## 6.3. Sea and Geotechnical Conditions

### (1) Wave

#### 1) Estimation for short period

Tables 6.3.1. (1) and (2) show the data obtained by the visual observation at the Port of Sorong through June 3 to July 24, 1980. In these Tables, "high" would approximately correspond to the wave with the maximum wave height of less than 1.0 m or a significant wave height of less than 0.6 m. Fig. 6.3.1. shows the frequency of waves of each rank. "High" wave appeared 21 times during the total observation period. Since the observation was made 104 times in all, the ratio of "High" waves is about 20 percent.

The wave height at the Port of Sorong is not so large because the port area is surrounded by many islands which prevent the waves from coming into the port and also because the wind velocity is not high around the port. This will be easily understood from Fig. 6.3.2. and Table 6.2.1.

Table 6.3.2. is the hindcasting of wave at the Port of Sorong based upon the wind data obtained by the Team during June 23 to July 23, 1980. The estimation corresponds fairly well to the visual observation results in Fig. 6.3.1. The maximum significant wave height is 0.5 m assuming that the diffraction and shoaling coefficient are 1.0.

#### 2) Estimation for medium period

Geographically, the Port of Sorong, has no major obstacle to winds blowing from the sea. This means that wind records at Yefman airport could be safely applied to the estimation of wind waves. Moreover, according to the meteorolotical observation around the port, great winds, such as Typhoon in Japan, have never arisen in the past. The Team has estimated wave height and period within the port based on the data shown in Table 6.2.1. and Fig. 6.3.2. The winds were classified into four groups according to the prevailing wind directions, namely the first group is the winds from January through March, the second, in April and December, the third, from June through October and the last, in November. As the prevailing wind direction in May is the western south-west this group is omitted from the estimation of waves.

The Team tried to estimate waves with the maximum winds of the four groups, finding out that the most important group in terms of wave estimation in the port is the first group.

Table 6.3.1. Visual Wave Observation (June 3 to July 16, 1980)

| NO. | Date | | Wave observation | | Weather | |
|---|---|---|---|---|---|---|
| | | | Morning | Afternoon | Morning | Afternoon |
| 1 | June | 3 | calm | calm | fine | fine |
| 2 | | 4 | calm | little high | fine | rain/fine |
| 3 | | 5 | calm | calm | fine | fine |
| 4 | | 6 | little | calm | cloudy | fine |
| 5 | | 7 | little hight | high | fine | rain/fine |
| 6 | | 8 | calm | calm | fine | cloudy/rain |
| 7 | | 9 | little | little | cloudy/rain/fine | fine/rain |
| 8 | | 10 | calm | calm | fine | fine |
| 9 | | 11 | little | little | cloudy | cloudy |
| 10 | | 12 | calm | calm | fine | fine |
| 11 | | 13 | calm | calm | cloudy | cloudy/rain |
| 12 | | 14 | calm | calm | fine | fine |
| 13 | | 15 | little | little | fine | fine |
| 14 | | 16 | calm | calm | rain/fine | fine |
| 15 | | 17 | calm | calm | fine | fine/rain |
| 16 | | 18 | calm | calm | fine | fine/rain |
| 17 | | 19 | calm | little | fine | fine |
| 18 | | 20 | calm | little | fine | fine/rain |
| 19 | | 21 | calm | little high | fine | fine |
| 20 | | 22 | little high | little | cloudy | cloudy |
| 21 | | 23 | high | little high | fine | fine |
| 22 | | 24 | little | high | fine | fine |
| 23 | | 25 | calm | high | fine | fine |
| 24 | | 26 | calm | little high | fine | fine |
| 25 | | 27 | calm | high | fine | fine |
| 26 | | 28 | calm | high | fine | fine |
| 27 | | 29 | calm | high | fine | fine |
| 28 | | 30 | calm | high | cloudy | cloudy |
| 29 | July | 1 | calm | high | fine | fine |
| 30 | | 2 | calm | little high | cloudy | cloudy |
| 31 | | 3 | little | little high | cloudy | cloudy |
| 32 | | 4 | calm | little high | fine | fine |
| 33 | | 5 | calm | high | fine | fine |
| 34 | | 6 | calm | high | fine | fine |
| 35 | | 7 | little high | high | fine | fine |
| 36 | | 8 | calm | high | fine | fine |
| 37 | | 9 | calm | calm | fine | fine |
| 38 | | 10 | calm | calm | fine | fine |
| 39 | | 11 | little | little high | cloudy | — |
| 40 | | 12 | high | high | fine | — |
| 41 | | 13 | little | little high | fine | — |
| 42 | | 14 | calm | little high | cloudy | — |
| 43 | | 15 | little | little high | cloudy | — |
| 44 | | 16 | high | little high | cloudy | — |

(continued)

| No. | Date | Wave observation | | Weather | |
|---|---|---|---|---|---|
| | | Morning | Afternoon | Morning | Afternoon |
| 45 | July 17 | high | high | fine | – |
| 46 | 18 | little | little high | cloudy/rain | – |
| 47 | 19 | little | little high | cloudy | fine |
| 48 | 20 | calm | calm | fine | fine |
| 49 | 21 | little | little high | fine | fine |
| 50 | 22 | calm | high | fine | fine |
| 51 | 23 | calm | high | fine | fine |
| 52 | 24 | calm | calm | fine | fine |

Notes: 1. calm : no waves
little : between calm and little high
little high : waves with occasional white caps
high : waves with frequent white caps
2. observation : morning 10:00
afternoon 16:00
3. position : the center point between Concrete Wharf and Doom Jetty

Fig. 6.3.1. Frequency of Each Rank of Waves

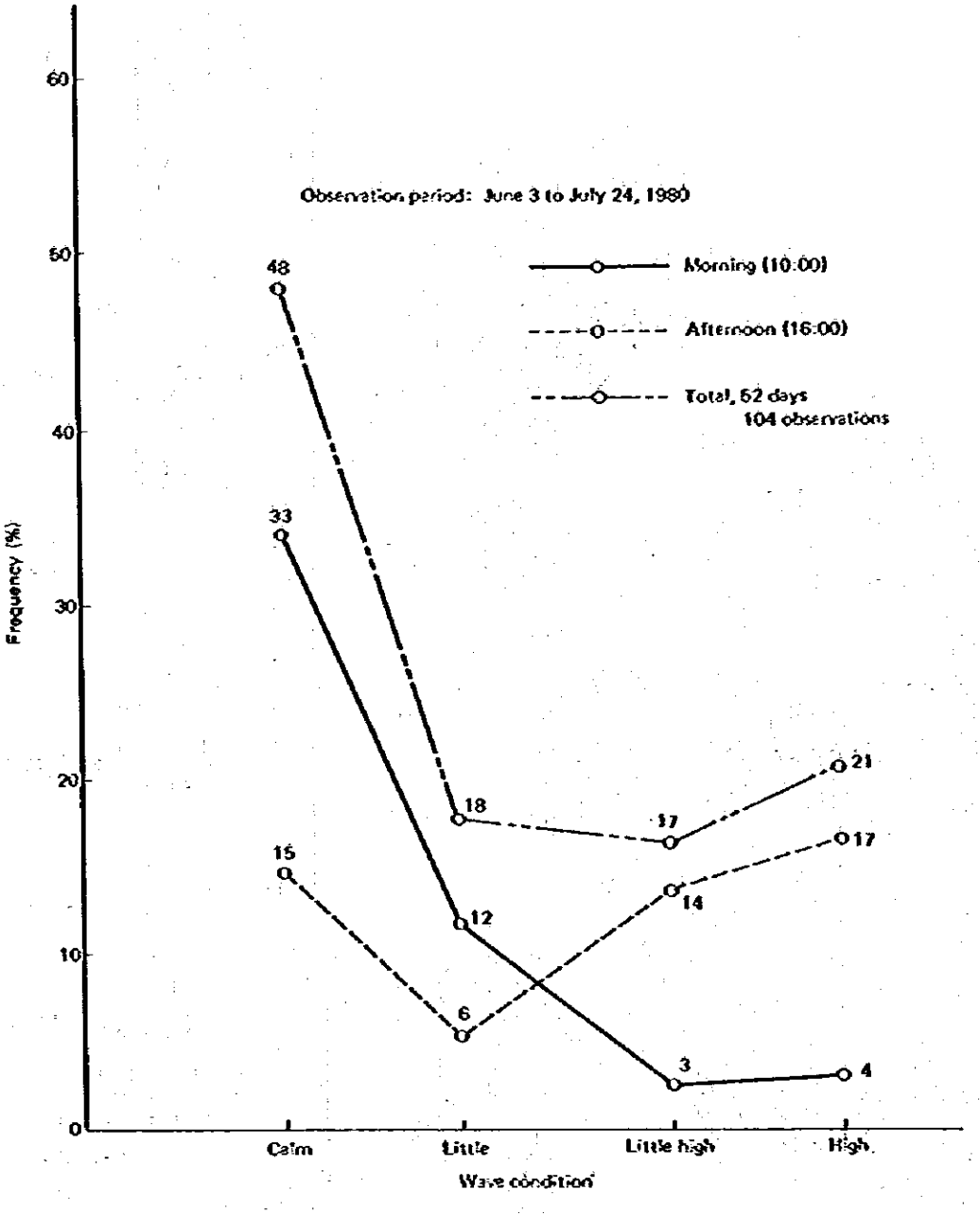


Fig. 6.3.2. Islands Surrounding the Port of Sorong

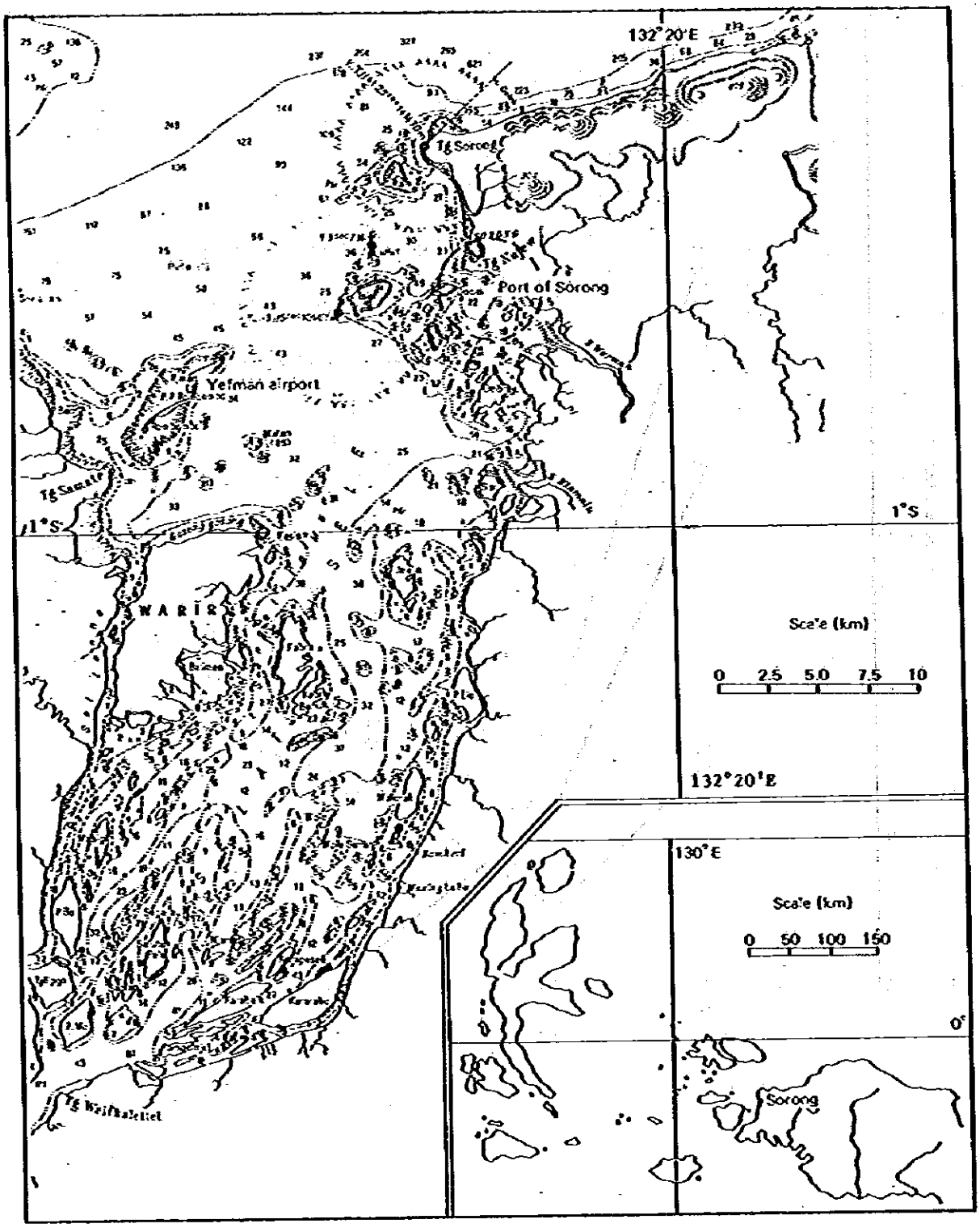


Table 6.3.2. Wave Estimation by S.M.B. Method

| Date | Time | | Direction | Speed (m/sec) | Duration (hr) | Fetch (km) | Wave height $H_{1/3}$ (m) | |
|---|---|---|---|---|---|---|---|---|
| | Start | End | | | | | From duration | From fetch |
| June 23, 1980 | 15.20 | 15.25 | SSW | 6 | 0.083 | 22 | < 0.2 | 0.45 |
| | 15.25 | 15.30 | SSW | 5.5 | 0.083 | 22 | < 0.2 | 0.41 |
| | 15.37 | 15.40 | SSW | 5.3 | 0.05 | 22 | < 0.2 | 0.39 |
| | 15.57 | 16.15 | SSW | 5.3 | 0.30 | 22 | < 0.2 | 0.39 |
| | 16.40 | 16.45 | SSW | 5.2 | 0.083 | 22 | < 0.2 | 0.38 |
| June 26, 1980 | 16.20 | 16.50 | S | 5.4 | 0.50 | 6.3 | < 0.2 | 0.26 |
| | 18.00 | 18.27 | S | 5.2 | 0.45 | 6.3 | < 0.2 | 0.24 |
| June 27, 1980 | 12.35 | 12.58 | S-SSW | 6.5 | 0.38 | 22 | < 0.2 | 0.50 |
| | 13.22 | 13.45 | S-SSW | 6.2 | 0.38 | 22 | < 0.2 | 0.48 |
| | 14.03 | 17.15 | S-SSW | 6 | 3.2 | 22 | 0.4 | 0.46 |
| July 1, 1980 | 13.20 | 15.30 | SSW | 5.5 | 2.17 | 22 | 0.3 | 0.41 |
| | 16.10 | 17.10 | SSW | 5.5 | 1 | 22 | 0.2 | 0.41 |
| July 2, 1980 | 12.18 | 12.32 | S | 5.2 | 0.3 | 6.3 | < 0.2 | 0.24 |
| | 14.03 | 14.14 | SSW | 5.2 | 0.08 | 22 | < 0.2 | 0.38 |
| | 14.28 | 15.00 | S-SSW | 5.4 | 0.53 | 22 | < 0.2 | 0.40 |
| | 15.12 | 15.38 | SSW | 6 | 0.43 | 22 | < 0.2 | 0.46 |
| | 16.32 | 16.43 | W | 5.2 | 0.35 | 5 | < 0.2 | 0.23 |
| | 17.42 | 18.26 | WNW | 6 | 0.73 | 25 | 0.2 | 0.48 |
| July 4, 1980 | 17.12 | 17.45 | S | 5.2 | 0.55 | 6.3 | < 0.2 | 0.24 |
| | 18.42 | 20.30 | S | 5.5 | 1.80 | 6.3 | 0.27 | 0.27 |
| July 8, 1980 | 12.30 | 15.30 | SSW | 6 | 3 | 22 | 0.40 | 0.46 |
| | 15.30 | 16.00 | S-SSW | 5.4 | 0.50 | 22 | < 0.2 | 0.40 |
| | 16.08 | 16.22 | S-SSW | 5.2 | 0.23 | 22 | < 0.2 | 0.38 |
| | 16.40 | 16.46 | S-SSW | 5.2 | 0.10 | 22 | < 0.2 | 0.38 |
| | 16.55 | 17.60 | S-SSW | 5.2 | 0.083 | 22 | < 0.2 | 0.38 |
| | 18.00 | 18.05 | S-SSW | 5 | 0.083 | 22 | < 0.2 | 0.36 |
| July 11, 1980 | 14.24 | 14.37 | SSW-SW | 5.5 | 0.22 | 25 | < 0.2 | 0.43 |
| | 14.50 | 15.30 | SSW-SW | 6 | 0.67 | 25 | 0.2 | 0.49 |
| | 15.30 | 18.30 | S-SSW | 5.5 | 3 | 22 | 0.35 | 0.41 |
| July 12, 1980 | 14.27 | 14.54 | S-SSW | 5.5 | 0.45 | 22 | < 0.2 | 0.41 |
| July 17, 1980 | 17.20 | 17.30 | SSW-SW | 5.5 | 0.17 | 25 | < 0.2 | 0.43 |
| July 22, 1980 | 15.00 | 19.30 | SSW | 5.2 | 4.5 | 22 | 0.40 | 0.38 |
| July 23, 1980 | 13.00 | 19.30 | SSW-SW | 5.2 | 6.5 | 25 | 0.45 | 0.41 |

January through March:

The wind velocity is 17 m/sec, and the offshore wind direction is the west-north west. The fetch is 320 km from the Halmahera island to the port of Sorong. As the wind duration was not observed, it is assumed to be three hours. The wave height and period were estimated through the S.M.B. method as follows:

$H_{1/3}$ = 180 cm
$T_{1/3}$ = 4.7 sec

where,

$H_{1/3}$ : offshore significant wave height
$T_{1/3}$ : wave period

By applying the diffraction theory to the simplified chart, the diffraction coefficient $K_d$ for waves coming into the port area is obtained as follows:

$K_d$ = 0.75 in front of the existing wharf

The shoaling coefficient is 1.0, because the water depth in the port is large enough to omit these effects.

Therefore, the wave height in front of the wharf is easily calculated:

$$H'_{1/3} = 0.75 \times H_{1/3} = 0.75 \times 180 = 135 \text{ cm}$$

The summary of estimation is as follows:

| | | |
|---|---|---|
| Wave height | $H'_{1/3}$ | : 135 cm |
| Wave period | $T_{1/3}$ sec. | : 4.7 sec. |
| Wave direction | | : WNW |
| Occurence | | : January to March. |

The wave frequency calculated from Table 6.2.1. is 0.08 percent in 11 years, corresponding to 0.29 day per year.

Accroding to another report, the wave height and period were estimated as follows:

| | |
|---|---|
| Wave height | : 114 cm |
| Wave period | : 5.4 sec. |
| Wave direction | : 300° |
| Occurring | : March |

Source: UN Report on Preliminary Design for Project FUNDWI-30, a Detailed Engineering Design for Port Facilities in Sorong in West Irian, Indonesia, Pacific Consultants International, March 1973.

This estimation is based upon the assumption. The estimation, however, may be considered reasonable because, at the existing Wooden Wharf and the Concrete Wharf which opened in 1978, no disadvantage due to high waves is reported, and houses at seashore in the bay are free from revetments to high waves.

(2) Tidal Current and Tide Range

The Tidal Stream Tables and the Tide Tables published by the Markas Besar Tni-Angkatan Laut, Jawatan Hidro-Oceanografi, Jakarta in 1980 show the characteristics of the tidal current

and the tide range at Sorong. The Team checked the tide at the Wooden Wharf confirming little difference between our survey and the published tide table. As for the tidal stream, since the current meter provided by the Indonesian hydraulic survey team did not operate well, the published tidal stream tables were used for reference. Table 6.3.3. and Table 6.3.4. are the results analyzed by the harmonic method. The constant current has not been included in the prediction of the tidal current.

Table 6.3.3. Tidal Current

| Tidal constants | $M_2$ | $S_2$ | $N_2$ | $K_2$ | $K_1$ | $O_1$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| Amplitude in sea-miles $36^\circ - g^\circ$ | 0.74 | 0.21 | 0.16 | 0.06 | 0.51 | 0.33 | 0.17 |

Note: Standard time (GMT + 09.00).

Position:

| | |
|---|---|
| Latitude | 01° 1 S |
| Longitude | 131° 1 E |

Constant stream in sea-miles:

| Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| +0.15 | +0.15 | +0.15 | +0.15 | 30.15 | +0.15 | +0.15 | +0.15 | +0.15 | +0.15 | +0.15 | +0.15 |

Source: "Tidal Stream Tables" Markas Besar Tni-Angkatan Laut, Jawatan Hidro-Oceanografi, Jakarta, 1980.

Table 6.3.4. Tidal Range

| Tidal constants | $M_2$ | $S_2$ | $N_2$ | $K_2$ | $K_1$ | $O_1$ | $P_1$ | $M_4$ | $MS_4$ | $Z_0$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Amplitude in sea-miles | 41 | 18 | 7 | 5 | 23 | 13 | 8 | – | – | 100 |
| $360^\circ - g^\circ$ | 165 | 150 | 185 | 150 | 134 | 187 | 134 | – | – | |

Note: Standard time (G.M.T. + 09.00)

Position:

| | |
|---|---|
| Latitude | 00° .8 S |
| Longitude | 131° .2 E |

Source: "Tide Tables" Markas Besar Tni-Angkatan Laut, Jawatan Hidro-Oceanografi, Jakarta 1980.

(3) Sea Depth

1) Outline of sounding

The sounding was carried out by DGSC, the Government of Indonesia, under the guidance of the engineer of the Team. The area of sounding is divided into three areas as shown in Fig. 6.3.3. The outline of the sounding is shown in Table 6.3.5.

The depth of the sea is revised to the Low Water Springs (LWS) based upon the bench mark installed by the Markas Besar Tni-Angkatan Laut, Jawatan Hidro-Oceanografi, in 1977 after confirming the time lag of the tide at the Wooden Wharf. The Low Water Spring is shown with

the Mean Sea Level (MSL) as follows:

LWS = MSL-100 (cm)

Table 6.3.5. Outline of Sounding

| Sounding area No. | Area ($km^2$) | Interval of sounding (m) |
|---|---|---|
| I | 0.7 | 25 |
| II | 1.6 | 100 |
| III | 1.0 | 200 |
| Total | 3.3 | – |

2) The result of the sounding

Fig. 6.3.4. show the depth of the seabed below the LWS in the areas I, II, and III. The typical topographical features are as follows:

1) The contour lines of the depth are very complicated because the sea went into the mountainous areas in ancient times.
2) The gradient of the seabed increases sharply as it goes offshore, especially over the depth of 5 m.
3) There are many reefs and shoals in the port area.

Fig. 6.3.3. Hydraulic Survey and Location of Borings

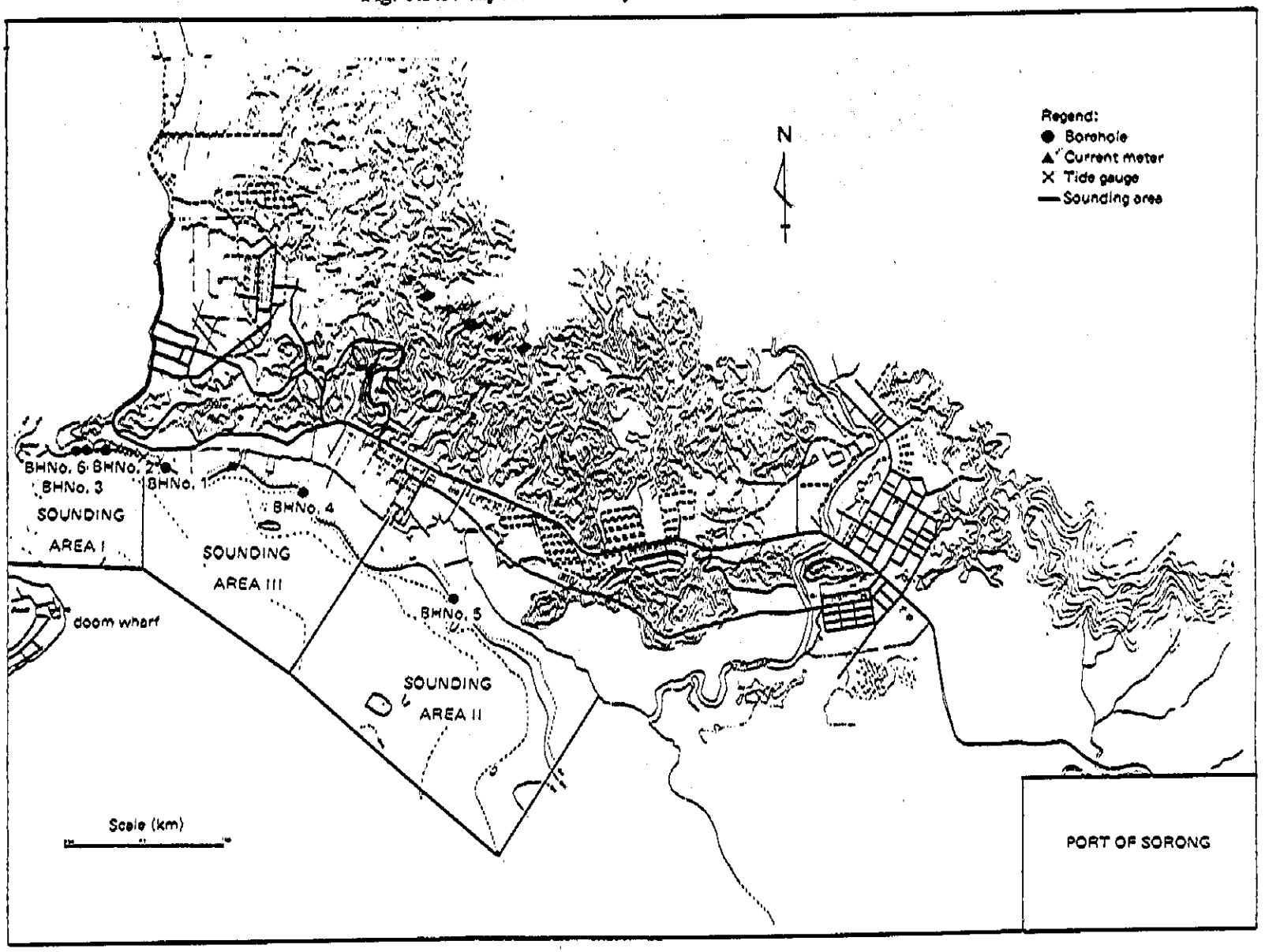
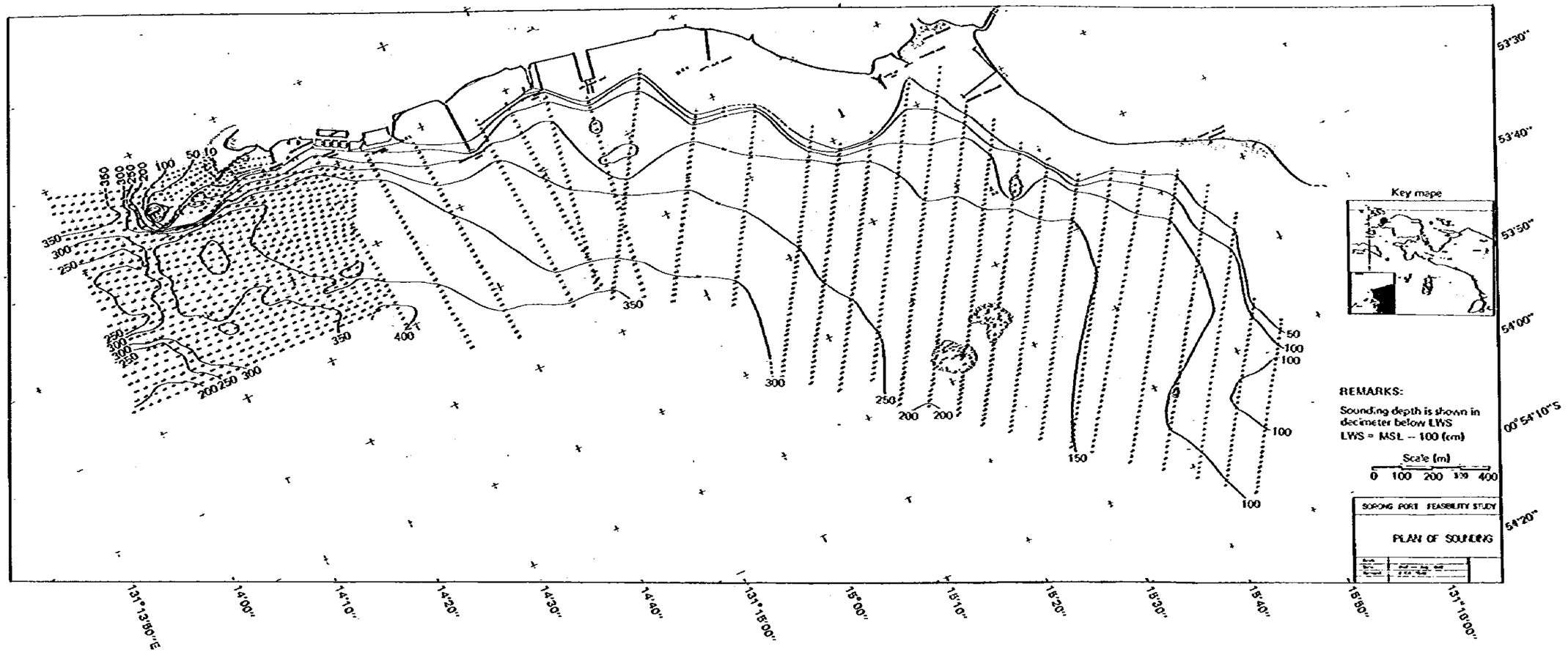
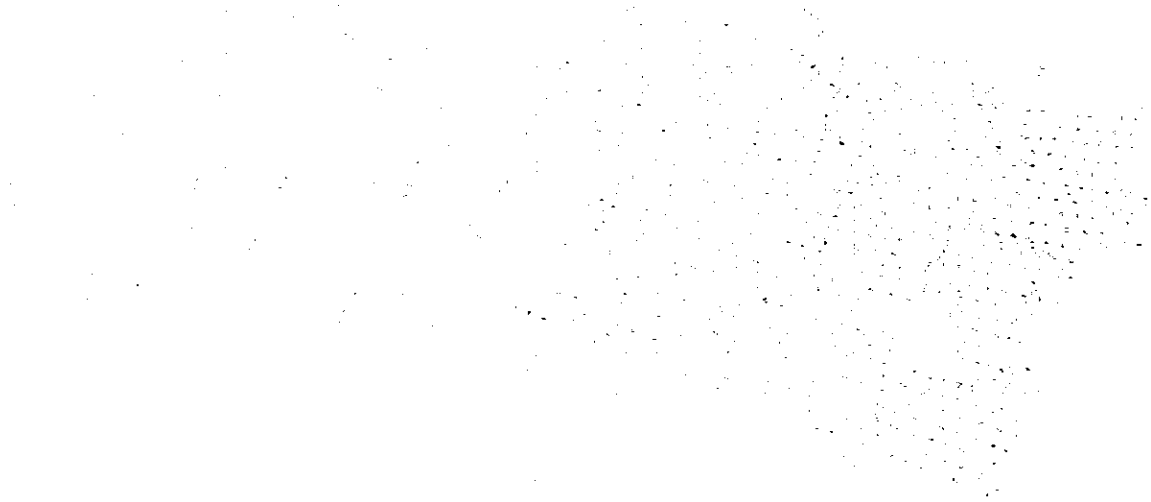


Fig. 6.3.4. Depth of the Sea





(4) Soil

1) Outline of soil survey

The soil survey was conducted by DGSC, the Government of the Republic of Indonesia, in cooperation with the Team at 6 points. The field investigations were started from June 19, 1980 and completed July 21, 1980. The Standard Penetration Test (SPT) was carried out in conformity to Japan Industrial Standard at every 1.5 m interval. A pontoon was used for the boring. The location of each borehole was decided by the geotechnical engineer of the Team. The depth of the sea is revised to the LWS based upon the tide table published by the Jawatan Hidro-Oceanografi in 1980.

The outline of soil investigation on the site is shown in Table 6.3.6.

Table 6.3.6. Outline of Soil Investigation

Site : The Port of Sorong, Irian Jaya, Indonesia
Period : From June 19, 1980 to July 21, 1980
Equipment : Rotary boring machine (SANDER 3A, Kokenshisui)
Casing NW, Single coretube NX for rock
Test : SPT at every 1.5 m deep

| Borehole No. | Sea depth below LWS (m) | Depth below seabed (m) | SPT (blows) | Period | Remarks |
|---|---|---|---|---|---|
| BH No. 1 | -8.7 | 15.6 | 11 | July 16 to July 19 | |
| BH No. 2 | -9.7 | 15.3 | 10 | July 7 to July 9 | Core sampling 2.6 m |
| BH No. 3 | -7.1 | 7.0 | 2 | July 2 to July 4 | Core sampling 2.6 m |
| BH No. 4 | -9.2 | 22.5 | 15 | June 24 to June 27 | |
| BH No. 5 | -9.4 | 15.3 | 10 | June 19 to June 22 | |
| BH No. 6 | -8.2 | 3.3 | 2 | June 30 to July 1 | |
| Total | | 79.0 | 50 | | |

Note: No laboratory tests were conducted.

2) Location

The location of boreholes is shown in Fig. 6.3.3.

It was decided with reference to the topographical conditions at the Port of Sorong and also the development plan of the port. Boreholes No. 1, 2, 3 and 6 correspond to the site for the medium term plan, and, boreholes No. 4 and 5 for the master plan.

The position of each borehole is shown in detail in Table 6.3.7.

Table 6.3.7. Detail Position of Each Borehole

| Borehole No. | Longitude (East) | Latitude (South) | Remarks |
|---|---|---|---|
| 1 | 131° 14' 37.45" | 00° 52' 50.6" | At the corner of the Wooden Wharf |
| 2 | 131° 14' 25.4" | 00° 52 47.3 | Between the Ferry Jetty and the Pertamina Barge |
| 3 | 131° 14' 22.4" | 00° 52' 47.6" | 15 m to the west from the Ferry Jetty |
| 4 | 131° 15' 7.9" | 00° 52' 56.0" | Near the Alfa Kurnia Jetty |
| 5 | 131° 15' 33.5" | 00° 53' 22.0" | In front of the Fishery's Jetty |
| 6 | – | – | Near the Borehole No. 3, 15 m to the west from the the borehole No. 3 |

3) Result of soil investigation

Figs. 6.3.5. (1), (2), (3), (4), (5) and (6) show the boring logs at each borehole. Among 6 boreholes, the bearing stratum appears at the depth not more than 20.2 m below the LWS except the borehole No.4. As expected, at the boreholes No. 3, and 6, the stratum composed of rock was found at the depth of about 3 m below the seabed.

Borehole No. 1

The subsoil is composed of coral layer, silt, sand and weathered rock. The coral layer, which is found at the depth of 0.9 m to 7.7 m, contains gravelly sand. The average N-value of this layer is approximately 20. Below the coral layer, a silt layer with the thickness of 1.6 m exists and the N-value of this layer is less than 6. Below the silt layer, down to 14.2 m deep from the seabed, there exists fine to coarse sand with an average N-value of 15. The bearing stratum is found below 14.2 m in depth.

Borehole No. 2

The subsoil is divided into four kinds of layers.

1) Gravelly sand with the N-value of less than 15, which is composed of gravel, sand, coral tips, seashells and fine clayey particles.
2) Silty sand with the N-value of less than 15.
3) Silty sand with the N-value between 40 and more than 50, which seems to be a weathered rock.
4) Rock

Borehole No. 3 and Borehole No. 6

The bearing stratum is found at a very shallow place of, less than about 3 m below the seabed.

Borehole No. 4

The subsoil, different from other boreholes, involves clay and silty clay layer between sand layers. The clay and silty clay layer with the N-value of 3 to 6 is found at the depth from 21.2 m down to 27.2 m below the LWS.

Moreover, the bearing stratum was found for the first time at the depth of 31.7 m below the LWS. The soil condition of this area is not be so good for the construction of port facilities.

Borehole No. 5

The bearing stratum of gravelly sand begins from the depth of 20.2 m below the LWS. BEtween the bearing stratum and the seabed, there exists sand and gravelly sand layer with an N-value of 1 to 15.

Fig. 6.3.5. (1) Boring Log (BH No. 1)

**BORING LOG**

Location: 00°52'50.6"S, 131°14'37.45"E — Depth of seabed: -8.7m below LWS

Borehole No.: 1 — Date: July 16 to July 19, 1980

| STAFF (m) | ELEVATION (m) | DEPTH (m) | THICKNESS (m) | CLASSIFICATION | COLOR | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | | Silty Sand | Grey | Silty, fine to medium sand with cobbles |
| | -9.60 | -0.90 | 0.90 | | | |
| | | | | Coral | White | Coral layer |
| | -12.50 | -3.80 | 2.90 | | | |
| | | | | Gravelly Sand | Light grey | Gravel and fine to medium sand with seashells |
| | -14.50 | -5.80 | 2.00 | | | |
| | | | | Coral | White | Coral layer |
| | -16.40 | -7.70 | 1.90 | | | |
| | | | | Silt | Dark grey | Silt with seashells |
| | -18.00 | -9.30 | 1.60 | | | |
| | | | | Sand | Light grey | Fine to coarse sand with clayey material |
| | -19.70 | -12.00 | 2.70 | | | |
| | | | | Sand | Light grey | Fine sand with seashells |
| | -22.90 | -14.20 | 2.20 | | | |
| | | | | Gravelly Sand | Light grey | Gravelly sand with fine to coarse particle |
| | -24.30 | -15.60 | 1.40 | | | |
| | | | | Gravelly Sand | | |
| | -25.27 | -16.57 | 0.97 | | | |

SPT

| Depth (m) | Blows / Penetration (cm) | Blows in every 10cm (10 cm) | (20 cm) | (30 cm) |
|---|---|---|---|---|
| -1.50 | 8 | 3 | 2 | 3 |
| -1.80 | 30 | 10 | 10 | 10 |
| -3.00 | 22 | 7 | 7 | 8 |
| -3.30 | | | | |
| -4.50 | 16 | 6 | 5 | 5 |
| -4.80 | 30 | 10 | 10 | 10 |
| -6.20 | 27 | 11 | 9 | 7 |
| -6.50 | 30 | 10 | 10 | 10 |
| -7.50 | 5 | 2 | 2 | 1 |
| -7.80 | 30 | 10 | 10 | 10 |
| -9.00 | 6 | 2 | 2 | 2 |
| -9.30 | 30 | 10 | 10 | 10 |
| -10.50 | 13 | 4 | 4 | 5 |
| -10.80 | 30 | 10 | 10 | 10 |
| -12.00 | 14 | 5 | 5 | 4 |
| -12.30 | 30 | 10 | 10 | 10 |
| -13.50 | 18 | 3 | 5 | 10 |
| -13.80 | 30 | 10 | 10 | 10 |
| -15.00 | 50 | 50 | | |
| -15.04 | 4 | 4 | | |
| -16.50 | 50 | 50 | | |
| -16.57 | 7 | 7 | | |

N-value: 10 20 30 40 50

Fig. 6.3.5. (2) Boring Log (BH No. 2)

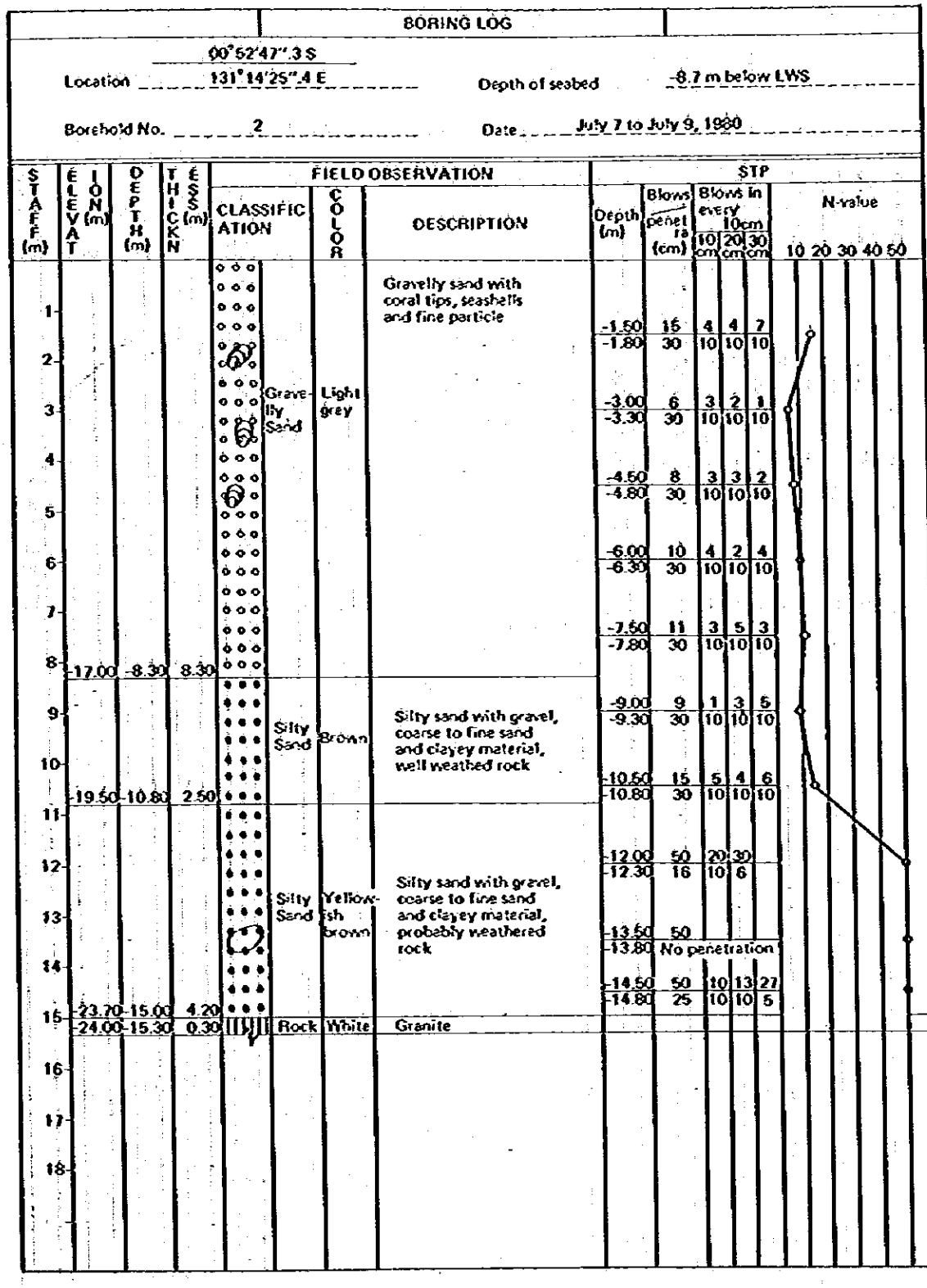
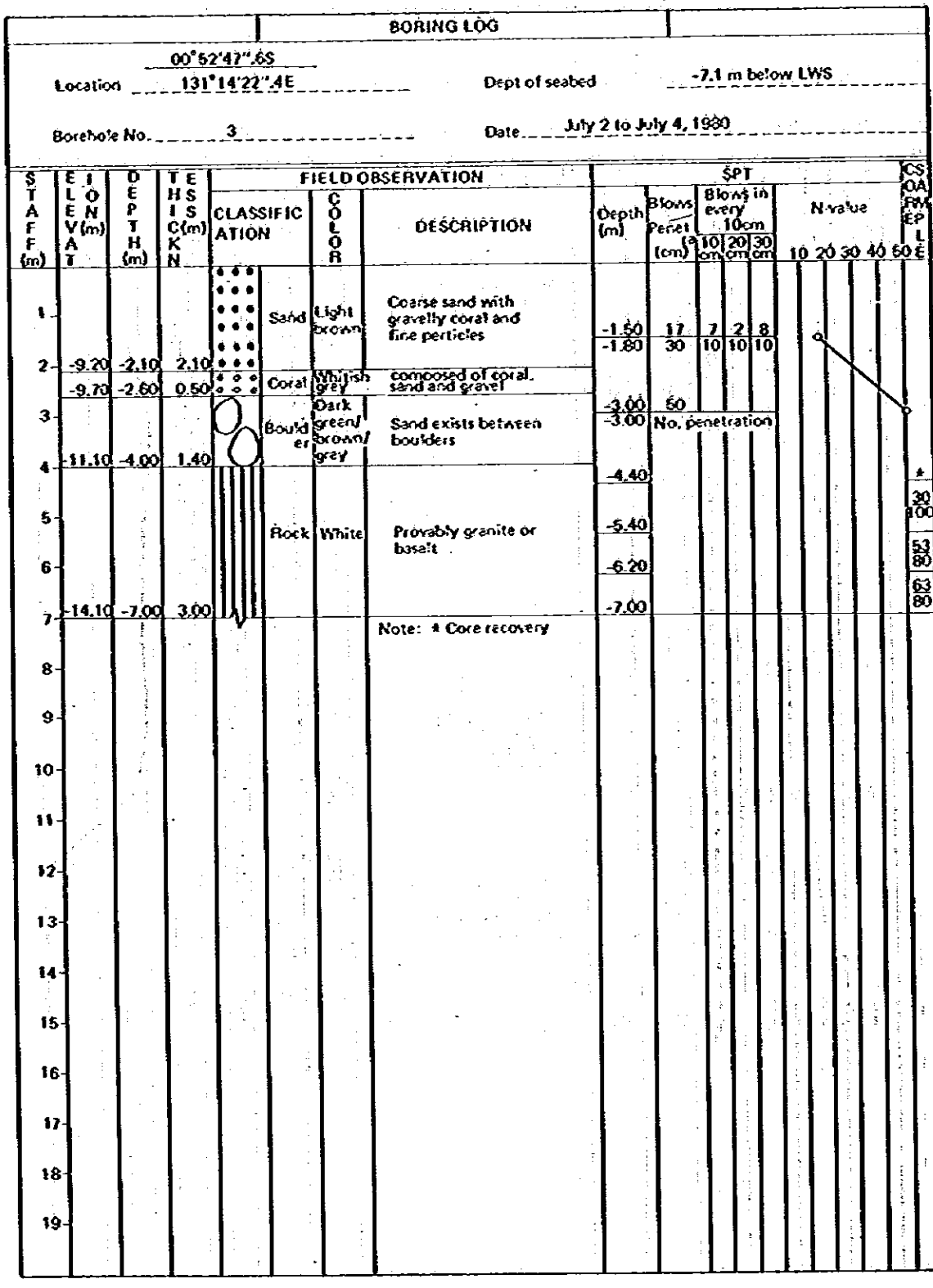


Fig. 6.3.5. (3) Boring Log (BH No. 3)



## Fig. 6.3.5 (4) Boring Log (BH No. 4)

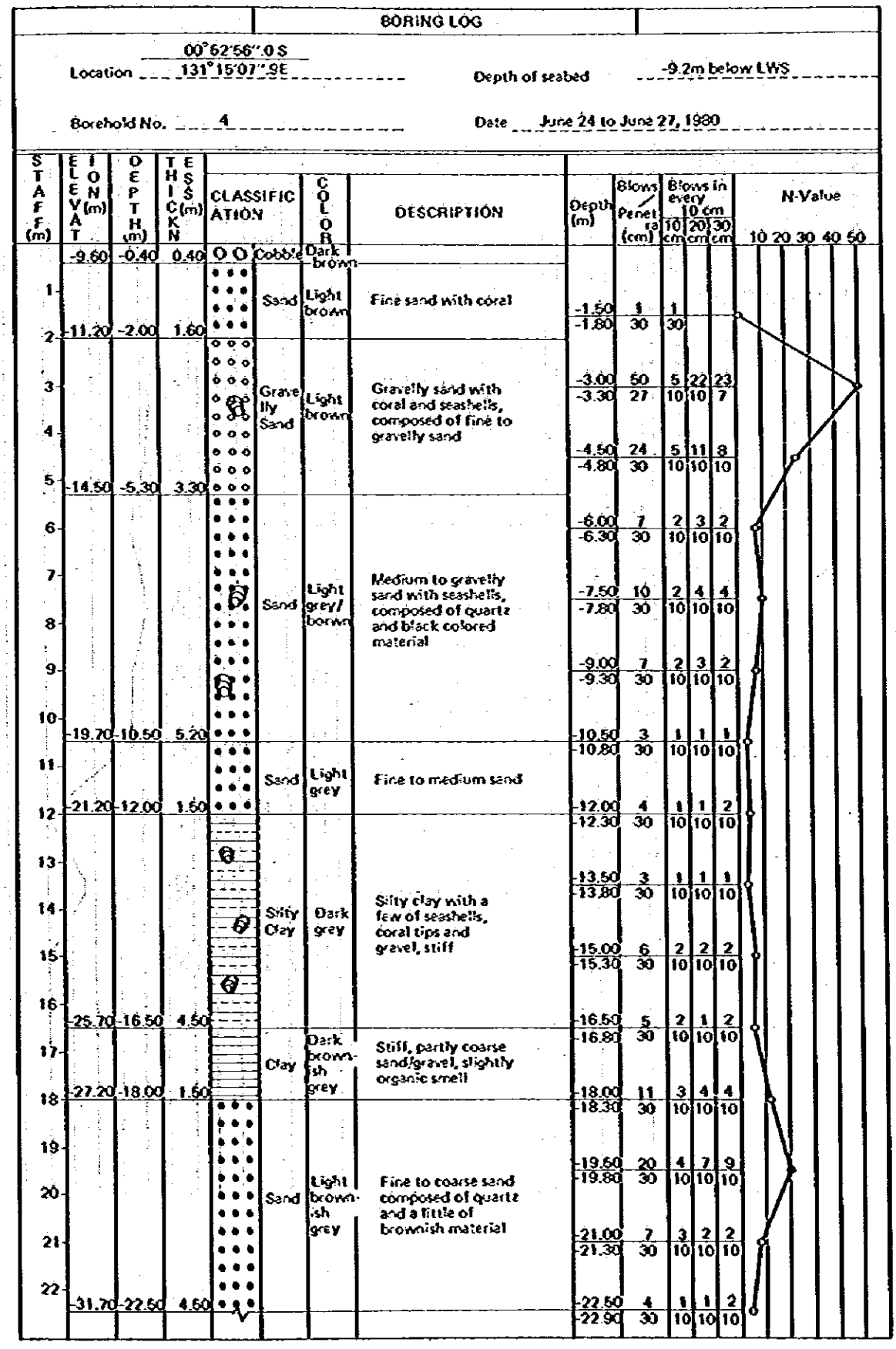


Fig. 6.3.5 (5) Boring Log (BH No. 5)

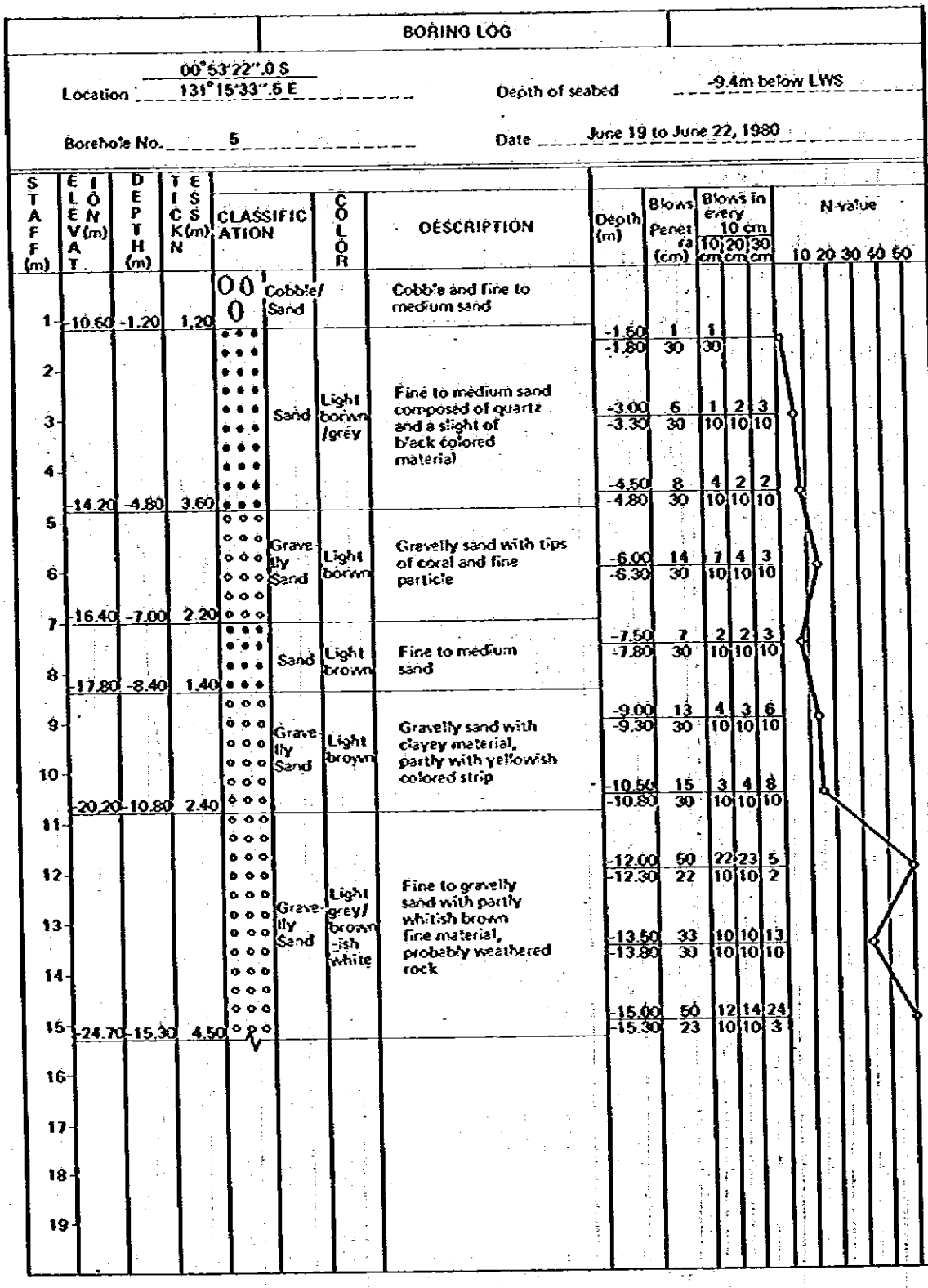


Fig. 6.3.5. (6) Boring Log (BH No. 6)

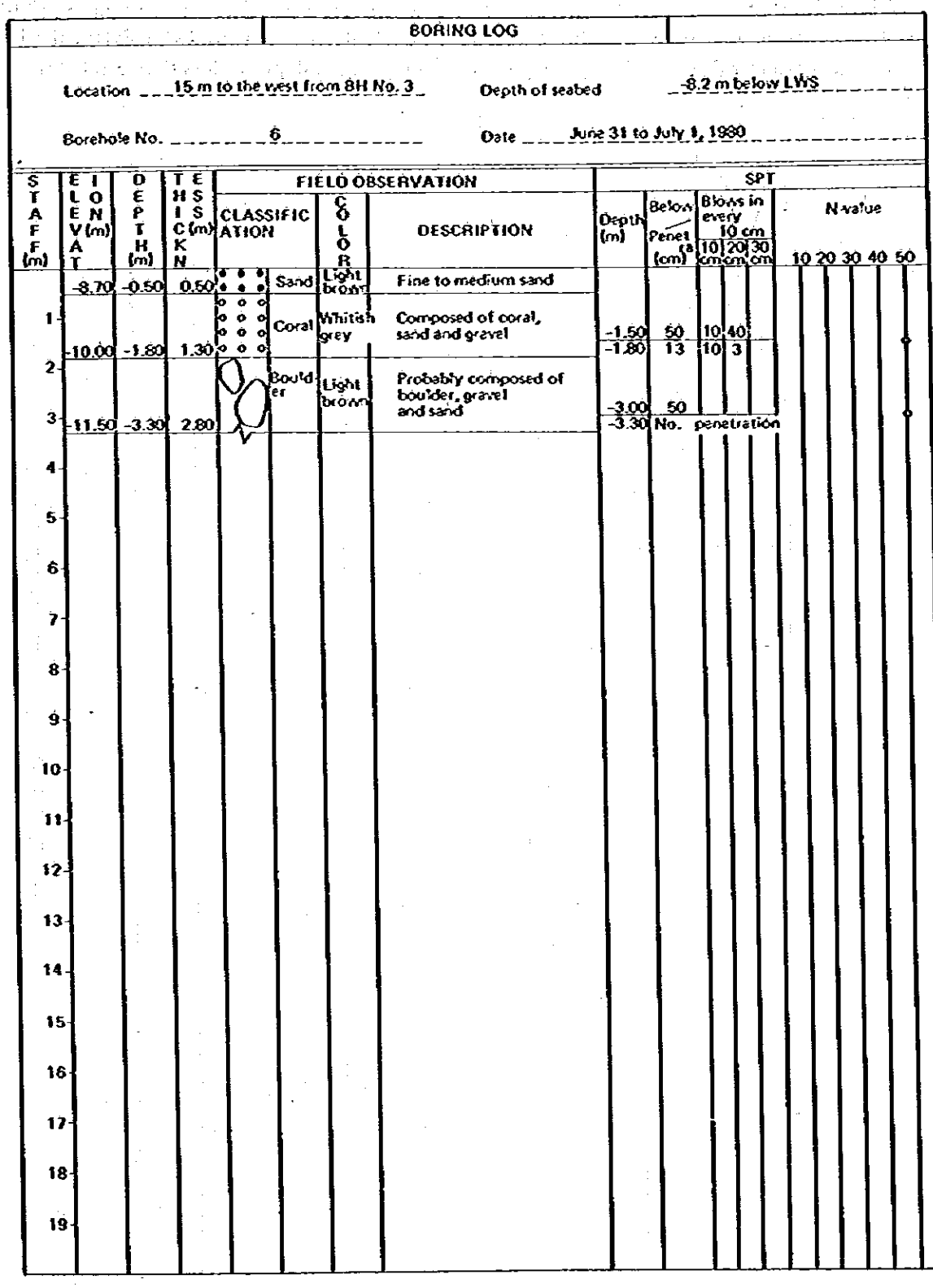


Fig. 6.3.6 shows the geological cross section around the Ferry Jetty estimated from the boring logs at BH No. 2, 3 and 6. The depth of the bed rock tends to decrease as it goes to the west. Judging from Fig. 6.3.6 and the topographical features around the Ferry Jetty, the bed rock, on the western side of the Ferry Jetty seems to exist at the depth of less than 3m below the seabed.

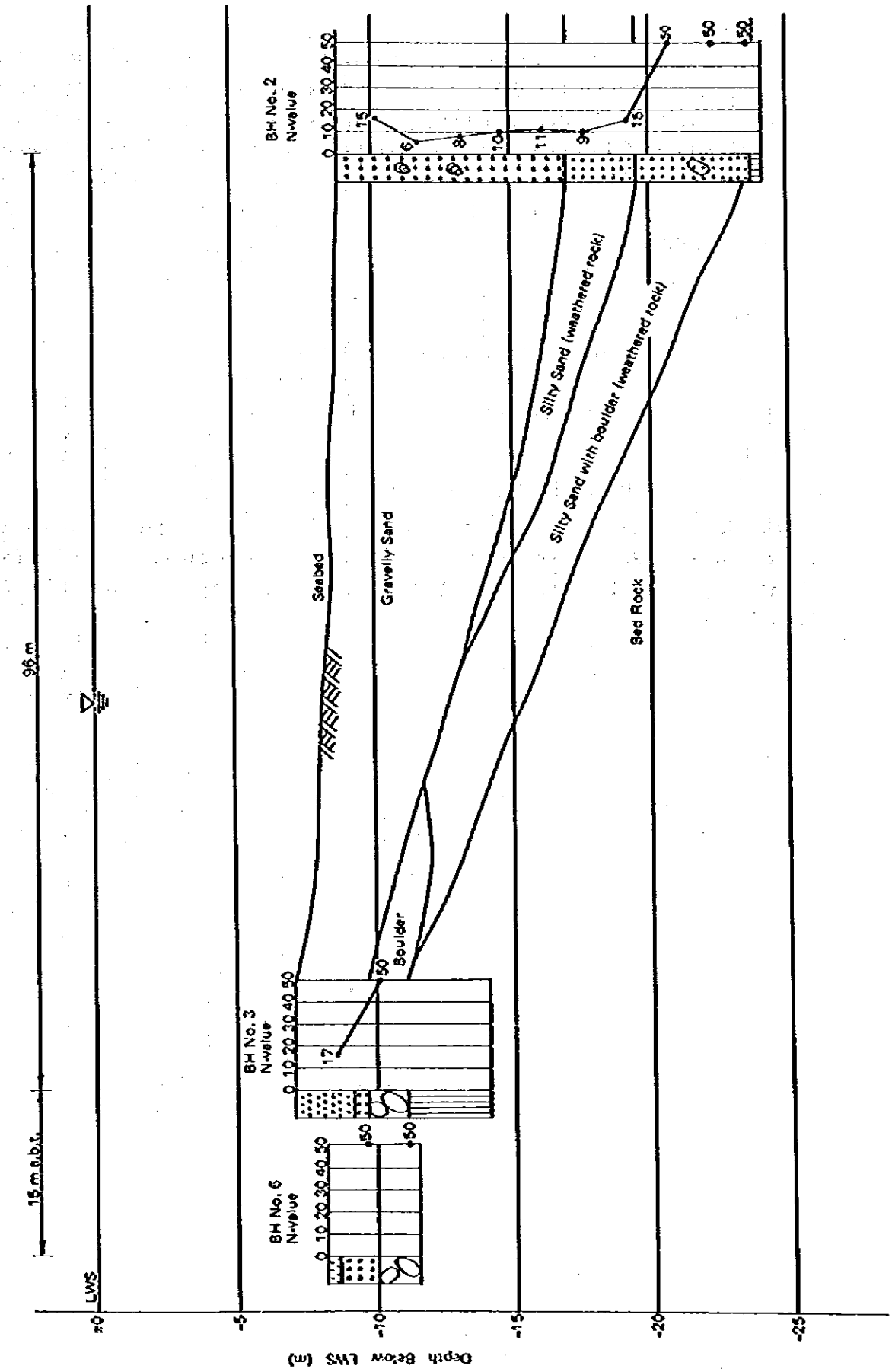



Fig. 6.3.6. Seabed Substrata Cross Section

(5) Earthquake

Fig. 6.3.7. shows the major shallow-sea earthquakes which occurred around the Port of Sorong. Judging from the Fig. 6.3.7., the earthquakes around the Port of Sorong will have very important effects on the design of the port facilities. The design seismic coefficient should be accurately estimated. However, as no dependable seismic zones map of Indonesia is available, the regional seismic coefficient of the "2nd Region" in Japanese port and harbour area was applied to obtain the design seismic coefficient. The design seismic coefficient $k_d$ is estimated with the following equation:

$$k_d = k_r \times e_s \times e_i$$

where,

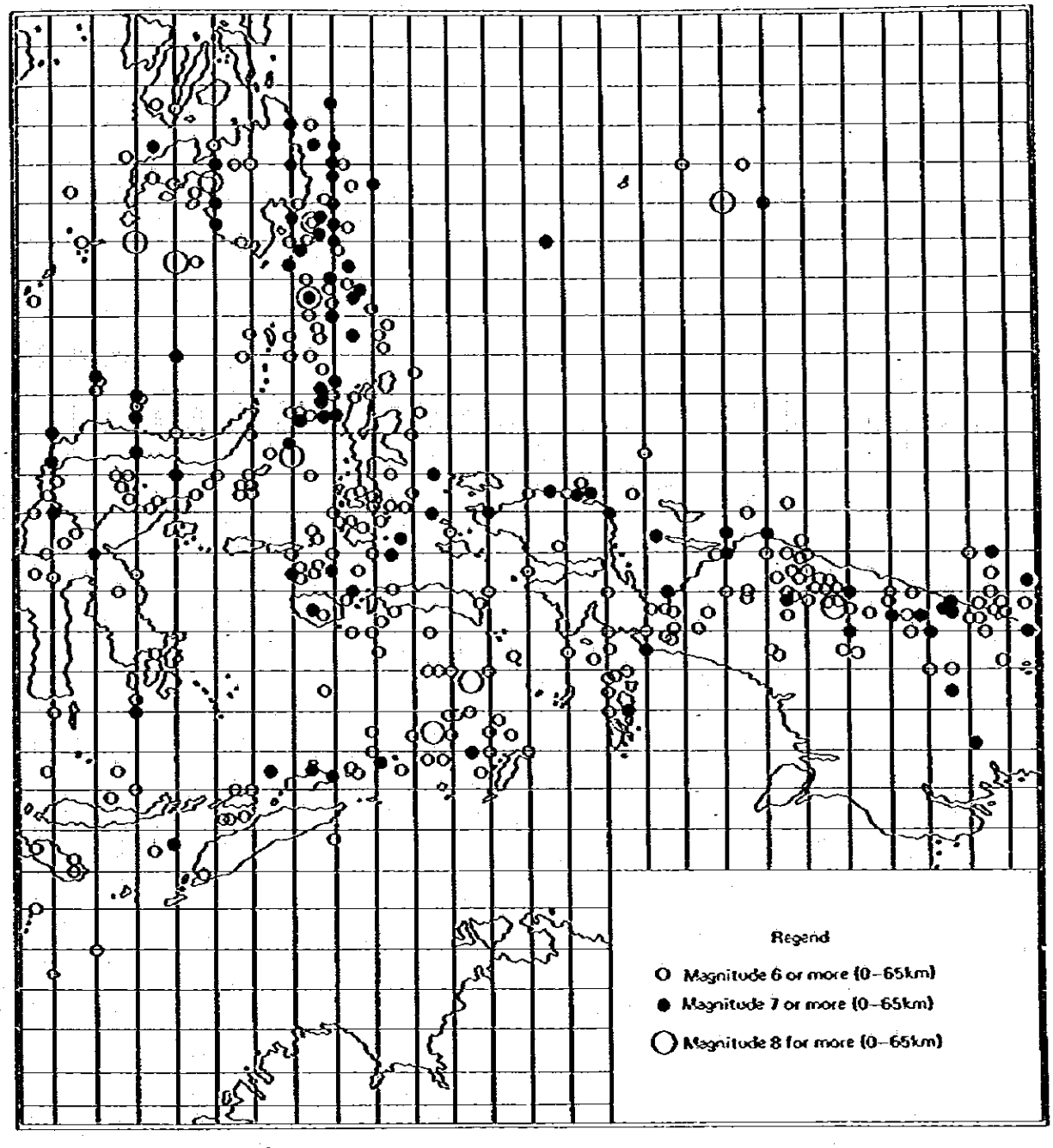
$k_r$ : regional seismic coefficient (0.1 is assumed)
$e_s$ : factor for subsoil condition (0.8 for rock)
$e_i$ : coefficient of importance (1.2 for class A)

therefore,

$$k_d = 0.1 \times 0.8 \times 1.2 = 0.096 \div 0.1$$

The design seismic coefficient of 0.1 has been applied to the preliminary design of the Concrete Wharf which was constructed in 1978 (UN Report on Preliminary Design for Project FUNDWI30,a Detailed Engineering Study for Port Facilities in Sorong in West Irian, Indonesia, March 1973).

Fig. 6.3.7. Major Shallow Earthquakes Arround Sorong




Source: Pusat Meteorologi dan Geofisika, Departemen Perhubungan.

# Chapter 7.
# FUNDAMENTAL CONCEPT FOR DEVELOPMENT

# CHAPTER 7. FUNDAMENTAL CONCEPT FOR DEVELOPMENT

## 7.1. Character of the Port

The master plan of port development should be drawn based on socio-economic requirements of the nation as well as of the region where the port is to be located. It should also conform to the natural conditions in possible expansion sites. Therefore, the character of the port should be studied in terms of its present functions and any possible changes in future.

### 7.1.1. Present Character and Activities of the Port

The study area and the Port of Sorong can be characterized as follows:

1) The study area covers two provinces, of which one is Irian Jaya with less developed inland traffic and the other is Maluku with many islands. Consequently most of their cargoes are carried by means of marine transportation.

2) There are nine RLS routes (Table 3.1.20.) and one Perintis route based at the Port of Sorong (Table 3.1.21.). Although they connect Maluku and Irian Jaya, there is little cargo flow by RLS between the two provinces as is seen in Tables 7.1.1. (1) – (3).

3) The Port of Sorong is located in the Bay of Sorong where the coastline consists of coral. There are two small rivers running into the bay; siltation is not observed except at their estuaries.

The entire Bay of Sorong, of which the natural conditions are suitable for port development, has already been established as the harbour area of the Port of Sorong. The land area of the port is limited to its immediate hinterland and the vicinity of the existing public wharfs.

4) This port has three functions: (i) commercial port dealing mainly with consumer goods in the distribution service area, and with materials and equipment required for the development of natural resources, (ii) loading point for export of logs and crude oil, and (iii) fishing port.

## Table 7.1.1. Inter-regional Flow of Dry Cargo in the Study Area (by RLS)

(1) 1975

(x $10^3$ tons)

| From \ To | N. Maluku | C. Maluku | S. Maluku | Irian Jaya | S. Total | Other Region | Total | S/W.M./S | G. Total |
|---|---|---|---|---|---|---|---|---|---|
| North Maluku | 4.4 | 0.5 | 0.1 | – | 5.0 | 27.3 | 32.3 | – | 32.3 |
| Central Maluku | 2.2 | 3.6 | 4.7 | 0.1 | 10.6 | 12.8 | 23.4 | – | 23.4 |
| South Maluku | – | 2.2 | 0.1 | – | 2.3 | 0.3 | 2.6 | 0.4 | 3.0 |
| Irian Jaya | – | – | 0.1 | 13.5 | 13.6 | 3.4 | 16.9 | – | 16.9 |
| Sub Total | 6.6 | 6.3 | 5.0 | 13.6 | 31.5 | 43.8 | 75.2 | 0.4 | 75.6 |
| Other Region | 23.9 | 55.4 | 1.4 | 41.3 | 122.0 | 5,824.9 | 5,946.9 | 1,598.6 | 7,545.5 |
| Total | 30.5 | 61.7 | 6.4 | 54.9 | 153.5 | 5,868.6 | 6,022.1 | 383.7 | 7,621.1 |
| S/W.M./S | – | – | – | – | – | 180.5 | 180.5 | 384.1 | 563.8 |
| Grand Total | 30.5 | 61.7 | 6.4 | 54.9 | 153.5 | 6,049.1 | 6,202.6 | 1,982.3 | 8,184.9 |

Source: DGSC/Angkutan Antar Pulau Menurut Jenis Barang di Indonesia
Note: S/W.M./S = Singapore/West Malaysia/Sabang

(2) 1976

(x $10^3$ tons)

| From \ To | N. Maluku | C. Maluku | S. Maluku | Irian Jaya | S. Total | Other Region | Total | S/W.M./S | G. Total |
|---|---|---|---|---|---|---|---|---|---|
| North Maluku | 17.3 | 1.1 | – | – | 18.4 | 51.6 | 70.0 | 5.2 | 75.2 |
| Central Maluku | 1.8 | 3.1 | 6.4 | 0.2 | 11.5 | 11.1 | 22.6 | 1.6 | 24.2 |
| South Maluku | – | 0.6 | 0.2 | – | 0.8 | 0.2 | 1.0 | – | 1.0 |
| Irian Jaya | – | – | – | – | – | – | – | 1.7 | 1.7 |
| Sub Total | 19.1 | 4.8 | 6.6 | 0.2 | 30.7 | 62.9 | 93.6 | 8.5 | 102.1 |
| Other Region | 42.2 | 66.2 | 3.6 | 66.5 | 178.5 | 6,707.3 | 6,885.8 | 2,018.3 | 8,904.1 |
| Total | 61.3 | 71.0 | 10.2 | 66.7 | 209.2 | 6,770.2 | 6,979.4 | 2,026.8 | 9,006.2 |
| S/W.M./S | 0.1 | – | – | 10.5 | 10.6 | 381.4 | 392.0 | – | 392.0 |
| Grand Total | 61.4 | 71.0 | 10.2 | 77.2 | 219.8 | 7,151.6 | 7,371.4 | 2,026.8 | 9,398.2 |

Source: DGSC/Angkutan Antar Pulau Menurut Jenis Barang di Indonesia
Note: S/W.M./S = Singapore/West Malaysia/Sabang

(3) 1977

(× $10^3$ tons)

| From \ To | N. Maluku | C. Maluku | S. Maluku | Irian Jaya | S. Total | Other* Region | Grand Total |
|---|---|---|---|---|---|---|---|
| North Maluku | 22.7 | 0.6 | – | – | 23.4 | 41.4 | 64.8 |
| Central Maluku | 2.6 | 1.9 | 7.5 | 0.1 | 12.1 | 11.7 | 23.8 |
| South Maluku | – | 0.1 | – | – | 0.1 | 0.7 | 0.8 |
| Irian Jaya | 0.1 | – | – | 11.9 | 12.0 | 7.6 | 19.6 |
| Sub Total | 25.4 | 2.6 | 7.6 | 12.0 | 47.6 | 61.4 | 109.0 |
| Other Region* | 41.8 | 69.9 | 5.4 | 57.2 | 174.3 | 7,160.9 | 7,335.2 |
| Grand Total | 67.2 | 72.5 | 13.0 | 69.2 | 221.9 | 7,222.3 | 7,444.2 |

Source: DGSC/Angkutan Antar Pulau Menurut Jenis Barang di Indonesia
Note: Other Region includes Singapore, West Malaysia and Subang.



## Table 7.1.2. Interregional Cargo Flow by Perintis (1978/79) (Kabupaten to Kabupaten)

(tons)

| From \ To | Jayapura | Paniai | Y. Waropen | T. Chen. | Manokwari | Sorong | Fak-Fak | Merauke | (Tual) | (Ternate) | (Bitung) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jayapura | 194.3 | 114.9 | 69.2 | 308.9 | 50.8 | 65.1 | | | | | | 804.2 |
| Paniai | 23.3 | | | 30.1 | | 4.2 | | | | | | 57.6 |
| Y. Waropen | 6.7 | 1.0 | | | | | | | | | | 7.7 |
| T. Chenderawasih | 2.2 | 490.5 | 191.4 | | 132.7 | 128.0 | 200.0 | 920.0 | | | | 2,064.8 |
| Manokwari | 24.3 | 5.0 | 27.6 | 254.7 | | 50.8 | | | | | | 362.4 |
| Sorong | 42.0 | 7.0 | 135.0 | 1,112.6 | 16.0 | | 4,715.5 | 1,061.2 | 1.0 | 9.9 | 396.4 | 7,496.6 |
| Fak-Fak* | | | | | | 185.0 | 305.1 | 105.5 | 3.0 | | | 598.6 |
| Merauke | | | | | | 44.9 | 20.5 | 1,264.2 | | | | 1,329.6 |
| (Tual) | | | | | | | | | | | 6.0 | 6.0 |
| (Ternate) | | | | 54.5 | 34.2 | 211.1 | | | | | | 334.0 |
| (Bitung) | 35.1 | | | | | | | | | | | |
| Total | 327.9 | 618.4 | 423.2 | 1,760.8 | 233.7 | 689.1 | 5,241.1 | 3,350.9 | 4.0 | 9.9 | 403.4 | 13,062.4 |

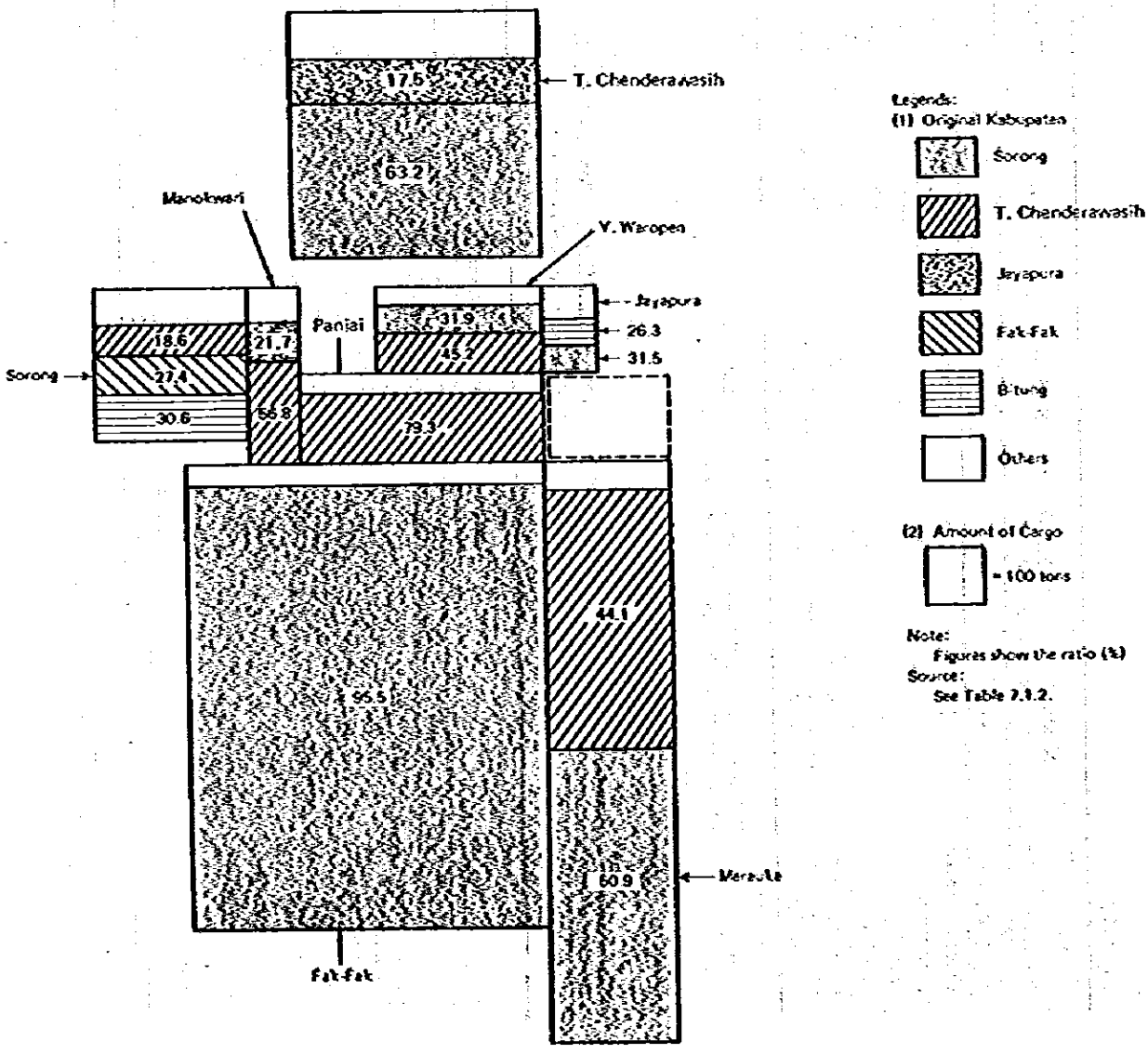
Source: See Table 3.1.23.
Note: 1. Fak-Fak includes Port of Bintuni
2. ( ) show the ports in Maluku province.

5) The Port of Sorong is one of the major ports in Irian Jaya which are called on by RLS vessels and is a base port of Perintis. Large amount of cargoes are distributed by Perintis, through Sorong Port to neighbouring ports (Table 7.1.2. and Fig. 7.1.1.).

Fig. 7.1.1. shows the amount and origin of Perintis cargo arriving at various ports. As is seen in Fig. 7.1.1., Kabupatens Fak-Fak, T. Chenderawasih and Merauke are highly dependent on the Port of Sorong for their cargo transportation. Kabupaten T. Chenderawasih (its main port is Biak) seems to have a great influence on the cargs flow from Kabupaten Paniai, Manokwari and Yapen Waropen. Kabupaten Jayapura is more closely tied with outer Irian Jaya area in cargo flow than with Irian Jaya area.

6) For foreign trade, no liners call the ports presently; there are only tramp-carries of crude oil, logs and fishery products.

**Fig. 7.1.1. Amount and Ratio of Cargo Origin Transported by Perintis (1978/79)**



### 7.1.2. Selection of Terminal Ports in the Study Area

Prior to the determination of the future character of the Port of Sorong, proper functions or roles of each port should be decided taking the geographical condition of the port and socio-economic conditions of the hinterland into consideration. Most importantly, the terminal port which serves other ports as a distribution center of seaborne cargo must be selected.

(1) Candidates for Terminal Port

As is mentioned in Section 3.1.1, Maluku and Irian Jaya have 48 ports which have a harbour master. They are classified into several groups by function and character to facilitate the port management. For determinating terminal port, it is desirable to select some candidates with reference to their current functions.

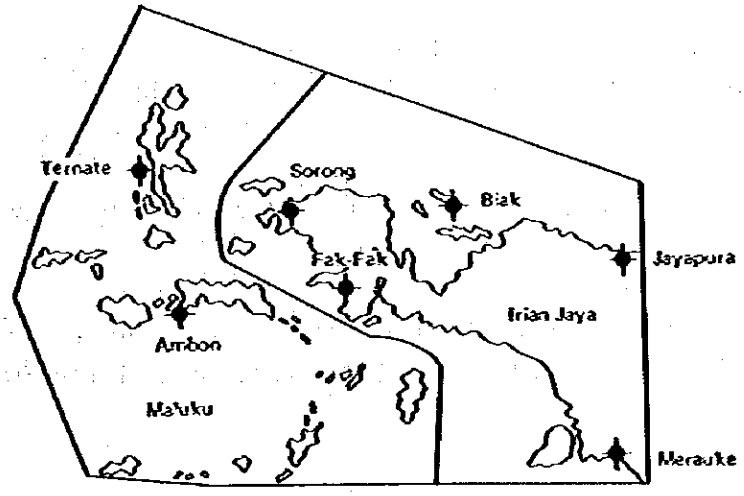
1) Classification of port

These ports are classified by objects of development and by functions and are controlled and managed by DGSC. (The classification of ports in the study area is shown in Table 3.1.2. and 3.1.3.) The classification is based on location of port, level of port activity and situation of port facility. It can be said that highly-graded ports are located in important places, handle big amount of cargo and have sufficient port facilities.

2) Seaport and coastal port

Ports are divided into the two categories of seaport and coastal port. The seaport means a port which allows foreign vessels to enter without permission. In the study area, there are 7 seaports, that is Ternate, Ambon, Jayapura, Biak, Sorong, Fak-Fak and Merauke. They are shown in Fig. 7.1.2.

Fig. 7.1.2. Location of Seaport in the Study Area



3) Base ports of Perintis

There are 4 base ports of Perintis in the study area. They are Ambon, Jayapura, Sorong and Merauke. These ports play an important roles in the sea transportation network (Table 3.1.12. and Fig. 3.1.11. show the routes of Perintis from 1979/80 to 1983/84).

Everything considered, 5 ports have been as the candidates for the terminal port. They are Port of Ternate, Ambon, Jayapura, Sorong and Merauke. The potentials of these ports as the future terminal port are studied and compared.

(2) Conditions Required for a Terminal Port

The conditions required for a terminal port are the following four items.

1) Location

In order for the terminal port to function effectively, it must be located in a good position both for the main shipping route and for the feeder service within the distribution service area.

The seaborne cargo traffic of the Republic of Indonesia is the heaviest between Sumatra or Jawa and other districts (Table 7.1.3). The cargoes loaded at Sumatra and Jawa amounted to 6.33 million tons (more than 67 percent of total cargoes) and about 1.3 million tons of these are unloaded in the eastern part of the country.

Therefore the shipping route from the western to the eastern part of the country forms the trunk line of the domestic shipping service. It is one of the essential conditions for the terminal port to be included in this route service.

Another essential condition is to be located in an economically advantageous position for the feeder service. In this case, the cost of transportation is the primary concern. The lesser the cost of transportation, the better the location. From this point of view, it is desirable to be located around the center of the service area. If the feeder service is to be performed by ships which require the same shipping cost, it is desirable to have the terminal port in a position where the summation ($\Sigma d \cdot V$) of the distance (d) and quantity of cargo (V) becomes minimum.

2) Natural conditions

Natural conditions are also an important factor in evaluating the terminal port. The cost of construction, the efficiency of the port operation and the capacity of the port are greatly effected by natural conditions. The items which should be evaluated are as follows:

a. weather conditions

It should be calm enough not to disturb the port activities. The less the rainy days, the better for port operation.

b. geographical conditions

In addition to the regular conditions of port construction, sufficient extent of water surface is required to enable the expansion of the port facilities in the future. It will affect the capacity of the port.

## Table 7.1.3. Inter-island Flow of Dry Cargo (1976)

(x10³ tons)

| From \ To | Sumatera | Jawa | Kalimantan | Sulawesi | Bali + NTB + NTT | Maluku | Irian Jaya | Total | Singapore West Malaysia Sabang | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Sumatera | 1,335.5 | 1,041.4 | 24.5 | 9.7 | 4.3 | 1.9 | 0.3 | 2,417.6 | 1,261.2 | 3,678.8 |
| Jawa | 899.1 | 274.6 | 605.8 | 275.9 | 300.7 | 50.3 | 33.9 | 2,440.3 | 214.7 | 2,655.0 |
| Kalimantan | 19.6 | 480.9 | 205.1 | 25.2 | 15.0 | 1.3 | 5.9 | 753.0 | 422.0 | 1,175.0 |
| Sulawesi | 71.1 | 415.8 | 102.3 | 276.0 | 40.4 | 58.2 | 25.4 | 989.2 | 117.9 | 1,107.1 |
| Bali+NTB+NTT | 4.6 | 215.3 | 8.5 | 2.0 | 54.0 | 0.3 | 1.0 | 285.7 | 2.5 | 288.2 |
| Maluku | 0 | 60.7 | 1.1 | 1.1 | 0 | 30.5 | 0.2 | 93.6 | 6.8 | 100.4 |
| Irian Jaya | 0 | 0 | | | | | | 0 | 1.7 | 1.7 |
| Total | 2,329.9 | 2,488.7 | 947.3 | 589.9 | 414.4 | 142.5 | 66.7 | 6,979.4 | 2,026.8 | 9,006.2 |
| Singapore/West Malaysia/Sabang | 106.2 | 226.7 | 24.4 | 23.5 | 0.6 | 0.1 | 10.5 | 392.0 | | 392.0 |
| Total | 2,436.1 | 2,715.4 | 971.7 | 613.4 | 415.0 | 142.6 | 77.2 | 7,371.4 | 2,026.8 | 9,398.2 |

Source: See Table 7.1.1

3) Economic activities

In order to play the role of distribution center to other ports, the port have some quantity of cargoes which are related to its own hinterland. Namely, not only the port of distribution center should have its service area but also its hinterland should maintain certain amount of base loads. For example, the Port of Singapore is one of the big distribution centers of the neighbouring countries; at the same time the port has a big accumulation of productive functions, such as factories, in its hinterland which covers the whole country.

In other words, there must be or will have to be big economic activities in its hinterland, and they can be estimated by area, population, GRDP and so on (Table 7.1.4.).

Table 7.1.4. Socio-economic Indices in Maluku and Irian Jaya

| | Present (1978) | | Future (2000) | | Remarks |
|---|---|---|---|---|---|
| | Maluku | Irian Jaya | Maluku | Irian Jaya | |
| Area ($km^2$) | 74,505 (1) | 421,981 (5.66) | 74,505 (1) | 421,981 (5.66) | |
| Population ($x10^3$ people) | 1,281 (1) | 1,101 (0.86) | 2,229 (1) | 1,882 (0.84) | |
| GRDP ($x10^5$ US$) | 298,652 (1) | 647,134 (2.17) | 1,231,303 (1) | 1,877,155 (1.52) | 1975 constant price |
| Per Capita GRDP (US$) | 228 (1) | 242 [582] (1.06) [2.55] | 552 (1) | 740 [981] (1.34) [1.78] | 1975 constant price |

Notes: 1. ( ) shows a ratio of Maluku to Irian Jaya.
2. [ ] shows per capita GRDP excluding oil sector.

4) Accumulation of administrative functions

Various kinds of business routines exist where cargoes are collected and distributed. To conduct these businesses smoothly, accumulation of administrative functions are required in the city of the terminal port.

The accumulation of the functions can be estimated by accumulation of public organizations.

(3) Evaluation of Potential as the Terminal Port

The present and future situations of 5 candidate ports are compared in terms of these conditions. The evaluation is shown in Table 7.1.5.

(4) Conclusions

The conclusions can be summarized as follows:

1) There is scarecely any cargo flow between the two provinces of Maluku and Irian Jaya.
2) The two provinces are too big to be served by one terminal port that is the Port of Ambon.
3) It will be good to develop another terminal port in the eastern part of the study area.
4) The Port of Sorong is the most suitable candidate for a new terminal port.

## Table 7.1.5. Evaluation of Potentials for Terminal Port

| Name of Port / Condition | Ternate | Ambon | Jayapura | Sorong | Merauke |
|---|---|---|---|---|---|
| (1) Location (Strategical Condition) | Not Good | Good | Not Good | Good | Not Good |
| (2) Natural Condition<br>Wave<br>Depth<br>Siltation<br>Room for expansion | Calm<br>Enough<br>No Siltation | Calm<br>Enough<br>No Siltation<br>Enough | Calm<br>Enough<br>No Siltation<br>Not Enough | Calm<br>Enough<br>No Siltation<br>Enough | Calm<br>Not Enough<br>No Siltation |
| (3) Economic Activities | Small | Existing activities are big but hinterland is small. | Small | Existing activities are small but hinterland is big. | Small |
| (4) Accumulation of administrative functions | The capital of Kabupaten | The capital of Province | The capital of Province | The capital of Kabupaten | The capital of Kabupaten |

References

| | | | | | |
|---|---|---|---|---|---|
| (1) Existing Facilities<br>Wharfs | 97 m | 187 m<br>83 m | 132m (9–12m)<br>65m (3–9m)<br>33m (5–6m) | 132m (10–12m)<br>120m (9–15m)<br>40m (5–7m) | 40m |
| Warehouse ($m^2$) | 600 | 8,750 | 3,525 | 744 | 952 |
| (2) Cargo Flows* (tons) (1978)** | 505,794<br>(379,139) | 949,752<br>(772,582) | 112,259<br>(n.a.) | 165,338<br>(n.a.) | 71,665<br>(n.a.) |

Note: 1. * including logs, its amount shows in ( ).
2. ** Ternate and Ambon in 1979.
3. n.a. = not available.

### 7.1.3. Future Character of the Port

The future character and function of the port will be determined by the form and extent of development in its hinterland and will include the following factors:

1) Distribution center to the central and the western part of Irian Jaya

There is some cargo distributed through the port to other neighbouring ports. This transit cargo will increase because Perintis service assists it year by year under the control of RLS service by DGSC.

But the distribution function of the port will be limited to the central and the western part of Irian Jaya and will not extend to Maluku and the eastern part of Irian Jaya.

2) Log and timber loading point

At present, wood is exported in the form of logs to foreign countries and as sawn timber to other provinces in Indonesia. However, most of the export will change to sawn timber in the near future. In view of this prospect the port should provide necessary facilities such as the wharves for ocean-going vessels and the cargo handling equipment for the semi-finished products of sawn timber.

3) Oil loading port

The port has an oil jetty belonging to the state oil company Pertamina for export of crude oil and distribution of refinery products such as bunkering fuel to ships and other consumers in the service area. The company is now planning to construct a new refinery around the Sorong area. If the company does not use the present facilities when the operation of the new refinery is started, that space in sea and on land can be used for the expansion of the port. However, the details of the plans of the company are not informed.

4) Daily consumption goods

The local government is finding it very hard to promote the transmigration from other islands to develop agriculture with the Irian people. This program will change the pattern of food consumption and it will effect the composition and the amount of cargo flow through the ports concerned. There will be a big time lag between the program initiation and completion.

Therefore, if the effects of the foregoing factors, which involve too many uncertain elements, are excluded at the present stage, it may be said that there will be no basic change in the character of the Port of Sorong in the future. However, based on the development of the hinterland, quantitative increases in the respective cargo fields can be expected, and thus, a port development plan must be formulated in accordance with such growth.

## 7.2. Distribution Service Area

### 7.2.1. Premise

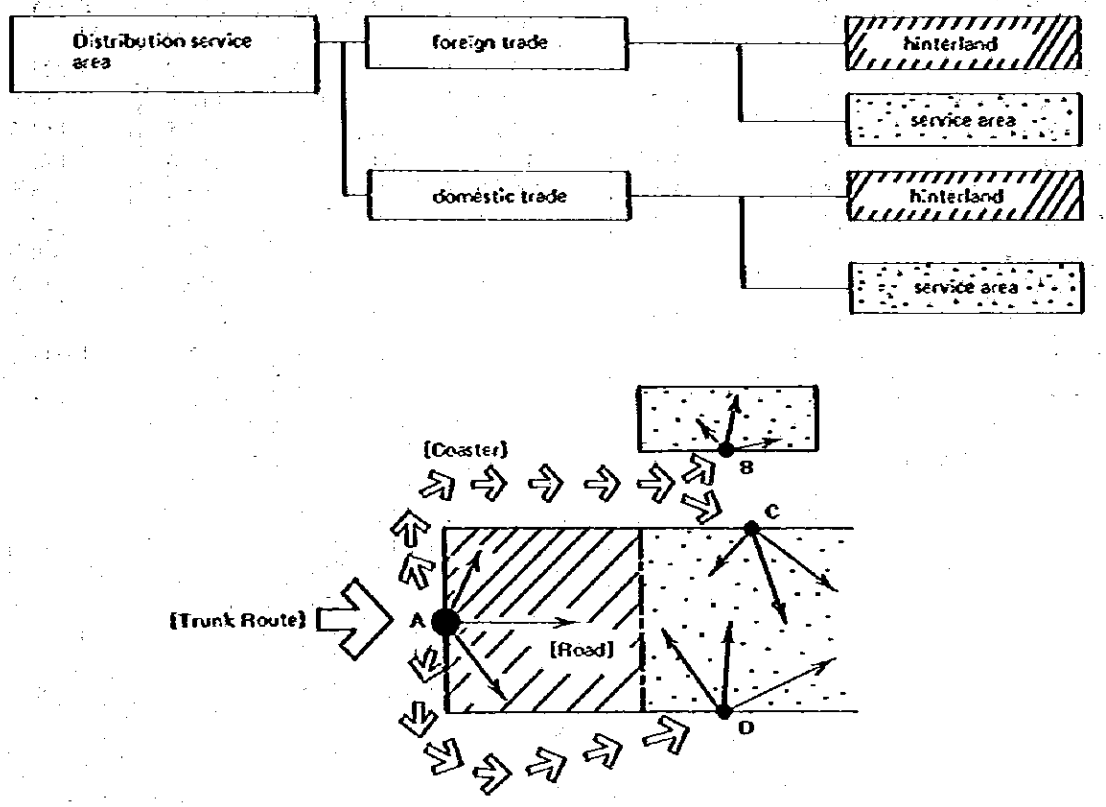
(1) Kinds of Distribution Service Area

With regard to the present situatiin of transportation in Irian Jaya, most of the cargo is transported by ships, because, as mentioned in Chapter 3, inland traffic network is under developed. Owing to the same reason, the present distribution service area of each port is limited

mostly to its vicinity. But the service area will extend inland as the inland traffic network develops.

It is to be desired that the distribution service area is determined by the kind of trade and by the type of service. As for the kind of trade, it consists of foreign trade and domestic trade. As for the type of service, it can be divided into direct hinterland or "hinterland" which means the area where the seaborne cargoes are distributed by land transportation (road), and secondary hinterland or "service area" which means the area where goods are distributed by feeder service vessels (coaster).

Fig. 7.2.1. Type of the Distribution Service Area




Port A terminal port; port B, C and D feeder port linked by coaster

(2) Port Related Area

Because of underdevelopment of inland traffic network, not all regions in Irian Jaya have relations with port activities. A port related area, namely a region which affects port activities is limitted to the area which has ports or is connected with the ports by roads.

Port related areas in Irian Jaya are assumed as follows:

1978 (Present situation):

Kecamatans in which 6 major ports and 8 small ports are located and other Kecamatans which are connected with these ports by roads.

1985:

Kecametans which have ports or are connected with the ports by roads.

2000:

Kecamatans which have ports or which are and will be connected with the ports by roads. Port related areas by Kecamatan are shown in Fig. 7.2.2. and their populations are indicated in Table 7.2.1. In this figure, Kecamatans with no marks have no relations with the port activities in general cargo traffic.

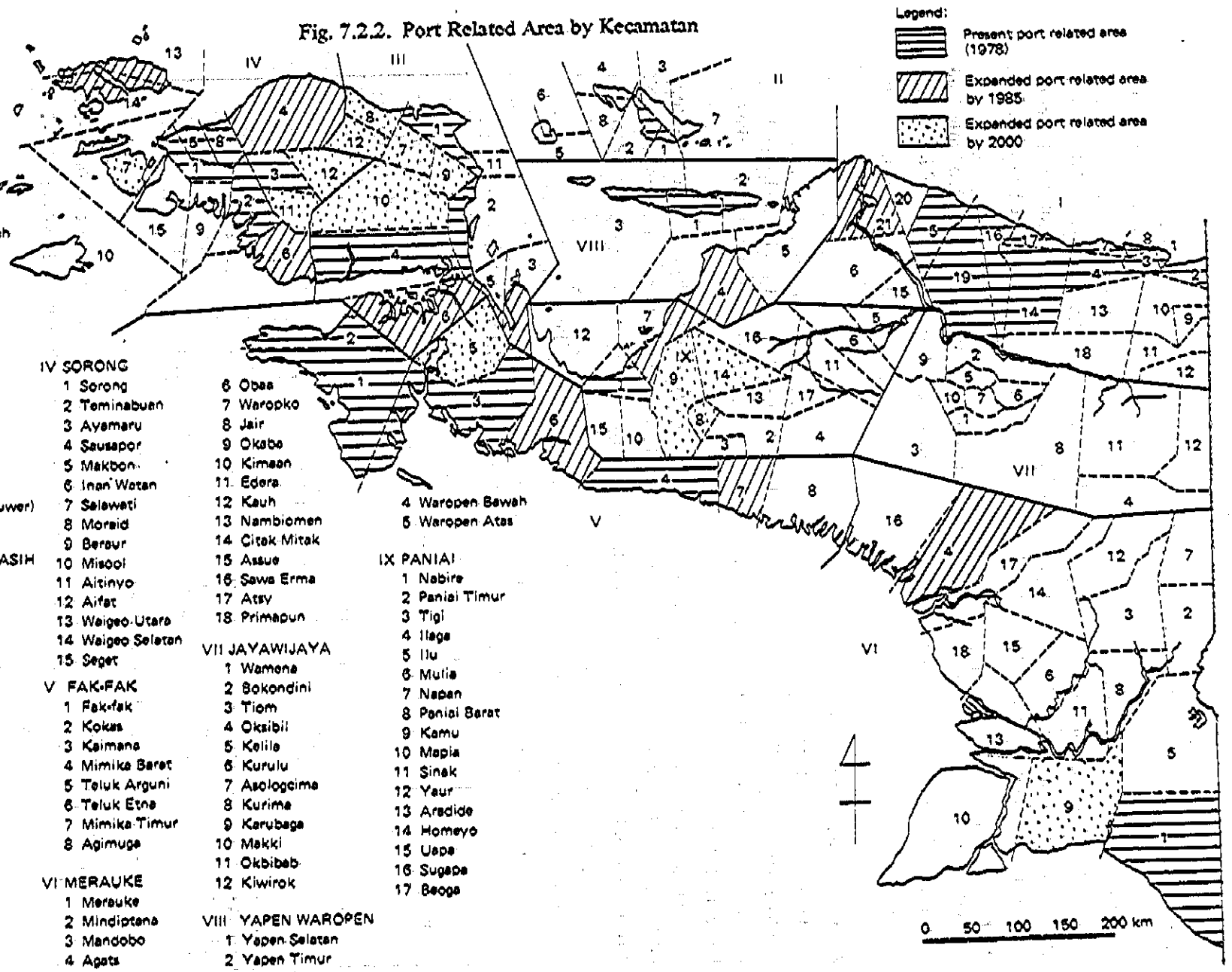
Table 7.2.1. Population of Port Related Areas in Irian Jaya by Kabupaten

(x $10^3$ people)

| Year | 1978 | | 1985 | | 2000 | |
|---|---|---|---|---|---|---|
| Kabupaten | Whole Area | P.R.A. | Whole Area | P.R.A. | Whole Area | P.R.A. |
| Jayapura | 131.1 | 112.2 | 162.6 | 140.2 | 263.3 | 227.1 |
| T. Cendrawasih | 72.2 | 57.3 | 86.0 | 68.3 | 112.8 | 89.6 |
| Manokwari | 78.6 | 45.6 | 104.1 | 76.4 | 184.5 | 184.5 |
| Sorong | 122.3 | 66.1 | 152.5 | 108.7 | 217.6 | 173.7 |
| Fak-Fak | 53.5 | 27.1 | 63.3 | 45.9 | 83.0 | 66.5 |
| Merauke | 152.8 | 25.3 | 185.7 | 41.3 | 259.6 | 67.7 |
| Jayawijaya | 222.3 | 0 | 264.3 | 0 | 346.9 | 0 |
| Yapen Waropen | 53.2 | 27.1 | 63.2 | 59.4 | 90.0 | 85.2 |
| Paniai | 177.9 | 12.0 | 218.2 | 18.0 | 323.4 | 111.3 |
| Irian Jaya | 1,064.1 | 392.7 | 1,300 | 558.2 | 1,882 | 1,005.6 |
| Share (%) | | 36.9 | | 42.9 | | 53.4 |

Note: P.R.A. = Port Related Area.

Fig. 7.2.2. Port Related Area by Kecamatan




I JAYAPURA
1 Jayapura
2 Abepura
3 Sentani
4 Nimboran
5 Sarmi
6 Memberamo Tengah
7 Demta
8 Depapre
9 Waris
10 Arso
11 Senggi
12 Web
13 Kemtuk Gresi
14 Unurum Guai
15 Memberamo Hulu
16 Pantai Timur
17 Bonggo
18 Kaureh
19 Tor Atas
20 Pantai Barat (Apouwer)
21 Memberamo Hilir

II TELUK CENDERAWASIH
1 Biak Kota
2 Biak Barat
3 Biak Utara
4 Supiori Utara
5 Numfor Barat
6 Numfor Timur
7 Biak Timur
8 Supiori Selatan

III MANOKWARI
1 Manokwari
2 Ransiki
3 Wasior
4 Bintuni
5 Windesi
6 Babo
7 Warmare
8 Amberbaken
9 Anggi
10 Merdey
11 Oransbari
12 Kebar

IV SORONG
1 Sorong
2 Teminabuan
3 Aymaru
4 Sausapor
5 Makbon
6 Inan Watan
7 Seleweti
8 Moraid
9 Beraur
10 Misool
11 Aitinyo
12 Aifat
13 Waigeo Utara
14 Waigeo Selatan
15 Seget

V FAK-FAK
1 Fak-fak
2 Kokas
3 Kaimana
4 Mimika Barat
5 Teluk Arguni
6 Teluk Etna
7 Mimika Timur
8 Agimuga

VI MERAUKE
1 Merauke
2 Mindiptana
3 Mandobo
4 Agats
5 Muting
6 Obaa
7 Waropko
8 Jair
9 Okaba
10 Kimaan
11 Edera
12 Kauh
13 Nambiomen
14 Citak Mitak
15 Assue
16 Sawa Erma
17 Atsy
18 Primapun

VII JAYAWIJAYA
1 Wamena
2 Bokondini
3 Tiom
4 Oksibil
5 Kelila
6 Kurulu
7 Asologaima
8 Kurima
9 Karubaga
10 Makki
11 Okbibab
12 Kiwirok

VIII YAPEN WAROPEN
1 Yapen Selatan
2 Yapen Timur
3 Yapen Barat
4 Waropen Bawah
5 Waropen Atas

IX PANIAI
1 Nabire
2 Paniai Timur
3 Tigi
4 Ilaga
5 Ilu
6 Mulia
7 Napan
8 Paniai Barat
9 Kamu
10 Mapia
11 Sinak
12 Yaur
13 Aradide
14 Homeyo
15 Uapa
16 Sugapa
17 Beoga

7.2.2. Distribution Service Area for Domestic Trade

(1) Hinterland for Domestic Trade

The hinterland of the Port of Sorong is considered to be the city of Sorong and its vicinity. As mentioned above and shown in Fig. 7.2.2. the hinterland of the Port of Sorong is the Kecamatan in which the Port is located and other Kecamatans which are connected with the Port by roads.

The hinterland will extend as the road network is extended. But the range of the hinterland in the year 2000 will be limited to, and may be assumed almost equal to the area of Kabupaten Sorong.

(2) Service Area for Domestic Trade

1) Present service area

At present, three Perintis services are based at the Port of Sorong (see Table 3.1.21.), and they connect almost all of major ports in Irian Jaya, even the Port of Jayapura and Merauke (see Fig. 3.1.11. (2)).

Among these hinterlands the areas which are dominatly affected by the Port of Sorong [Kabupaten T. Chenderawasih (and the area dominated by it, that is Manokwari, Paniai and Y. Waropen), Fak-Fak and Merauke (Fig. 7.1.1.)] are assumed as the service area of Sorong Port.

2) Population and distance from Sorong Port

Table 7.2.2. shows the population and the distance from Sorong Port.

Table 7.2.2. Population and Distance from Sorong Port

| Kabupaten | Main Port | Population ($\times 10^3$ people) | | | | Distance from Sorong Port (Miles) |
|---|---|---|---|---|---|---|
| | | Whole Area | | P.R.A. | | |
| | | 1985 | 2000 | 1985 | 2000 | |
| Sorong | Sorong | 152.5 | 217.6 | 108.7 | 173.7 | 0 |
| Jayapura | Jayapura | 162.6 | 263.3 | 140.2 | 227.1 | 600 |
| Paniai | Nabire | 218.2 | 323.4 | 18.0 | 111.3 | 370 |
| Y. Waropen | Serui | 63.3 | 90.9 | 59.4 | 85.2 | 300 |
| T. Chenderawasih | Biak | 86.0 | 112.8 | 68.3 | 89.6 | 340 |
| Manokwari | Manokwari | 104.1 | 184.5 | 76.4 | 184.5 | 230 |
| Fak-Fak | Fak-Fak | 63.3 | 83.0 | 45.9 | 66.5 | 170 |
| Merauke | Merauke | 185.7 | 259.6 | 41.3 | 67.7 | 760 |

Note: P.R.A. = Port Related Area (see section 7.2.1) and Table 7.2.1.).

The populations of Kabupaten Jakapura, Paniai and Merauke will be more than that of Kabupaten Sorong in 1985 and 2000. The populations of these areas are large enough to form distribution service areas by themselves.

As for the distance between Sorong Port and the main port in each Kabupatens, Kabupaten Paniai is very close to the Port of Sorong.

Then,

(i) Jayapura Port will serve as one of the terminal port for Kabupaten Jayapura and Jayawijaya, because their population (of not only the whole area but also of the port related

area) is rather large.

(ii) The population of the port related area of Merauke is very small because of its poor inland traffic network. But, taking the big amount of its population and possibility of development of road network into consideration, it is better for the Port of Merauke to become one of the terminal ports of Irian Jaya.

(iii) For other areas that is Fak-Fak, T. Chenderawasih, Paniai, Y. Waropen and Manokwari, their domestic cargoes (mostly to and from the western part of the country) will be transported through Sorong Port.

### 7.2.3. Distribution Service Area for Foreign Trade

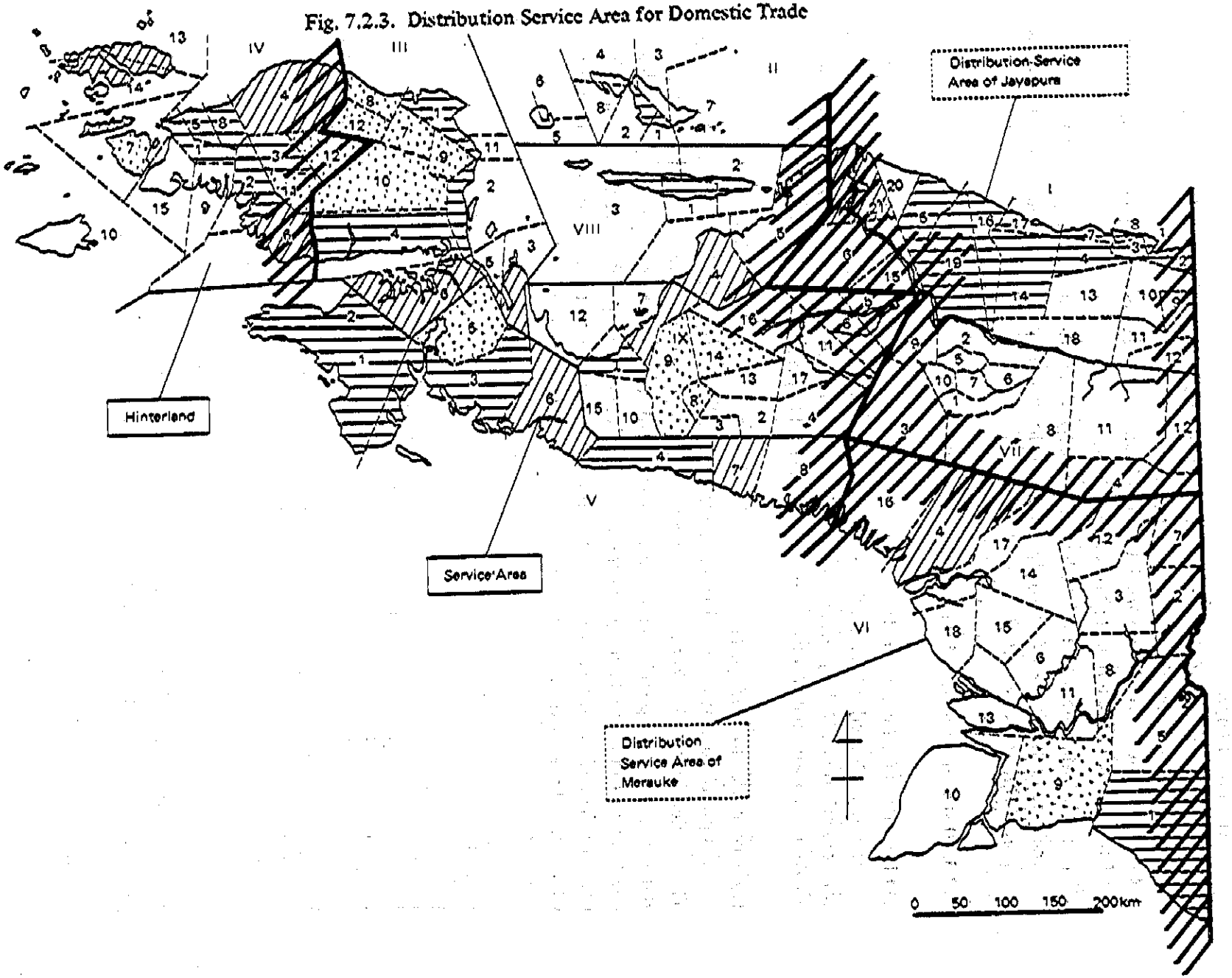
#### (1) Hinterland for Foreign Trade

The direct hinterland for foreign trade of general cargo is assumed the same as the hinterland for domestic trade. Namely, Kecamatan in which the Port is located and other Kecamatans which are connected with the Port by roads. This will extend as the road network is extended.

#### (2) Service Area for Foreign Trade

It is projected that the population of the province will increase to about 1,882,000 in 2000. The development and effective use of the natural resources in the province will be carried out. But taking the large population and the industrial structure of the province into consideration, one liner port (a port which foreign trade vessels or liners call regularly) will be enough for the province. Therefore, the service area of Sorong Port for foreign trade is assumed to cover the whole area of the province.

Fig. 7.2.3. Distribution Service Area for Domestic Trade



# Chapter 8.
# DEMAND FORECAST

# CHAPTER 8. DEMAND FORECAST

## 8.1. Population

### (1) Results of Population Forecast

Tables 8.1.1. and 2. show the results of population forecast for Irian Jaya and Maluku Provinces up to the year 2000.

It was forecast that the population in Indonesia will be 210 million in the year 2000, 1.54 times as large as that in 1978. On the other hand, the populations in Irian Jaya and Maluku Provinces in 2000 were forecast to be 1,882,000 and 2,229,000 respectively: the annual growth rate of 2.5 and 2.6 percent, which are slightly higher than the average, are expected.

In Irian Jaya, Kabupaten Manokwari shows the highest growth rate of 3.8 percent due to the governmental transmigration program. Jayawijaya, the most populated mountaineous Kabupaten, shows a low growth rate and its share of 21 percent in 1978 will fall to 18 percent in the year 2000.

In Maluku, Kabupaten Halmahera Tengah and Maluku Tengah show higher growth rate of 3.4 and 3.1 percent. The population share of Maluku Tengah area (including Kotamadya Ambon) will rise from 44 percent in 1978 to 47 percent in 2000, which is approximately one half of the population in Maluku.

Table 8.1.1. Results of Population Forecast

| | 1985 | | 2000 | | Annual Growth Rate | |
|---|---|---|---|---|---|---|
| | Population | % | Population | % | '78–'85 | '78–2000 |
| Indonesia | 160,159 | 100.0 | 210,234 | 100.00 | 2.3 | 2.0 |
| Irian Jaya | 1,300 | 0.8 | 1,882 | 0.9 | 2.4 | 2.5 |
| Jayapura | 162.6 | (13) | 263.3 | (14) | 2.6 | 3.1 |
| T. Cendrawasih | 86.0 | ( 7) | 112.8 | ( 6) | 2.1 | 1.9 |
| Manokwari | 104.1 | ( 8) | 184.5 | (10) | 3.6 | 3.8 |
| Sorong | 152.5 | (12) | 217.6 | (12) | 2.6 | 2.5 |
| Fak-Fak | 63.3 | ( 5) | 83.0 | ( 4) | 2.1 | 1.9 |
| Merauke | 185.7 | (14) | 259.6 | (14) | 2.3 | 2.3 |
| Jayawijaya | 264.3 | (20) | 346.9 | (18) | 2.0 | 1.9 |
| Y. Waropen | 63.3 | ( 5) | 90.9 | ( 5) | 2.1 | 2.3 |
| Paniai | 218.2 | (16) | 323.4 | (17) | 2.5 | 2.6 |
| Maluku | 1,540 | 1.0 | 2,229 | 1.1 | 2.6 | 2.6 |
| M. Utara | 441.6 | (29) | 613.8 | (28) | 2.2 | 2.2 |
| M. Tengah | 606.7 | (39) | 935.7 | (41) | 3.5 | 3.1 |
| K. Ambon | 93.3 | ( 6) | 123.4 | ( 6) | 1.7 | 1.8 |
| M. Tenggara | 279.8 | (18) | 373.9 | (17) | 1.7 | 1.9 |
| Halmahera T. | 118.6 | ( 8) | 182.2 | ( 8) | 4.5 | 3.4 |

Note: ( ) indicates share of population within a province.

## Table 8.1.2. Population Forecast 1979–2000

(x $10^3$ people)

| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indonesia[3] | 131,304.3 | 133,940.2 | 136,630.7 | 139,376.3 | 142,178.8 | 145,038.8 | 147,939.7 | 150,900.8 | 153,923.7 | 160,159.4 | 176,400.9 | 139,240.1 | 210,233.7 |
| Irian Jaya[1] | 1,040 | 1,065 | 1,101 | 1,127 | 1,154 | 1,182 | 1,211 | 1,240 | 1,269* | 1,300* | 1,475* | 1,670* | 1,882* |
| I Jayapura | | | 135.4 | 139.0 | 142.7 | 146.5 | 150.5 | 154.4 | 158.4 | 162.6 | 191.9 | 225.6 | 263.3 |
| II T. Cendrawasih | | | 74.9 | 76.3 | 77.8 | 79.4 | 81.0 | 82.6 | 84.2 | 86.0 | 94.5 | 103.5 | 112.8 |
| III Manokwari | | | 81.5 | 84.5 | 87.8 | 90.9 | 94.1 | 97.4 | 100.7 | 104.1 | 127.0 | 153.9 | 184.5 |
| IV Sorong | | | 126.6 | 130.0 | 133.6 | 137.2 | 141.0 | 144.7 | 148.5 | 152.5 | 172.2 | 194.0 | 217.6 |
| V Fak-Fak | | | 55.1 | 56.1 | 57.2 | 58.4 | 59.6 | 60.8 | 62.0 | 63.3 | 69.5 | 76.1 | 83.0 |
| VI Merauke | | | 158.4 | 162.1 | 165.7 | 169.5 | 173.5 | 177.5 | 181.4 | 185.7 | 208.3 | 233.0 | 259.6 |
| VII Jayawijaya | | | 230.1 | 234.5 | 239.1 | 243.8 | 248.8 | 253.9 | 258.9 | 264.3 | 290.4 | 318.2 | 346.9 |
| VIII Y. Waropen | | | 55.1 | 56.1 | 57.2 | 58.4 | 59.6 | 60.8 | 62.0 | 63.3 | 71.6 | 80.8 | 90.9 |
| IX Paniai | | | 183.9 | 188.4 | 193.0 | 197.9 | 202.9 | 207.9 | 212.9 | 218.2 | 249.6 | 284.9 | 323.4 |
| Maluku[2] | 1,222 | 1,251 | 1,281 | 1,313 | 1,347 | 1,382 | 1,419 | 1,458 | 1,498 | 1,540 | 1,747* | 1,978* | 2,229* |
| I M. Utara | | | 381.7 | 388.3 | 395.7 | 403.4 | 411.7 | 422.1 | 431.6 | 441.6 | 492.2 | 550.1 | 613.8 |
| II M. Tengah | | | 479.1 | 497.3 | 518.5 | 540.1 | 557.4 | 567.3 | 586.6 | 606.7 | 707.8 | 817.9 | 935.7 |
| III K. Ambon | | | 83.3 | 84.7 | 85.8 | 86.9 | 88.2 | 89.9 | 91.5 | 93.3 | 101.9 | 112.0 | 123.4 |
| IV M. Tenggara | | | 249.8 | 254.1 | 257.3 | 260.7 | 264.5 | 269.7 | 274.6 | 279.8 | 306.8 | 338.4 | 373.9 |
| V Halmahera T. | | | 87.1 | 88.6 | 89.7 | 90.9 | 97.2 | 109.0 | 113.7 | 118.6 | 138.3 | 159.6 | 182.2 |

Sources: 1. Irian Jaya Dalam Angka 1977 and Pelita III in Irian Jaya.
2. Proyeksi Penduduk, Angkatan Kerja dan Anak Sekolah, 1971–1986 Maluku.
3. Proyeksi Penduduk, Indonesia 1976–2001, 1978 CBS.

Notes: * shows figures forecast by the survey team. All figures for Kabupaten were also forecast by the survey team.

(2) General Method for Population Forecast

Future populations can be forecast with the following formula:

$$P_{(t)} = P_{(t-1)} \pm \text{Natural increase}_{(t-1)} \pm \text{Population movement}_{(t-1)}$$

t : a certain year

Natural increase consists of the number of births and deaths in a period.

Using census data, natural increase can be forecast with a demographic method, such as in the Manual IV*).

Population movement consists of transmigrants and immigrants/migrants. This can be forecast with the functions proved by the regression method.

When these necessary are not available, the population growth rates in the past can be adopted for forecasting.

(3) Available Data

Population data sources are mainly 3 kinds: population census, registration of births and deaths, and inter-census survey.

The Census is the best source for population data covering all people in Indonesia. It was taken in 1930 (by Dutch Government), in 1961 (Irian Jaya was not included) and in 1971 (some items covered Irian Jaya). However, the census survey encountered problems such as the fact that many people do not know their ages exactly. Thus, estimation of approximate figures, such as the population by age group, using smoothing techniques is an important part of data interpretation.

The registration of births and deaths is said to be incomplete, because it greatly depends on person's will of registration. The registered population is usually smaller than that in the Census. For these reasons, fertility rates or mortality, which are otherwise calculated from the registration of births and deaths, are estimated from the Census data.

A inter-census survey, which covers only a small sample of the population, was conducted in 1976.

As for transmigration or inter-regional population movement, we can only get approximate data from the Census (Series D). Pieces of information on the transmigration program and on the number of passengers in ports and airports, or some data by adhoc surveys are available. However, no comprehensive and periodic data exist so far.

As a result, most of the available population figures are estimates or forecasts. Considering the progress in forecast techniques and the data collection method, recent data is regarded the most reliable among all population data. There are three recent forecasts usable in this study which are authorized in the Pelita III programs. However, none of them include figures of each Kabupaten.

1) Pelita III (1979 – 1983) Irian Jaya

In the Pelita III Irian Jaya, the population in the province during Pelita III was forecast using the annual population growth rate of 2.4 percent which was calculated on the basis of the Census in 1971.

*) Manual on methods of estimating population, Manual IV: Methods of Estimating Basic Demographic Measures from Incomplete Data, United Nations, 1967.

The forecast did not include distribution by Kabupaten. However, it was stated that the population in urbanized areas will start to grow during Pelita III.

The program described the demographic characteristics and population movement only qualitatively.

2) Pelita III (1979 – 1983) Maluku

The populatios used in Pelita III are the forecast figures in a study report made by the District Bureau of Statistics in Maluku (DBS)*).

The object of this study was to forecast the population of the province by five-year age group from 1961 to 1986, but excluded populations by Kabupatens. This study adopted the method of United Nation Manual IV, and used the Census in 1961 and 1971.

As for mortality, the expectation of life at birth is assumed to increase gradually. However, the total fertility rate is fixed at the level in 1971 (4.43 percent).

Population movement was verified by the data of the Census in 1971 (Serie D), and the rate of net inward transmigration was calculated as 0.0225 percent of the total population. The rate is small and was concluded to be negligible.

3) Proyeksi Penduduk Indonesia 1976 – 2001

This is the latest study made by CBS and its aim was to supply population base for Pelita III for the whole Indonesia.

The purpose of this study was to forecast the population in two areas (Jawa and Outer Jawa) of Indonesia from 1976 to 2001. This study also adopted the method of United Nations Manual IV and used the Census up to 1971 and the inter-census survey in 1976.

It was assumed that the expectation of life will increase gradually and the total fertility rate will decrease from 6.2 percent for Outer Jawa and 5.0 percent for Jawa in 1971 to 4.3 percent and 2.5 percent respectively in the year 2001.

In the study of transmagration during the 5 years (1966 – 1971) between Jawa and Outer Jawa areas, it was made clear that net transmigration toward the outer Jawa areas was 19,794 people annually. This is 0.026 percent of the population in Jawa, or 0.047 percent in Outer Jawa. This figure was concluded to be negligible.

(4) Method and Process of Forecast

The aim of population forecast in this study is to supply appropriate data for demand forecast of port activities. Required forecasts are the population of each Kabupaten in the study area (Irian Jaya and Maluku Provinces) in the year 1985 and 2000.

For this target, available data were examined, as mentioned above, then the following principles were adopted.

i) The forecasts in Pelita III and data authorized by provincial governments, which do not contradict with data supplied by other sources, are to be used.

ii) The forecast system comprise two steps in sequence: total population forecast for each province and population distribution by Kabupaten.

iii) For the forecast of the total population in each province, population estimates in Pelita III and planning conditions pertinent to Pelita II are adopted.

*) "Proyeksi Penduduk, Angkatan Kerja dan Anak Sekolah, Propinsi Maluku 1971–1986", 1975 DBS in Maluku.

iv) For population distribution by Kabupaten, a simple projection method using the present proportion of each Kalupaten in the total population is adopted because of the lack of reliable data.

1) Total population forecast in each province

For 1979 – 1983:

Population estimates in Pelita III (1979 – 1983) by each province were adopted.

For 1984 and 1985:

Population estimates in Pelita III in Irian Jaya are based on the annual growth rate of 2.4 percent. This rate was adopted to forecast the population in 1984 and 1985.

Population estimates in Pelita III in Maluku were taken from a study report made by DBS in Maluku. Figures for 1984 and 1985 from the same source were adopted as populations in 1984 and 1985.

For 1986 – 2000:

There is no population study by either provincial government covering the period up to the year 2000. The only study is the "Proyeksi Penduduk, Indonesia 1976 – 2001" in 1978 by CBS.

Table 8.1.3. shows the average annual population growth rates up to 2001. These figures are considered the guideline of the Indonesian Government growth rates in Outer Jawa areas are used for both provinces. Although there is one year difference in period between our study and the CBS study, it is considered to be negligible.

Table 8.1.3. Population Growth Rates of Indonesia by Regions (1986–2001)

| | 1986–1991 | 1991–1996 | 1996–2001 |
|---|---|---|---|
| Jawa | 1.57 | 1.39 | 1.20 |
| Outer Jawa | 2.56 | 2.52 | 2.42 |
| Indonesia | 1.95 | 1.84 | 1.70 |

Source: Proyeksi Penduduk, Indonesia 1976–2001, Series K No. 2, CBS.

2) Population distribution by Kabupaten

Population distribution by Kabupaten is assumed to be stable in the future, as stated above. The latest registered population of 1978 is used for calculating the distribution, as shown in Table 8.1.4.

However, population movement greatly effects the population of Kabupatens. The important factor which affects the population movement is employment oportunities. The only reliable and available data concerned is the transmigration program sponsored by government, the number of transmigrants in the program is presumed to be the net transmigrants into a Kabupaten.

i) The number of transmigrants planned in Pelita III (1974 – 1983) in both provinces is adopted, and the annual average during Pelita III (1,000 families in Irian Jaya and 3,000 families in Maliku) is adopted for 1984 and 1985.

ii) On account of the size of the vast area and its development level, the number of annual transmigrants in Maluku are presumed to be constant up to the year 2000. It was assumed that

Table 8.1.4. Distribution of Population by Kabupaten in 1978

| | Registered Population in 1978 | |
|---|---|---|
| | Persons | % |
| Irian Jaya[1] | 1,064,101 | 100.0 |
| I Jayapura | 131,110 | 12.3 |
| II Teluk Cenderawasih | 72,204 | 6.8 |
| III Manokwari | 78,613 | 7.4 |
| IV Sorong | 122,316 | 11.5 |
| V Fak-Fak | 53,548 | 5.0 |
| VI Merauke | 152,802 | 14.4 |
| VII Jayawijaya | 222,331 | 20.9 |
| VIII Yapen Waropen | 53,249 | 5.0 |
| IX Paniai | 177,928 | 16.7 |
| Maluku[2] | 1,276,751 | 100.0 |
| III Kotamadia Ambon | 82,903 | 6.5 |
| II Maluku Tengah | 477,904 | 37.4 |
| IV Maluku Tenggara | 248,530 | 19.5 |
| I Maluku Utara | 380,060 | 29.8 |
| V Halmahera Tengah | 87,354 | 6.8 |

Sources: 1. Persiapan Sensus Penduduk 1980, Propinsi Irian Jaya.
2. Registrasi Penduduk Propinsi Maluku 1978.

those in spacious Irian Jaya will increase gradually up to the same level as in Maluku (3,000 families) during the period from 1995 to 2000 (Table 8.1.5.).

iii) The average number of transmigrant family is assumed to be 5 people, which is the real average, as shown in the Section 2.2.

iv) Transmigrants up to the year 1983 will be assigned to the areas planned in Pelita III.

v) Sites for transmigrants after 1984 are planned as follows (Table 8.1.6.): The Irian Jaya Government is planning to make a survey of potential farming areas in Pelita III. Transmigrants are assumed to be proportionally distributed to these sites.

Similar information about Maluku is not available. The areas planned for transmigration and resettlement* in Pelita III are supposed to be the sites for transmigrants.

*) Maluku provincial Government promoted a resettlement program from small islands which are not large enough to support a standard level of community life, or from densely populated areas to spacious and high potential areas. The Government realized the resettlement of 1,800 families during Pelita II.

Table 8.1.5. Estimated Governmental Transmigration Programs 1979–2000

(x $10^3$ people)

| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986–90 | 1991–95 | 1996–2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Irian Jaya | | | | | | | | | | |
| (family) | (1.0) | (1.0) | (1.0) | (1.0) | (1.0) | (1.0) | (1.0) | (10.0) | (12.5) | (15.0) |
| persons | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 50.0 | 62.5 | 75.0 |
| Sorong | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 5.3 | 6.6 | 7.9 |
| Manokwari | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 13.6 | 17.1 | 20.5 |
| Paniai | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 10.5 | 13.1 | 15.27 |
| Jayapura | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 13.9 | 17.4 | 20.9 |
| Merauke | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 4.6 | 5.7 | 6.8 |
| Y. Waropen | – | – | – | – | – | – | – | 2.1 | 2.6 | 3.2 |
| Maluku | | | | | | | | | | |
| (family) | (2.0) | (3.5) | (3.5) | (3.5) | (2.5) | (3.0) | (3.0) | (15.0) | (15.0) | (15.0) |
| persons | 10.0 | 17.5 | 17.5 | 17.5 | 12.5 | 15.0 | 15.0 | 75.0 | 75.0 | 75.0 |
| M. Utara | | 2.5 | 2.5 | 2.5 | 2.5 | 2.0 | 2.0 | 11.3 | 11.3 | 11.3 |
| M. Tengah | 10.0 | 15.0 | 15.0 | 10.0 | 0 | 10.0 | 10.0 | 51.8 | 51.8 | 51.8 |
| M. Tenggara | | | | | | | | 1.2 | 1.2 | 1.2 |
| Halmahera T. | | | | 5.0 | 10.0 | 3.0 | 3.0 | 10.7 | 10.7 | 10.7 |

Sources: 1. Pelita III in Irian Jaya (data 1979–83)
2. Pelita III in Maluku (data 1979–83)

Table 8.1.6. Distribution of Transmigration Sites after 1984

| Survey areas in Pelita III for farming in Irian Jaya Province | | |
|---|---|---|
| | 1,000 ha | % |
| Total | 143 | 100.0 |
| Sorong | 15 | 10.5 |
| Manokwari | 39 | 27.3 |
| Paniai | 30 | 21.0 |
| Jayapura | 40 | 27.9 |
| Merauke | 13 | 9.1 |
| Y. Waropen | 6 | 4.2 |

| Areas planned for transmigration and resettlement in Pelita III in Maluku Province | | |
|---|---|---|
| | 1,000 ha | % |
| Total | 126 | 100.0 |
| M. Utara | 19 | 15.1 |
| M. Tengah | 87 | 69.0 |
| M. Tenggara | 2 | 1.6 |
| Halmahera T. | 18 | 14.3 |

## 8.2. Regional Activities

### 8.2.1. Method of Forecast

(1) General

In principle, the forecast is made by authorized data collected in this study the future plans of the governments (National and/or Regional Pelita III) are incorporated into the estimation. After the calculation of the future product volume by main commodity, the gross regional domestic product (GRDP) is estimated based upon production volumes.

The basic assumptions for the forecast of Irian Jaya and Maluku are as follows:

(2) Production

As for food and estate crops, the production volume is presumed to be a function of the cultivated area developed by farmers, mainly transmigrants.

$$PV_Y = F(A_Y)$$

where,

$PV_Y$ : the production volume in the year of Y

$A_Y$ : the cultivated area in the year of Y

As for food and estate crops, the production volume in the year of Y is represented by the following formula:

$$PV_Y = A_Y \times \text{Yield rate per crop}$$

As for the production forecast of other commodities the average growth rate by Pelita III or of past records is applied after careful examination.

(3) Consumption

In this study, the consumption is estimated only for Irian Jaya and the Sorong area.

Consumption is presumed to be a function of population increased in future.

$$CV_Y = F(P_Y)$$

where,

$CV_Y$ : the consumption volume in the year of Y

$P_Y$ : the population in the year of Y

Consumption volume in the year of Y is represented by the following formula:

$$CV_Y = P_Y \times C_Y^{capita}$$

where,

$C_Y^{capita}$ : the per capita consumption in the year of Y

In this study, per capita consumption is represented by that of the base year of 1976 or 1977 in Irian Jaya and 1977 in the Indonesian average. Since the calorie balance is expected to improve in future, the formula below is employed to forecast the consumption in 2000.

$$CV_{2000} = P_{2000} \times C_{2000}^{capita}$$

$$C_{2000}^{capita} = C_{1976}^{capita} \times \alpha \text{ (food balance in 1977 Indonesia average)}$$

This means that the calorie balance (or food balance) in Irian Jaya remains to be the same as the 1976 base (estimated at 1,240 – 1,830 cal per day – source: Pelita III in Irian Jaya) until 1985, and the calorie balance in 2000 would be about the same as the Indonesian average of 1977 (2,314 cal per day – Source: Statistical Yearbook of Indonesia 1977 – 1978).

However, the consumption of sweet potato and pork were examined separately considering the fact that Irian Jaya is a major producer of these products.

Table 8.2.1. Main Indexes of Per Capita Consumption (Kg/Capita/Year)

| | Irian Jaya | | Indonesia (1977) |
|---|---|---|---|
| | Jayawijaya | Other Areas | |
| Rice | 2.1 | 34.3 | 120.85 |
| Maize | 0.3 | 1.7 | 21.52 |
| Sweet potato and cassava, etc. | 854.8 | 419.0 | 92.36 |
| Peanut and soybean | 0.1 | 2.2 | 4.03 |
| Cow meat | – | 0.28 | 0.97 |
| Pork | 5.40 | – | 0.50 |
| Poultry | – | 0.71 | 1.07 |

Source: Statistical Yearbook of Indonesia 1977–78
Pelita III in Irian Jaya

(4) Forecast of GRDP

The product categories are determined by the past production records and products included in Pelita III in Irian Jaya and Maluku.

By multiplying the annual production of a given sector by its unit price of the base year of 1975, the representative value of the sector can be determined. The growth rate in relation to the base year (1978 or 1977) can be calculated if the representative value of the sector in 1985 or 2000 is divided by the representative value of the base year. Using this growth rate, the GRDP by sector is calculated and determined.

However, GRDP of the sectors other than agriculture and petroleum are estimated by the annual growth rate of the period from 1973 to 1978 and by the annual growth rate of agriculture sector during the period from 1985 to 2000. The average annual growth rate of 1973 – 1978 period is applied to the value of 1985 and the rate of 1985 – 2000 period is applied to the value of 2000. However, the growth rate of National Pelita III is used for the construction sector in Maluku. As for the petroleum sector, the following assumptions were made:

The production of crude oil would continue at the same level as in 1978 until 2000.

The composition of oil products from the refinery plant is assumed to be the same as that from Balikpapan Refinery. Assuming that 61 percent of the treated crude oil is supplied from

within the Irian Jaya area, the GRDP of the refinery in 2000 is determined as US $ 107.4 million in 1975 constant prices.*)

Table 8.2.2. Main Indexes of Applicable Unit Price

(1975 Price base)

| Category | Unit Price | | Source |
|---|---|---|---|
| Rice | 97.01 | Rp./100 Kg | Indicator Economy 1980 |
| Sweet potato | 20.03 | " | " |
| Cassava | 20.03 | " | " |
| Maize | 72.87 | " | " |
| Peanut | 253.64 | " | " |
| Soybean | 15.74 | " | " |
| Conconut | 65.72 | " | Pelita III in Irian Jaya |
| Nutmeg | 55.83 | " | " |
| Cocoa | 142.11 | " | " |
| Rubber | 213.38 | " | " |
| Coffee | 331.85 | " | " |
| Pepper | 1,410.00 | " | Indicator Economy 1980 |
| Clove | 341.52 | " | " |
| Other potato | 27.77 | " | (decided by Study Team) |
| Fish (export) | 3,374.4 | $/Ton | Irian Jaya dalam Angka 1977 |
| Fish (export) | 2,869 | " | Pelita III in Meluku |
| Fish (domestic) | 1,691.6 | " | Derived from the aboves |
| Cow/Buffalow | 960 | Rp./100 Kg | Derived from Indicator Economy and others |
| Goat/Sheep | 820 | " | " |
| Poultry | 770 | " | " |
| Pork | 1,150 | " | " |

Note: Forestry ..... Includes an additional value to sawn timber 17.8 percent per $m^3$ logs (Source: Study Report on the Expansion Project of the Port of Balikpapan, JICA)

8.2.2. Future Industrial Structure in Irian Jaya and Maluku

As shown in Table 8.2.3. the agriculture sector is the most important sector for both provinces in the future, with the large share of about 50 percent in Maluku and 60 percent (excluding the petroleum sector) in Irian Jaya.

Note that the petroleum sector in Irian Jaya has a great influence on future economic activities, taking account of the continuing crude oil production and the future construction of a refinery plant in the Sorong area.

*) Source: Study Report on the Expansion Project of the Port of Balikpapan, JICA.

Table 8.2.3. Composition of GRDP by Sector

(%)

| | | 1978 | 1985 | 2000 |
|---|---|---|---|---|
| Agriculture | Irian Jaya | 24.2 (58.3) | 36.3 (62.0) | 46.2 (62.3) |
| | Maluku | 57.9 | 50.0 | 51.1 |
| Mining | Irian Jaya | 59.1 ( 2.3) | 42.6 ( 2.2) | 27.1 ( 1.7) |
| | Maluku | 1.8 | 5.3 | 3.1 |
| Manufacturing | Irian Jaya | 0.6 ( 1.3) | 0.5 ( 0.9) | 0.7 ( 0.9) |
| | Maluku | 1.1 | 1.1 | 1.1 |
| Others | Irian Jaya | 16.1 (38.1) | 20.0 (34.9) | 26.0 (35.1) |
| | Maluku | 39.2 | 43.6 | 44.7 |
| Total | Irian Jaya | 100 | 100 | 100 |
| | Maluku | 100 | 100 | 100 |
| GRDP Total (Mill.$) | Irian Jaya | 647.134 | 914.174 | 1,877.155 |
| | Maluku | 298.625 | 626.786 | 1,231.303 |

Note: The figure in parentheses shows the share excluding the petroleum sector.

With respect to the per capita GRDP, the value in Irian Jaya is bigger than that of Maluku. The growth rate in Irian Jaya is lower than that of Maluku up to 1985. However, Irian Jaya's value up to 2000 is bigger than that of Maluku.

Table 8.2.4. Per Capita GRDP

(U.S.$)

| | 1978 | 1985 | 2000 | AAGR | |
|---|---|---|---|---|---|
| | | | | 1978–85 | 1978–2000 |
| Irian Jaya | 242 (582) | 413 (703) | 740 (997) | 8.0% (2.7) | 5.2% (2.4) |
| Maluku | 228 | 407 | 552 | 8.6% | 4.1% |

Note: The figure in parentheses shows the value and share including the petroleum sector.

### 8.2.3. Irian Jaya Province

#### (1) General Conclusion

As shown in Table 8.2.6. the agriculture sector excluding the petroleum sector shows the high share of 62 percent in 1985 and 62 percent in 2000.

Comparing with the average annual growth rate (AAGR) by National Pelita III (since the province of Irian Jaya has not made its projection), the future development of the province is as shown below.

Table 8.2.5. Programmed Average Annual Growth Rate by Industrial Sector

(%)

| | Indonesia | | Irian Jaya | |
|---|---|---|---|---|
| | Pelita II | Pelita III | 1978–85 | 1978–2000 |
| Agriculture | 3.8 | 3.5 | 11.3 | 8.1 |
| Mining | 4.8 | 4.0 | 2.0 | 1.3 |
| Manufacturing & Industry | 12.7 | 11.0 | 9.8 | 6.3 |
| Construction | 11.1 | 9.0 | 9.0 | 7.3 |
| Transport & Communication | 11.3 | 10.0 | | |
| Others | 8.4 | 8.1 | | |
| Total | 6.9 | 6.5 | 5.1 | 5.0 |

It can be said that the growth rate of the regional income is low.

The main reason is the low projection figure in the mining sector, whose method of forecast is discussed in detail in the following paragraph.

Considering the natural resources in Irian Jaya with its vast area of 42.2 million ha, there certainly is a possibility of mineral deposits. However, it is questionable at present whether rapid development of the natural resource will take place since the present infrastructure is small, especially the road network is not adequate in the far and mountainous inland area. On the other hand, the systematic survey for natural resources has not been made for economical reasons, as far as the province of Irian Jaya is concerned.

The average annual growth rate of the agriculture sector does not seem very high.

Processed timber is included in the forestry sector. However, should it be included in the manufacturing sector, AAGR of manufacturing sector is 11.7 percent for 1978 – 1985 period and 12.1 percent for the period from 1978 to 2000.

Regarding the province of Irian Jaya, the area of irrigation identified during the period of Pelita I and II is confirmed as follows:

| | |
|---|---|
| Jayapura | 62,500 ha |
| Paniai | 36,000 ha |
| Manokwari | 49,600 ha |
| Sorong | 27,300 ha |
| Yapen Waropen | 8,000 ha |
| Merauke | 47,400 ha |
| Total | 230,800 ha |

However, only about 6,500 ha of land is expected to be cultivated by the transmigrants in the program by 1985. According to the program, transmigrants will be assigned to the areas of Jayapura, Paniai, Manokwari, Sorong and Merauke (these areas are to be cultivated for the first time during Pelita III).

Table 8.2.6 Forecast GRDP of Irian Jaya

(1975 Constant prices) (x $10^6$ US$.)

| Year / Sector | 1978 | % | 1985 | % | 2000 | % | AAGR 1978–1985 | AAGR 1978–2000 |
|---|---|---|---|---|---|---|---|---|
| Food crops | 11.534 | 17.2 | 247.271 | 27.0 | 621.021 | 33.1 | 12.0 | 8.2 |
| Estate crops | 2.119 | 0.3 | 10.575 | 1.2 | 36.255 | 1.0 | 25.8 | 14.0 |
| Livestock | 27.322 | 4.2 | 33.032 | 3.6 | 47.851 | 2.5 | 2.7 | 2.5 |
| Forestry | 3.054 | 0.5 | 9.345 | 1.0 | 87.405 | 4.6 | 17.0 | 16.5 |
| Fishery | 12.879 | 2.0 | 32.365 | 3.5 | 75.175 | 4.1 | 14.0 | 8.4 |
| Agriculture Total | 156.908 | 24.2 | 332.588 | 36.3 | 867.707 | 46.2 | 11.3 | 8.1 |
| Petroleum | 377.915 | 59.0 | 377.915 | 41.3 | 485.315 | 25.9 | – | 1.2 |
| Others | 6.135 | 0.1 | 11.580 | 1.3 | 23.160 | 1.2 | 9.5 | 6.2 |
| Mining Total | 384.050 | 59.1 | 389.495 | 42.6 | 508.475 | 27.1 | 2.0 | 1.3 |
| Manufacturing & Industry | 3.418 | 0.6 | 5.024 | 0.5 | 13.103 | 0.7 | 9.8 | 6.3 |
| Others | 102.758 | 16.1 | 187.067 | 20.6 | 487.870 | 26.0 | 9.0 | 7.3 |
| Grand Total | 647.134 | 100 | 914.174 | 100 | 1,877.155 | 100 | 5.1 | 5.0 |

As for estate crops, the province plans to develop fields as follows:

| | | |
|---|---|---|
| Cocoa | : | Jayapura, Manokwari, Yapen Waropen |
| Coconut | : | Jayapura, Biak, Sorong, Manokwari |
| Nutmeg | : | Fak-Fak |
| Coffee | : | Paniai, Jayawijaya |
| Clove | : | The above areas concerned |

These areas must be developed by transmigrants and local inhabitants.

In conclusion, it can be said that the future industrial structure and growth in Irian Jaya will be sustained mainly by agriculture while the agricultural land will have developed by transmigrants and others.

(2) Food Crops

1) Paddy

The harvest area for wet land paddy (irrigated) is planned by Pelita III in Irian Jaya as follows:

The wet land paddy area is to be developed by transmigrants at the rate of 1 hectar per family, and the area are to be continuously developed by transmigrants until the year of 2000.

The number of transmigrants in the program is estimated below.

Table 8.2.7. Development of Harvest Area for Wet Land Paddy

(ha)

| Year | New Developed Area (A) | Existing Area (Previous Year) (B) | Total Accumulated Area (A + B) |
|---|---|---|---|
| 1979 | 450 | 1,087 | 1,537 |
| 1980 | 300 | 1,537 | 1,837 |
| 1981 | 1,050 | 1,837 | 2,887 |
| 1982 | 1,050 | 2,887 | 3,937 |
| 1983 | 950 | 3,937 | 4,887 |
| 1984 | 1,050 | 4,887 | 5,987 |
| 1985 | 900 | 5,987 | 6,887 |

Source: Pelita III in Irian Jaya.

Table 8.2.8. Number of Program Transmigrants

| Period | Number (family) | Required Area (ha) |
|---|---|---|
| 1986 – 1990 | 10,000 | 10,000 |
| 1991 – 1995 | 12,500 | 12,500 |
| 1996 – 2000 | 15,000 | 15,000 |

Source: Table 8.1.5.

Dry paddy fields are to be developed and cultivated by transmigrants and inhabitants near the irrigation area.

Harvest area of dry land paddy is assumed to have the same composition rate of 36.3 percent as in 1978.

Table 8.2.9. Forecast Harvest Area of Paddy

(ha)

| | 1978 | 1985 | 2000 |
|---|---|---|---|
| Wet land paddy | 1,087 | 6,880 | 44,380 |
| Dry land paddy | 620 | 3,900 | 25,270 |

Table 8.2.10. Yield Rate of Paddy

(tons/ha)

| | Average in Irian Jaya* 1973–1978 | 1985 | 2000 |
|---|---|---|---|
| Wet land paddy | 1.909 | 1.909 | 2.959 |
| Dry land paddy | 1.198 | 1.198 | 1.272 |

Source: Statistical Yearbook of Indonesia 1977–1978

Note: * 1985 applied by the average value 1973–78 in Irian Jaya.
2000 applied by the average value 1973–78 in Indonesia.

Table 8.2.11. Forecast Production of Paddy

(tons)

| | 1978 | 1985 | 2000 |
|---|---|---|---|
| Wet land paddy | 1,785 | 13,130 | 131,320 |
| Dry land paddy | 633 | 4,670 | 32,140 |
| Total | 2,368 | 17,800 | 163,460 |

The regional consumption in the year 2000 is computed based on the 1978 average per capita value in Indonesia, 120.85 kg. Thus the consumption in 1985 has the following values:

Jayawijaya : 2.1 kg/ha/Yr
Other areas of Irian Jaya : 34.3 kg/ha/Yr

(Source: Pelita III in Irian Jaya)

Table 8.2.12. Rice Production and Consumption

(tons)

| 1985 | | | 2000 | | |
|---|---|---|---|---|---|
| Production | Consumption | Balance | Production | Consumption | Balance |
| 11,570 | 36,080 | ▲24,510 | 110,500 | 227,440 | ▲116,880 |

Note: Waste rate 24 percent and milling loss 11 percent are considered.

2) Other food crops

Considering the locality (especially the area of Jayawijaya) for the production and consumption of sweet potato group crops, the estimated cultivated area in 1985 is based on the AAGR of 11 percent (1973 – 1978).

Its value in 2000 is calculated by the consumption value in 2000 of 372 kg/ha/Y at the same base in 1985.

The farm for maize, cassava, peanut and soybean, are assumed to be developed by transmigrants (both government-sponsored families and volunteers) and local inhabitants in the area of irrigation proposed by Irian Jaya Province. In this case, the total developed area is assumed to be one hectar per family multiplied by the number of transmigrants in the program.

Crop composition rate of the cultivated area is to be the same as that in 1978, excluding the area for sweet potato.

Table 8.2.13. New Developed Area by Food Crop

| | 1978 | 1985 | 2000 |
|---|---|---|---|
| Maize | 2,616 (28%) | + 1,910 | + 10,500 |
| Cassava | 3,593 (38%) | + 2,600 | + 14,250 |
| Peanut | 1,786 (19%) | + 1,300 | + 7,130 |
| Soybean | 1,374 (15%) | + 1,030 | + 5,620 |
| Total | 9,369 (100%) | + 6,840 | + 37,500 |

Note: The number of introduced farmers (family) is 6,840 in 1985 and 37,500 in 2000.

Table 8.2.14. Forecast Harvest Area by Food Crop

(ha)

| Crops | 1978 | 1985 | 2000 |
|---|---|---|---|
| Sweet potato | 36,221 | 51,650 | 74,800 |
| Maize | 2,616 | 4,530 | 15,030 |
| Cassava | 3,593 | 6,190 | 19,440 |
| Peanut | 1,786 | 3,090 | 10,220 |
| Soybean | 1,374 | 2,400 | 8,020 |
| Total | 45,590 | 67,860 | 127,510 |

Table 8.2.15. Yield Rate by Food Crop

(tons/ha)

| | 1978 | 2000 |
|---|---|---|
| Sweet potato | 9.36 | 9.36 |
| Maize | 0.80 | 1.33 |
| Cassava | 6.65 | 9.30 |
| Peanut | 0.61 | 0.85 |
| Soybean | 0.78 | 0.81 |

Source: Statistical Yearbook of Indonesia 1977–1978 & Pelita III in Irian Jaya.

Note: The value in 2000 is based on the Indonesia average value 1973–1978 without sweet potatoes.

Table 8.2.16. Forecast Production of Food Crops

(tons)

| Crops | 1978 | 1985 | 2000 |
|---|---|---|---|
| Sweet potato | 223,850 | 483,440 | 700,130 |
| Maize | 2,888 | 3,620 | 19,990 |
| Cassava | 22,714 | 34,510 | 180,790 |
| Soybean | 1,072 | 1,870 | 6,500 |
| Total | 251,487 | 525,320 | 916,100 |

Table 8.2.17. Per Capita Consumption of Food Crops

(kg/ha/Y)

| | 1985 | 2000 |
|---|---|---|
| Sweet potato | 372 | 372 |
| Maize | 1.7 | 21.52 |
| Cassava | 26.55 | 75.72 |
| Peanut | 2.2 | 2.40 |
| Soybean | 2.2 | 4.03 |

Sources: 1. Statistical Yearbook of Indonesia 1977–1978
2. Pelita III in Irian Jaya

Table 8.2.18. Food Crop Production and Consumption Balance

(tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production | Consumption | Balance | Production | Consumption | Balance |
| Sweet potato | 483,440 | 483,440 | – | 700,130 | 700,130 | – |
| Maize | 3,620 | 2,210 | 1,410 | 19,990 | 40,500 | ▲20,510 |
| Cassava | 34,510 | 34,510 | – | 180,790 | 142,510 | 38,280 |
| Peanut | 1,880 | 2,860 | ▲980 | 8,690 | 4,520 | 4,170 |
| Soybean | 1,870 | 2,860 | ▲990 | 6,500 | 7,580 | ▲ 1,080 |
| Total | 525,320 | 525,880 | ▲560 | 916,100 | 895,240 | 20,860 |

(3) Estate Crops

1) Forecast of production

According to Pelita III in Irian Jaya, the production of estate crops is planned as follows:

Table 8.2.19. Production & New Development Area of Estate Crops during Pelita III

| | Production (tons) | New Development Area (ha) | Required Fertilizer | |
|---|---|---|---|---|
| | | | ton | ton/ha |
| Conconut | 70,583 | 10,200 | 14,484 | 1.45 |
| Clove | 431 | 5,000 | 50 | 0.10 |
| Nutmeg | 11,677 | 2,000 | 75 | 0.04 |
| Cocoa | 1,096 | 4,350 | 50 | 0.13 |
| Rubber | 4,147 | 1,100 | 450 | 0.45 |
| Coffee | 725 | 850 | 50 | 0.25 |
| Others | – | 500 | 20 | 0.04 |
| Total | 88,659 | 24,000 | 15,179 | |

*Source: Pelita III in Irian Jaya*

Table 8.2.20. shows the newly development area by estate crop.

With respect to the forecast of estate crops, it is assumed that the new development area for estate crops will continue to produce at the average value of Pelita III period until 2000, since the present situation including land, road condition and inhabitants in West Irian will be developed yearly at the same speed (the average annual value of the period of Pelita III).

Based on the foregoing assumptions, the harvest area in 1985 and 2000 is shown hereunder.

Table 8.2.20. Development of Harvest Area for Estate Crops

(ha)

| | Kinds | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|
| Newly development area (A) | Coconut | 40 | 1,800 | 2,100 | 2,100 | 2,100 | 2,100 |
| | Nutmeg | 13 | 590 | 390 | 215 | 340 | 465 |
| | Cocoa | 9 | 340 | 690 | 990 | 1,090 | 1,240 |
| | Rubber | 89 | 100 | 200 | 250 | 250 | 200 |
| | Clove | – | 910 | 1,110 | 1,010 | 860 | 1,110 |
| | Coffee | – | 115 | 140 | 165 | 190 | 240 |
| | Others | 63 | 100 | 100 | 100 | 100 | 100 |
| | Total | 290 | 3,955 | 4,730 | 4,930 | 4,930 | 5,555 |
| Existing area (B) | Conconut | 16,464 | 16,504 | 18,304 | 20,404 | 22,504 | 24,604 |
| | Nutmeg | 4,918 | 4,931 | 5,521 | 5,911 | 6,126 | 6,466 |
| | Cocoa | 1,407 | 1,416 | 1,756 | 2,446 | 3,436 | 4,526 |
| | Rubber | 1,245 | 1,334 | 1,434 | 1,634 | 1,884 | 2,134 |
| | Clove | 1,378 | 1,378 | 2,288 | 3,398 | 4,408 | 5,268 |
| | Coffee | 392 | 392 | 507 | 647 | 812 | 1,002 |
| | Others | 8,182 | 8,245 | 8,345 | 8,445 | 8,545 | 8,645 |
| | Total | 33,910 | 34,200 | 38,155 | 42,885 | 47,715 | 52,645 |
| Total accumulated area (A + B) | Conconut | 16,504 | 18,304 | 20,404 | 22,504 | 24,604 | 26,704 |
| | Nutmeg | 4,931 | 5,521 | 5,911 | 6,126 | 6,446 | 6,931 |
| | Cocoa | 1,416 | 1,756 | 2,446 | 3,436 | 4,526 | 5,766 |
| | Rubber | 1,334 | 1,434 | 1,634 | 1,884 | 2,134 | 2,434 |
| | Clove | 1,378 | 2,288 | 2,398 | 4,408 | 5,268 | 6,378 |
| | Coffee | 392 | 507 | 647 | 812 | 1,002 | 1,242 |
| | Others | 8,245 | 8,345 | 8,445 | 8,545 | 8,645 | 8,745 |
| | Total | 34,200 | 38,155 | 42,885 | 47,715 | 52,645 | 58,200 |

Source: Pelita III in Irian Jaya

Table 8.2.21. Harvest Area by Estate Crops

(ha)

| Crops | Total Harvested Area | | Annual Extension of Area (ha/Yr) | Total Estimated Harvest Area | |
|---|---|---|---|---|---|
| | 1978 | 1983 | | 1985 | 2000 |
| Coconut | 16,504 | 26,704 | 2,040 | 30,784 | 61,384 |
| Nutmeg | 4,931 | 6,931 | 400 | 7,731 | 13,731 |
| Cocoa | 1,416 | 5,766 | 870 | 7,506 | 20,556 |
| Rubber | 1,334 | 2,434 | 220 | 2,874 | 6,174 |
| Clove | 1,378 | 6,378 | 1,000 | 8,378 | 23,378 |
| Coffee | 392 | 1,242 | 170 | 1,582 | 4,132 |
| Others | 8,245 | 8,745 | 100 | 8,945 | 10,445 |
| Total | 34,200 | 58,200 | 4,800 | 67,800 | 139,800 |

Considering the vast area of Irian Jaya and the comparison with Maluku, the production by crop is calculated on the basis of the yield rate per hectare as listed below.

Table 8.2.22. Yield Rate by Estate Crops

(tons/ha)

| Crops | National Base (Average 1973 to 1977) | Maluku Base (Average 1976 to 1978) |
|---|---|---|
| Coconut | 0.717 | 1.307 |
| Nutmeg | – | 0.216 |
| Cocoa | 0.249 | 0.133 |
| Rubber | 0.563 | – |
| Clove | – | 0.272 |
| Coffee | 0.391 | 0.169 |
| Others | 0.444 | 0.090 |

Source: 1. Statistics Yearbook in Indonesia 1977–1978.
2. Maluku Dalam Angka 1977 as for clove

Note: Others represent the value of fibre.

The lower yield value is to be used for the calculation of the production in 1985 and the higher value for the estimation of the production in 2000.

The results of the calculation are listed below.

Table 8.2.23. Forecast Production by Estate Crops

(tons)

| Crops | 1977 | 1985 | 2000 |
|---|---|---|---|
| Coconut | 7,121 | 22,100 | 80,200 |
| Nutmeg | 800 | 1,700 | 3,000 |
| Cocoa | 34 | 1,000 | 5,100 |
| Rubber | 171 | 1,600 | 3,500 |
| Clove | – | 2,300 | 6,400 |
| Coffee | 56 | 300 | 1,600 |
| Others | – | 800 | 4,600 |

2) Forecast of Consumption

Most of the produced cocoa, rubber, cloves and others (mainly fibre products) are assumed to be sent to other parts of the country, except for some regional consumption.

With respect to the consumption of coconut, nutmeg, and coffee, the values for 2000 are based on the national base in 1977. The values of 1985 are estimated as follows.

Assuming that the balance between production and export is consumed within the study area, per capita consumption of each crop is calculated from the balance of the respective crops.

Conconut : 27.7 Kg/ha/Y (Source: Pelita III in Irian Jaya)
Nutmeg : 0.19 " (Source: – ditto – )
Coffee : 0.34 " (Source: Statistical Yearbook of Indonesia 1977–1978).

Using these consumption rates, the balance between production and consumption is estimated as in the following table.

Table 8.2.24. Forecast Balance between Production and Consumption for Estate Crops

(tons)

| Crops | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production | Consumption | Balance | Production | Consumption | Balance |
| Coconut | 22,100 | 4,524 | 17,576 | 80,200 | 6,700 | 73,500 |
| Clove | 2,200 | – | 2,200 | 6,400 | – | 6,400 |
| Nutmeg | 1,700 | 247 | 1,453 | 3,000 | 358 | 2,642 |
| Cocoa | 1,000 | – | 1,000 | 5,100 | – | 5,100 |
| Rubber | 1,600 | – | 1,600 | 3,500 | – | 3,500 |
| Coffee | 300 | 442 | ▲142 | 1,600 | 640 | 960 |
| Others | 800 | – | 800 | 4,600 | – | 4,600 |
| Total | 29,700 | 5,213 | 24,487 | 104,400 | 7,698 | 96,702 |

(4) Livestock

According to National Pelita III, the annual growth rate of livestock is planned as follows:

Cattle : 2%
Poultry : 5.5%

Applying these rates, the number of livestock is estimated as in the following table.

Table 8.2.25. Forecast Number of Livestock

(heads)

| Year | Pig | Cow | Goat | Sheep | Poultry |
|---|---|---|---|---|---|
| 1977 | 196,620 | 9,290 | 10,160 | 1,090 | 417,670 |
| 1985 | 230,430 | 10,880 | 11,900 | 1,270 | 641,120 |
| 2000 | 310,000 | 14,650 | 16,020 | 1,710 | 1,430,900 |

Note: The number of Poultry is taken as the 1977 value in Pelita III for Irian Jaya.

Applying the national average ratio of slaughtered livestock (Source: Statistical Yearbook of Indonesia 1977 – 1978), the number of slaughtered livestock is estimated below:

Table 8.2.26. Forecast Livestock Slaughtered

(heads)

| Year | Pig | Cow | Goat | Sheep | Poultry |
|---|---|---|---|---|---|
| 1985 | 181,800 | 1,400 | 5,430 | 110 | 1,154,000 |
| 2000 | 244,500 | 1,880 | 7,320 | 960 | 2,575,000 |
| Slaughter ratio | 0.789 | 0.129 | 0.457 | 0.565 | 1.0 |

From the above Table, the production of meat is estimated in the table below.

(tons)

| Year | Pig | Cow | Goat | Sheep | Poultry |
|---|---|---|---|---|---|
| 1978 | 5,998 | 316 | 96 | 1 | 772 |
| 1985 | 7,270 | 220 | 50 | 5 | 1,150 |
| 2000 | 9,780 | 290 | 70 | 10 | 2,580 |

Note: Yield rate of meat per animal is as follows:
Pig: 0.040 ton/head
Cow: 0.156 "
Goat: 0.010 "
Sheep: 0.008 "
Poultry: 0.001 "

Source: Pelita III in Irian Jaya

With respect to the consumption per capita in 1985, the value of Irian Jaya in 1978 is used as a base and the per capita consumption in 2000 is based on the national average in 1977.

Table 8.2.27. Per Capita Livestock Consumption Rate

(kg/capita/Y)

| Year | Pig | Cow | Goat | Sheep | Poultry |
|---|---|---|---|---|---|
| 1985 | 5.40 | 0.97 | 0.09 | 0.09 | 0.710 |
| 2000 | 5.40 | 0.97 | 0.28 | 0.09 | 1.07 |

Source: 1. Statistical Yearbook of Indonesia
2. Pelita III in Irian Jaya

Table 8.2.28. Balance between Livestock Production and Consumption

(tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production | Consumption | Balance | Production | Consumption | Balance |
| Pig | 7,270 | 7,020 | 250 | 9,780 | 10,160 | ▲ 380 |
| Cow | 220 | 1,260 | ▲1,040 | 290 | 1,830 | ▲1,540 |
| Goat | 50 | 120 | ▲ 70 | 70 | 530 | ▲ 460 |
| Sheep | 5 | 120 | ▲ 115 | 10 | 170 | ▲ 160 |
| Poultry | 1,150 | 925 | 225 | 2,580 | 2,010 | 570 |

(5) Forestry

According to Pelita III in Irian Jaya, the production of logs is planned to increase by the same rate as the AAGR during Pelita I & II.

Table 8.2.29. Production of Logs and Sawn Timber

($m^3$)

| Year | Logs | Export of logs | Regional use of logs | Sawn Timber |
|---|---|---|---|---|
| 1970 | 28,214 | 24,379 | 4,890 | 1,534 |
| 1971 | 43,790 | 20,133 | 4,890 | 7,507 |
| 1972 | 28,372 | 7,100 | 5,730 | 6,217 |
| 1973 | 33,869 | – | 7,817 | 10,421 |
| 1974 | 59,935 | 7,227 | 13,948 | 15,334 |
| 1975 | 44,873 | 9,379 | 8,669 | 10,736 |
| 1976 | 54,853 | 15,377 | 11,561 | 11,166 |
| 1977 | 72,215 | 17,638 | 10,234 | 18,511 |
| 1978 | 89,816 | 30,578 | 8,044 | 20,478 |
| AAGR | 15% | 2.9% | 6.4% | 38.25% |

Source: Pelita III in Irian Jaya.

Taking the policy of Pelita III into consideration, the log production in 1985 and 2000 is estimated on the basis of AAGR during Pelita I & II, which is 15 percent. However, AAGR of National Pelita III, 4.64 percent is used in the calculation of the export volume of logs.

The production of sawn timber is estimated by its share in the total production of logs in 1978. The remaining is used within the province.

Table 8.2.30. Production of Forestry Products

($m^3$)

| | 1978 | AAGR ('70–'78) | 1985 | AAGR ('78–'85) | 2000 | AAGR ('85–2000) |
|---|---|---|---|---|---|---|
| Logs | 89,820 | 15 | 274,750 | 15 | 2,570,830 | 15 |
| Export logs | 30,580 | 2.9 | 43,950 | 4.64 | 90,540 | 4.64 |
| Regional use logs | 8,040 | 6.4 | 74,190 | 37.4 | 1,014,920 | 19.1 |
| Sawn timber | 20,480 | 38.3 | 62,640 | 17.3 | 586,150 | 16.1 |

Note: Waste rate of log to timber is assumed at 60 percent of Pelita III in Irian Jaya.

(6) Fishery

According to Pelita III in Irian Jaya, fishery production is planned as follows:

Table 8.2.31. Production and Consumption of Fishery

(tons)

| Year | Production | Export | Consumption |
|---|---|---|---|
| 1978 | 23,916 | 5,467 | 18,859 |
| 1979 | 27,762 | 6,985 | 21,177 |
| 1980 | 32,457 | 8,894 | 23,923 |
| 1981 | 37,198 | 10,603 | 26,918 |
| 1982 | 42,917 | 12,913 | 30,294 |
| 1983 | 48,034 | 14,220 | 33,994 |
| AAGR ('78–'83) | 15% | 21% | 12.5% |

Source: Pelita III in Irian Jaya.

Assuming that the production will continue to increase at the same rate as that of Pelita III up to 1985, the production in 1985 can be calculated from the average growth rate of 15 percent during the period of Pelita III. The production of marine fish in 2000 is based on the average growth rate of National Pelita III of 5 percent.

Until 1985, the consumption is assumed to stay at the same level as that of 1978, which is 16.9 kg/capita. This value is very high compared with the national average value of 8.66 kg/capita

in 1977 (ref. 34.85 kg/capita in Japan).

The balance between production and consumption is sent to other parts of the country. The export volume in 2000 can be calculated by applying the export ratio of 30 percent in 1983.

Table 8.2.32. Forecast Production and Consumption of Fishery

(tons)

| Year | Production | Export | Outward | Consumption |
|---|---|---|---|---|
| 1978 | 23,916 | 5,467 | -- | 18,859 |
| 1985 | 63,500 | 10,320 | 13,980 | 29,290 |
| 2000 | 131,950 | 39,600 | 49,950 | 42,400 |
| AAGR (from 1978) | 8.1 | 9.4 | 8.9 | 3.8 |

Note: With respect to consumption, the waste rate of 25 percent is assumed.
Source: Statistical Yearbook of Indonesia.

(7) Mining

1) Petroleum

As it is very difficult to forecast future crude oil production, it is assumed in this study that the production in 1978, when the maximum production was achieved, would remain unchanged in 1985 and 2000.

Table 8.2.33. Forecast Production of Crude Oil

($\times 10^3$ tons)

| Year | 1978 | 1985 | 2000 |
|---|---|---|---|
| Production | 5,089 | 5,100 | 5,100 |

2) Oil Refinery

At present, Pertamina is planning a refinery plant in the area of Sorong. Its production capacity has not been published.

In this study, supply of oil products by pertamina is assumed to commence after 1986 and until then, the regional demand is assumed to be covered by the Balikpapan Plant.

It is assumed that the composition of oil products in future will be the same as that of the Balikpapan Plant and that oil refining capacity at Sorong will continue to be 60,000 BPSD until the new plant reinforce and increase the capacity up to 100,000 BPSD in 2000.

Table 8.2.34. Production of Oil Products and Treated Crude Oil in 2000

(tons)

| Oil Products | Treated Crude Oil |
|---|---|
| $4{,}596 \times 10^3$ $(3{,}064\ \text{Kl} \times \frac{10}{6} \times 0.9 \times 10^3)$ | $4{,}668 \times 10^3$ $(3{,}112\ \text{Kl} \times \frac{10}{6} \times 0.9 \times 10^3)$ |

Source: *Study Report on the Expansion Project of the Port of Balikpapan, JICA.*

## 8.2.4. Maluku Province

### (1) General Conclusion

As shown in Table 8.2.35, the agriculture sector shows the high value with the share of 50 percent in 1985 and 51.1 percent in 2000.

The main reason is the rapid development of fields for food crops by transmigrants and resettlers.

Especially, Maluku Province plans to turn the paddy area into irrigated fields.

As for Maluku Province, the areas intended for transmigrants and resettlers in Perita III is confirmed as follows:

a) Areas for transmigrants

| | | |
|---|---|---|
| Pulau Buru | (Maluku Tenggara) | 20,000 ha |
| Makariki | ( " ) | 5,000 ha |
| Pasahari | ( " ) | 40,000 ha |
| Kao | (Maluku Utara ) | 15,000 ha |
| Weda | (Harmahera Tengah) | 9,000 ha |
| Wasile | ( " ) | 9,000 ha |

b) Areas for resettlements

| | | |
|---|---|---|
| Makariki | (Maluku Tengah) | 4,000 ha |
| Masiwang | ( " ) | 5,000 ha |
| Piru/Eti | ( " ) | 4,000 ha |
| Pasahari | ( " ) | 4,000 ha |
| Pulan Buru | ( " ) | 5,000 ha |
| Kao | (Maluku Utara) | 4,000 ha |
| Pulau Wetar | (Maluku Tenggara) | 2,000 ha |
| | Total | 126,000 ha |

The area of about 51,000 ha is planned to be cultivated between 1979 and 1985 and about 139,000 ha during 1986 – 2000 period.

21,375 ha out of the area developed by 1983 is planned to be paddy fields.

As for estate crops, Maluku Province plans to develop new areas as follows:

| | | |
|---|---|---|
| Tobelo | (Maluku Utara) | 2,100 ha |
| Labuha | ( " ) | 1,200 ha |
| Sanana | ( " ) | 1,100 ha |
| Ternate | | 3,200 ha |
| Ambon | | 1,300 ha |
| Namlea | (Halmahera Tengah) | 1,300 ha |
| Amahai | (Maluku Tengah) | 2,100 ha |
| Tual | (Maluku Tenggara) | 1,300 ha |
| Dobo | ( " ) | 200 ha |
| Saumlaki | ( " ) | 1,500 ha |
| Tepa | ( " ) | 100 ha |
| Wetar | ( " ) | 1,100 ha |
| | Total | 16,500 ha |

These new areas (seeding area) is to be developed during Pelita III.

As for mining resources in Maluku, the nickel in Gebe island is incorporated into the forecast in this study. At present, only Associated Australian Resources N.L. is investigating her oil concession in Seram island. However, the future production of crude oil is not included in this study forecast.

Sectors other than agriculture and mining also shows the high share of 43.6 percent in 1985 and 44.7 percent in 2000. This is mainly due to the growth of trades sector (16.2 percent in 1978) and the public sector (9.7 percent in 1978).

In conclusion, it can be said that the future industrial structure in Maluku will be sustained by the agriculture sector, and that food crops, estate crops and fishery will promote the growth of the agriculture sector.

Table 8.2.35. Forecast GRDP of Maluku Province

(1975 Constant Prices
x $10^6$ US$)

| Sector | 1978 | % | 1985 | % | 2000 | % | AAGR 1978–1985 | AAGR 1978–2000 |
|---|---|---|---|---|---|---|---|---|
| Food crops | 63.174 | 21.2 | 149.596 | 23.9 | 364.324 | 29.6 | 27.2 | 8.3 |
| Estate crops | 54.494 | 18.2 | 64.630 | 10.3 | 86.972 | 7.1 | 2.5 | 2.2 |
| Livestock | 1.914 | 0.7 | 2.747 | 0.4 | 4.800 | 0.4 | 5.5 | 4.1 |
| Forestry | 22.434 | 7.5 | 34.324 | 5.5 | 30.936 | 2.5 | 6.3 | 1.5 |
| Fishery | 30.802 | 10.3 | 62.035 | 9.9 | 142.398 | 11.5 | 10.5 | 7.2 |
| Agriculture Total | 172.818 | 57.9 | 313.332 | 50.0 | 629.430 | 51.1 | 8.9 | 6.1 |
| Mining | 5.479 | 1.8 | 33.039 | 5.3 | 38.519 | 3.1 | 29.3 | 9.3 |
| Manufacturing & Industry | 3.211 | 1.1 | 6.624 | 1.1 | 13.308 | 1.1 | 10.9 | 6.7 |
| Others | 117.117 | 39.2 | 273.791 | 43.6 | 550.046 | 44.7 | 13.0 | 7.3 |
| Grand Total | 298.625 | 100 | 626.786 | 100 | 1,231.303 | 100 | 11.2 | 6.7 |

(2) Food Crops

1) Paddy

The harvest area for paddy in Maluku is planned by Pelita III as follows:

Table 8.2.36. Forecast Harvest Area for Paddy in 1983

| Area (1983) | ha | % | Yield Rate (ton/ha) | Total Production (ton) |
|---|---|---|---|---|
| Wet land paddy | 21,375 | 52 | 1.97 | 62,739 |
| Dry land paddy | 10,470 | 48 | | |
| Total | 31,845 | 100 | 1.97 | 62,739 |

Source: Pelita III in Maluku

The composition of dry land and wet land paddy is obtained by the following formula:

$$(A \times Y_1) + (B \times Y_2) = 62{,}739 \text{ tons}$$
$$A + B = 31{,}845 \text{ ha}$$

where,

A : areas for wet land paddy

B : areas for dry land paddy

$Y_1$ : yield rate of wet land paddy
($Y_1$ = 2.482 – Average value 1974 to 1978)

$Y_2$ : yield rate of dry land paddy
($Y_2$ = 0.925 – Average value 1974 to 1978)

According to Pelita III in Maluku, these areas are scheduled to be developed and irrigated by transmigrants and resetting people.

The irrigation area is assumed to be developed continuously by transmigrants and resettles at the rate of one hectar per family until the year of 2000. The ratio of the dry land paddy and the wet land paddy, considering the double cropping, will be the same as that in 1983.

Table 8.2.37. Number of Transmigrants & Resetting Population

| Period | Number of Families | Required Area (ha) |
|---|---|---|
| 1984–1985 | 7,500 | 7,500 |
| 1986–2000 | 56,250 | 56,250 |

Source: derived from Table 8.1.5.

Table 8.2.38. Forecast Harvest Area of Paddy

(ha)

| | 1983 | 1985 | | 2000 | |
|---|---|---|---|---|---|
| | Harvest Area | Newly Area Developed | Harvest Area | Newly Area Developed | Harvest Area |
| Wet land paddy | 21,375 | 7,500 | 28,875 | 56,250 | 85,125 |
| Dry land paddy | 10,470 | 3,390 | 13,860 | 27,000 | 40,860 |
| Total | 31,845 | 10,890 | 42,735 | 83,250 | 125,985 |

Table 8.2.39. Yield Rate of Paddy

(tons/ha)

| | Average value in Maluku 1974 to 1978 | 1985 | 2000 |
|---|---|---|---|
| Wet land paddy | 2.482 | 2.482 | 2.959 |
| Dry land paddy | 0.925 | 0.925 | 1.272 |

Source: Pelita III in Maluku and Statistical Yearbook of Indonesia

Note: 1. 1985 using the average value in Maluku

2. 2000 using the average value in Indonesia

From Tables 8.2.38 and 8.2.39, the production of paddy is calculated below:

Table 8.2.40. Forecast Production of Paddy

(tons)

| | 1978 | 1983 | 1985 | 2000 |
|---|---|---|---|---|
| Wet land paddy | 891 | 53,059 | 71,670 | 251,880 |
| Dry land paddy | 15,026 | 9,680 | 12,650 | 51,970 |
| Total | 15,917 | 62,739 | 84,320 | 303,850 |

2) Other food crops

With respect to other food crops, Maluku Province plans as follows:

Table 8.2.41. Planned Harvest Area by Food Crop in 1983

| Crops | Total Harvest Area | | Yield Rate (tons/ha) | Total Production (tons) |
|---|---|---|---|---|
| | ha | % | | |
| Maize | 19,200 | 30 | 1.91 | 36,713 |
| Cassava | 16,200 | 26 | 11.90 | 192,778 |
| Sweet potato | 10,720 | 17 | 7.70 | 82,528 |
| Other potato | 6,420 | 10 | 9.62 | 61,764 |
| Peanut | 4,800 | 8 | 0.63 | 3,024 |
| Greenpea | 3,149 | 5 | 0.57 | 1,809 |
| Soybean | 528 | 1 | 0.61 | 320 |
| Other beans | 1,850 | 3 | 0.42 | 777 |
| Total | 62,867 | 100 | | 379,713 |

These harvest areas were calculated on the assumption that one hectar of land is cultivated by a family of transmigrants.

Each crops share in the total harvest area is calculated to be the same as in 1978.

Table 8.2.42. Forecast Harvest Area by Food Crop

| Crops | 1983 | 1985 | | 2000 | |
|---|---|---|---|---|---|
| | Total Area | Newly Area Developed | Total Area | Newly Area Developed | Total Area |
| Maize | 19,200 | 2,240 | 21,440 | 16,870 | 38,310 |
| Cassava | 16,200 | 1,950 | 18,150 | 14,630 | 32,780 |
| Sweet potato | 10,720 | 1,280 | 12,000 | 9,560 | 21,560 |
| Other potato | 6,420 | 750 | 7,170 | 5,630 | 12,800 |
| Peanut | 4,800 | 600 | 5,400 | 4,500 | 9,900 |
| Greenpea | 3,149 | 370 | 3,520 | 2,810 | 6,330 |
| Soybean | 528 | 80 | 610 | 560 | 1,170 |
| Other beans | 1,850 | 230 | 2,080 | 1,690 | 3,770 |
| Total | 62,867 | 7,500 | 70,370 | 56,250 | 126,620 |

Table 8.2.43. Forecast Yield Rate by Food Crops

(tons/ha)

| Crops | 1985 | 2000 |
|---|---|---|
| Maize | 1.91 | 1.91 |
| Cassava | 11.90 | 11.90 |
| Sweet potato | 7.70 | 9.36* |
| Other potato | 9.62 | 9.62 |
| Peanut | 0.63 | 0.85* |
| Soybean | 0.61 | 0.81 |
| Greenpea | 0.57 | 0.61** |
| Other bean | 0.42 | 0.50** |

Source: 1. Pelita III in Maluku
2. Statistical Yearbook of Indonesia 1977–1978.

Note: * Applied high value by National base
** Applied the highest value during Pelita II in Maluku

Table 8.2.44. Forecast Production of Food Crops

(tons)

| Crops | 1978 | 1985 | 2000 |
|---|---|---|---|
| Maize | 19,060 | 40,950 | 73,170 |
| Cassava | 163,329 | 215,990 | 390,080 |
| Sweet potato | 60,214 | 92,400 | 201,800 |
| Other potato | (42,922) | 68,990 | 123,140 |
| Peanut | 1,339 | 3,400 | 8,420 |
| Soybean | 99 | 370 | 950 |
| Greenpea | ( 1,220) | 2,010 | 3,860 |
| Other bean | ( 723) | 870 | 1,890 |
| Total | 288,906 | 424,970 | 803,310 |

(3) Estate Crops

According to Pelita III in Maluku, the area planned for estate crops is as follows:

Table 8.2.45. Planned Development of Estate Crop Area during Pelita III

| Crops | Newly Developed Area during Pelita III (ha) | Annual Extension of Area (ha/Y) |
|---|---|---|
| Coconut | 8,483 | 1,697 |
| Clove | 5,875 | 1,175 |
| Nutmeg | 1,840 | 368 |
| Cocoa | 12 | 2 |
| Coffee | 250 | 50 |
| Pepper | 21 | 5 |
| Fibre (Kapok) | – | – |
| Total | 16,481 | 3,297 |

Source: Pelita III in Maluku

It is assumed that the newly development area for estate crops will continue to increase at the average value of Pelita III until 2000 and after.

The newly developed area (seeding area) is considered to be the harvest area.

However, considering the time difference between seeding and harvesting, the areas developed in and after 1983 will begin to be regarded as part of the harvest area of the year 1978.

Based on the foregoing assumptions, the harvest area in 1985 and 2000 is shown hereunder.

Table 8.2.46. Forecast Harvest Area by Estate Crops

(ha)

| Crops | 1978 | 1985 | | 2000 | |
|---|---|---|---|---|---|
| | Total Area | Newly Developed Area | Total Area | Newly Developed Area | Total Area |
| Coconut | 116,982 | 3,398 | 120,380 | 25,460 | 145,840 |
| Clove | 18,031 | 2,349 | 20,380 | 17,630 | 38,010 |
| Nutmeg | 15,018 | 732 | 15,750 | 5,520 | 21,270 |
| Cocoa | 4,801 | 9 | 4,810 | 40 | 4,850 |
| Coffee | 2,040 | 100 | 2,140 | 750 | 2,890 |
| Pepper | – | 40 | 40 | 80 | 120 |
| Fibre | 1,357 | 3 | 1,360 | – | 1,360 |
| Total | 158,229 | 6,631 | 164,860 | 49,480 | 214,340 |

Table 8.2.47. Forecast Yield Rate for Estate Crops

(tons/ha)

| Crops | 1985 | 2000 |
|---|---|---|
| Coconut | 1.307 | 1.307 |
| Clove | 0.272 | 0.272 |
| Nutmeg | 0.216 | 0.216 |
| Cocoa | 0.133 | 0.249* |
| Coffee | 0.169 | 0.391 |
| Pepper | 0.653* | 0.653* |
| Fibre | 0.090 | 0.444* |

Sources: 1. *; Statistical Yearbook of Indonesia 1977–1978
2. Maluku Dalam Angka 1977

From Tables 8.2.46. and 8.2.47, the production of estate crops is calculated below.

Table 8.2.48. Forecast Production by Estate Crops

(tons)

| Crops | 1978 | 1985 | 2000 |
|---|---|---|---|
| Coconut | 136,014 | 157,340 | 190,610 |
| Clove | 3,981 | 5,540 | 10,340 |
| Nutmeg | 3,277 | 3,400 | 4,590 |
| Cocoa | 548 | 640 | 1,210 |
| Coffee | 352 | 360 | 1,130 |
| Pepper | – | 30 | 80 |
| Fibre (Kapok) | 171 | 120 | 600 |
| Total | 144,343 | 167,430 | 208,560 |

(4) Livestock

Maluku Province plans the production of cattle as follows:

Table 8.2.49. Production Plan for Livestock

(heads)

| Year | Pig | Cow | Buffalo | Goat | Horse | Poultry |
|---|---|---|---|---|---|---|
| 1979 | 60,436 | 27,095 | 26,091 | 140,772 | 2,891 | 1,046,389 |
| 1980 | 64,131 | 28,607 | 27,761 | 153,605 | 3,076 | 1,159,096 |
| 1981 | 67,825 | 30,119 | 29,432 | 166,438 | 3,260 | 1,271,803 |
| 1982 | 71,519 | 31,630 | 31,102 | 179,271 | 3,445 | 1,384,510 |
| 1983 | 75,214 | 33,142 | 32,722 | 192,104 | 3,630 | 1,497,218 |
| AAGR (1979–1983) | 4.5 | 4.1 | 4.6 | 6.4 | 4.6 | 7.5 |

Source: Pelita III in Maluku

The growth rates of livestock in Maluku are very high compared with the comparable values of National Pelita III, where cattle is 2.0 percent and poultry is 5.5 percent.

Therefore, the growth rates of National Pelita III will be used in estimating the number of livestock in and after 1984.

Table 8.2.50. Forecast Number of Livestock

(heads)

| Year | Pig | Cow | Buffalo | Goat | Horse | Poultry |
|---|---|---|---|---|---|---|
| 1978 | 59,601 | 26,605 | 24,807 | 133,294 | 2,654 | 896,000 |
| 1985 | 78,200 | 34,400 | 34,000 | 199,700 | 3,700 | 1,666,400 |
| 2000 | 105,200 | 46,300 | 45,800 | 268,900 | 5,000 | 3,720,500 |

Applying the average ratio of slaughtered livestock in Maluku (Source: Table 2.4.23.), the number of slaughtered livestock is calculated below:

Table 8.2.51. Forecast Number of Slaughtered Livestock

(heads)

| Year | Pig | Cow | Buffalo | Goat | Horse | Poultry |
|---|---|---|---|---|---|---|
| 1978 | 3,848 | 2,456 | 356 | 1,119 | *37 | 896,000 |
| 1985 | 5,080 | 3,160 | 470 | 1,590 | 50 | 1,688,000 |
| 2000 | 6,830 | 4,200 | 640 | 2,150 | 70 | 3,768,800 |
| Slaughter Ratio | 0.065 | 0.092 | 0.014 | 0.008 | *0.014 | **1.013 |

Note: * Decided by Study Team

** Derived from the average value 1976–77 of Pelita III in Maluku

Table 8.2.52. Yield Rate of Meat per Animal

| Pig | Cow | Buffalo | Goat | Horse | Poultry |
|---|---|---|---|---|---|
| 0.156 | 0.165 | 0.20* | 0.05 | 0.20* | 0.001** |

Source: Pelita III in Maluku

Note: * Yield Rate of Buffalo and Horse were decided by Study Team

** Pelita III in Irian Jaya

From Tables 8.2.51. and 8.2.52, the production of meat is estimated in the following table:

Table 8.2.53. Forecast Production of Meat

(tons)

| Year | Pig | Cow | Buffalo | Goat | Horse | Poultry |
|---|---|---|---|---|---|---|
| 1978 | 612 | 404 | 62 | 56 | *7 | *910 |
| 1985 | 790 | 520 | 90 | 80 | 10 | 1,680 |
| 2000 | 1,070 | 690 | 120 | 110 | 10 | 3,760 |

Note: * derived from Table 8.2.51. and 8.2.52.

(5) Forestry

According to Pelita III in Maluku, the production of logs and sawn timber is planned as follows:

Table 8.2.54. Production of Logs and Sawn Timber

($m^3$)

| | 1978 | 1979/1980 | 1983/1984 | AAGR 1979–84 |
|---|---|---|---|---|
| Logs | 1,016,281 | 1,000,000 | 1,500,000 | 10.7 |
| Sawn timber | 2,235 | 60,000 | 210,000 | 36.8 |

Source: Pelita III in Maluku

It is assumed that the production volume of logs in 1985 is the same as in 1983/1984. Maluku Province sets the ceiling to the future production of logs at 1,200,000 $m^3$ from the standpoint of forest conservation. Therefore, this figure, 1,200,000 $m^3$ is incorporated in Pelita III as the production volume in 2000.

With respect to the production of sawn timber, considering that the growth rate of sawn timber production is affected mainly by the growth rate of the construction sector, the production is estimated on the basis of the growth rate of 9 percent from National Pelita III.

Table 8.2.55. Forecast Production of Forestry Products

($m^3$)

| | 1978 | 1985 | 2000 |
|---|---|---|---|
| Logs | 1,016,000 | 1,500,000 | 1,200,000 |
| Sawn timber | 2,000 | 120,000 | 437,000 |

(6) Fishery

In Pelita III in Maluku, the production and consumption of fishery products is planned as follows:

Table 8.2.56. Planned Production and Consumption of Fishery Products

(tons)

| Year | Production | Consumption | Export |
|---|---|---|---|
| 1979 | 74,575 | 64,530 | 10,045 |
| 1980 | 79,524 | 68,915 | 10,609 |
| 1981 | 85,578 | 74,815 | 11,316 |
| 1982 | 91,889 | 80,811 | 12,078 |
| 1983 | 103,303 | 90,300 | 13,003 |
| AAGR (1979–83) | 8.5% | 8.8% | 6.7% |

Source: Pelita III in Maluku

It is assumed that the production of fishery products up to 2000 continues at the same growth rate as in the period from 1979 to 1983 (i.e., 8.5 percent). With respect to per capita consumption, Maluku Province plans 36.8 Kg/Y in 1979 and 46.5 Kg/Y in 1983, taking the waste rate of 25 percent into account.

These values are very high compared with the national average of 8.7 Kg/Y in 1978. In this study, it is assumed that the consumption up to 2000 continues to remain at the same level as that of 1979, which is 36.8 Kg/Capita/Y.

Table 8.2.57. Forecast Production and Consumption of Fishery Products

(tons)

| Year | 1978 | 1985 | 2000 |
|---|---|---|---|
| Production | 72,224 | 121,610 | 252,830 |
| Consumption | 66,449 | 75,690 | 109,550 |
| Export | 5,775 | 45,920 | 143,280 |

(7) Mining

Maluku Province has planned a production of nickel ores in Gebe Island, which is incorporated in Pelita III as follows:

Table 8.2.58. Planned Production of Nickel Ore

| Year | Production (tons) | Amount ($\times 10^6$ U.S.$) |
|---|---|---|
| 1979 | 1,000,000 | 18.307 |
| 1980 | 1,200,000 | 21.979 |
| 1981 | 1,200,000 | 21.979 |
| 1982 | 1,300,000 | 23.837 |
| 1983 | 1,500,000 | 27.560 |

It is assumed in this study that the production volume of nickel ore in 1985 through 2000 will remain the same as in 1983.

The currency value is added to the GRDP of the mining sector in 1979.

## 8.3. Port Activities

### 8.3.1. Forecast of Cargo Traffic Through the Port

#### (1) Macro Forecast

1) General idea of macro forecast

In general, forecast of port activities, mainly cargo and passenger traffic through a port, is based on a relation between basic indices and port activities. The basic indices have already been forecast for population, GRDP and other regional activities as mentioned in sections 8.1 and 8.2. The series of these basic indices and the cargo traffic through the ports are shown in Table 8.3.1.

Table 8.3.1. Basic Data Series of Irian Jaya and the Port of Sorong

(1) Population and GRDP

| Year | Population ($x10^3$ people) | | GRDP (1975 constant price, $x10^6$ US$) | | | | |
|---|---|---|---|---|---|---|---|
| | Whole Area | Port Related Area | Total | Forestry | Mining & Quarrying | Petroleum | Fishery |
| 1971 | 923.4 | | | | | | |
| 1972 | 945.6 | | | | | | |
| 1973 | 968.3 | | 232.60 | 1.13 | 57.73 | 57.63 | 22.29 |
| 1974 | 995.1 | | 358.48 | 1.59 | 168.54 | 168.23 | 18.50 |
| 1975 | 1,015.3 | | 496.13 | 1.60 | 292.45 | 291.91 | 13.21 |
| 1976 | 1,039.9 | | 575.89 | 2.49 | 350.63 | 345.16 | 10.55 |
| 1977 | 1,064.7 | | 612.30 | 2.75 | 375.56 | 368.89 | 12.65 |
| 1978 | 1,090.3 | 392.7 | 647.13 | 3.05 | 384.05 | 377.92 | 12.88 |
| 1985 | 1,300 | 558.2 | 914.17 | 9.35 | 389.50 | 377.92 | 32.37 |
| 2000 | 1,882 | 1,005.6 | 1,877.16 | 87.41 | 508.48 | 485.32 | 75.18 |

(2) Cargo Traffic

| Year | Cargo Traffic through the Ports (tons) | | | | | |
|---|---|---|---|---|---|---|
| | Irian Jaya | | | | | Sorong |
| | Total | Log | Fish | Crude Oil | Copper | Total* |
| 1971 | | | | | | |
| 1972 | | | | | | |
| 1973 | | | | | | |
| 1974 | 2,095,485 | 12,213 | - | 1,421,120 | 223,553 | 122,305 |
| 1975 | 3,724,146 | 20,313 | 2,596 | 3,063,303 | 234,279 | 131,665 |
| 1976 | 4,456,057 | 24,515 | 4,437 | 3,705,867 | 254,964 | 142,950 |
| 1977 | 4,724,143 | 42,500 | 5,717 | 4,017,435 | 188,125 | 145,568 |
| 1978 | 6,224,112 | 82,236 | 11,566 | 5,418,613 | 201,430 | 165,338 |

Note: * excluding crude oil

2) Relation between cargo flow and GRDP

A. Elasticity of cargo flow for GRDP

The elasticity of the growth of cargo flow's against GRDP's growth, in other words the ratio of the two growth rates is one of the basic relations between the two indices. Cargo volume of the target years can be estimated by using this relation.

That is:

$$C_t = C_n\ (1 + k_{t/n})^{t-n}$$

$$k_{t/n} = r_{t/n} \times \frac{k_{n/o}}{r_{n/o}}$$

where, $C_t$ : cargo volume in target year
$C_n$ : cargo volume in base year
$k$ : average annual growth rate (AAGR) of cargo
$t/n$ : from base year (n) to target year (t)
$n/o$ : from the first year (o) to base year (n)
$r$ : AAGR of GRDP

$\frac{k_{n/o}}{r_{n/o}}$ : elasticity (e)

A-1. Elasticity of whole Irian Jaya's cargo flow

As is seen in Table 8.3.2., the elasticity of the growth rate between GRDP (excluding Mining sector) and whole Irian Jaya's cargo flow (excluding Crude Oil and Refined Copper) is,

$$e = \frac{7.59\%}{8.48\%} = 0.895$$

$$k_{'85/'78} = 10.36\% \times 0.895 = 9.27\%$$

$$k_{2000/'78} = 7.78\% \times 0.895 = 6.96\%$$

consequently

$$C_{t\ '85} = 604.07 \times (1 + 0.0927)^{7} \fallingdotseq 1{,}120 \times 10^3 \text{ tons}$$

$$C_{t\ 2000} = 604.07 \times (1 + 0.0696)^{22} \fallingdotseq 2{,}650 \times 10^3 \text{ tons}$$

If the ratio of Sorong Port to whole Irian Jaya's cargo flow is assumed (Table 8.3.3.) as 26.5 percent in 1985 and 23.2 percent in 2000, the cargo flow in Sorong Port is-

$$C_{s\ '85} = 1{,}120 \times 0.265 \fallingdotseq 300 \times 10^3 \text{ tons}$$

$$S_{s\ 2000} = 2{,}650 \times 0.232 \fallingdotseq 610 \times 10^3 \text{ tons}$$

A-2. Elasticity of Sorong Port's cargo flow

The elasticity between the AAGR of whole Irian Jaya's GRDP and Sorong Port's cargo flows may be used as follows:

$$e' = \frac{7.83\%}{8.48\%} = 0.923$$

therefore

$$k'_{'85/'78} = 10.36\% \times 0.923 = 9.56\%$$

$$k'_{2000/'78} = 7.78\% \times 0.923 = 7.18\%$$

consequently

$$C_{s\,'85} = 165.34 \times (1 + 0.0956)^{7} \fallingdotseq 310 \times 10^{3} \text{ tons}$$

$$C_{s\,2000} = 165.34 \times (1 + 0.0718)^{22} \fallingdotseq 760 \times 10^{3} \text{ tons}$$

Table 8.3.2. Forecast by Elasticity of Average Annual Growth Ratio

| Period | AAGR (%) | | | Elasticity (e) | |
|---|---|---|---|---|---|
| | GRDP* (t) | Cargo Flow** (k) | | Irian Jaya | Sorong |
| | | Irian Jaya | Sorong | | |
| '78/'74 | 8.48 | 7.59 | 7.83 | 0.895 | 0.923 |
| '85/'78 | 10.36 | 9.27 | 9.56 | | |
| '00/'78 | 7.78 | 6.96 | 7.18 | | |

Note: 1. * excluding Mining sector.
2. ** excluding Crude Oil and Refined Copper.
3. [ ] shows the estimated AAGR of cargo flow.

B. Corelation between cargo flow and GRDP

Using corelation between some indices is the most popular method of forecast. According to the graph of the two indices of cargo flow and GRDP, the following functional relationship is assumed.

$$C = aV + b$$

where, $C$ : cargo volume
$V$ : GRDP
$a, b$ : coefficient

To determine the coefficients of a and b, the least square method is most convenient. The results are

$$C_I = 2.287\, V_I - 12.640 \quad (R = 0.948)$$

and $$C_s = 0.563\, V_I + 15.515 \quad (R = 0.992)$$

where, $C_I$ : Irian Jaya's cargo traffice (x $10^3$ tons) (excluding crude oil and refined copper)
$C_s$ : Sorong's cargo traffic (x $10^3$ tons)
$V_I$ : GRDP in whole Irian Jaya (x $10^6$ US$ in 1975 constant price) (excluding Mining sector)

The forecast results are shown in Table 8.3.3.

Table 8.3.3. Forecast by Corelation between GRDP and Cargo Flow

| Year | GRDP ($V_I$) (x10$^6$ US$) | Cargo Flow (x10$^3$ tons) | | $C_S/C_I$ |
|---|---|---|---|---|
| | | Irian Jaya ($C_I$) | Sorong ($C_S$) | |
| 1974 | 189.94 | 450.81 | 122.31 | 0.271 |
| 1975 | 203.68 | 426.56 | 131.67 | 0.309 |
| 1976 | 225.26 | 495.23 | 142.95 | 0.289 |
| 1977 | 236.74 | 518.58 | 145.57 | 0.281 |
| 1978 | 263.08 | 604.07 | 165.34 | 0.274 |
| 1985 | 524.67 | 1,190 | 310 | 0.265 |
| 2000 | 1,368.68 | 3,120 | 790 | 0.232 |

Note: 1. GRDP excluding mining sector.
2. Cargo Flow excluding crude oil and refined copper.
3. [ ] shows the results of forecasting
4. [ ] is assumed by

$$\frac{C_S}{C_I} = -0.0022T + 0.2914 \quad (T: T_{1974} = 1, T_{1985} = 12, T_{2000} = 27)$$

3) Relation between cargo flow and population

Population is the most basic index of regional activities; However, it is difficult to relate the fluctuation of cargo flow directly to population movement. Improvement of the standard of living and other activities affect cargo flow more directly than the increase of the population.

Nonetheless, cargo flow may be estimated by the following equation.

$$C = a\frac{V}{P} + b$$

where, P : population

The results are

$$C_I = 3.303\frac{V_I}{P_I} - 209.671 \quad (R = 0.944)$$

$$C_S = 0.823\frac{V_I}{P} - 34.929 \quad (R = 0.995)$$

where, $\frac{V_I}{P_I}$ : standard of living in Irian Jaya (US$/person)
(per capita GRDP in which mining sector excluding)

The forecast results are shown in Table 8.3.4.

Table 8.3.4. Forecast by Standard of Living

| Year | Standard of Living ($\frac{V_I}{P_I}$) (US$/person) | Cargo Flow ($x10^3$ tons) | |
|---|---|---|---|
| | | Irian Jaya ($C_I$) | Sorong ($C_S$) |
| 1974 | 190.88 | 450.81 | 122.31 |
| 1975 | 200.61 | 426.56 | 131.67 |
| 1976 | 216.62 | 495.23 | 142.95 |
| 1977 | 222.35 | 518.58 | 145.57 |
| 1978 | 241.29 | 604.07 | 165.34 |
| 1985 | 403.59 | 1,120 | 300 |
| 2000 | 727.25 | 2,190 | 560 |

Note: 1. GRDP excluding mining sector.
2. Cargo Flow excluding crude oil and refined copper.
3. [illegible] shows the results of forecasting.

4) Results of macro forecast

The results of all forecast techniques are summarised in Table 8.3.5.

As is seen in this table, cargo flow through Sorong Port is estimated about 300 – 320 thousand tons in the year of 1985, and 510 – 790 thousand tons in the year of 2000. But these estimations do not take possible functional changes of Sorong Port into consideration.

Table 8.3.5. Results of Cargo Flow Forecast

($x10^3$ tons)

| Technique | Irian Jaya | | Sorong | |
|---|---|---|---|---|
| | 1985 | 2000 | 1985 | 2000 |
| Elasticity | | | | |
| A-1 | 1,120 | 2,650 | 300 | 610 |
| A-2 | – | – | 310 | 760 |
| Corelation | | | | |
| B-1 | 1,190 | 3,120 | 320 | 720 |
| B-2 | – | – | 310 | 790 |
| Standard of Living | 1,120 | 2,190 | 300 | 510 |
| | – | – | 300 | 560 |

(2) Micro estimation

1) General idea of micro estimation

Micro estimation for cargo traffic through Sorong Port is based on the difference between the production and the consumption of commodities in each region. If the production of a region is bigger than its consumption, the difference or a surplus is assumed to be shipped to other countries (export) or other provinces of Indonesia (outbound). If the production is smaller than the consumption, the deficit is assumed to be supplied by other countries (imports) or other parts of Indonesia (inbound).

Fig. 8.3.1. Basic Concept of Micro Estimation

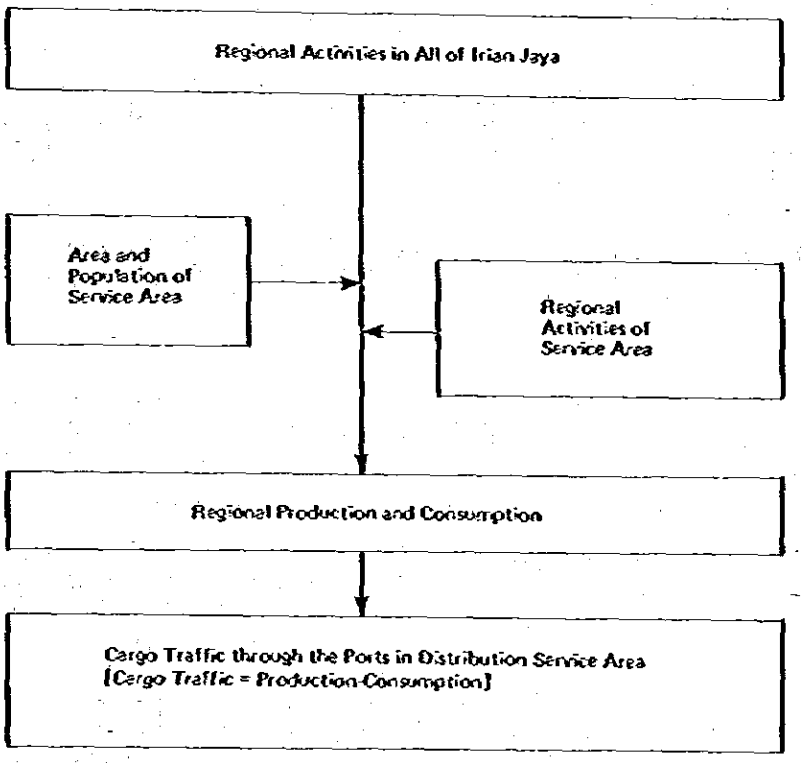


Table 8.3.6. Basic Indicies of Port Distribution Service Area

| Port Distribution Service Area | Kabupaten | Area ($km^2$) | Population (x $10^3$ persons) | | | | Transmigration (x $10^3$ families) | | Potential Area of Irrigation (x $10^3$ ha) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1985 | | 2000 | | 1979/ 1985 | 1979/ 2000 | |
| | | | Whole Area | P.R.A. | Whole Area | P.R.A. | | | |
| Hinterland | Sorong | 40,549 (9.9) | 152.5 (11.7) | 108.7 (19.5) | 217.6 (11.6) | 173.7 (17.3) | 1.4 (20.0) | 5.36 (12.0) | 27.3 (11.8) |
| Service Area | Paniai | 46,400 (11.3) | 218.2 (16.8) | 18.0 (3.2) | 323.4 (17.2) | 111.3 (11.1) | 1.4 (20.0) | 9.26 (20.8) | 36.0 (15.6) |
| | Y. Waropen | 18,994 (4.6) | 63.3 (4.9) | 59.4 (10.6) | 90.0 (4.8) | 85.2 (8.5) | | 1.58 (3.6) | 8.0 (3.4) |
| | T. Chenderawasih | 4,010 (1.0) | 86.0 (6.6) | 68.3 (12.2) | 112.8 (6.0) | 89.6 (8.9) | | | |
| | Manokwari | 36,773 (8.9) | 104.1 (8.0) | 76.4 (13.7) | 184.5 (9.8) | 184.5 (18.3) | 2.1 (30.0) | 12.34 (27.7) | 49.6 (21.5) |
| | Fak-Fak | 44,566 (10.9) | 63.3 (4.9) | 45.9 (8.2) | 83.0 (4.4) | 66.5 (6.6) | | | |
| | Sub Total | 150,743 (36.7) | 534.9 (41.2) | 268.0 (48.0) | 794.6 (42.2) | 537.1 (53.4) | 3.5 (50.0) | 23.18 (52.1) | 93.6 (40.5) |
| Other Area | Jayapura | 48,188 (11.7) | 162.6 (12.5) | 140.2 (25.1) | 263.3 (14.0) | 227.1 (22.6) | 1.4 (20.0) | 11.84 (26.6) | 62.5 (27.1) |
| | Jayawijaya | 47,960 (11.7) | 264.3 (20.3) | | 346.9 (18.4) | | | | |
| | Merauke | 123,220 (30.0) | 185.7 (14.3) | 41.3 (7.4) | 259.6 (13.8) | 67.7 (6.7) | 0.5 (10.0) | 4.12 (9.3) | 47.4 (20.6) |
| | Sub Total | 219,368 (53.4) | 612.6 (47.1) | 181.5 (32.5) | 869.8 (46.2) | 294.8 (29.3) | 1.9 (30.0) | 15.96 (35.9) | 10.99 (47.7) |
| Total Irian Jaya | | 410,660 (100.0) | 1,300.0 (100.0) | 558.2 (100.0) | 1,882.0 (100.0) | 1,005.6 (100.0) | 7.0 (100.0) | 44.5 (100.0) | 230.4 (100.0) |
| Original Table or Section | | Table 2.2.2 | Table 8.1.1. and 7.2.1. | | | | Table 8.1.5. | | Section 8.2.3.-(1) |

Note: 1. P.R.A. = Port Related Area (see section 7.2-2)
2. ( ) shows share of Total Irian Jaya (%)

2) Methods of calculation in estimation

The methods of calculation for micro estimation are as follows.

(a) Foodstuffs

(a)-1 Rice

With regard to rice, the balance between production and consumption of each are is shown in Table 8.3.7. (1).

As is seen in this table, shortage of rice is estimated at 2,910 tons for the hinterland and 12,570 tons for the service area in 1985. These cargoes will be brought to the Port of Sorong by sea and then transported by land to the hinterland and by ship to the service area (Table 8.3.7. (1)).

Table 8.3.7. Rice

(1) Production Consumption Balance

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A−B | Production (A) | Consumption (B) | A−B |
| Hinterland | 2,320 | 5,230 | ▲2,910 | 13,270 | 26,300 | ▲13,030 |
| Service Area | 5,780 | 18,350 | ▲12,570 | 57,600 | 96,030 | ▲38,430 |
| Jayapara | 2,320 | 6,130 | ▲3,810 | 29,410 | 73,740 | ▲44,330 |
| Merauke | 1,150 | 6,370 | ▲5,220 | 10,280 | 31,370 | ▲21,090 |
| Total Irian Jaya | 11,570 | 36,080 | ▲24,510 | 110,560 | 227,440 | ▲116,880 |

Note: 1. The amount of production in each area is calculated by using the ratio of transmigrants.
2. Per capita consumption in 1985 is 2.1 kg/H/Y for Jayawijaya, 34.3 kg/H/Y for other Kabupatens, and it is 120.85 kg/H/Y for all Kabupatens in 2000.

(2) Cargo Traffic Through the Ports (tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | 2,910 | | 13,030 | |
| Service Area | 12,570 | 12,570 | 38,430 | 38,430 |
| Sorong Total | 15,480 | 12,570 | 51,460 | 38,430 |
| Jayapara | 3,810 | | 44,330 | |
| Merauke | 5,220 | | 21,090 | |
| Total Irian Jaya | 24,510 | 12,570 | 65,420 | 38,430 |

(a)-2 Wheat and sugar

With regard to wheat and sugar, it is assumed that they will not be produced in Irian Jaya either in 1985 or 2000, and the amount required in the service area will be brought in from other areas of the country.

According to the Statistical Yearbook of Indonesia 1977 – 1978, the highest per capita consumption in the last few years was 5.05 kg/H/Y for wheat flour and 12.71 kg/H/Y for sugar (Table 8.3.8.).

The per capita consumption in Irian Jaya will be the same as the highest Indonesian average in the last few years.

Table 8.3.8. Wheat flour and Sugar

(1) Per capita Consumption (kg/H/Y)

| Year | Wheat flour | Sugar |
|---|---|---|
| 1974 | 4.90 | 12.71 |
| 1975 | 3.95 | 10.14 |
| 1976 | 5.05 | 10.87 |
| 1977 | 3.96 | 11.10 |

*Source: CBS/Statistical Yearbook of Indonesia, 1977–1978.*

(2) Production Consumption Balance

① Wheat flour (tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A−B | Production (A) | Consumption (B) | A−B |
| Hinterland | nil | 770 | ▲770 | nil | 1,100 | ▲1,100 |
| Service Area | | 2,700 | ▲2,700 | | 4,010 | ▲4,010 |
| Jayapara | | 2,160 | ▲2,160 | | 3,080 | ▲3,080 |
| Merauke | | 940 | ▲940 | | 1,310 | ▲1,310 |
| Total Irian Jaya | | 6,570 | ▲6,570 | | 9,500 | ▲9,500 |

② Sugar (tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A−B | Production (A) | Consumption (B) | A−B |
| Hinterland | nil | 1,940 | ▲1,940 | nil | 2,770 | ▲2,770 |
| Service Area | | 6,800 | ▲6,800 | | 10,100 | ▲10,100 |
| Jayapara | | 5,430 | ▲5,430 | | 7,760 | ▲7,760 |
| Merauke | | 2,360 | ▲2,360 | | 3,300 | ▲3,300 |
| Total Irian Jaya | | 16,530 | ▲16,530 | | 23,930 | ▲23,930 |

(3) Cargo Traffic through the Port

① Wheat flour

(tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | 770 | | 1,100 | |
| Service Area | 2,700 | 2,700 | 4,010 | 4,010 |
| Sorong Total | 3,470 | 2,700 | 5,110 | 4,010 |
| Jayapara | 2,160 | | 3,080 | |
| Merauke | 940 | | 1,310 | |
| Total Irian Jaya | 6,570 | 2,700 | 9,500 | 4,010 |

② Sugar

(tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | 1,940 | | 2,770 | |
| Service Area | 6,800 | 6,800 | 10,100 | 10,100 |
| Sorong Total | 8,740 | 6,800 | 12,870 | 10,100 |
| Jayapara | 5,430 | | 7,760 | |
| Merauke | 2,360 | | 3,300 | |
| Total Irian Jaya | 16,530 | 6,800 | 23,930 | 10,100 |

(a)-3 Marine products

With respect to marine products, it is assumed that the export amount will be 10,320 tons in 1985 and 39,600 tons in 2000, and that the shipping to other provinces will be 13,980 tons in 1985 and 49,950 tons in 2000.

All marine products for export and for other provinces from Irian Jaya are loaded at Sorong Port. One half of all the shipment will be handled at the public wharves.

Table 8.3.9. Cargo Traffic through the Port
(Marine Products)

(tons)

| | 1985 | 2000 |
|---|---|---|
| Export | 5,160<br>(10,320) | 19,800<br>(39,600) |
| Outward | 6,990<br>(13,980) | 24,975<br>(49,950) |

(a)-4 Livestock

With regard to livestock, the shortage in Irian Jaya will amount to 750 tons in 1985 and 1970 tons in 2000. The shortage in each area is calculated by using the population ratio.

Table 8.3.10. Livestock

(1) Production Consumption Balance (tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A – B | Production (A) | Consumption (B) | A – B |
| Hinterland<br>Service Area | | | ▲90<br>▲310 | | | ▲230<br>▲830 |
| Jayapura<br>Merauke | | | ▲240<br>▲110 | | | ▲640<br>▲270 |
| Total Irian Jaya | 8,695 | 9,445 | ▲750 | 12,730 | 14,700 | ▲1,970 |

(2) Cargo Traffic through the Port (tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hintesland<br>Service Area | 90<br>310 | <br>310 | 230<br>830 | <br>830 |
| Sorong Total | 400 | 310 | 1,060 | 830 |
| Jayapura<br>Merauke | 240<br>110 | | 640<br>270 | |
| Irian Jaya Total | 750 | 310 | 1,970 | m 830 |

(a)-5 Other crops

With regard to other food crops, i.e. sweet potatoes, maize, cassava, peanuts and soybeans, the production is calculated from the ratio of transmigrants and the consumption is calculated from the ratio of inhabitants.

The distribution service area of Sorong Port is divided into the north and the south to supplement the shortages in the Jayapura and Merauke areas with the surpluses in the service area.

Service Area – S comprises the whole of Fak-Fak, and Bintuni and Babo of Manokwari. The service area was divided according to the inhabitant ratio, the transmigrant ratio and the area ratio.

Inhabitants Ratio (%)

| | | |
|---|---|---|
| 11.7 (11.6) | 35.2 (36.4) | 32.8 (32.4) |
| | 6.0 (5.8) | 14.3 (13.8) |

Transmigrants Ratio (%)

| | | |
|---|---|---|
| 20.0 (12.0) | 45.7 (48.2) | 20.0 (26.6) |
| | 4.3 (3.9) | 10.0 (9.3) |

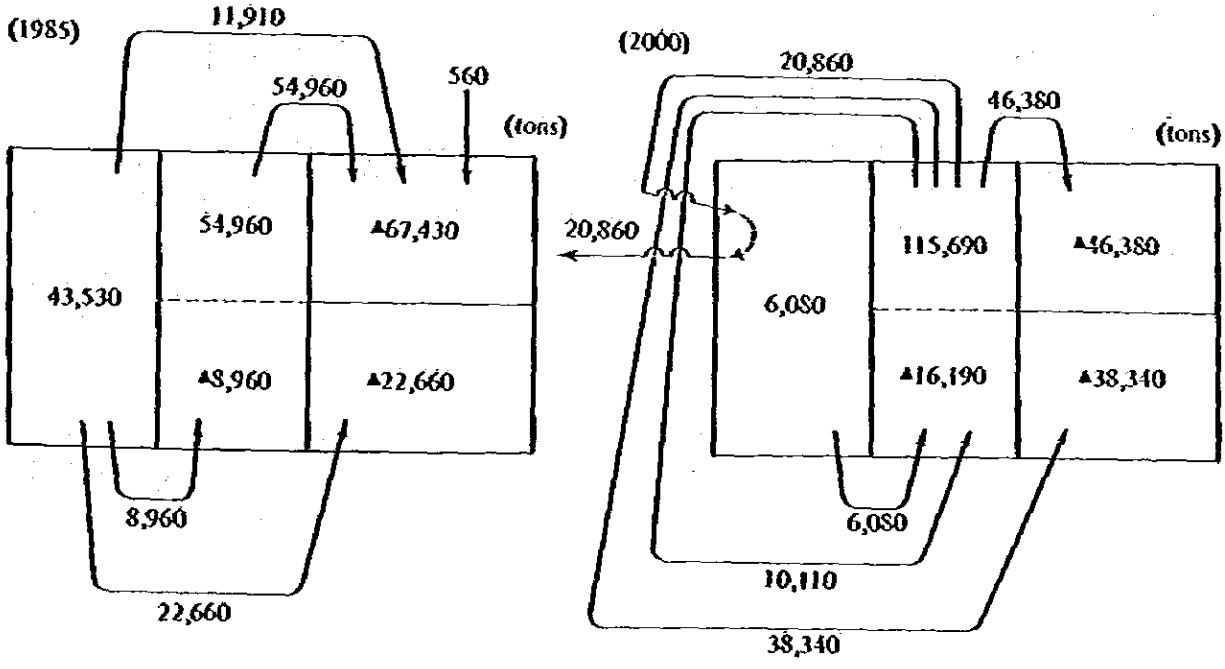
Note: 1. Figures in ( ) are for the year 2000.
2. Transmigrants in Manokwari are apportioned by inhabitant ratio.

Area Ratio (reference) (%)

| | | |
|---|---|---|
| 9.9 | 23.1 | 23.4 |
| | 13.6 | 30.0 |

Note: N 70% and S 30% for manokwari

The flow of cargo in 1985 and in 2000 is assumed to be as follows:



## Table 8.3.11. Other Crops

### (1) Production Consumption Balance

(tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A – B | Production (A) | Consumption (B) | A – B |
| Hinterland | 105,060 | 61,530 | 43,530 | 109,930 | 103,850 | 6,080 |
| Service Area–N | 240,070 | 185,110 | 54,960 | 441,560 | 325,870 | 115,690 |
| Service Area–S | 22,590 | 31,550 | ▲8,960 | 35,730 | 51,920 | ▲16,190 |
| Jayapura | 105,060 | 172,490 | ▲67,430 | 243,680 | 290,060 | ▲46,380 |
| Merauke | 52,540 | 75,200 | ▲22,660 | 85,200 | 123,540 | ▲38,340 |
| Total Irian Jaya | 525,320 | 525,880 | ▲560 | 916,100 | 895,240 | 20,860 |

### (2) Cargo traffic through the ports

(tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | | 43,530 | | 6,080 |
| Service Area | | | 20,860 | 20,860 |
| Sorong Total | | 43,530 | 20,860 | 26,940 |
| Jayapura | 67,430 | | 46,380 | |
| Merauke | 22,660 | | 38,340 | |
| Irian Jaya Total | 90,090 | 43,530 | 84,720 | 26,940 |

Note: 1. In 1985, a surplus crop of 54,960 tons in Service Area–N will be shipped directly to Jayapura.
2. In 2000, the shortage of 46,380 tons in Jayapura and 38,340 tons in Merauke will be shipped from Service Area–N. The net surplus in the Hinterland of 6,080 tons will be shipped to Service Area–S.

(b) Estate crops

The production and consumption of estate crops are estimated as in Table 8.2.24. The production and consumption are allocated to each Kabupaten as follows:

Refer to 8.2.3. (1) and Table 8.3.12. for the production area and the potential area of irrigation. Each Kabupaten's production is determined in proportion to the ratio of the potential area of irrigation. As to T. Chenderawasih, Fak-Fak and Jayawijaya where production is planned but the potential irrigation area is not specified, the potential area is estimated from the ratio of the potential area to the total area in the district where the potential area is located.

Table 8.3.12. Estate Crops

(1) Area Planned for Estate Crops

| Kabupaten | Coconut | Clove | Nutmeg | Cocoa | Coffee | Rubber and others | Potential Area of Irrigation ($\times 10^3$ ha) |
|---|---|---|---|---|---|---|---|
| Sorong | O | O | | | | O | 27.3 |
| Paniai | | O | | | O | O | 36.0 |
| Y. Waropen | | O | | O | | O | 8.0 |
| T. Chenderawasih | O | O | | | | O | – |
| Manokwari | O | O | | O | | O | 49.6 |
| Fak-Fak | | O | O | | | O | – |
| Jayapura | O | O | | O | | O | 62.5 |
| Jayawijaya | | O | | | O | O | – |
| Merauke | | | | | | O | 47.4 |

(2) Estimated Potential Area of Irrigation

| | Total area ($km^2$) | Potential Area of Irrig. ($\times 10^3$ ha) | Estimated Potential Area of Irrigation ($\times 10^3$ ha) | Remarks |
|---|---|---|---|---|
| Sorong | 40,549 | 27.3 | 27.3 | |
| Paniai | 46,400 | 36.0 | 36.0 | |
| Y. Waropen | 18,994 | 8.0 | 8.0 | |
| T. Chenderawashi | 4,010 | – | 3.0 | |
| Marokwari (1) | 36,773 | 49.6 | 34.7 | Area ratio (1) 70%, (2) 30% |
| Manokwari (2) | | | 14.9 | |
| Fak Fak | 44,566 | -- | 32.7 | |
| Jayapura | 48,188 | 62.5 | 62.5 | |
| Jayawijaya | 47,960 | – | 35.2 | |
| Morauke | 123,230 | 47.4 | 47.4 | |
| All Irian Jaya | 410,660 | 230.8 | 301.7 | |

Note: Potential area in total area

$$\frac{230.8 \times 10^3 \text{ ha}}{314,134 \text{ km}^2} = 0.73 \text{ ha/km}^2$$

(3) Production Consumption Balance

(tons)

| | | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|---|
| | | Production (A) | Consumption (B) | A−B | Production (A) | Consumption (B) | A−B |
| Coconut | Hinterland | 4,240 | 530 | 3,800 | 15,380 | 780 | 14,940 |
| | Service Area-N | 5,850 | 1,590 | 4,260 | 21,230 | 2,440 | 18,790 |
| | Service Area-S | 2,310 | 270 | 2,040 | 8,390 | 390 | 8,000 |
| | Jayapura | 9,700 | 1,480 | 8,220 | 35,200 | 2,170 | 33,030 |
| | Merauke | – | 650 | ▲650 | – | 920 | ▲920 |
| | Total | 22,100 | 4,520 | 17,580 | 80,200 | 6,700 | 73,500 |
| Clove | Hinterland | 250 | – | 250 | 690 | – | 690 |
| | Service Area-N | 740 | – | 740 | 2,050 | – | 2,050 |
| | Service-Area-S | 430 | – | 430 | 1,200 | – | 1,200 |
| | Jayapura | 880 | – | 880 | 2,460 | – | 2,460 |
| | Merauke | – | – | – | – | – | – |
| | Total | 2,300 | | 2,300 | 6,400 | | 6,400 |
| Nutmeg | Hinterland | | 30 | ▲30 | | 40 | ▲40 |
| | Service Area-N | | 90 | ▲90 | | 130 | ▲130 |
| | Area-S | 1,700 | 20 | 1,680 | 3,000 | 20 | 2,980 |
| | Jayapura | | 80 | ▲80 | | 120 | ▲120 |
| | Merauke | | 30 | ▲30 | | 50 | ▲50 |
| | Total | 1,700 | 250 | 1,450 | 3,000 | 360 | 2,640 |
| Cocoa | Hinterland | | | | | | |
| | Service Area-N | 360 | – | 360 | 1,810 | – | 1,810 |
| | Service Area-S | 120 | – | 120 | 630 | – | 630 |
| | Jayapura | 520 | – | 520 | 2,660 | – | 2,660 |
| | Merauke | | | | | | |
| | Total | 1,000 | – | 1,000 | 5,100 | – | 5,100 |
| Coffee | Hinterland | | 50 | ▲50 | | 70 | ▲70 |
| | Service Area-N | 150 | 150 | 0 | 810 | 230 | 580 |
| | Service Area-S | | 30 | ▲30 | | 40 | ▲40 |
| | Jayapura | 150 | 140 | 10 | 790 | 210 | 580 |
| | Merauke | | 70 | ▲70 | | 90 | ▲90 |
| | Total | 300 | 440 | ▲140 | 1,600 | 640 | 960 |
| Rubber & Others | Hinterland | 220 | – | 220 | 730 | – | 730 |
| | Service Area-N | 650 | – | 650 | 2,200 | – | 2,200 |
| | Service Area-S | 380 | – | 380 | 1,280 | – | 1,280 |
| | Jayapura | 770 | – | 770 | 2,620 | – | 2,620 |
| | Merauke | 380 | – | 380 | 1,270 | – | 1,270 |
| | Total | 2,400 | – | 2,400 | 8,100 | – | 8,100 |
| Grand Total | | 29,800 | 5,210 | 24,590 | 104,400 | 7,700 | 96,700 |

Production : Estimated by using the ratio of potential area of irrigation
Consumption: Estimated by using the ratio of inhabitants

(4) Cargo Traffic through the Ports

(tons)

| | | 1985 | | 2000 | |
|---|---|---|---|---|---|
| | | UL | L | UL | L |
| Coconut | Hinterland | | *3,800 | | *14,940 |
| | Service Area-N | 4,260 | *4,260 | 18,790 | *18,790 |
| | Service Area-S | 1,390 | *1,390 | 7,080 | *7,080 |
| | Jayapura | | *8,220 | | *33,030 |
| | Merauke | 650 | | 920 | |
| | Total | 6,300 | *17,670 | 26,790 | *73,840 |
| Clove | Hinterland | | *250 | | *690 |
| | Service Area-N | 740 | *740 | 2,050 | *2,050 |
| | Service Area-S | 430 | *430 | 1,200 | *1,200 |
| | Jayapura | | *880 | | *2,460 |
| | Merauke | | | | |
| | Total | 1,170 | *2,300 | 3,250 | *6,400 |
| Nutmeg | Hinterland | 30 | | 40 | |
| | Service Area-N | | | | |
| | Service Area-S | 1,450 | *1,450 | 2,640 | *2,640 |
| | Jayapura | 80 | | 120 | |
| | Merauke | 30 | | 50 | |
| | Total | 1,590 | *1,450 | 2,850 | *2,640 |
| Cocoa | Hinterland | | | | |
| | Service Area-N | 360 | *360 | 1,810 | *1,810 |
| | Service Area-S | 120 | *120 | 630 | *630 |
| | Jayapura | | *520 | | *2,660 |
| | Merauke | | | | |
| | Total | 480 | *1,000 | 2,440 | *5,100 |
| Coffee | Hinterland | 50 | | 70 | |
| | Service Area-N | | | 380 | *380 |
| | Service Area-S | 30 | 30 | 40 | 40 |
| | Jayapura | | *10 | | *580 |
| | Merauke | 70 | | 90 | |
| | Total | 150 | 30 | 580 | 40 |
| | | | *10 | | *960 |
| Rubber & Others | Hinterland | | *220 | | *730 |
| | Service Area-N | 650 | *650 | 2,200 | *2,200 |
| | Service Area-S | 380 | *380 | 1,280 | *1,280 |
| | Jayapura | | *770 | | *2,620 |
| | Merauke | | *380 | | *1,270 |
| | Total | 1,030 | *2,400 | 3,480 | *8,100 |

| | | 1985 | | 2000 | |
|---|---|---|---|---|---|
| | | UL | L | UL | L |
| Total | Hinterland | 80 | *4,270 | 110 | *16,360 |
| | Service Area-N | 6,010 | *6,010 | 25,230 | *25,230 |
| | Service Area-S | 3,800 | *3,770<br>30 | 12,870 | *12,830<br>40 |
| | Jayapura | 80 | *10,400 | 120 | *41,350 |
| | Merauke | 750 | *380 | 1,060 | *1,270 |
| | Total | 10,720 | 24,860 | 39,390 | 97,080 |
| Sorong Total | Hinterland | 80 | *4,270 | 110 | *16,360 |
| | Service Area-N | 6,010 | *6,010 | 25,230 | *25,230 |
| | Service Area-S | 3,800 | *3,770<br>30 | 12,870 | *12,830<br>40 |
| | Jayapura | 10,400 | *10,400 | 41,350 | *41,350 |
| | Merauke | 380 | *380 | 1,270 | *1,270 |
| | Total | 20,670 | *24,830<br>30 | 80,830 | *97,040<br>40 |

Note: * foreign trade

(c) Sawn timber

As for sawn timber, the production is calculated in Section 8.2 (Table 8.2.30.).

The demand is assumed on the basis of the estimated per capita consumption in Sorong area in 1979. The 1979 consumption in Sorong area is estimated from the difference between cargo loading and unloading at Sorong Port and the production in the area.

## Table 8.3.13. Sawn Timber

(1) Consumption

| | | Hinterland (Sorong) | Service Area | Jayapura | Merauke | Remarks |
|---|---|---|---|---|---|---|
| 1979 | Unloading (A) | 419 | | | | |
| | Loading (B) | 634 | | | | |
| | Production (C) | 4,182 | | | | |
| | Estimated Demand (D = A−B+C) | 3,967 | | | | Table 4.2.7. |
| | Population (P) | 126,200 | | | | |
| | $d'79 = \frac{D}{P}$ | 31.45 kg/H/Y | | | | |
| 1985 | Population | 152,500 | 534,900 | 426,900 | 185,700 | d'79 × |
| | d'85 | 48.82 | 48.82 | 48.82 | 48.82 | $\frac{(V/P)\ '85}{(V/P)\ '79}$ |
| | D'85 | 7,450 | 26,120 | 20,840 | 9,070 | |
| 2000 | Population | 217,600 | 794,600 | 610,200 | 259,600 | d'79 × |
| | $d_{2000}$ | 85.09 | 85.09 | 85.09 | 85.09 | $\frac{(V/P)\ 2000}{(V/P)\ '79}$ |
| | $D_{2000}$ | 18,520 | 67,610 | 51,920 | 22,090 | |

(2) Production Consumption Balance

(tons)

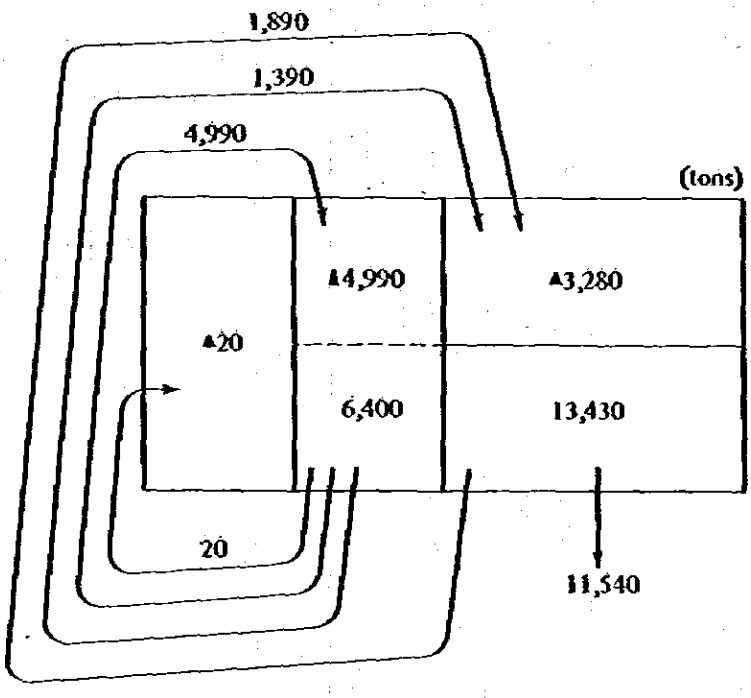
| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A−B | Production (A) | Consumption (B) | A−B |
| Hinterland | 7,430 | 7,450 | ▲20 | 69,500 | 18,520 | 50,980 |
| Service Area-N | 27,530 (17,330 | 26,120 (22,320 | ▲4,990 | 162,150 | 67,610 (58,320 | 103,830 |
| Service Area-S | 10,200) | 3,800) | 6,400 | 95,470 | 9,290) | 86,180 |
| Jayapura | 17,560 | 20,840 | ▲3,280 | 164,260 | 51,920 | 112,340 |
| Merauke | 22,500 | 9,070 | 13,430 | 210,600 | 22,090 | 188,510 |
| Total | 75,020 | 63,480 | 11,540 | 701,980 | 160,140 | |

Note: 1. The production is divided up according to area ratio.
2. The consumption in Service Area N and S is divided up according to inhabitant ratio.

(3) Cargo Traffic through the Ports

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | 20 | | | 50,980 |
| Service Area | | | 95,010 (190,010) | 95,010 (190,010) |
| Sorong Total | 20 | | 95,010 | 145,990 |
| Jayapura | 3,280 | | | 112,340 |
| Merauke | | 13,430 | | 188,510 |
| Total Irian Jaya | 3,300 | 13,430 | 95,010 | 446,840 |

Note: The flow of cargo in 1985 is estimated as follows:



(d) Machinery

As for machinery, 1,279 tons of cargoes are unloaded and 100 tons are loaded at Sorong Port. By using this data and the population of the hinterland, per capita demand is estimated.

Demand for machinery in each area is calculated by the indexes shown in Table 8.3.14.

(e) Vehicles

As for vehicles, the demand for new cars is estimated by the number of newly registered cars and replacements (Table 8.3.15.).

Table 8.3.14. Machinery

(1) Estimated Demand in Port Distribution Service Area

| | | Hinterland (Sorong) | Service Area | Jayapura | Merauke | Remarks |
|---|---|---|---|---|---|---|
| 1979 | Unloading (A) | 1,279 tons | | | | |
| | Loading (B) | 100 tons | | | | |
| | Estimated Demand (D = A−B) | 1,179 tons | | | | |
| | Population (P) | 126,200 | | | | 122.3 x 1.032 |
| | $d'79 = \frac{D}{P}$ | 9.34 kg/H/Y | | | | |
| 1985 | Population | 152,500 | 534,900 | 426,900 | 185,700 | $d'79 \times \frac{(V/P)\ '85}{(V/P)\ '79}$ |
| | d'85 | 14.50 | 14.50 | 14.50 | 14.50 | |
| | D'85 | 2,210 | 7,760 | 6,190 | 2,690 | |
| 2000 | Population | 217,600 | 794,600 | 610,200 | 259,600 | $d'79 \times \frac{(V/P)\ 2000}{(V/P)\ '79}$ |
| | d2000 | 25.27 | 25.27 | 25.27 | 25.27 | |
| | D2000 | 5,500 | 20,100 | 15,420 | 6,560 | |

(2) Cargo Traffic through the Ports

(tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | 2,210 | | 5,500 | |
| Service Area | 7,760 | 7,760 | 20,100 | 20,100 |
| Sorong Total | 9,970 | 7,760 | 25,600 | 20,100 |
| Jayapura | 6,190 | | 15,420 | |
| Merauke | 2,690 | | 6,560 | |
| Total Irian Jaya | 8,880 | | 21,980 | |

## Table 8.3.15. Vehicles

(1) Number of Registered Motor Vehicle

| | Standard of Living (US$/person) | Registered Motor Vehicle | | | | | Increased number per year | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Irian Jaya | Hinterland | Service Area | Jayapura | Merauke | Hinterland | Service Area | Jayapura | Merauke |
| 1975 | 200.61 | 11,496 | | | | | | | | |
| 76 | 216.62 | 12,635 | | | | | | | | |
| 77 | 222.35 | 14,289 | | | | | | | | |
| 78 | 241.29 | 15,399 | (1980 2,260) | | | | | | | |
| 1985 | 403.59 | 31,690 | 3,710 | 13,060 | 10,390 | 4,530 | 400 | 1,410 | 1,130 | 490 |
| 2000 | 727.25 | 63,860 | 7,410 | 26,950 | 20,690 | 8,817 | 370 | 1,350 | 990 | 420 |

Note: 1. R.M.V. = $99.12\frac{V}{P} - 8,438$ (R = 0.965)
2. Allocated by ratio of inhabitants
3. Estimated by AAGR of registered motor vehicles. ('78 – '85 : 10.86%, '85 – 2000 : 4.78%)

(2) Cargo Traffic through the Port

(tons)

| | | 1985 | | 2000 | |
|---|---|---|---|---|---|
| | | UL | L | UL | L |
| Hinterland | Net Increasing | 4,000 | | 3,700 | |
| | Replacement | 1,860 | | 7,410 | |
| Service Area | Net Increasing | 14,100 | 14,100 | 13,500 | 13,500 |
| | Replacement | 6,510 | 6,510 | 26,950 | 26,950 |
| Total | | 26,470 | 20,610 | 51,560 | 40,450 |
| Jayapura | Net Increasing | 11,280 | | 9,890 | |
| | Replacement | 5,200 | | 20,690 | |
| Merauke | Net Increasing | 4,900 | | 4,210 | |
| | Replacement | 2,270 | | 8,810 | |
| Total | | 23,650 | | 43,600 | |

Note: 1. 1 car = 10 tons
2. Ratio of replacement is estimated 5% in 1985, 10% in 2000.

(f) Chemical products

(f)-1 Cement

The demand for cement is calculated by the same method as with the machinery demand (Table 8.3.16.).

(f)-2 Fertilizer

The volume of fertilizers brought in through the Port is calculated by using the indexes of fertilizer required per estate crop's production (Table 8.3.17.).

Table 8.3.16. Cement

(1) Estimated Demand in Port Distribution Service Area

| | | Hinterland | Service Area | Jayapura | Merauke | Remarks |
|---|---|---|---|---|---|---|
| 1979 | Unloading (A) | 2,192 tons | | | | |
| | Loading (B) | 486 tons | | | | |
| | Estimated Demand (D = A−B) | 1,706 tons | | | | |
| | Population (P) | 126,200 | | | | 122.3 × 1.032 |
| | $d'79 = \frac{D}{P}$ | 13.52 kg/H/Y | | | | |
| 1985 | Population | 152,500 | 534,900 | 426,900 | 185,700 | $d'79 \times \frac{(V/P)\,'85}{(V/P)\,'79}$ |
| | d'85 | 20.98 | 20.98 | 20.98 | 20.98 | |
| | D'85 | 3,200 | 11,200 | 8,960 | 3,900 | |
| 2000 | Population | 217,600 | 794,600 | 610,200 | 259,600 | $d'79 \times \frac{(V/P)\,2000}{(V/P)\,'79}$ |
| | d2000 | 37.82 | 37.82 | 37.82 | 37.82 | |
| | D2000 | 8,200 | 30,100 | 23,080 | 9,820 | |

(2) Cargo Traffic through the Port

(tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland | 3,200 | | 8,200 | |
| Service Area | 11,200 | 11,200 | 30,100 | 30,100 |
| Sorong Total | 14,400 | 11,200 | 38,300 | 30,100 |
| Jayapura | 8,960 | | 23,080 | |
| Merauke | 3,900 | | 9,820 | |
| Irian Jaya Total | 12,860 | | 32,900 | |

## Table 8.3.17. Fertilizer

(1) Required Fertilizer per Estate Crop's Production

| | Yield Rate (ton/ha) | | Required Fertilizer (ton/ha) | Fertilizer Rate (RF/Prod.) | |
|---|---|---|---|---|---|
| | 1985 | 2000 | | 1985 | 2000 |
| Coconut | 0.717 | 1.307 | 1.45 | 2.02 | 1.11 |
| Clove | 0.272 | 0.272 | 0.10 | 0.37 | 0.37 |
| Nutmeg | 0.216 | 0.216 | 0.04 | 0.19 | 0.19 |
| Cocoa | 0.133 | 0.249 | 0.13 | 0.98 | 0.52 |
| Rubber | 0.563 | 0.563 | 0.45 | 0.80 | 0.80 |
| Coffee | 0.169 | 0.391 | 0.25 | 1.48 | 0.64 |
| Others | 0.090 | 0.444 | 0.04 | 0.45 | 0.09 |

(2) Required Fertilizer

(tons)

| | | 1985 | 2000 |
|---|---|---|---|
| Coconut | Hinterland | 8,570 | 17,070 |
| | Service Area | 16,480 | 32,880 |
| | Jayapura | 19,590 | 39,070 |
| | Merauke | – | – |
| | Total | 44,640 | 89,020 |
| Clove | Hinterland | 90 | 260 |
| | Service Area | 430 | 1,200 |
| | Jayapura | 330 | 910 |
| | Merauke | – | – |
| | Total | 850 | 2,370 |
| Nutmeg | Hinterland | | |
| | Service Area | 320 | 570 |
| | Jayapura | | |
| | Merauke | | |
| | Total | 320 | 570 |
| Cocoa | Hinterland | | |
| | Service Area | 470 | 1,270 |
| | Jayapura | 100 | 1,380 |
| | Merauke | | |
| | Total | 570 | 2,650 |

| | | 1985 | 2000 |
|---|---|---|---|
| Coffee | Hinterland<br>Service Area | 220 | 520 |
| | Jayapura<br>Merauke | 220 | 510 |
| | Total | 440 | 1,030 |
| Rubber & Others | Hinterland<br>Service Area | 180<br>820 | 580<br>2,780 |
| | Jayapura<br>Merauke | 620<br>300 | 2,100<br>1,020 |
| | Total | 1,920 | 6,480 |
| Total | Hinterland<br>Service Area | 8,840<br>18,740 | 17,910<br>39,220 |
| | Jayapura<br>Merauke | 20,860<br>300 | 43,970<br>1,020 |
| | Total | 48,740 | 58,150 |

(3) Production Consumption Balance

(tons)

| | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | Production (A) | Consumption (B) | A−B | Production (A) | Consumption (B) | A−B |
| Hinterland<br>Service Area | | 8,840<br>18,740 | ▲8,840<br>▲18,740 | | 17,910<br>39,220 | ▲17,910<br>▲39,220 |
| Jayapura<br>Merauke | | 20,860<br>300 | ▲20,860<br>▲300 | | 43,970<br>1,020 | ▲43,970<br>▲1,020 |
| Total Irian Jaya | | 48,740 | ▲48,740 | | 102,120 | ▲102,120 |

(4) Cargo Traffic through the Ports

(tons)

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | UL | L | UL | L |
| Hinterland<br>Service Area | 8,840<br>18,740 | 18,740 | 17,910<br>39,220 | 39,220 |
| Sorong Total | 27,580 | 18,740 | 57,130 | 39,220 |
| Jayapura<br>Merauke | 20,860<br>300 | | 43,970<br>1,020 | |
| Total Irian Jaya | 48,740 | 18,740 | 102,120 | 39,220 |

(g) Other cargo

Other cargoes accounted for about 52 percent of the total volume of cargo handled in 1979. This is probably because they include:

1. Items not specified in the statistics of 1979, such as other crops, estate crops and fertilizer.
2. The cargoes whose contents can not be specified because of faulty reports.

Although it is difficult to estimate statistical errors for 1985 and 2000, they could be assumed to be about 5 percent in 1985 and about 20 percent in 2000.

(3) Estimation of Cargo Handled at Private Wharves

The volume of cargo handled at private wharves, such as logs, crude oil and fuel oil, is determined in order to estimate the total number of calling ships, which, in turn is related to the port revenues.

(a) Logs

In view of the government policy of holding down the export of logs, the export of logs for 1985 and 2000 is estimated to be the same level as in 1979, i.e., 50,000 $m^3$.

As to logs bound for other provinces, the total volume is shown in Table 8.2.30. and the allotment to Sorong Port is calculated from ratio of the hinterland area.

1985: 52,210 $m^3$ x 0.099 = 5,170 $m^3$ ≒ 6,200 tons
2000: 488,450 $m^3$ x 0.099 = 48,360 $m^3$ ≒ 57,900 tons

Table 8.3.18. Production and Consumption of Logs and Sawn Timber in Irian Jaya

($m^3$)

| | 1978 | 1985 | 2000 | Remarks |
|---|---|---|---|---|
| *Production* | 89,820 | 274,750 | 2,570,830 | |
| Export | 30,580 | 43,950 | 90,540 | |
| Regional Consumption | 8,040 | 74,190 | 1,014,920 | |
| Sawn Timber | 20,480 | 62,640 | 586,150 | waste rate 0.60 |
| (Log base) | (34,140) | (104,400) | (976,920) | |
| Outward Logs | 17,060 | 52,210 | 488,450 | |

Note: Source Table 8.2.30.

(b) Crude oil and oil products

Until 1985, all crude oil produced will be shipped elsewhere outside, presumably to foreign countries.

From 1986, the oil refinery in the Sorong area is expected to be in operation and its treating capacity is likely to reach 100,000 BPSD in 2000. Thus, about 4,670,000 tons will be locally treated in 2000, as indicated in Table 8.2.34.

Table 8.3.19. Crude Oil Production and Treatment

(x $10^3$ tons)

| | 1985 | 2000 | Remarks |
|---|---|---|---|
| Crude oil production | 5,100 | 5,100 | |
| Crude oil treating capacity (BPSD) | 0 | 100,000 | |
| Treated crude oil | 0 | 4,668 | Table 8.2.34. |
| Oil products | 0 | 4,596 | |

The volume of crude oil and oil products to be handled by Sorong Port, depends on 1) location of the oil refinery and 2) system of producing and distributing crude oil. So, the handling in 2000 is not specified in the table.

The demand for oil products (fuel oil) is estimated in Table 8.3.20. from the apparent consumption in the Sorong area in 1979. Oil products needed in the hinterland seem likely to be handled at the private pier of Pertamina.

Table 8.3.20. Fuel Oil

Estimated Demand in Port Distribution Service Area

| | | Hinterland | Service Area | Remarks |
|---|---|---|---|---|
| 1979 | Unloading (A) | 7,992 tons | | |
| | Loading (B) | 938 tons | | |
| | Estimated Demand (D = A−B) | 7,054 tons | | AAGR '85/'80 10.42% |
| | Registered Car | 2,050 No. | | No. '80 = 2,260 |
| | $d'79 = \frac{D}{No.}$ | 3,440 kg/No. | | |
| 1985 | Registered Car | 3,710 No. | 13,020 | $d'79 \times \frac{(V/P)'85}{(V/P)'79}$ |
| | d'85 | 5,340 | 5,340 | |
| | D'85 | 19,810 | 69,530 | |
| 2000 | Registered Car | 7,410 | 26,950 | |
| | $d_{2000}$ | 9,620 | 9,620 | |
| | $D_{2000}$ | 71,300 | 259,300 | |

(c) Marine products

Marine products are landed at the private facilities of fishery companies, but it is assumed that public wharves will handle 50 percent of their shipment.

(4) Results of Estimation

1) General conclusion

The results of estimation are summarized in Table 8.3.21.

According to the macro forecast, the cargo traffic through Sorong Port will amount to 300,000 – 320,000 tons in 1985 and 510,000 – 790,000 tons in 2000. The total amount in 1985 by micro estimation is equal to the minimum value of macro forecasting, but in 2000 the

Table 8.3.21. Projection of Cargo Traffic through the Port of Sorong

| | 1979 (tons) | | | | | 1985 ( x $10^3$ tons) | | | | | 2000 (x $10^3$ tons) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Foreign Trade | | Domestic Trade | | Total | Foreign Trade | | Domestic Trade | | Total | Foreign Trade | | Domestic Trade | | Total |
| | UL | L | UL | L | | UL | L | UL | L | | UL | L | UL | L | |
| Foodstuffs | | | | | | | | | | | | | | | |
| Rice | 11,695 | | 725 | 4,123 | 16,543 | | | 15 | 12 | 27 | | | 51 | 38 | 89 |
| Wheat | | | 356 | 69 | 425 | | | 3 | 3 | 6 | | | 5 | 4 | 9 |
| Sugar | | | 1,510 | 10 | 1,520 | | | 9 | 7 | 16 | | | 13 | 10 | 23 |
| Marine Prod. | | 6,138 | 5,131 | 200 | 11,469 | | 5 | | 7 | 12 | | 20 | | 25 | 45 |
| Livestock | | 70 | 235 | | 305 | | | 1 | 1 | 2 | | | 1 | 1 | 2 |
| Other crops | * | * | * | * | * | | | | 43 | 43 | | | 21 | 27 | 48 |
| Estate Crops | | * | * | * | * | | 25 | 21 | | 46 | | 97 | 81 | | 178 |
| Sawn Timber | | | 419 | 634 | 1,053 | | | 1 | | 1 | | | 95 | 146 | 241 |
| Machinery | | | 1,279 | 100 | 1,379 | | | 10 | 8 | 18 | | | 26 | 20 | 46 |
| Vehicles | | | 620 | | 620 | | | 26 | 21 | 47 | | | 51 | 40 | 91 |
| Chemical Prod. | | | | | | | | | | | | | | | |
| Cement | | | 2,192 | 486 | 2,678 | | | 14 | 11 | 25 | | | 38 | 30 | 68 |
| Fuel Oil | | | 7,992 | 938 | 8,930 | | | | | | | | | | |
| Fertilizer | * | | * | * | * | | | 27 | 19 | 46 | | | 57 | 39 | 96 |
| Others | 15,862 | 974 | 21,381 | 9,579 | 47,796 | | | 3 | 8 | 11 | | 23 | 71 | 70 | 164 |
| Total | 27,557 | 7,182 | 41,840 | 16,139 | 92,718 | | 30 | 130 | 140 | 300 | | 140 | 510 | 450 | 1,100 |
| Logs ($M^3$) | | 50,830 | 168 | 691 | | | 50 | | 5 | | | 50 | | 48 | |
| Petroleums (x $10^3$ KL) | | | | | | | | | | | | | | | |
| Crude Oil | | 3,199 | | | | | 5,100 | | | | | | | | |
| Others | | | 62 | | | | | 20 | | | | | 71 | | |

Note: 1. 1979 is based on STP of Sorong.
2. * are included in others.
3. Figures for 1985 and 2000 have been rounded off to the nearest 1,000 tons, or if less than 1,000 tons, raised to 1,000 tons.

volume by micro estimation is larger by about 290,000 tons than that by the macro forecast. This is because the macro forecast is based on the actual trend of cargo traffic of the last few years, and does not reflect the change in functions at the Port of Sorong.

2) Comparison of forecasts with UNDP's Report and Pelita III traffic assumptions.

The results of the above mentioned forecast is compared with the forecasts of UNDP's Report (1976) and Pelita III in Table 8.3.22.

Table 8.3.22. Comparison of Forecast Traffic

(x $10^3$ tons)

| | 1970 | 1975 | 1978 | 1980 | 1983 | 1985 |
|---|---|---|---|---|---|---|
| New Forecast | | 131.7 | 165.3 | | | 300.0 |
| UNDP's Report [1] | 26.7 | 102.9 | | 160.0 | | 235.0 |
| Pelita III[2] | | 138.8 | | 174.2 | 215.0 | |

Source: 1. EIU/Economic Study for Sea Transportation in Irian Jaya, 1976.
2. Kanwil IX/Forecast Cargo Flow 1978 s/d 1983.

3) Volume of cargo to be handled in the province of Irian Jaya

The volume of cargo to be handled by the six major ports in Irian Jaya in 1985 is forecasted as in Table 8.3.24. The sum total is expected to reach 700,000 tons in that year.

It represents only the inter-regional flow at the major ports and does not include secondary transportation from these ports to the service areas by local ships and others.

By macro estimate, the volume of cargo to be handled by all ports in Irian Jaya in 1985 will be 1,020,000 to 1,090,000 tons. The share of the six major ports in the past five years averaged 86 percent. At this ratio, the volume of cargo to be handled by these ports in1985 will be about 880,000 to 940,000 tons. From the difference of 180,000 to 240,000 tons between the two totals, the average volume of secondary transportation from each port to its hinterland is estimated at 30,000 to 40,000 tons.

Table 8.3.23. Ratio of Six Major Ports

| Year | All Ports (A) | Six Ports (B) | B/A |
|---|---|---|---|
| 1974 | 450,812 | 338,801 | 0.75 |
| 1975 | 426,561 | 380,415 | 0.89 |
| 1976 | 495,226 | 456,770 | 0.92 |
| 1977 | 518,583 | 457,138 | 0.88 |
| 1978 | 604,069 | 540,068 | 0.89 |
| Average | | | 0.86 |

Table 8.3.24. Volume of Cargo Handled at Six Major Ports (1985)

(x $10^3$ tons)

| | Sorong | | | | | Service Area | | | Jayapura | | | Merauke | | | Total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Foreign | | Domestic | | Total | Domestic | | Total | Domestic | | Total | Domestic | | Total | Foreign | | Domestic | | Total |
| | UL | L | UL | L | | UL | L | | UL | L | | UL | L | | UL | L | UL | L | |
| Foodstuffs | | | | | | | | | | | | | | | | | | | |
| Rice | | | 15 | 12 | 27 | 12 | | 12 | 4 | | 4 | 5 | | 5 | | | 36 | 12 | 48 |
| Wheat | | | 3 | 3 | 6 | 3 | | 3 | 2 | | 2 | 1 | | 1 | | | 9 | 3 | 12 |
| Sugar | | | 9 | 7 | 16 | 7 | | 7 | 5 | | 5 | 2 | | 2 | | | 23 | 7 | 30 |
| Marine Prod. | | 5 | | 7 | 12 | | | | | | | | | | | 5 | | 7 | 12 |
| Live Stock | | | 1 | 1 | 2 | 1 | | 1 | 1 | | 1 | 1 | | 1 | | | 4 | 1 | 5 |
| Other Crops. | | | | 43 | 43 | 9 | 55 | 64 | 67 | | 67 | 23 | | 23 | | | 99 | 98 | 197 |
| Estate Crops | | 25 | 21 | | 46 | | 10 | 10 | | 10 | 10 | 1 | 1 | 2 | | 25 | 22 | 21 | 68 |
| Sawn Timber | | | 1 | | 1 | 5 | 6 | 11 | 3 | | 3 | | 13 | 13 | | | 9 | 19 | 28 |
| Machinery | | | 10 | 8 | 18 | 8 | | 8 | 6 | | 6 | 3 | | 3 | | | 27 | 8 | 35 |
| Vehicles | | | 26 | 21 | 47 | 21 | | 21 | 16 | | 16 | 7 | | 7 | | | 70 | 21 | 91 |
| Chemical Prod. | | | | | | | | | | | | | | | | | | | |
| Cement | | | 14 | 11 | 25 | 11 | | 11 | 9 | | 9 | 4 | | 4 | | | 38 | 11 | 49 |
| Fertilizer | | | 27 | 19 | 46 | 19 | | 19 | 21 | | 21 | 1 | | 1 | | | 68 | 19 | 87 |
| Others | | | 3 | 8 | 11 | 4 | 9 | 13 | 6 | | 6 | 2 | 6 | 8 | | | 15 | 23 | 38 |
| Total | | 30 | 130 | 140 | 300 | 100 | 80 | 180 | 140 | 10 | 150 | 50 | 20 | 70 | | 30 | 420 | 250 | 700 |

### 8.3.2. Forecast of Passenger Traffic Through the Port

As the economic activities expand, the passenger flow will also increase and the number of passengers in future can be forecast by the following indicies.

(1) Index of Economic Activities

The most representative index of economic activities is GRDP, and the passenger flow through the port can be estimated by following function.

$$PF = aV + b$$

where,
- PF : passenger flow
- V : GRDP
- a and b: coefficient

$$PF_I = 92.08\ V_I - 6{,}295.10 \qquad (R = 0.867)$$

and

$$PF_S = 14.28\ V_I + 3{,}540.03 \qquad (R = 0.635)$$

where,
- $PF_I$ : passenger flow through all the ports in Irian Jaya (people)
- $PF_S$ : passenger flow through Sorong Port (people)
- $V_I$ : GRDP in whole Irian Jaya (x $10^6$ US$ in 1975 constant price)

(2) Index of Standard of Living

The standard of living also affects the passenger flow, and the passenger flow through the port can be estimated by following function.

$$PF = q\frac{V_I}{P_I} + \gamma$$

where,
- $P_I$ : population in whole Irian Jaya
- q and $\gamma$ : coefficient

$$PF_I = 110.43\frac{V}{P} - 1{,}354.04 \qquad (R = 0.857)$$

$$PF_S = 18.51\ \frac{V}{P} + 1{,}704.31 \qquad (R = 0.678)$$

(3) Results of Forecast

The results from each technique mentioned above are summarized in Table 8.3.26. As is seen in this table, passenger flow through Sorong Port is estimated about 14,700 – 16,600 people in 1985 and about 20,200 – 30,400 people in 2000.

Table 8.3.25. Basis Data Series of Passenger Flow

| Year | GRDP ($V_I$) ($x10^6$ US$) | Population ($P_I$) ($x10^3$ people) | Passenger Flow (people) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Irian Jaya | | | Sorong | | |
| | | | Total | Dis. | Em. | Total | Dis. | Em. |
| 1974 | 358.48 | 995.1 | 24,865 | 14,727 | 10,138 | 7,046 | 4,210 | 2,836 |
| 1975 | 496.13 | 1,015.3 | 47,056 | 25,827 | 21,229 | 14,023 | 7,239 | 6,784 |
| 1976 | 575.89 | 1,039.9 | 39,758 | 21,725 | 18,033 | 11,724 | 5,734 | 5,990 |
| 1977 | 612.30 | 1,064.7 | 46,408 | 24,503 | 21,905 | 11,013 | 5,531 | 5,482 |
| 1978 | 647.13 | 1,090.3 | 58,117 | 32,700 | 25,417 | 12,311 | 6,640 | 5,671 |
| 1985 | 914.17 | 1,300 | | | | | | |
| 2000 | 1,877.16 | 1,882 | | | | | | |

Table 8.3.26. Results of Passenger Flow Forecast

| Year | Irian Jaya | | Sorong | |
|---|---|---|---|---|
| | V | V/P | V | V/P |
| 1978 | 58,117 | | 12,311 | |
| 1985 | 78,000 | 64,000 | 16,600 | 14,700 |
| 2000 | 167,000 | 97,000 | 30,400 | 20,200 |

## 8.3.3. Estimation of the Number of Ships Calling at the Port

**(1) Number of Ships using Public Wharves**

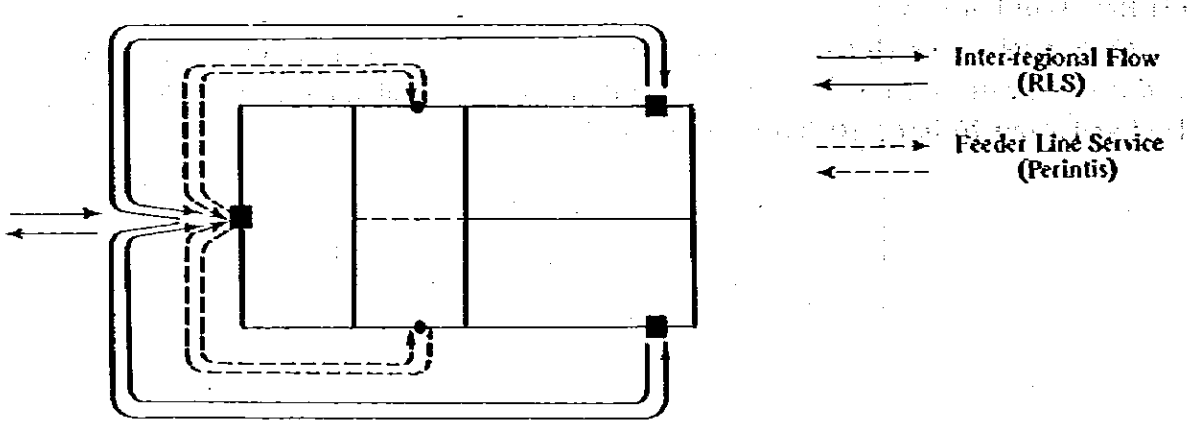
The number of ships using public wharves is estimated from the volume of public cargo.

The movement of cargo by routes is shown in Fig. 8.3.2.

1) Movement between the areas of Sorong, Jayapura and Merauke is carried out by large ships represented by RLS.

2) Secondary transportation between Sorong Port and its service area is carried out by medium ships represented by Perintis.

Fig. 8.3.2. Flow of Cargo



## Table 8.3.27. Cargo Flow by Kinds of Ship

(x $10^3$ tons)

| Year | 1985 | | | | | | | | | | 2000 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kind of Ship | RLS (outward) | | | RLS (inward) | | | Perintis | | Foreign | | RLS (outward) | | | RLS (inward) | | | Perintis | | Foreign | |
| | Other Province →S. | S. →Jay. | S. →Mer. | S.→ Other Province | Jay. →S. | Mer. →S. | Out. | In. | Ex. | Im. | Other Province →S. | S.→ Jay. | S.→ Mer. | S.→ Other Province | Jay. →S. | Mer. →S. | Out. | In. | Ex. | Im. |
| Foodstuffs | | | | | | | | | | | | | | | | | | | | |
| Rice | 15 | | | | | | 12 | | | | 51 | | | | | | 38 | | | |
| Wheat | 3 | | | | | | 3 | | | | 5 | | | | | | 4 | | | |
| Sugar | 9 | | | | | | 7 | | | | 13 | | | | | | 10 | | | |
| Marine Prod. | | | | 7 | | | | | 5 | | | | | 25 | | | | | 20 | |
| Live Stock | 1 | | | | | | 1 | | | | 1 | | | | | | 1 | | | |
| Other Crops | | 12 | 23 | | | | 9 | | | | | | | 21 | | | 6 | 21 | | |
| Estate Crops | | | | | 10 | 1 | | 10 | 25 | | | | | | 41 | 2 | | 38 | 97 | |
| Sawn Timber | | | | | | | | 1 | | | | | | 146 | | | | 95 | | |
| Machinery | 10 | | | | | | 8 | | | | 26 | | | | | | 20 | | | |
| Vehicles | 26 | | | | | | 20 | | | | 51 | | | | | | 40 | | | |
| Chemical Prod. | | | | | | | | | | | | | | | | | | | | |
| Cement | 14 | | | | | | 11 | | | | 38 | | | | | | 30 | | | |
| Fertilizer | 27 | | | | | | 19 | | | | 57 | | | | | | 39 | | | |
| Others | 1 | 1 | 1 | 1 | 1 | | 5 | 1 | | | 36 | | | 38 | 9 | | 32 | 26 | 23 | |
| Sub Total | 106 | 13 | 24 | 8 | 11 | 1 | 95 | 12 | 30 | | 278 | | | 230 | 50 | 2 | 220 | 180 | 140 | |
| Total | 163 | | | | | | 107 | | 30 | | 560 | | | | | | 400 | | 140 | |

Notes: 1. S. = Sorong, Jay. = Jayapura, M. = Merauke,
2. Out. = Outward, In. = Inward
3. Ex. = Export, Im. = Import

However, it is not realistic to assume that the differentiation of ship functions according to the character of cargoes (RLS for inter-regional flow and Perintis for feeder line service) will be completed by 1985. Therefore, the number of ships calling for purposes other than foreign trade is estimated on the assumption that the functional differentiation will be 90 percent complete for inter-regional flow and 45 percent complete for feeder line service.

Moreover, there will not be full containerization either in 1985 or 2000. Only some cargoes will be carried in containers; no full container ship are expected to call the port in 2000.

Table 8.3.28. Forecast of Calling Vessels (Public Wharves)

| Route | Cargo (x $10^3$ tons) | | Loading Factor | Estimated DWT (x $10^3$) | |
|---|---|---|---|---|---|
| | 1985 | 2000 | | 1985 | 2000 |
| Foreign Trade | 30 ( 30) | 140 | 0.388 | 75 | 465 |
| Inter-region | 163 (147) | 560 | 0.172 | 855 | 4,590 |
| Feeder Service | 107 ( 65) | 400 | 0.345 | 189 | 1,925 |
| | 300 (242) | 1,100 | – | 1,119 | 6,980 |

| Route | Average Type (DWT) | | Ship Calls (No.) | |
|---|---|---|---|---|
| | 1985 | 2000 | 1985 | 2000 |
| Foreign Trade | 8,500 | 10,000 | 10 | 50 |
| Inter-region | 2,400 | 5,000 | 355 | 920 |
| Feeder Service | 760 | 1,000 | 245 | 1,930 |
| | – | – | 610 | 2,900 |

Notes: 1. The figures in brackets for 1985 in the cargo space indicates that part of the volume of cargo on each route handled by the average ship type. This rate is 90 percent for inter-regional flow, the remaining 10 percent being by ships intended for feeder line service.
A rate of 45 percent is used for feeder line service from the ratio of the volume of domestic trade cargo on each route in the total volume of cargo during 1974–1979 (9 percent for Perintis and 20 percent for Local + Rakyat).

Inter regional flow : $163 \times 0.9 = 147$

Feeder line service : $107 \times \frac{9}{20} + 163 \times (1 - 0.9) = 65$

2. The loading factors and the average types are represented as follows:

Foreign trade : Ocean shipping (including S'pore shipping)
Inter-regional flow : RLS and non-RLS
Feeder line service : Perintis

3. The maximum value during 1974–1979 is used for future loading factors by routes. As for average types, the following is used:

1985 : the maximum type in the past (1974–1979)
2000 : the most popular type of vessels

From the above, 610 large ships of 760 DWT or more on average (10 for foreign trade, 355 for inter-regional flow and 245 for feeder line service) will use public wharves in 1985. This is about 2.7 times the total of 226 in 1978.

(2) Number of Ships using Private Mooring Facilities

The number of ships using private mooring facilities or loading points can be estimated from the volume of cargoes that are privately handled. However, it is not estimated for 2000 because the volume of privately handled cargoes then will, as stated in 8.3.1.3), greatly vary, depending on where the oil refinery will be located.

Table 8.3.29. Number of Ships Using Private Mooring Facilities

| | Cargo (x $10^3$ tons) | | Loading Factor (tons/DWT) | DWT (x$10^3$ DWT) | Average Type (DWT) | Ship Call (No) |
|---|---|---|---|---|---|---|
| | 1979 | 1985 | 1985 | 1985 | 1985 | 1985 |
| Logs | 61 | 61 | 1.000 | 61 | 5,000 | 13 |
| Marine Products | | | | | | |
| Export | – | 6 | 0.325 | 19 | 880 | 22 |
| Outward | – | 7 | 0.328 | 22 | 880 | 25 |
| Crude Oil | 3,199 | 5,100 | 1.000 | 5,100 | 60,000 | 85 |
| Pet.Products | 65 | 182 | 0.546 | 333 | 6,000 | 56 |

Notes: 1. Logs $1m^3$ = 0.835 tons.
2. The maximum value during 1974–1979 is used for future loading factors. Loading factor of shrimp carrier for Japan as the export of marine products, and 1.000 for Logs and Crude Oil.
3. As for average types, the maximum type during 1974–1979 is used.

# Chapter 9.
# HANDLING CAPACITY AND PORT CONGESTION

# CHAPTER 9. HANDLING CAPACITY AND PORT CONGESTION

## 9.1. Past Record of Cargo Handling Capacity

The past record of cargo handling capacity (throughput of wharf) are shown in the following table.

Table 9.1.1. Cargo Throughput 1974 to 1979

| Year | Throughput (Ton/Meter) | Length of Wharf (Meter) | Cargo Volume Handled at Public Wharf (Min.) |
|---|---|---|---|
| 1974 | 670 | 132 | 88,660 |
| 1975 | 740 | 132 | 98,270 |
| 1976 | 650 | 132 | 85,620 |
| 1977 | 710 | 132 | 95,650 |
| Average 1974–1977 | 700 | 132 | 92,050 |
| 1978 | 330 | *222 | 72,260 |
| 1979 | 330 | 252 | 83,800 |

Source: Table 3.1.16.
Note: 1) The cargo volume handled at the public wharf is estimated as the minimum values.
2) The concrete wharf with its length of 120 m was introduced from March, 1978. Therefore, such introduction and commencement are considered in the length of wharf in 1978.

## 9.2. Future Cargo Handling Capacity

For the future handling capacity of wharf, the following factors are thought to have the greatest influence:

1) Cargo handling capacity of dock workers
2) Future vessel type & number of calls
3) Future packing style and loading & unloading cargo by vessel.

However, since the above 3 factors are mutually related and difficult to foresee at present, the following method of estimation is employed. Regarding the future vessel type, drastic change is not foreseeable in the near future. Even containerization at the port is not supposed to have much effect until the year of 2000, judging from the study in Singapore.

Table 9.2.1. Average DWT Singapore to West Irian

| Destination | 1978 | | | 1979 | | |
|---|---|---|---|---|---|---|
| | Average DWT | | Cargo Volume (tons) | Average DWT | | Cargo Volume (tons) |
| | Indonesian | Singapore | | Indonesian | Singapore | |
| Jayapura | 1,700 | 5,600 | 3,440 | 7,000 | 3,900 | 4,660 |
| Sorong | 5,800 | 5,600 | 12,260 | 11,600 | 3,600 | 11,380 |
| Biak | 1,100 | 1,400 | 1,210 | 7,100 | 2,500 | 3,060 |
| Fak-Fak | – | 1,400 | 600 | – | 2,500 | 140 |
| Manokwari | 1,300 | 2,710 | 1,040 | 4,800 | – | 500 |
| Merauke | – | 1,400 | 340 | – | – | – |

Source: Indonesian Embassy in Singapore.
Note: Indonesian and Singapore in Average DWT mean the respective national flag ships.

Accordingly, the existing vessel type and cargo style will continue until 2000.

The improvement of the cargo handling capacity, on the other hand, is possible in future. Such improvement will be incorporated in estimating the future handling capacity. Accordingly, the target values of Pelita III are applied in the Master Plan as follows:

Table 9.2.2. Port Handling Target Values of Throughput of Wharf

(tons/m)

| Class | Target Value |
|---|---|
| over 1,000 thousand tons of cargo/year | 900 |
| 500 to 1,000 thousand tons of cargo/year | 800 |
| 250 to 500 thousand tons of cargo/year | 700 |
| less than 250 thousand tons of cargo/year | 450 |

Source: National Pelita III

## 9.3. Analysis of Present Conditions

### (1) Ships Covered by Analysis

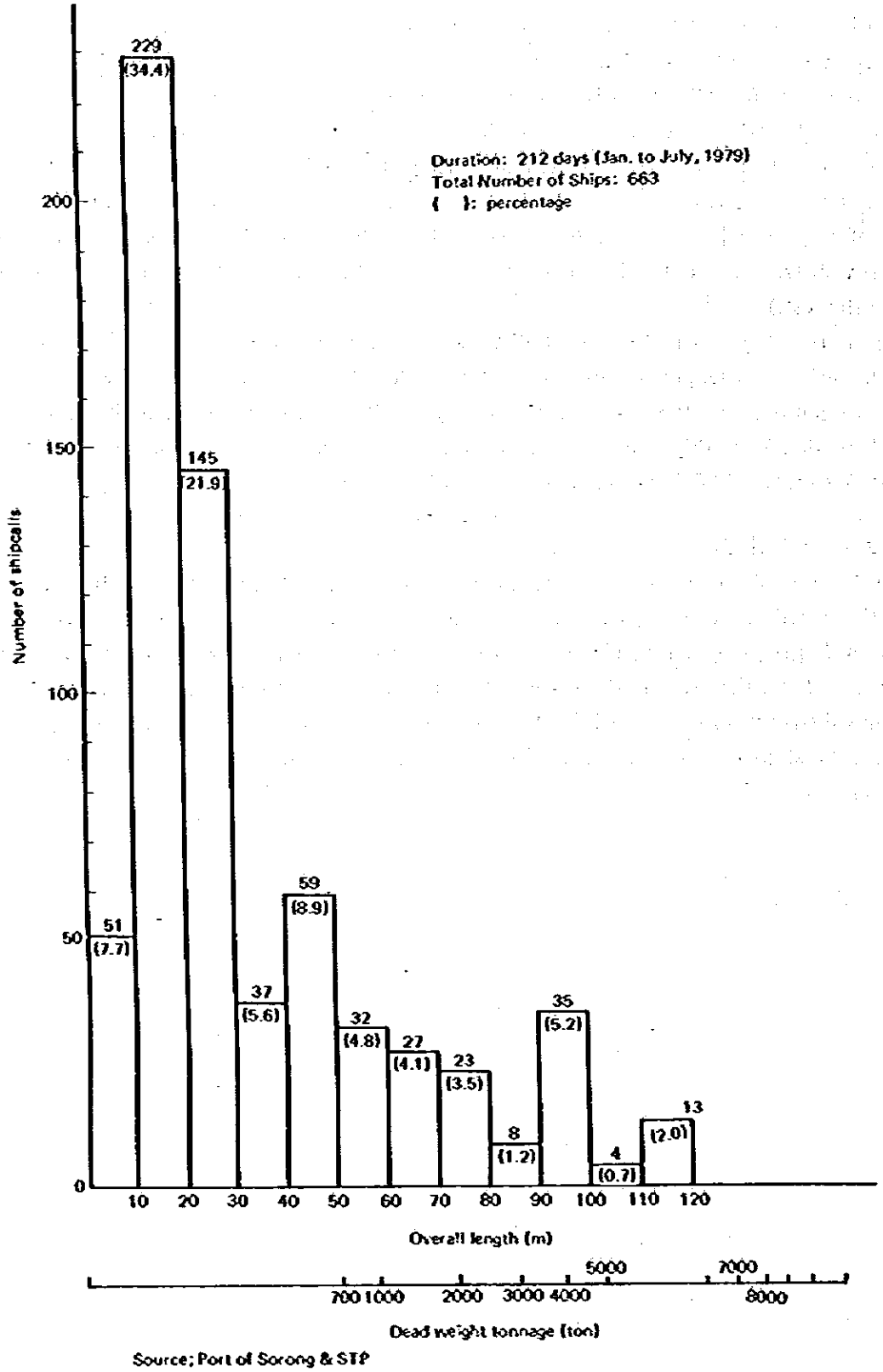
Fig. 9.3.1. shows the relation between the number and lengths of the ships which used the Port of Sorong from the original data of the 212-day period from January to July in 1979 (Source; Sorong Port & STP). A fairly large number of ships calling at this port are not berthed but merely call for the purpose of oil bunkering, water supply or repair. Since sufficient anchorage can be secured in the port area of Sorong due to its topographical features, ships calling at the port without using its public berths were excluded from the scope of the analysis. The length of 56 ships were unknown because of incomplete statistical data. So, these ships were proportionally distributed to the length of each ship. (Counting fractions over 1/2 as one and disregarding the rest.)

As is clear from Fig. 9.3.1, 462 out of all the ships arrived at Sorong Port, or 69.6 percent of the total 663 ships, had lengths of less than 40 m while 201 others, representing 30.4 percent, had lengths of more than 40 m. This analysis only handled ships with the lengths of 41 m or more, which require large shipping costs. Moreover, 54 ships, whose staying time was unknown, were excluded; so it was 147 ships that were covered by this analysis.

### (2) Distribution of Arrivals

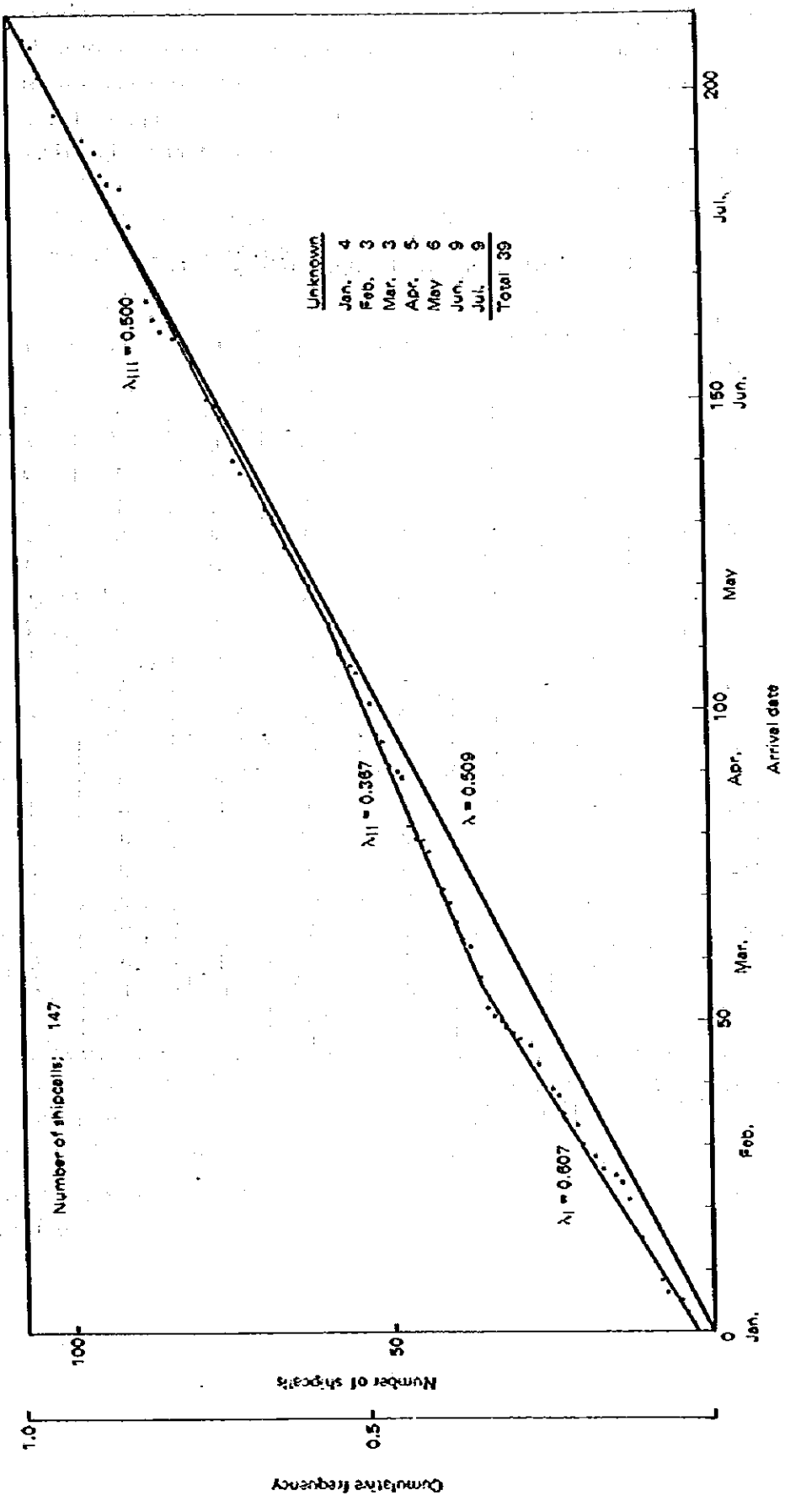
Fig. 9.3.2. shows the cumulative frequency of ships calling at Sorong Port. As is clear from Fig. 9.3.2, the distribution of ships calling at the port shows considerable seasonal fluctuations, particularly in January to March. However, as it can be seen from past examples in Japan and some other countries, the arriving ships are distributed in Poisson's distribution pattern. Therefore, Poisson's distribution is assumed for Sorong Port and seasonal fluctuations are disregarded. In Fig. 9.3.2, 39 ships (monthly average of slightly less than 6) are ignored since their arriving times are unknown.

Fig. 9.3.1. Overall Length and Number of Shipcalls




Source; Port of Sorong & STP

Fig. 9.3.2. Cumulative Frequency of Arriving Ships



(3) Records on Staying Time of Vessels

Table 9.3.1. shows the distribution of staying time of the 147 ships covered by this analysis. The average staying time was 59.4 hours. It includes ships with records only on staying dates and lacking records on their exact staying time. Therefore, this figure represents a maximum value. An average staying time differs considerably, depending on whether a ship arrives at or leaves the port in the early morning or in the evening.

Table 9.3.1. Number of Ships and Staying Time

| Staying time (hr) \ Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Total |
|---|---|---|---|---|---|---|---|---|
| 1 – 10 | 4 | 1 | 1 | 0 | 1 | 5 | 3 | 15 |
| 11 – 20 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 21 – 30 | 5 | 5 | 2 | 7 | 7 | 3 | 4 | 33 |
| 31 – 40 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 14 |
| 41 – 50 | 3 | 2 | 2 | 2 | 4 | 3 | 8 | 24 |
| 51 – 60 | 0 | 1 | 1 | 2 | 0 | 1 | 1 | 6 |
| 61 – 70 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| 71 – 80 | 1 | 0 | 1 | 3 | 3 | 3 | 2 | 13 |
| 81 – 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 91 – 100 | 2 | 4 | 2 | 2 | 2 | 3 | 3 | 18 |
| 101 – 110 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 111 – 120 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 5 |
| 121 – 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 131 – 140 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 141 – 150 | 0 | 1 | 2 | 2 | 1 | 0 | 2 | 8 |
| 151 – 160 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 161 – 170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 171 – 180 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 191 – 200 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| 200< | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Total | 24 | 20 | 15 | 79 | 22 | 21 | 26 | 147 |

Note: 1. From Jan. to July, 1979.
2. Ship length is more than 40m.

(4) Estimation of Berthing Time

Since the staying time of ships calling at Sorong Port is inaccurate as stated in (3) and the berthing time of vessels is not available, the average berthing time was estimated by the following method:

1) Equivalent number of berths

Table 9.3.2. shows the equivalent number of berths. First of all, the average length of ships berthed in Sorong Port was calculated from the data of 1975 – 1976.

Table 9.3.2. Equivalent Number of Berths

| | 1975 | 1976 | 1977 | 1978 | 1979 (1–8) |
|---|---|---|---|---|---|
| Equivalent number of berths | 1.6 | 1.5 | 1.5 | 2.8 | 2.9 |

To obtain the equivalent number of berths, the length of the existing berths was divided by the average length of ships plus marginal length of 20 m. The length of the existing berths (of the Wooden Wharf) was 132 m in 1977, and that of the Wooden and Concrete Wharves was 252 m in and after 1978. The number of ships in each year is shown in Table 3.1.16. of the Chapter 3.

2) Estimation of berth occupancy ratio and average berthing time

Fig. 9.3.3 shows the relation between berth occupancy ratio $\rho$, daily ship dealing capacity $\mu$ and the number of equivalent berths S represented in the following formula:

$$\rho = \frac{\lambda}{\mu S}$$

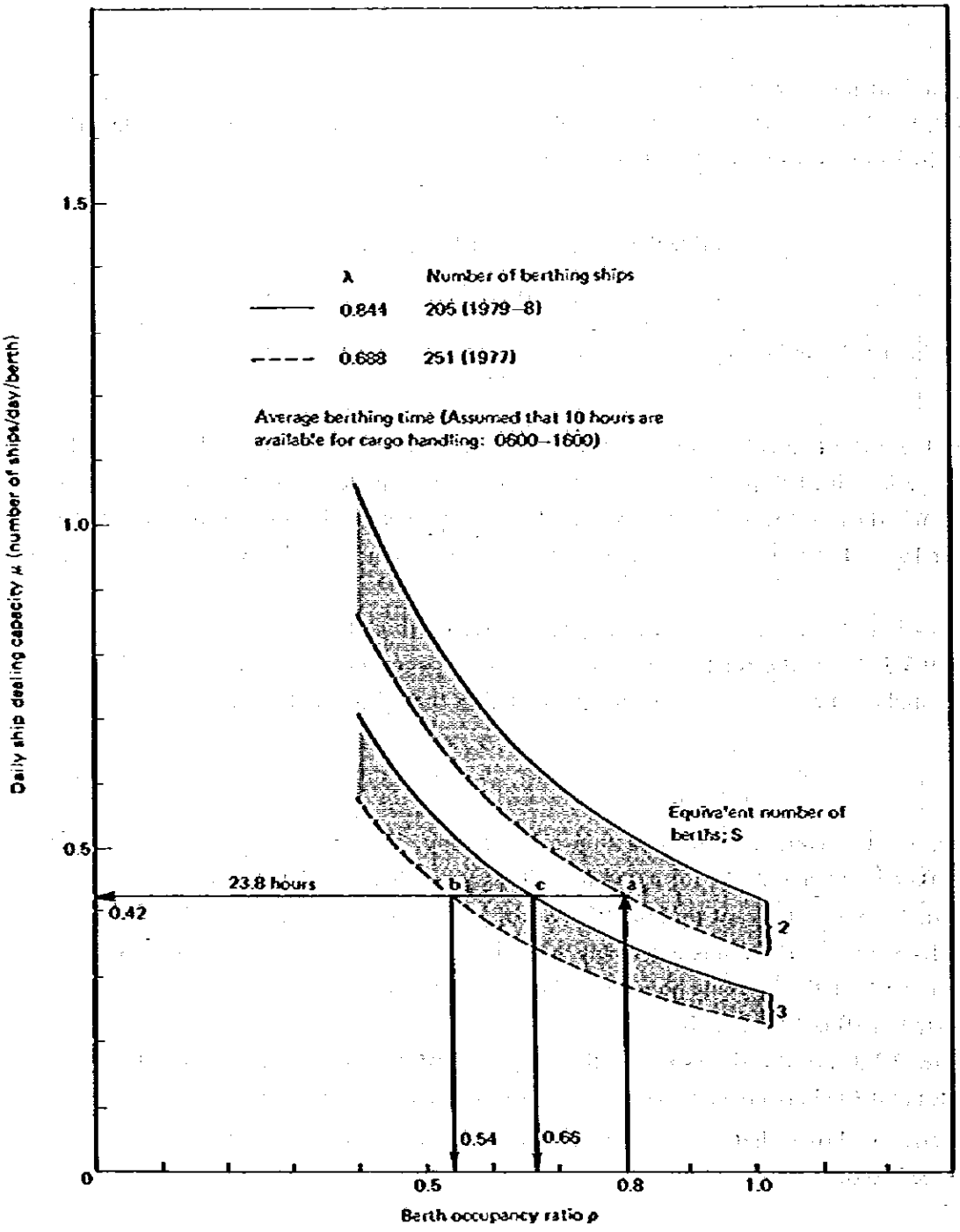
Here, $\lambda$ is the average number of ship calls per day. The broken lines indicate ships in 1977 and $\lambda \doteqdot 0.688$ and $S = 2$. As for $\rho$, $\rho = 0.8$ was assumed because the Concrete Wharf began to be utilized in 1978 and it meant that in 1977, Sorong Port was greatly congested and the occupancy ratio of its Wooden Wharf was extremely high. In this case, $\mu = 0.42$ is obtained from Fig. 9.3.3.

Assuming that the working hours is 10 hours a day (6:00 – 16:00), the average berthing time is calculated as $10/0.42 \doteqdot 23.8$ hr.

In Fig. 9.3.3, point b shows the berth occupancy ratio of 0.54 when $S = 3$ in 1977, and point c indicates that the berth occupancy ratio in 1979 was 0.66 when $S = 3$.

Experience shows that a port begins to be somewhat congested when its berth occupancy ratio exceeds 0.6.

Fig. 9.3.3. Ship Dealing Capacity and Berth Occupancy Ratio in 1979



(5) Distribution of Berthing Time

In Fig. 9.3.4, the average berthing time is 23.8 hours (about 1/2.5 of 59.4 hours) and the berthing time in Table 9.3.1. is shortened by the ratio of 1/2.5 in accordance with the description of (4).

Fig. 9.3.5. shows the cumulative distribution of berthing time. It also shows theoretical curves of Poisson's distribution and Erlang's distribution (phase k = 2). It indicates that the distribution of the average berthing time is close to the Poisson's distribution when the berthing time is less than 30 hours and close to the Erlang's distribution when it is more than 30 hours.

From this analysis, the present conditions of ships arriving and berthing at Sorong Port are assumed as follows:

| | |
|---|---|
| Distribution of arriving time | : Poisson's distribution |
| Distribution of berthing time | : Poisson's distribution or Erlang's distribution (k = 2) |

It should be noted that the accurate statistical data on berthing time of vessels are indispensable for obtaining the accurate output of queuing theory.

Fig. 9.3.4 Number of Berthing Ships and Estimated Berthing Time

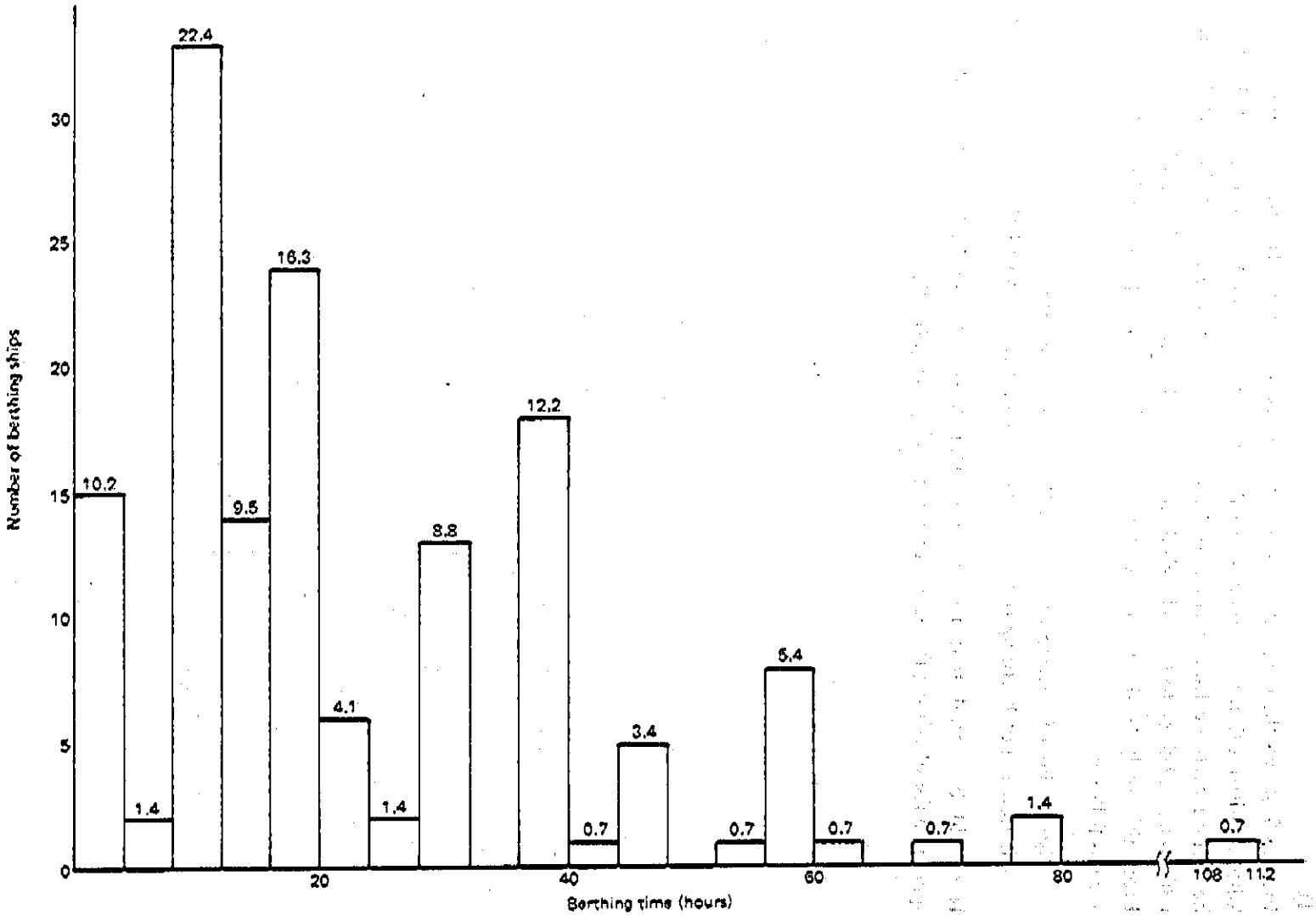


Fig. 9.3.5 Cumulative Frequency of Berthing Time