing activities by the communities of Wewak islands, thus contributing to the regeneration of fishing villages.

The following various points suggest that it is appropriate to implement the Requested Japanese Assistance by means of grant aid cooperation:

- ① Those who will benefit from the Project are the general public including vendors who use the Wewak Market (approximately 850), the residents of Wewak Town (approximately 3,700) and gardening & fishing villagers in the Wewak area (approximately 9,300).
- ② The aim of the Project is to increase income earning opportunities for gardening and fishing villagers of the Project target area, by which the living standard of those who benefit from the Project could be improved.

- ③ The PNG government will be able to finance and provide human resources and technology for the operation and management of the facilities and equipment which are provided by the Project. No extremely sophisticated or complicated technologies will be required for running the facilities and equipment.
- ④ The Project will contribute to the success of PNG's Medium Term Development Strategy 2005 – 2010.
- ⑤ The operation of the Project will bring profitability to the extent that the smooth operation and maintenance of the facilities and equipment is ensured.
- ⑥ While the implementation of the Project involves a certain period of time needed to carry out construction work, some of the regular users will have to agree to the limited use of the Wewak Market, although temporarily. However, such an environmental and social impact has been taken into account and appropriate measures are in place to lessen the impact.
- ⑦ The Project is executable under the system of Japanese Grant Aid scheme without any particular difficulties.

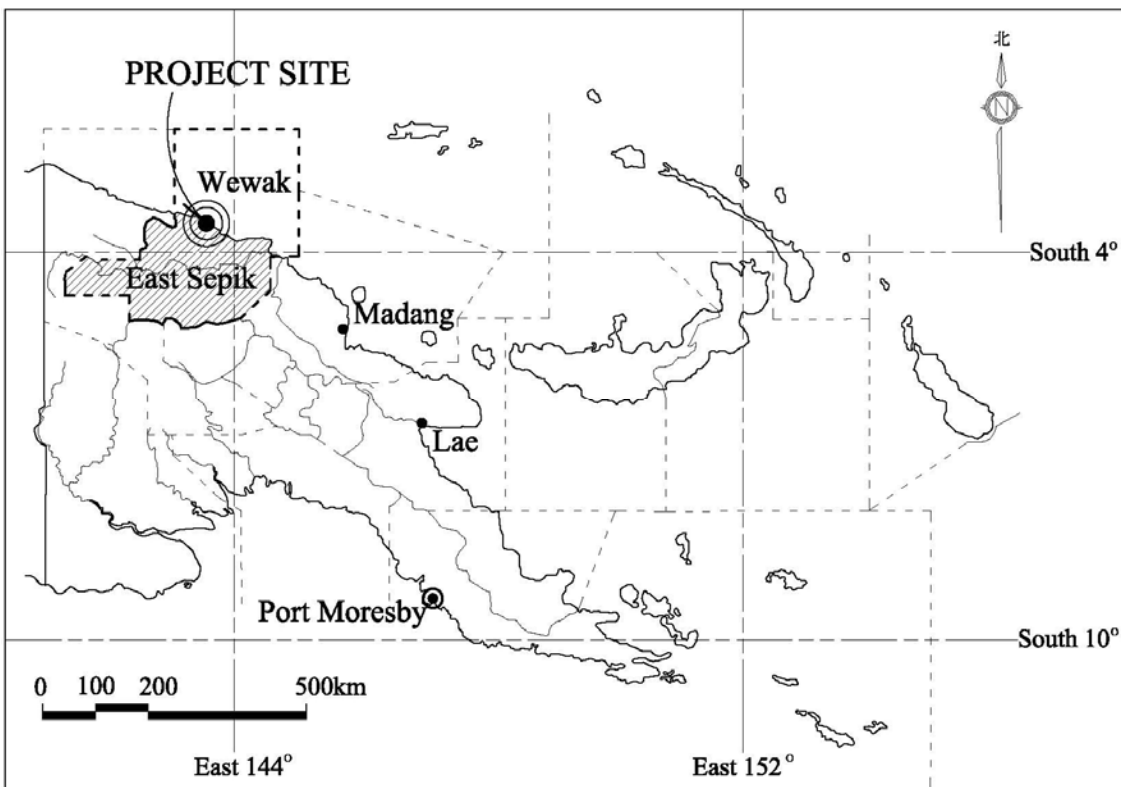
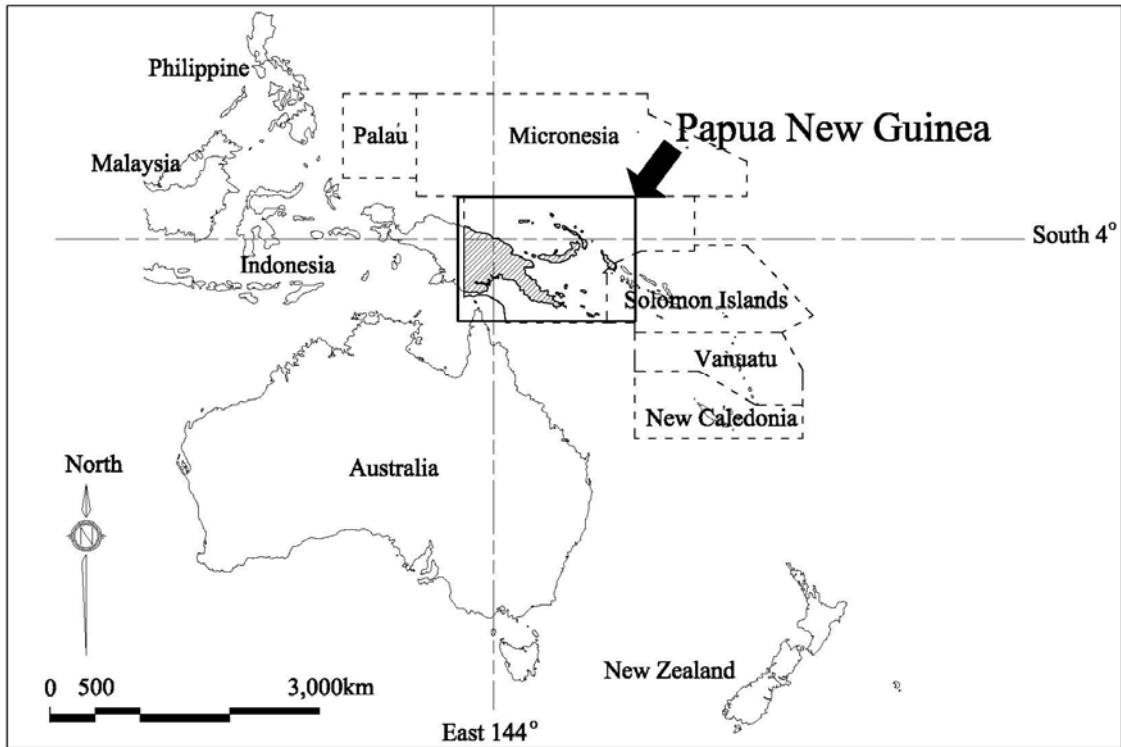
The following suggestions should ensure the smooth and effective implementation of the Project:

- ① To provide in advance, explanation and public information for the market users who are likely to be affected by the construction work which will be carried out as part of the implementation of the Project for a certain period of time.
- ② To establish a system and implement budget measures appropriate for sustainable refuse collection at the Wewak Market.
- ③ To ensure savings and budget control appropriate for maintaining and updating equipment such as ice making machines by managing finance in a separate account.
- ④ It is essential to accurately identify the effectiveness of the Project so as to ensure its steady progress. Hence, the concerned parties of the Project in the PNG side should preferably measure the effectiveness of the Project regularly and continuously.
- ⑤ In PNG, improvements have been made to market facilities through donors' cooperation in areas other than the target area of the Project. The Wewak Market should be operated more efficiently by taking advantage of learning other markets' examples.
- ⑥ A large variety of people, including vendors and customers, gather at the Wewak Market for different interests. This often creates managerial issues concerning site arrangement, refuse collection and hygiene management. Through the implementation of the Soft Component, the acquisition of knowledge about how to operate markets and the learning of their examples should contribute to the more effective and efficient operation of the Wewak Market.

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### Location Map





PERSPECTIVE/ WEWAK MARKET



PERSPECTIVE/ NEW WEWAK JETTY AND ICE MAKING PLANT

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## Abbreviations

<b>Abbreviation</b>	<b>Formal Name</b>
ADB	Asian Development Bank
AIDS	Acquired Immunodeficiency Syndrome
BOD	Biochemical Oxygen Demand
DL	Datum Line
EU	European Union
GDP	Gross Domestic Product
GNI	Gross National Income
HIV	Human Immunodeficiency Virus
HWL	High Water Level
LLWL	Lowest Low Water Level
LWL	Low Water Level
MSL	Mean Sea Water Level
PMV	Public Motor Vehicle
RC	Reinforced Concrete
RCB	Reinforced Concrete Block
S	Steel

# **Chapter 1 Background of the Project**

# Chapter 1 Background of the Project

## 1-1 Background

With regards to Wewak in the East Sepik Province, the Project's target region, the Wewak Market provides the economic base for local gardening & fishing villagers who sell their products. During the busiest hours, the Market accommodates 850 vendors (on average) and becomes packed with shoppers. The half-destroyed Wewak Jetty once provided the main access by sea to the Wewak Market, serving as part of the transport infrastructure. The channels for distributing key products, which are available at the Wewak Market, are consisted of fishing communities (gardening also supports their livelihoods in these areas but fishing is more actively operated) of the inland areas, eastern coasts and Wewak islands and, as well as agricultural products, fresh fish and smoked fish are distributed. However, the following issues have been raised:

- ① The Wewak Market is in a lowland area and the premises become contaminated with mud at the time of high tide and heavy rain, creating too unhygienic a condition to use. The 27 years old market buildings are at risk of collapse because of their decrepit state.
- ② The Wewak Jetty is 47 years old and was partially destroyed by the earthquake in 2002. The remaining parts are also in a decrepit state and are feared to collapse. The Jetty has therefore been out of use. Due to this condition, vendors who access the Wewak Market by sea have no choice but to operate landing and loading at the water's edge, which is rather inconvenient and inefficient.
- ③ After over 20 years of use, the old ice block making machines have been removed, which has disabled the supply of ice blocks to fishing operators for storing harvested fish as well as storing ice prior to fishing.

This condition has entailed problems such as the loss of income earning opportunities, inadequate landing and loading of products by banana boat, and inadequate fresh fish preservation.

Under such circumstances, the PNG government formulated "The Project for Construction of Wewak Fish Market and Jetty" with the aim of reconstructing the Wewak Market and the Wewak Jetty as well as re-establishing the ice supply system. The PNG government also requested grant aid cooperation from the Japanese government. Detail of requested component is outlined as follows:

Wewak Market	: Market buildings (2,752m <sup>2</sup> ), Administration Office Building(112 m <sup>2</sup> ), Kiosk(99 m <sup>2</sup> ), Public Toilet(56m <sup>2</sup> ), Storage (138m <sup>2</sup> ), Refreshment space(40 m <sup>2</sup> ), Corridors(1,400 m <sup>2</sup> ), Parking space (2,000m <sup>2</sup> ), Bus terminal (27m <sup>2</sup> ), Fence (550m), Paved Premises (138m <sup>2</sup> ),
Wewak Jetty	: Jetty (width15m , length 25 m), pontoon bridge (width 3m , length 6 m), Ice making machine (5 ton/ day, ice storage capacity 25 tons), 30 kVA emergency generator
Ancillary Equipment	: Ice box (100 liter x 50, 200 liter x 20), Balance scale (5, 20, 100 kg), Ice machine tool kit x 1 set, High pressure washer x 3 sets, Market maintenance equipment (cleaning equipment x 1 set), Pickup truck (1 vehicle), Computer (2 sets), Printer (2 sets), Furniture (1 sets)

In response to the request, the Japanese government dispatched a preliminary study team to carry out evaluation work between April 29 and June 2, 2007. The following outcomes were reached:

- ① The Wewak Market lacks space and is unhygienic. Renovation is urgently required.
- ② The Wewak Jetty is collapsed and out of use. Renovation is urgently required in the light of the regeneration of local fishing communities.
- ③ The PNG government states that an ice making plant is much needed but it is necessary to identify the actual demand.

From the views of necessity, relevancy, and urgency, the each component was examined based on the suitability as the project for Japanese Grant Aid scheme on the basic design study. Several discussions were held with recipient government and Japanese study teams (basic design team and preliminary study team). Some items have agreed to be deleting from the request component from following reasons. Parking lot, Bus terminal, Fence, Market ancillary equipment (cleaning equipment), and Furniture are to be deleted from the list, for the reason of possibilities of PNG government being able to prepare by self-help. In addition, due to low priority in urgency and necessity, Pontoon bridge, High-pressure washer, Pick-up truck, Computers, and Printers are also deleted from the list of requested component.

## 1-2 Environmental and social considerations

### (1) Measures with respect to the social and environmental consideration

The following mitigation and/or preventive measures were taken for the possible impact on which this Project would have for the environment and society:

- ① The family living illegally in the Jetty Site had one temporary house (the secondhand 20 ft container, approx. 15 m<sup>2</sup>) and one grocer (the hut, approx. 6 m<sup>2</sup>) there. Based on the agreed matters with the Japanese side in the preliminarily study, the PNG side agreed with that family on their removal from the site in the consolidated meeting on 16, August, 2007. However, with taking consideration on their family life after removal, the PNG side gave time to their removal and took intercession for acquisition of a new house. As the temporary house was relocated on 30, October, the grocer was relocated in the middle of February, 2008 after the extended time. The East Sepik Provincial government shared the removal cost of the temporary house and the grocer.
- ② As consideration was given to utilize the existing trees as much as possible in the site when designing the facilities of the Wewak Market, only five small trees of the totally twenty trees were planned to be cut down.
- ③ A septic tank suitable for the planned Public Toilet was planned to be installed.
- ④ In selecting the Ice Making Machine's refrigerant, consideration was given to such factors as ozone layer protection.
- ⑤ The venders who will need to use the other markets during the construction of the Wewak Market are the venders who retail their products in the circumference of the existing market at present. The number of those venders are estimated as approx. 150 venders out of approx. 850 venders totally in the existing market. Since 18, October, 2007 and through radio, bulletins and other public announcement means to those venders, the PNG side has promoted a public comprehension of the necessities of using the other markets during the construction of the Wewak Market. As, in the public hearing on 2, November, 2007, the PNG side explained the detail contents of that construction and proposed Kreer Market and Dagua Market as substitute market during the construction, all 39 participants, who attended the public hearing as representative of the users of the existing market, agreed this proposal. When the venders use the other markets, the costs such as transportation fee

will not increase.

- ⑥ Silt sheets were planned to be placed on the surface of the sea along the Project site in order to prevent silt and sand from spreading in the sea during jetty construction.
- ⑦ The construction site were planned to be fenced temporally to prevent outsiders from entering the site to avoid accidents.
- ⑧ Establishment of a system of collection and disposal of garbage in the Wewak Market was initiated by the preparation of the budget for renting collection vehicles and the increase of the cleaning staff by the PNG side.
- ⑨ As, in the above-mentioned public hearing on 2, November, 2007, the PNG side proposed the increase of the vender fee of the new market to 1.5 Kina per day, the attended representatives of the users presented opinions such as “Leaving 1 Kina per day is desirable”, “Raise to 2 Kina per day is necessary for maintenance” and “Consideration on different fees according to the type of the selling place is desirable”. With taking consideration of these opinions, the PNG side planned to leave 1 Kina for the vender fee of the floor selling place which has the same specifications of the existing one and to settle 1.5 Kina for the vender fee of the stand selling place, the specifications of which is improved.

## (2) Procedure for Environmental Impact Assessment

The following procedure will be used to assess the possible impact on the environment:

- ① As the scale of this Project is below level 2B stipulated in the PNG’s Environment Act 2000 and is unlikely to have any serious environmental impact, this Project is considered by the PNG side to fall under the category of level 1, which does not require an Environment Permit.
- ② The procedure for level 1 is as follows: The National Fisheries Authority as implementation agency prepares a report describing an outline of this Project and the measures to be taken to alleviate or avoid the possible impact on the environment and submits it to the Department of Environment and Conservation. The procedure is completed after that Department checks the report and notifies the National Fisheries Authority of its receipt. As the report was submitted to the Department of Environment in March, 2008, the National Fisheries Authority waits presently its notification of the receipt.

## (3) Classification of category

While this Project will not have any serious socio-environmental impact, it is, however, necessary to take appropriate measures to reduce the possible socio-environmental influence during execution of the Project. In this connection, this Project is considered to fall under Category B (having some unfavorable, if not serious, impact) as stipulated by Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations.

## **Chapter 2 Contents of the Project**

## Chapter 2 Contents of the Project

### 2-1 Basic Concept of the Project

The rehabilitation and maintenance of the transport infrastructure and the promotion of income earning opportunities are included in the seven development priorities of Medium Term Development Strategy in PNG. The Wewak Market is identify as the place to create their income for the gardening & fishing villages, who are living in surrounding of East Sepik Province of the Project site. They act as a vender to sell their products in the Market.

An average of 850 venders run business at the time of the peak time, and it is circumstances to become overcrowded in the Market hall. The Wewak Jetty used to play central roll for transportation infrastructure as the sea route access to the market before the partial collapse.

In addition, the distribution channel of the main sale product in the market consists of different fisheries districts (the district where the gardening & fishing activity are held, but more likely in fisheries activity) such as inland area, eastern part coast area, and remote island area. The major products are mainly composed of farming products together with a smoked fish and fresh fish. However, following problems are required to be solved in this area.

- ① As the Wewak Market is located at low ground, its plot becomes muddy after high tide and rainfall, and consequently it becomes unhygienic and unusable. The 27 year-old market sheds are likely to collapse due to structural deterioration.
- ② The Wewak Jetty, after construction 47 years, is partially destroyed by an earthquake occurred in 2002 and remaining part is also likely to collapse caused by structural deterioration. This structural deterioration is also causing the jetty to be useless, and causing low accessibility to the vender using sea transportation. Consequently, all venders are forced to land and unload their products at inconvenience and unstable beaches.
- ③ Cause from deterioration, the block ice making machine has been removed after installation after 20 years. Therefore, the block ice to utilize in a fresh fish distribution (preservation purpose before and after the fishing activities) is not readily and available to fisheries workers who are engaged in the market activities.

As the consequence from above reasons, the following concern has been appointed out, the revenue opportunity for the gardening & fisheries villages is lost, landing/loading operation by banana boat carrying the gardening & fisheries products is not conducted adequately, and the freshness of the fish is not maintained properly.

The objectives of this Project are to solve the problem mentioned above and to improve the revenue opportunity to the personal who are engage in gardening & fisheries communities by reconstruct the market function and renovation of the sea-access base function as a part of infrastructure. In regarding from this, the Project is to reconstruct the Wewak Market, the jetty and establish a system to enable the supply the block ice to users. As these functions to perform synergy effect, it is required to implement simultaneously in the Project. Furthermore, the reconstruction of the Wewak Market function is also significant in terms of the promotion of fishing villages, as approximately 70% of the vendors in the Wewak Market have family members or relatives who are also involved in fisheries business. This Project is planned for the development of fisheries village. The Project site is the area which is located to the Wewak Market in Wewak Town in the Wewak District, East Sepik Province.

In order to achieve the above objectives, the Project aims to reconstruct the Wewak Market to improve the facilities for supplying block ice and provide continuous management of these

facilities. It is expected that this in turn will increase the utilization ratio of the worker working in the facilities of the Wewak Market, improve loading & unloading activities at the sea-access base and increase the amount of block ice that can be supplied for the marketed fresh fish in the Wewak area. Under this Project, the Requested Japanese Assistance will implement the construction of Market Building, Administration Office Building (including Products Storage), Kiosk, Public Toilet, Refreshment Space, Corridor, Standby Rubbish Bays and Pavement on the Premises for the Wewak Market, the construction of the New Wewak Jetty and the construction of Ice Making Building and Ice Making Plant (including Ice Making Machine, Ice Storage, Emergency Generator and fixtures such as Maintenance Tools for Ice Making Machine, Ice Boxes, Scale etc.).

## 2-2 Basic Design of the Requested Japanese Assistance

### 2-2-1 Design policy

#### 2-2-1-1 Basic policy

##### (1) Basic policy

In preparing the Basic Design of the Requested Japanese Assistance for this Project, the following have been defined as the elements comprised in this basic policy:

- ① The planned Wewak Market will be renovated to replace the existing Wewak Market facilities, which PNG will demolish.
- ② The New Wewak Jetty will be built to replace the existing Wewak Jetty, which PNG will demolish.
- ③ An Ice Making Machine to make block ice will be installed as a substitute for the one which was removed because of aging.
- ④ The findings of the natural environmental survey around the Project site are to be reflected in the Basic Design.
- ⑤ Due consideration should be given to ease of maintenance, and lower cost of operation, of the planned facilities.

##### (2) Policy related to natural conditions

On the basis of the findings of the natural conditions survey, the following items are incorporated into this policy related to natural conditions:

- ① Since the Project site is in a high temperature tropical zone with high humidity, due consideration should be given to natural ventilation and insulation of direct sunlight when it comes to the design of the planned facilities.
- ② As the Project site is on a shore and can be affected by the ocean air, appropriate anticorrosive measures should be taken.
- ③ Measures should be taken to ensure that rainwater in the premises is drained into the sea smoothly through natural grade.
- ④ Appropriate measures should be taken to prevent the seashore from being polluted by sewage and other waste material from the toilet.
- ⑤ The facilities should be laid out such that the shady plants on the Market side can be utilized as effectively as possible rather than cutting them down.
- ⑥ Consideration should be given to the topographic characteristics of the ocean wave-facing



reef on the Jetty side.

- ⑦ In selecting the refrigerant for the Ice Making Machine, consideration should be given to its impact on the environment.

Table 2-1-1 shows the values set for the design of the planned facilities with respect to natural conditions based on the findings of the natural condition survey.

**Table 2-1-1 Values set for the design of the planned facilities with respect to natural conditions**

Item	Value	Source
Temperature	Max. 33°C; Min. 22°C	Observed data of 2006
Precipitation	Max. Precipitation a day: 159.2mm	Observed data from 2002 to 2006
Wind pressure	Wind velocity: 28m/sec.	PNG's provisions applied to Wewak region
Seismic force	Horizontal seismic coefficient: 0.2 (building: rigid frame) 0.3 (building: masonry construction)  Base seismic coefficient: 0.15 (jetty) Design of seismic coefficient: 0.4 (jetty)	Reference value equivalent to PNG's Zone-2 which is applicable to Wewak region  Outcome from a natural environmental survey
Wave height	Offing wave height: 3.6m Design offing wave height: 0.5m Design wave height: 0.9m Design wave cycle: 7.1 seconds	Calculated based on the estimated wave height due to the prevailing easterly wind and by taking into account inflections caused by the ocean floor topography, wave breaking on the reef, and changes in wave height on the reef

(3) Policy related to socio-economic conditions

The policy related to socio-economic conditions with respect to this Project is as follows:

1) Wewak Market

- ① In view of the fact that the selling of merchandise at the Market is the source of income for vendors, the layout of the planned Wewak Market should be made to provide as many locations as possible from which vendors can sell.
- ② The scheme of execution should be such that it affects the vendors' selling activities as little as possible.
- ③ The fee chargeable for the use of the Market should be set such that it does not become an excessive burden on vendors.

2) New Wewak Jetty and Ice Making Plant

- ① Due consideration should be given to ensure the ease of unloading, as well as loading, of people and freight for jetty users.
- ② The opinion of users as well as the need for meeting the cost of maintaining the facilities should be taken into account when setting the fee chargeable for use of the jetty and the price of ice.

(4) Policy related to construction and material procurement

1) Design criteria

By taking the following conditions into consideration, the designing of the facilities under this Project shall conform to the criteria shown in Table 2-1- 2.

- ① Relatively large-scale earthquakes tend to occur around the Project site. It is therefore necessary to take into consideration structural analysis with respect to seismic force. Although PNG's and Japan's architectural structure criteria are similar, the Japanese criteria have an edge in several respects. For example, the criteria stipulate that the story drift, modulus in torsion and eccentricity ratio be checked with respect to seismic force (secondary design). For this reason, application of the Japanese structure criteria is recommended.
- ② Generally speaking, the British or Japanese criteria are applied in PNG when it comes to designing marine structures, since there is lack of original standard in PNG. However, applying the Japanese standard is preferable in this project since it is more specific and detailed.
- ③ For other structures, PNG use their own criteria.

**Table 2-1-2 Design criteria for the designing of the Project facilities**

Item	Governing criteria
Building	Building Act and Regulations (Chapter 301) 1994 (PNG)
Structure	Building Standard Law (Japan), and Structure Design Criteria stipulated by the Architectural Institute of Japan
Equipment	Public Health Act (PNG) PNG Fire Code 1629 (PNG)
Marine structure (jetty)	Engineering Criteria for Harbor Facilities (and its explanatory book), and Design Guideline for Fishery Harbor/Bank Facilities 2003 (Japan)

2) Procurement of construction materials

Basically construction materials for this Project should be procured locally. However, from following reasons, a construction material such as steel pile and steel frame should be carefully considered for procurement location. Stipulation details of procurement from Japan, PNG and its neighboring countries are essential for comparison purpose.

- ① Difficulty in local procurement of corrosion-proof steel pipes
- ② Difficulty in local procurement of galvanized steel frames

(5) Policy related to use of local construction companies

The execution scheme needs to meet the specifications and construction methods generally accepted in PNG so that local construction companies can properly participate in this Project.

(6) Policy related to operation, management and administration

The policy related to operation, management and administration is as follows:

1) Wewak Market

- ① The new Wewak Market will be operated and maintained by drawing on Wewak Town Commission's expertise accumulated from its long years' experience in running the Wewak

Market . However, the possibility of increasing operation personnel and making partial changes in the operation setup also have to be discussed in order to reinforce hygienic management including waste processing and ensure proper accounting control.

- ② To ensure the continuing operation of the planned Wewak Market, consideration should be given to its independence in terms of business accountability.

#### 2) New Wewak Jetty and Ice Making Plant

- ① The Ice Making Plant will be operated in accordance with the work schedule of the Office of East Sepik Provincial (ESP) Administration.
- ② Subject to the future enhanced accountability of the facilities, recommendation as to future setting of the jetty utilization charges.
- ③ Recommendations concerning funding for the future upgrading of the Ice Making Plant will be submitted.

#### 3) Soft Component

In view of the fact that there exist the following problems and/or conditions, the feasibility of installing Soft Component is discussed in association with the operation, maintenance and management of the planned Wewak Market:

- ① PNG made a request for Soft Component in association with the operation, maintenance and management of the planned Wewak Market.
- ② At present, a large portion of market usage fees remain uncollected. To cope with this situation requires some guidance and support (Soft Component) to realize appropriate accounting control.
- ③ At present, garbage collection and disposal are not being properly executed. To cope with this situation requires some guidance and support (Soft Component) with respect to the enforcement of the relevant rules.
- ④ Since PNG has plans to train operating managers (freezing engineers), it may be unnecessary to provide Soft Component with respect to the operation, management and administration of the New Wewak Jetty and the Ice Making Plant.

#### (7) Policy related to setting the level of facilities and equipment

The following elements are comprised in this policy related to setting the level of facilities and equipment:

- ① Emphasis should be placed on functionality-focused simplicity when it comes to setting the level of the planned facilities and equipment for the Requested Japanese Assistance with respect to this Project.
- ② The level of the planned facilities should be set by examining existing similar local facilities, taking into consideration such factors as safety, ruggedness, ease of maintenance and administration, and economic efficiency.
- ③ The architectural structure and specifications of the planned facilities and equipment should be of a level of standard generally accepted in PNG.
- ④ The facilities will be constructed as a one-story complex.

(8) Policy related to the construction method, procurement method and construction period

- ① Basically, the construction equipment to be used for this Project is available in PNG and will therefore be procured locally.
- ② If some construction materials need to be imported, the execution schemes will be discussed, taking into consideration the necessary transportation period.

#### 2-2-1-2 Calculation of size requirement

##### 2-2-1-2-1 Wewak Market

###### (1) Market Building

###### 1) Installation policy

- ① The necessary scale of the Market Building is calculated by taking into account PNG's operation plans as well as the findings of the survey of the current status of the Wewak Market.
- ② The large majority of vendors selling their merchandise on the ground in the Wewak Market premises want to avoid the scorching sun. Therefore the project is to enclose housing to many vendors as possible in the Market Building.
- ③ The selling space per vendor is determined by examining the present selling method and taking the necessary improvements into consideration.
- ④ Separate spaces are provided for vendors who are forced to sell their merchandise outside the Market Building during peak hours.

###### 2) Vendor housing capacity

- ① The PNG's Wewak Market operation plan estimates the average number of vendors at 600 a day.
- ② Also, the survey of the current status of the Wewak Market showed that the average number of vendors is about 994 in the morning at peak time and about 571 in 2 PM of the afternoon (Table 2-1-3).
- ③ From the data, it indicates that the floor space of the Market Building could be more effectively used if the number of vendors to be housed in the buildings is set at 600 of which after the peak time and approximate to the average number of vendors working in the morning.
- ④ On the other hand, as shown in Table 2-1-4, the number of vendors working outside of facility during the peak hours of the Wewak Market is 800 to 900. (Average: 850).
- ⑤ Considering that the Wewak Market is able to contain about 700 vendors in its premises of  $4,360\text{m}^2$ , it is expected that the planned Wewak Market will be able to contain about 867 vendors in its premises area of  $5,400\text{m}^2$  ( $5,400\text{m}^2 \div 4,360\text{m}^2 \times 700$ ). From this, it would be appropriate to assume that the planned Wewak Market will be able to contain 850 vendors in its premises. Thus, it is necessary to prepare and to allocate utilization spaces for the extra 250 vendors ( $850 - 600 = 250$ ), all of whom having lack of access to premises, caused by indoor capacity.

**Table 2-1-3 Number of vendors in the Wewak Market from October to November, 2007**

(unit: person)

	Friday	Saturday	Tuesday	Wednesday	Thursday	Two-week Average
Date	10/19	10/20	10/23	10/24	10/25	
Morning 8:00 AM	935	1,256	1,016	1,153	1,069	
Afternoon 2:00 PM	701	-	503	894	520	
Date	10/26	10/27	10/30	10/31	11/1	994
Morning 8:00 AM	866	974	867	876	932	
Afternoon 2:00 PM	442	647	434	339	661	571

Note: In the peak hours in the morning, many vendors sell their merchandise outside the Market premises.

**Table 2-1-4 Mode of sale by merchandise group in the Wewak Market and the number of vendors in each group, together with its percentage to all vendors (Oct.-Nov. 2007)**

Merchandise group	Mode of sale		No. of vendors	Percentage
	Outside the building	On the ground		
Vegetables, fruits, root crops	Outside the building	On the ground	300-350	35-40%
Articles of taste (betelnuts, daka)	Outside the building	On the ground	150-200	20~25%
Smoked fish, fresh fish	Inside/outside the building	Table/on the ground	70-120	10~15%
Cooked foods, tobacco leaves, lime powder	In the building	Table/on the floor	About 100	10%
Accessories, artifacts	In the building	Table/on the floor	About 50	5%
Sundry goods, clothes	Inside/outside the building	Table	80-100	10%
Total			800-900	

Note: The number of vendors shows the average during the peak hours from 9:00 to 12:00 in the morning which including vendors doing business outside the premises.

### 3) Setting the number of selling places by merchandise group and mode of sale

Table 2-1-5 shows the number of selling places by merchandise group and mode of sale calculated with the following factors in mind:

- ① Calculate the number of selling places based on the percentage breakdown of vendors shown in Table 2-1-4
- ② In the merchandise group of vegetables, fruits, root crops, tomatoes and citrus fruits are suitable for selling on a table because they are easily damaged and usually sold one by one. Since they account for about 25% of the group, selling 25% of this merchandise group on tables and the rest on the floor is proposed.
- ③ Articles of flavorings such as betelnuts are usually sold one by one and suitable for selling on a table. Since, however, PNG is reluctant to promote the selling of betelnuts, the percentage of selling places for table selling should be limited to 25% as with the case of vegetables, fruits, root crops.

- ④ From the hygienic reasons, smoked fish, fresh fish, cooked foods, tobacco leaves and lime powder should be sold strictly on tables.
- ⑤ Since accessories and artifacts are small and available in large varieties, they are suitable for table selling. They should therefore be sold on tables.
- ⑥ Sundry goods and clothes are suitable for table selling. Many of them are purchased at town supermarkets, etc. Since, however, PNG is reluctant to promote the selling of these goods, the percentage of selling places for these items should be limited to 50%.

**Table 2-1-5 Number of selling places by merchandise group and mode of sale in the Wewak Market**

Merchandise group	Percentage of vendors	Total number of selling places	Number of selling tables	Number of on-floor selling points
Vegetables, fruits, root crops	40%	240	60	180
Articles of taste (betelnuts, daka)	20%	120	30	90
Smoked fish, fresh fish	15%	90	90	0
Cooked foods, tobacco leaves, lime powder	10%	60	60	0
Accessories, artifacts	5%	30	30	0
Sundry goods, clothes	10%	60	30	30
Total	100%	600	300	300

#### 4) Zoning of selling places and the number of Market Building

Table 2-1-6 shows the groupings of merchandise items of Table 2-1-5 sold in similar selling zones.

**Table 2-1-6 Zoning by merchandise group**

Selling zone	Merchandise group	Total number of selling places	Number of selling tables	Number of on-floor selling points
A zone	Smoked fish, fresh fish	150	150	0
	Cooked foods, tobacco leaves, lime powder			0
B zone	Accessories, artifacts	90	60	30
	Sundry goods, clothes			
C zone	Vegetables, fruits, root crops	360	90	270
	Articles of taste (betelnuts, daka)			
Total		600	300	300

With this data (Table 2-1-6) in mind, the following zoning will be made:

- ① Consolidate the selling places in the A zone into a building having selling tables of the same type.
- ② Consolidate the places of table selling in the B and C zones into a building equipped with selling tables of the same type.
- ③ Consolidate the places of floor selling in the B and C zones into a building having points of floor selling of the same type.

- ④ Since the building's floor space for selling is limited in terms of area, some places for floor selling will be allocated to the space under the eaves.

Therefore, the Market Building should be divided into three parts. The detailed layout of the selling floors is given in 2-2-2 Basic plan—Floor planning. It may be necessary to make some adjustment in the number of selling places to ensure an appropriate layout.

5) Per-vendor selling space available in the Market Building

Figure 2-1-1 shows the per-vendor selling space available in the Market Building. This is estimated based on the existing mode of selling with the following improvements in mind.

- ① The areas for table and floor selling will be segmented into portions, each allocated to four vendors. This will result in increased walkways, which in turn will help shoppers to move around for shopping more easily. Assume width of the pass to 1.2 meters, that a person can pass each other.
- ② The area for table selling will be provided with benches, making it unnecessary for users to bring chairs with them or leave their chairs in the Products Storage.

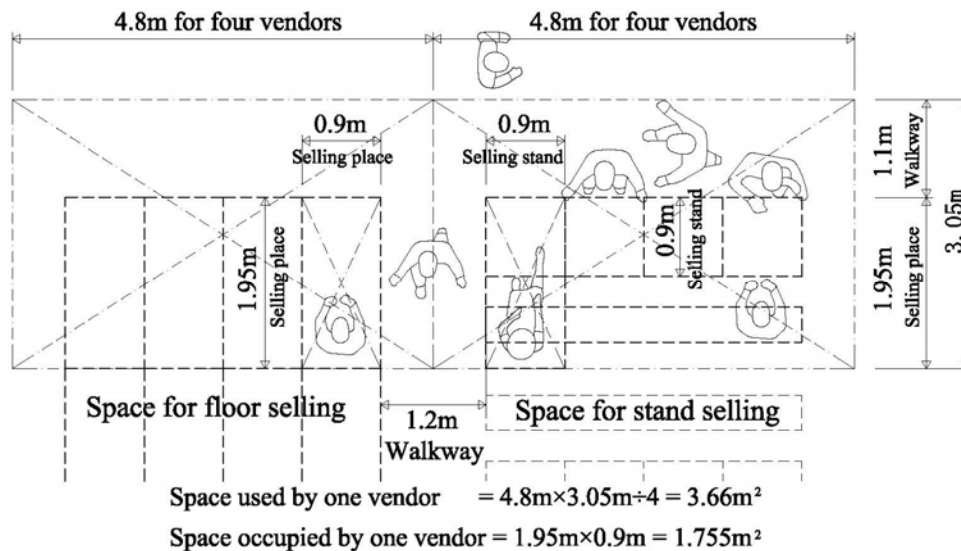
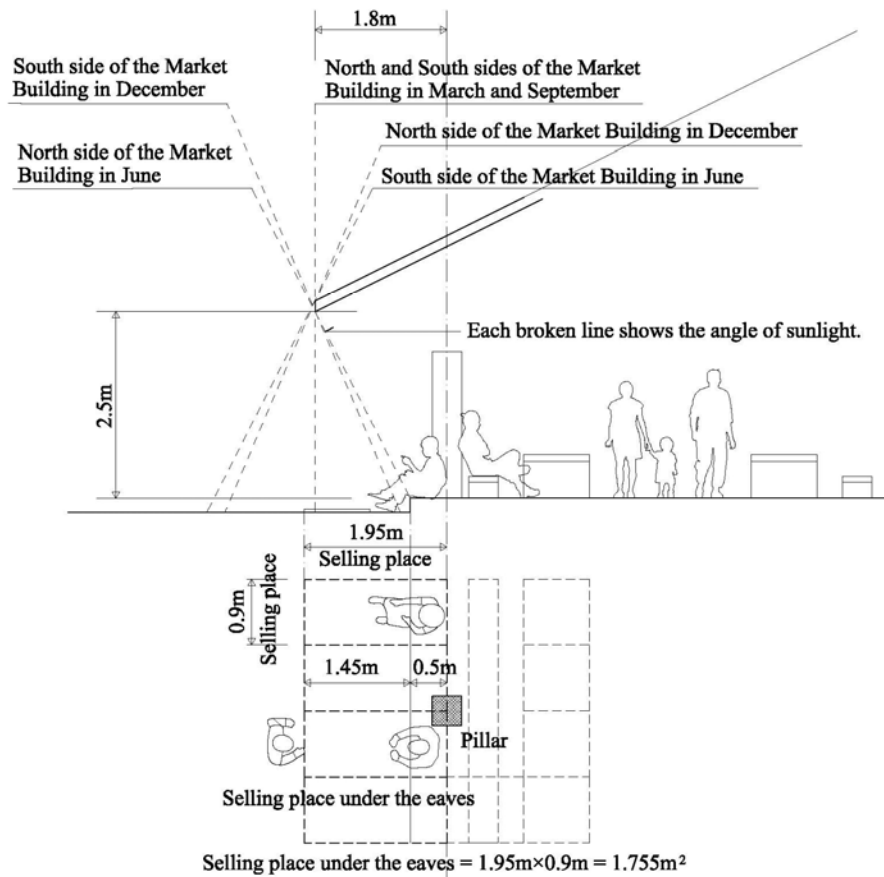


Figure 2-1-1 Indoor space used by one vendor

Consequently, the space used by one vendor will be about 3.7m<sup>2</sup> and the space occupied by one vendor will be about 1.8 m<sup>2</sup>. Compared with the present status, the space for table selling will be increased by about 30%, and the space for floor selling will be almost the same as at present.

6) Per-vendor space available under the eaves of the Market Building

Figure 2-1-2 shows the space available to vendors doing business under the eaves of the Market Building, as well as in what manner the space is to be used. As shown in the figure, vendors can avoid working under the scorching sun during the daytime. Even when they use the space under the eaves, the per-vendor selling space will be about 1.8 m<sup>2</sup>, providing the space facing the selling place should be used as a common walkway.



**Figure 2-1-2 Space used by one vendor under the eaves of the Market Building**

7) Spaces allocated to vendors who cannot be housed in the Market Building or contained in the space under the eaves

During the peak hours, about 250 vendors are expected to sell their merchandise outside the Market Building. By giving consideration to the following points, spaces provided to these vendors is planned. The details of space setting are discussed in 2-2-2-2 Architectural Plan, 2-2-2 Basic plan.

- ① Allocate an exclusive selling space of about 1.8 m<sup>2</sup> to one vendor.
- ② Secure reasonable walkway space by taking shoppers' convenience into consideration.
- ③ Allocate these vendors to a space in which they can avoid using beach parasols as far as possible.

(2) Administration Office Building

Each office of the Administration Office Building is given a layout in 2-2-2-2 Architectural Plan based on the criteria shown in Table 2-1-7. The same apply to the Administration Office of the Ice Making Building.



**Table 2-1-7 Office floor space criteria**

Name of Office	No. of persons housed	Criterion	Data compiled by the Architectural Institute of Japan	Data compiled by the Ministry of Land, Infrastructure, Transport and Tourism of Japan
Market Manager's Room	One	15 m <sup>2</sup>	Division manager: 13 to 18 m <sup>2</sup> per person	21.8 m <sup>2</sup> per person
Market Clerk's Room	One	10 m <sup>2</sup>	Designer: 7 to 10 m <sup>2</sup> per person	9.1 m <sup>2</sup> per person
Operation Office	One	10 m <sup>2</sup>	Designer: 7 to 10 m <sup>2</sup> per person	9.1 m <sup>2</sup> per person

The criteria reflect the following elements:

- ① The criteria should be based on the building design data compiled by the Architectural Institute of Japan taking into consideration the criteria of the Ministry of Land, Infrastructure, Transport and Tourism of Japan.
- ② The Market Manager's Room will have the average office floor space for division managers presented in the above-mentioned data.
- ③ The Market Clerk's Room and the Operation Office each will be a one-man room occupied by a person assigned to specialized duties. Therefore, these rooms should be given the above-mentioned largest floor space for designer.

The room allocated to staff members of the Administration Office Building is given a layout from the view of utilization figure as described in 2-2-2 Basic Plan.

(3) Kiosk

The new Kiosk will be the same as size as the existing kiosk with a floor space of about 44m<sup>2</sup>.

(4) Public Toilet

- ① Since the average shopper stays in the Market for about one hour, it is basically assumed that only vendors use the Public Toilet.
- ② The requirements of the Public Toilet and its sanitary equipment as well as the septic tank are determined based on PNG's Public Health Act.
- ③ The sanitary equipment criteria stipulated by PNG's Public Health Act, shown in table 2-1-8, are intended for use in sedentary work places such as offices and therefore need some adjustment if the criteria are to be applied to outdoor facilities such as markets. This problem was discussed with the Department of Health of PNG and a conclusion that it would be appropriate to apply the toilet criterion for 400 to 600 office workers to this Project involving 600 to 850 vendors was reached. Sanitary equipment according to the criterion will be installed.

**Table 2-1-8 Sanitary equipment criteria for public facilities stipulated by Public Health Act of PNG**

No. of users in a facility	No. of water-closets (for men)	No. of urinals	No. of water-closets (for women)
Less than 200	1	1	2
200 to 399	1	2	3
400 to 599	2	2	4
600 to 999	2	3	5

The capacity of the septic tank is set at about 10m<sup>3</sup> calculated based on the method stipulated by the Public Health Act of PNG.

$$\begin{aligned}\text{Capacity of septic tank} &= \text{No. of water-closetss} \times 20 \text{ people} \times 70\ell + 1,350\ell \\ &= 6 \times 20 \times 70 + 1,350 = 9,750\ell\end{aligned}$$

(This calculation is based on the predetermined formula.)

In the above calculation, the number of people, 20, and the additional capacity, 1,350ℓ, are constants, and the multiplier factor, 70ℓ, is the coefficient applicable to plants.

#### (5) Products Storage

The Products Storage is intended to keep miscellaneous items consigned by vendors, which, varying in kind and size, include parasols and goods left unsold. Assuming that the number of items to keep is 120 a day and that each item occupies a space of 0.35m<sup>2</sup> and that they are stored in two decks, the necessary storage space can be calculated as follows:

$$\text{Baggage storage space} = 0.35 \times 120 \div 2 = 21.0$$

By applying the effective storage space occupancy rate, 0.64, given in the data compiled by the Architectural Institute of Japan, the necessary storage space becomes about 32.8m<sup>2</sup> (21.0 ÷ 0.64).

#### (6) Refreshment Space

By allocating the largest possible selling space for vendors, the scale of the Refreshment Space should be limited to one water point and one bench for ten people.

#### (7) Pavement on the Premises

One of the major problems with the existing Wewak Market is that rainfall puts the ground in a muddy, unsanitary state, making the effective use of the facilities impossible. To address this problem, required pavement shall be installed to necessary part of premises floor in the Weak Market.

#### (8) Standby Rubbish Bays

It is expected that the planned Wewak Market will generate 6 to 7.5m<sup>2</sup> of waste material a day. The Standby Rubbish Bays should be adequate enough to accept two days' waste material in case the garbage truck fails to come for some reason or other. Therefore a capacity of 15m<sup>2</sup>, which is to be partitioned into 12m<sup>2</sup> for combustible and 3m<sup>2</sup> for non-combustible wastes, will be given as the Standby Rubbish Bays.

### 2-2-1-2-2 New Wewak Jetty

#### 1) Installation policy

- ① It is expected that no more than three dories will use the New Wewak Jetty and they will come not frequently. (Two small dories come once every two weeks and one middle-size dory about once a month.) Therefore, assuming that the New Wewak Jetty will be used primarily by banana boats, the scale and water depth of the New Wewak Jetty are determined. For dories, the use of the jetty is assessed by determining the possibility of berthing.

- ② The number of visiting banana boats is estimated based on the data obtained from several banana boats which visited during the period of the Basic Design Study.
- ③ For the above-mentioned estimation, the weekly average data will be used because banana boats come to the shore near the Wewak Market on a weekly basis.
- ④ Of these visiting banana boats, the number of boats using the New Wewak Jetty is estimated by using the data about the frequency of visits both on the jetty side and on the market side and by calculating the usage percentage on the jetty side.
- ⑤ Based on the data obtained by hearing from banana boats operators and the East Sepik Division of Fisheries & Marine Resources, the times for which the New Wewak Jetty is occupied for unloading and loading is estimated as shown in Table 2-1-9. It is expected that the occupation period will shorten as the usage of the jetty goes on, making it possible to cope with the possible future increase in the number of boats using the jetty.
- ⑥ Considering the fact that the number of coming boats is estimated based on the weekly average, the number of berths is calculated by comparing berth requirements during peak hours of unloading and loading. The findings of the marine transport and physical distribution survey made during the period of the Basic Design Study are used as related data.

**Table 2-1-9 Time which banana boats occupy the New Wewak Jetty**

	Activity	Time (minute)	Remarks
Unloading interval	Berthing	3	Because the banana boat is heavy, turn off the motor a short distance from the jetty and take the boat to the jetty slowly.
	Mooring	1	Only the skipper gets off and moors the boat on the bow side by rope.
	Unloading	20	2 minutes x 10 people: Each person picks up a load and goes ashore using the ladder.
	Turning	2	Turn the direction of the bow by hand.
	Leaving shore	1	Turn the motor on and leave shore.
	Total	27	
Loading interval	Berthing	1	Turn off the motor a little bit off the jetty and turn the helm in a large way.
	Turning	2	Turn the direction of the bow by hand.
	Mooring	1	Moor the boat on the bow side by rope.
	Loading	25	2.5 minutes x 10 people: Each person picks up a load, adjusts the body balance, and boards the boat using the ladder.
	Leaving shore	1	Turn the motor on and leave shore.
	Total	30	

## 2) Number of banana boats coming around the Wewak Market

Table 2-1-10 shows the data of the survey of the number of banana boats coming around the Wewak Market which was conducted during the period of the Basic Design Study. The average from October 22 to 27, 14.5 boats, is taken up as estimated number of boats coming around the Wewak Market for these reasons:

- ① During the monsoon season (starting November), the weather worsens and the number of boats that come tends to decrease.
- ② The period from October 29 to November 2 had a smaller number of boats than the referenced period because Halloween was observed during the period and because the mode

of rainy season had been getting strong since the latter half of October.

- ③ Therefore it is estimated that the data for the period from October 22 to 27 shows the typical pattern of boats' coming around the Wewak Market.

**Table 2-1-10 Number of banana boats coming around the Wewak Market during the period of the Basic Design Study**

(unit: boats/day)

	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Weekly average
Date	10/22	10/23	10/24	10/25	10/26	10/27	
Shore on the Jetty side	9	9	7	17	16	8	11.0
Shore on the Market side	2	7	4	1	4	3	3.5
Subtotal	11	16	11	18	20	11	14.5
Date	10/29	10/30	10/31	11/1	11/2	11/3	
Shore on the Jetty side	8	6	6	6	10	-	7.2
Shore on the Market side	3	7	3	5	5	-	4.6
Subtotal	11	13	9	11	15		11.8

Note: Social activity had been stagnant for some days centering on Halloween on October 31.

3) Number of banana boats expected to use the New Wewak Jetty

Table 2-1-11 shows the estimated number of banana boats expected to come to the shore near the Wewak Market, which was calculated based on the marine transport and physical distribution survey made during the period of the Basic Design Study. From this the probability of use of the jetty is set at 0.688:

Probability of use of the jetty:  $64.7 \text{ boats} \div 94 \text{ boats} = 0.688$

This result is used as the probability of the use of the New Wewak Jetty by banana boats coming to the shore around the Wewak Market. By applying this to the average number of banana boats coming to the shore, i.e., 14.5 boats per day, the average number of banana boats which use the New Wewak Jetty is estimated at 10 boats per a day:

Number of banana boats using the Wewak Jetty:  $14.5 \text{ boats/day} \times 0.688 = 9.98 \text{ boats/day}$

**Table 2-1-11 Estimated number of banana boats which come to the shore near the Wewak Market and use the Jetty**

Place of interview	Number of boats per a day	Use rate on the jetty-side shore	Number of boats using the jetty-side shore
Jetty-side shore	51	100%	$51 \times 1.0 = 51$
	6	80%	$6 \times 0.8 = 4.8$
	3	50%	$3 \times 0.5 = 1.5$
Market-side shore	8	70%	$8 \times 0.7 = 5.6$
	6	30%	$6 \times 0.3 = 1.8$
	20	0%	$20 \times 0.0 = 0$
	94		64.7

Note: Based on the findings of the marine transport and physical distribution survey made during the period of the Basic Design Study.

#### 4) Necessary number of berths

The marine transport and physical distribution survey result which have been implemented during Basic Design Study shows that about 43% of the banana boats leave shore during one hour from 3:00pm to 4:00pm, which is the peak loading hour. It can be said that the same pattern applies to the New Wewak Jetty. The necessary number of berths during this period can be calculated as below. In addition, the peak hour for unloading is between 8:00 to 9:00 AM with 30% of banana boats expected to arrive to the berths.

$$\text{Necessary number of berths: } 9.98 \text{ boats} \times 0.43 \times 30 \text{ minutes/boat (time the jetty is occupied)} \div 60 \text{ minutes} = 2.2 \text{ berths}$$

Considering the above calculations, it is considered appropriate to provide the New Wewak Jetty with two berths available for simultaneous use.

#### 5) Jetty water depth and the availability of berthing

It is necessary to determine where to install the new jetty in an economical sense by taking the findings of the survey of natural conditions into consideration.

The water depth required for boats to come alongside the jetty is as given below. Since the natural conditions of the Project site is moderate and quiet, a marginal water depth of 0.3 meter is set based on standards for design of the jetty as shown in table 2-1-2.

Banana boat: draft 0.5m + margin 0.3m = 0.8m

Dory (small): draft 1.0 + margin 0.3m = 1.3m

Dory (medium): draft 1.5m + margin 0.3m = 1.8m

In comparison with the datum line (DL), the water depth where the new jetty is expected to be built is almost flat between DL-0.5m and DL-0.7m. This means that it would be no easy task to increase the installation water depth even if the building place of the jetty is put forward.

And even if the planned jetty water depth is set at DL-0.5m, the possibility for banana boats to come alongside the jetty is about 97% and therefore a small problem would arise when it comes to using the jetty. For this reason, it seems economically justifiable to set the planned jetty water depth at DL-0.5m.

If the planned jetty water depth is set at DL-0.5m, the possibility of coming alongside the jetty is about 76% for small dories (visiting every two weeks) and about 26% for medium dories (visiting once a month). By taking the frequency of their visits, it seems possible to adjust their visits with high-tide periods without substantially affecting the use of the jetty by dories.

Therefore the planned jetty water depth is set at DL-0.5m.

##### ① Possibility for banana boats to come alongside the jetty

The necessary tide level for banana boats to come alongside the jetty is DL+0.3m (water depth 0.8m) or higher. In the four months from September to December, 2007, there are 13 times when the minimum tide level becomes lower than DL+0.3m. Supposing the jetty cannot be used for six hours during one lowest-tide-level period, the total hours for which the jetty cannot be used is about 78 hours. From this, the possibility of coming along the jetty becomes about 97% calculated as follows:

$$\begin{aligned} \text{Possibility of coming along the jetty} &= 100 - 78 \text{ hours} \div (30 \text{ days} \times 4 \text{ months} \times 24 \text{ hours}) \times 100 \\ &= 97.3\% \end{aligned}$$

##### ② Possibility of coming along the jetty for small dories

The necessary tide level for banana boats to come alongside the jetty is DL+0.8m (water depth 1.3m) or higher. In the four months from September to December, 2007, there are 108

times when the minimum tide level becomes lower than DL+0.8m. Supposing the jetty cannot be used for six hours during one lowest-tide-level period, the total hours for which the jetty cannot be used is about 648 hours. From this, the possibility of coming along the jetty becomes about 76% calculated as follows:

$$\begin{aligned} \text{Possibility of coming along the jetty} &= 100 - 648 \text{ hours} \div (30 \text{ days} \times 4 \text{ months} \times 24 \text{ hours}) \times 100 \\ &= 77.5\% \end{aligned}$$

③ Possibility of coming along the jetty for medium dories

The necessary tide level for small dories to come alongside the jetty is DL+1.3m (water depth 1.8m) or higher. In the four months from September to December, 2007, there are 124 times when the minimum tide level becomes lower than DL+1.3m. Supposing the jetty cannot be used for six hours during one lowest-tide-level period, the total hours for which the jetty cannot be used is about 744 hours. From this, the possibility of coming along the jetty becomes about 26% as calculated below:

$$\begin{aligned} \text{Possibility of coming along the jetty} &= 100 - 744 \text{ hours} \div (30 \text{ days} \times 4 \text{ months} \times 24 \text{ hours}) \times 100 \\ &= 25.8\% \end{aligned}$$

### 2-2-1-2-3 Ice Making Plant

#### (1) Ice Making Machine

##### 1) Installation policy

- ① To estimate the necessary volume of block ice required to keep fresh fish available for distribution in Wewak Town (cooling the fish caught as well as preserving the ice itself before fishing).
- ② For this purpose, it is necessary to preserve fresh fish for 3 to 4 days in the fishery area and provide volume of block ice required by the people engaged in the fishery business. The speed of ice melting depends on the surface area of ice. It is 1,740m<sup>2</sup>/ton for crushed ice and 435m<sup>2</sup>/ton for block ice. That is, crushed ice melts about four times as fast as block ice.
- ③ According to PNG's government and fishery personnel concerned, The Wewak islands and the Murik area require the volume of ice twice as much as the volume of fresh fish caught considering the melting of ice during the preservation period. On the other hand, it is said that the same volume of ice as that of fresh fish is sufficient in the fishery areas around Wewak Town.
- ④ Therefore it is estimated that the necessary volume of block ice would be twice the volume of fresh fish caught for The Wewak islands and the Murik area and the same volume for the rest.
- ⑤ The marine transport and physical distribution survey found that part of the ice purchased for The Wewak islands or the Murik Area is used for non-fishery purposes as well. The estimate of the necessary volume of block ice should include such possibilities.

##### 2) Necessary volume of block ice

Table 2-1-12 shows the estimated necessary volume of block ice calculated based on the volume of fresh fish sold in Wewak Town.

**Table 2-1-12 Volume of fresh fish distributed in Wewak Town and block ice requirements**

	Fish catches in fishing areas of Wewak Town	Fish catches in Wewak islands and Murik area
Volume of fresh fish sold by vendors	6.9 tons/year	9.7 tons/year
Volume of fresh fish purchased by fish buyers	12.6 tons/year ① (19.5-6.9)	36 tons/year ② (48.6-12.6)
Total volume of fresh fish distributed	19.5 tons/year	45.7 tons/year
Necessary volume of ice for fishery purposes	19.5 tons/year	91.4 tons/year

Note: For ①, the volume of fresh fish purchased by fish buyers was obtained by subtracting the volume of fresh fish sold by vendors from the total volume of fresh fish distribution which comprised all fresh fish caught and sold in the fishery areas of Wewak Town. For ②, the volume of fish catches bought by fish buyers was obtained by subtracting the volume of fish catches bought in Wewak Town from the total fresh fish bought by fish buyers. It is assumed that the necessary volume of ice for fishery purposes is the same as the volume of fish distribution for the fishery areas of Wewak Town and double the volume of fish distribution for The Wewak islands and the Murik area.

**Table 2-1-13 Weekly block ice requirements for fishery purposes by area and by type of purchase**

	Wewak Town fish catches	Wewak islands and Murik Area fish catches
Vendor-related fresh fish	133kg/week (6.9 tons/year)	373kg/week (19.4 tons/year)
Fish buyer-related fresh fish	242kg/week (12.6 tons/year)	1,385kg/week (72 tons/year)
	375kg/week	1,758kg/week

Note: The figures in Table 2-1-12 was divided by 52 weeks. The figures in parentheses each show the necessary volume of ice.

Table 2-1-13 shows the weekly requirements of block ice converted from the figures given in Table 2-1-12.

Weekly block ice requirements for fishery purposes:  
 $2,133\text{kg/week} = 375\text{kg/week} + 1,758\text{kg/week}$

Also, the marine transport and physical distribution survey found that about 23% of the ice purchased for The Wewak islands and the Murik area is used for non-fishery purposes (e.g., for the preservation of frozen meats, dairy products, etc.). The weekly total ice requirements are calculated by assuming that the volume of ice required for non-fishery purposes is about 20%:

Volume of ice required for non-fishery purposes in The Wewak islands and others:  
 $352\text{kg/week} = 1,758\text{kg/week} \times 0.2$

Total required volume of block ice:  
 $2,485\text{kg/week} = 2,133\text{kg/week} + 352\text{kg/week}$

### 3) Capacity of Ice Making Machine

The Ice Making Plant operation plan based on the present work schedule of the Office of ESP Administration is to produce ice from Monday to Friday and sell ice from Monday to Saturday (half-time operation on Saturdays). To make the above-mentioned weekly volume of ice requires an Ice Making Machine capable of producing about 500kg of ice a day:

Required daily ice making capacity:  $497\text{kg/day} = 2,485\text{kg/week} \div 5\text{days/week}$

4) Volume of ice currently used in Wewak Town and future uses

At present, block ice suitable for fishery purposes is not sold in Wewak Town. But the use of ice is essential when it comes to preserving and transporting fresh fish. As for their own convenience, fishing operators purchase crushed ice from sellers who produce ice for their own use. Table 2-1-14 shows the volume of crushed ice currently purchased for fishery purposes. Since, however, crushed ice is quick to melt, most of the time it does not last until fresh fish has reached to Wewak Town. Crushed ice cannot work for fishery purposes. To address the situation, producing block ice for fishery use is planned under this Project. If the supply of block ice is started with the implementation of this Project, crushed ice currently purchased for fishery purposes for convenience sake is to be used for the originally intended purposes such as the preservation and transport of fresh fish by buyers.

**Table 2-1-14 Volume of crushed ice currently purchased for fishery purposes in Wewak Town**

Sellers (Chiefly fresh fish buyers)	Volume of purchase	Calculation formula	Price per kg (Kina)
① Sepik Sea Products	750kg/week	150kg/day×5days/week	1
② Eel Fishery	250kg/week	50kg/day×5days/week	0.5
③ SPD	400kg/week	80kg/day×5days/week	1
④ Solwara Wara	135kg/week	3kg bag×15bags/day×50%×6days/week	1.3
Total	1,535kg/week		

Note: ①, ②, and ③ are the data obtained from conducting a hearing from each businesses about the average daily sales volume and the number of selling days. Selling takes place for five days a week from Monday to Friday. ④ is the data obtained by hearing Solwara Wara Ltd. about the average daily sales volume, the selling rate, and the number of selling days. Selling takes place for five days a week from Monday to Friday.

5) Estimated factors for double the volume of ice consumption for fishery purposes in the Wewak islands

Table 2-1-15 is a comparison of fresh fish selling prices in Wewak Town. Considering the following factors in connection with this, it is estimated that there is a situation in the Wewak islands which allows the use of double the volume of ice than that for fish catches.

- ① This Project assumes that the selling price of ice is about 0.5 Kina/kg. If the use of ice is doubled, the cost of ice for one kilogram of fish is about one Kina.
- ② During the period of the Basic Design Study, the price of fish sold by fishing operators of the Wewak islands was from two to three Kinas per kilogram. The price can be regarded as the cost of fresh fish (covering the operating expense without making an allowance for profit). By comparing this cost and the selling price shown in Table 2-1-15, it is estimated that the net profit (difference between cost and selling price) is about 4 Kinas.
- ③ To sell fish transported from the Wewak islands requires the transportation cost of about 0.5 Kina/kg in addition to the cost of ice used. The operating profit, which is obtained by subtracting the cost of ice from the net profit, would be at least 2.5 Kinas/kg (4-1-0.5).
- ④ At present, crushed ice is purchased at a price of around one Kina/kg. This means that paying one Kina for ice per one kilogram of fish is the same as the present expense burden.



**Table 2-1-15 Selling prices of fresh fish in Wewak Town (unit: Kina/kg)**

Kind of fish	Sepik Sea Products	Eel Fishery	Wewak Market
Snapper	12	14 (7)	6 to 7
Trevally	9	11 (4)	
Mackerel	9	11 (5)	
Parrotfish, etc.	8	-	
Bonito	7	9 (3)	-
Yellowfin tuna	9	13 (5)	-

Note: The price at the Wewak Market shows the typical vendor price. The others show shop store prices. The figures in parentheses in the Eel Fishery column show the purchase prices from fishers. Bonito and yellowfin tuna are rarely sold in the Market.

## (2) Ice Storage

### 1) Installation policy

- ① To estimate the necessary volume of ice to store in accordance with PNG's production and sales plans (schedules).
- ② It takes twelve hours to make 22kg of ice as planned under this Project. This means an ice making cycle of twice a day. In the project, ice is scheduled to store as the process of ice making ends at 6:00am and 6:00pm respectively.
- ③ It is necessary to take into consideration the fact that the pattern of purchasing ice varies with the location of fishing area and the mode of sale as described below.
- ④ In the fishing area of Wewak Town, fishing operation is conducted everyday from Monday to Saturday to supply fresh fish to vendors for selling, generating a constant demand for ice everyday.
- ⑤ Selling concentrates on Fridays and Saturdays for fresh fish caught in the fishing areas of the Wewak islands and others and sold by vendors. Ice is purchased three to four days ahead of fish selling, that is, on Tuesdays and Wednesdays.
- ⑥ In the fishing area of Wewak Town, fishing operation is conducted everyday from Monday to Friday to supply fresh fish to fish buyers, generating a constant demand for ice everyday.
- ⑦ For fresh fish caught in the fishing areas of the Wewak islands and others and sold to fish buyers, ice is purchased on Mondays, Thursdays, Fridays, that is, three to four days before buyers ship their fish from Monday to Friday.
- ⑧ Demand for block ice for non-fishery use is generated constantly everyday.
- ⑨ On Mondays, the first output of ice is available at 6:00pm if ice making starts at 6:00am. It is therefore necessary to have the necessary volume of ice in stock to meet sales requirements on Monday. It is necessary to have one ton of ice in stock to cope with estimated ice sales of about 600kg on Monday.

### 2) Required Ice Storage Capacity

Table 2-1-16 shows the estimated changes in the volume of ice in stock by day (Monday to Saturday) in relation to the above-discussed pattern of ice making and purchasing. The calculation reflects the weekly demand for block ice for different uses given in Table 2-1-13. The volume of ice in stock reaches the highest level, 1,271kg, on Thursday morning. Considering that the ice making cycle could be affected by holidays, it is considered reasonable to secure a reserve of ice equivalent to about one day's production (500kg). From this it is

necessary to build an ice storage capable of housing 80 ice blocks each weighing 22kg.

Reasonable volume of ice in stock:  $1,771\text{kg} = 1,271\text{kg} + 500\text{kg}$

In 22kg ice blocks:  $80.5\text{blocks} = 1,771\text{kg} \div 22\text{kg}$

**Table 2-1-16 Weekly changes in ice production and stock**

Production, stock and sales volume of ice for fishery purposes	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Week total
Addition to stock by production at 6:00am.	0	250	250	250	250	250	
Stock level at the start of selling (minimum necessary stock of ice)	1,000	907	1,089	1,271	1,178	1,085	
Vendor selling: Fish catches in fishing areas of Wewak Town	22	22	22	22	22	22	132
Vendor selling: Fish catches in the Wewak islands and other fishing areas	0	187	187	0	0	0	374
Purchase by fish buyers: Fish catches in fishing areas of Wewak Town	48	48	48	48	48	0	240
Purchase by fish buyers: Fish catches in the Wewak islands and other fishing areas	462	0	0	462	462	0	1,386
Sales of ice for non-fishery purposes	61	61	61	61	61	63	368
Total daytime (8:30 to 15:45) sales	593	318	318	593	593	85	2,500
Stock volume at the end of selling	407	589	771	678	585	1,000	
Addition to stock by production at 6:00pm.	250	250	250	250	250	0	
End-of-the-day stock volume	657	839	1,021	928	835	1,000	

### (3) Emergency generator

#### 1) Installation policy

- ① PNG requested to install an emergency generator to ensure the operation of the Ice Making Machine and the Ice Storage because of frequent power failures in Wewak.
- ② PNG Power Ltd., Wewak has a project to install an additional generator by the end of December 2008 in case the electric power fails. But it is uncertain whether the project will be executed due to the company's limited budget.
- ③ As for long-term perspective, possibility of PNG procuring an emergency generator by herself can not be ruled out.
- ④ The coverage of the Requested Japanese Assistance should therefore be limited to a scope such that only timely preparations need to be made at the start of this Project.
- ⑤ The scope means the capacity capable of keeping produced ice from melting, that is, not allowing the money invested in the ice making facilities to go to waste. Specifically, the Emergency Generator installed under this Project should have a capacity capable of delivering the electricity required to maintain and operate the Ice Storage.
- ⑥ Diesel oil should be used as fuel to operate the generator with an eye to reducing running costs associated with maintenance and administration.

#### 2) Capacity of the generator

The necessary capacity of the generator is calculated based on the capacity, plus the starting-up load, of the equipment to which power is supplied. The total capacity of the Ice Storage's cooling unit compressor and the air-cooling condenser unit is 1.25kW, and the starting

load of the Ice Storage equipment is another 1.25kW. Based on this, the necessary capacity of the generator becomes 6.08kVA. Since the types of generators are classified by capacity level 5kVA, 10kVA, and so on, the generator used for this Project must be of the 10kVA type.

#### (4) Furniture and fixtures

##### 1) Ice Box

PNG says that a total of ten ice boxes are required for such purposes as temporarily keeping block ice for sale, transporting ice blocks for sale, and keeping fresh fish in good condition. Since, however, ice boxes can be procured locally, and as for long-term perspective, possibility of PNG's self-potential in the procurement can not be ruled out.

The coverage of the Requested Japanese Assistance should therefore be limited to a scope such that only timely preparations need to be made at the start of this Project. Further considering that ice boxes for this purpose are just for temporarily keeping block ice for sale, two I50L-type Ice Boxes (one for transporting and one for keeping ice blocks) will be provided under this project.

##### 2) Scale

One scale will be installed to weigh an ice and landed fishery products. The scale is a 100kg balance-weight-type platform scale.

##### 3) Maintenance tools

Maintenance tools required for daily maintenance of the Ice Making Machine will be provided.