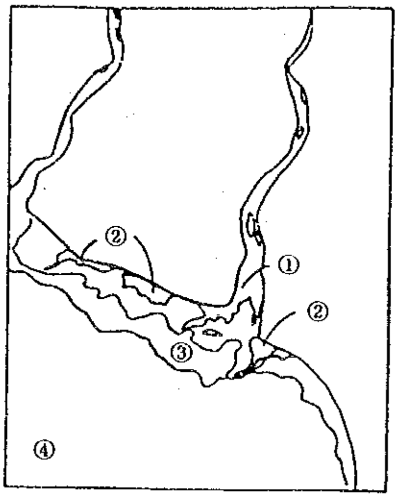
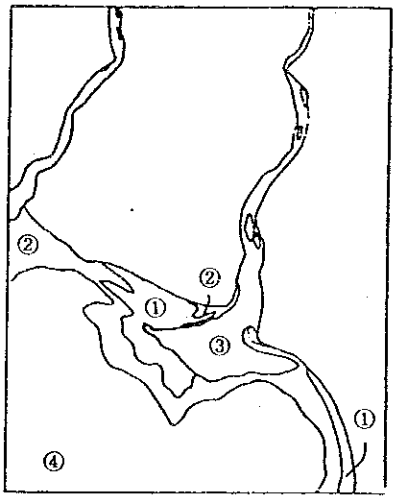
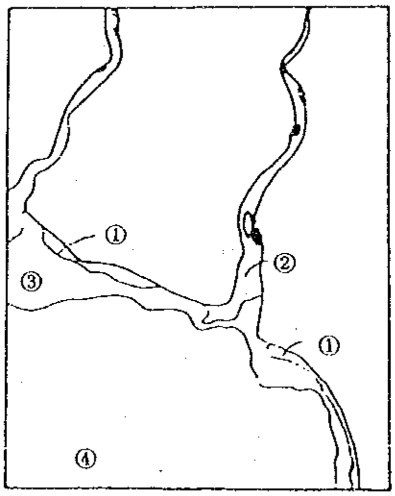
Table II.2.7-2(2) Features of Turbidity Patterns (2)

Landsat Data	Season etc	Feature of Turbidity Pattern	
18 Apr. 1988 (TM)	• rainy • ebb tide	There were clouds over the offing. Relative Turbidity ① very heavy ..... river water ② very heavy ..... coastal water ③ heavy ..... coastal water ④ slight ..... ocean water	
21 Jun. 1988 (TM)	• end of rainy season • flood around high tide	There was a clear front between the river water and coastal water. Relative Turbidity ① very heavy ..... coastal water ② heavy ..... coastal water ③ slight ..... river water ④ slight ..... ocean water	
10 Jul. 1989 (TM)	• end of rainy season • flood around high tide	There were clouds over the sea or haze around the mouth of the Barito River. Relative Turbidity ① very heavy ..... coastal water ② heavy ..... river water ③ slight ..... coastal water ④ slight ..... ocean water	

2-8 Summary of Results

The field survey for natural conditions, oceanographical conditions, and geographical conditions, etc., was commenced on September 10, 1988, and completed on September 10, 1989.

Major data observed are compiled in this report.

The results of the Natural Conditions Survey were utilized in the Numerical Simulations and Hydraulic Model Tests to examine the siltation mechanism and produce countermeasures for the access channel.

Chapter 3 The Present Condition of Siltation in the Access Channel

3-1 Long-term and Wide-ranging Changes in the Sea Bottom

3-1-1 Macroscopic Sea Bed Geography:

The Java Sea, or the Sunda Shelf, was a land area during the glacial lowering of sea levels, which are generally assumed to have reached 70 to 100 m below the present sea level. A chart of the Sunda Shelf is shown in Fig. II.3.1-1.

The most interesting feature of the chart is the bottom topography off the Barito River. The Barito and Kapuas rivers were confluent at a point 100 km offshore of the present river mouths. The extension of the 20 m depth counter towards the south can be explained by the remains of an old flat formed between the rivers, not by sedimentation discharged by the rivers.

The present fan-shaped bar can be understood to have been formed on this old sea bed geography.

An old navigational chart (UK No.3029, 1988) shows a rather simple fan-shaped shoal, as seen from Fig. A II.3.1-1, reflecting most possibly the topography in about 1905. On the other hand, the result of sounding survey depicts the recent condition in 1989 as shown in Fig. A II.3.1-2. According to these figures, it can be seen that a dried-up sand bar extends from the west bank of the Barito river mouth toward the access channel like a tongue and an isolated drying up sand bar exists on the east side flat. Neither of these bars cannot be found on the old UK chart, which suggests the possibility of the long-term and wide-range change of the bottom topography.

A comparison of depth contours among various charts was made and the result is illustrated in Fig. II.3.1-2 and -3. Assuming that each chart represent correct contours, it can be said that there has been a huge accumulation and development of banks around not only the Barito river mouth, but also at the Kapuas and Kahayan river mouths. It is

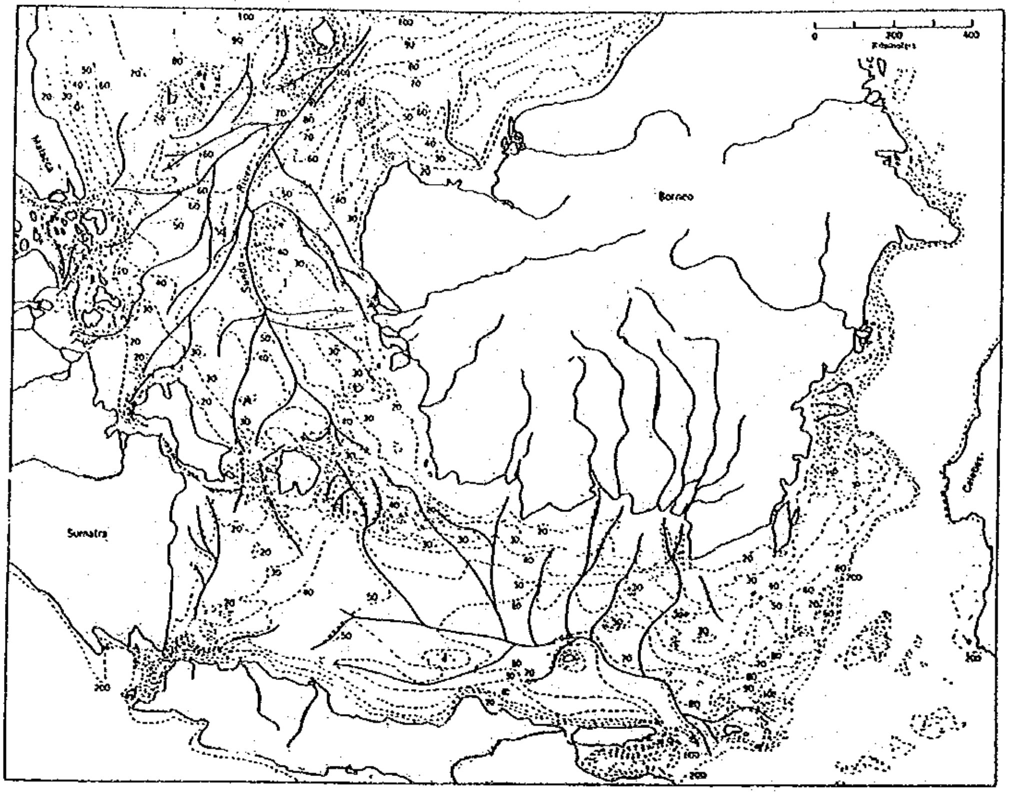


Fig. II.3.1-1 The Sunda Shelf with the Former River Channels
Source : Ph. H. Kuenen : Marine Geology, 1950

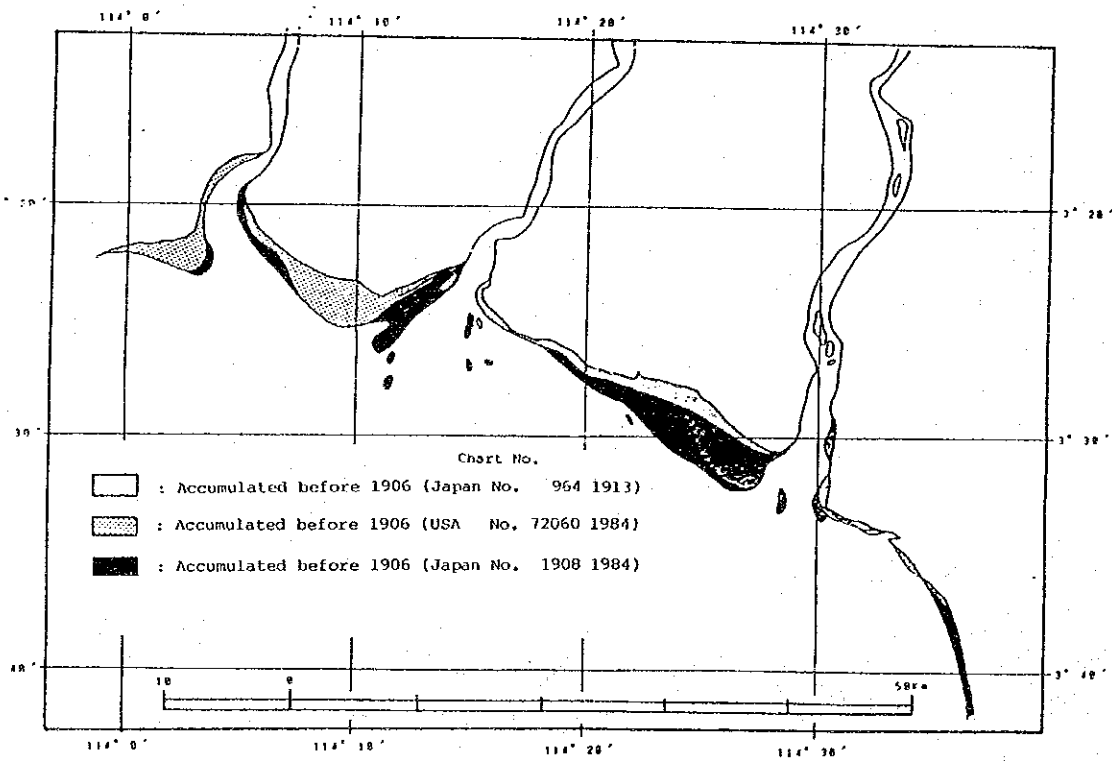


Fig. II.3.1-2 Change of the Topography around the Barito River Mouth characteristic that the right-hand banks of each river have proceeded much faster than the left-hand banks. In this case of the Barito river the right bank has developed annually with a speed of more than 100 m, whereas the development was less than 20 m on the eastern coast.

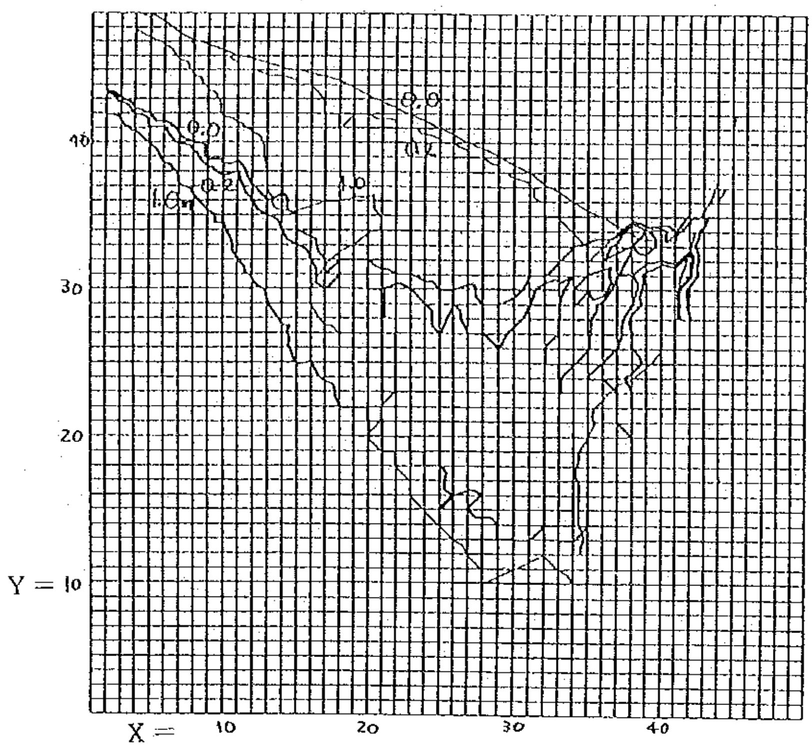
Another interesting point is accretion and erosion of the seabed. It can be understood from Fig. II.3.1-3 that, during an 84-year period, both the western and eastern areas, as well as the west side of the upper channel, experienced accumulation of soils on the seabed of more than 60 cm. On the other hand, the central edge of the bar and east side of the upper channel was eroded more than 50 cm.

The characteristics of the lateral cross-sectional slope or the difference of levels between the west and east sides of the channel might be an important factor for examining the siltation phenomenon.

Fig. II.3.1-4 was drawn to clarify the difference of the side levels along the channel direction. Fig. II.3.1-5 is the quantified diagram of the level difference. From this Figure we can understand that the level difference has been very stable seasonally, annually and locally. The level difference can be clearly divided into the following four areas: E1 and E2 are where the level of the east side is higher than that of the west side, whereas W1 and W2 are the opposite.

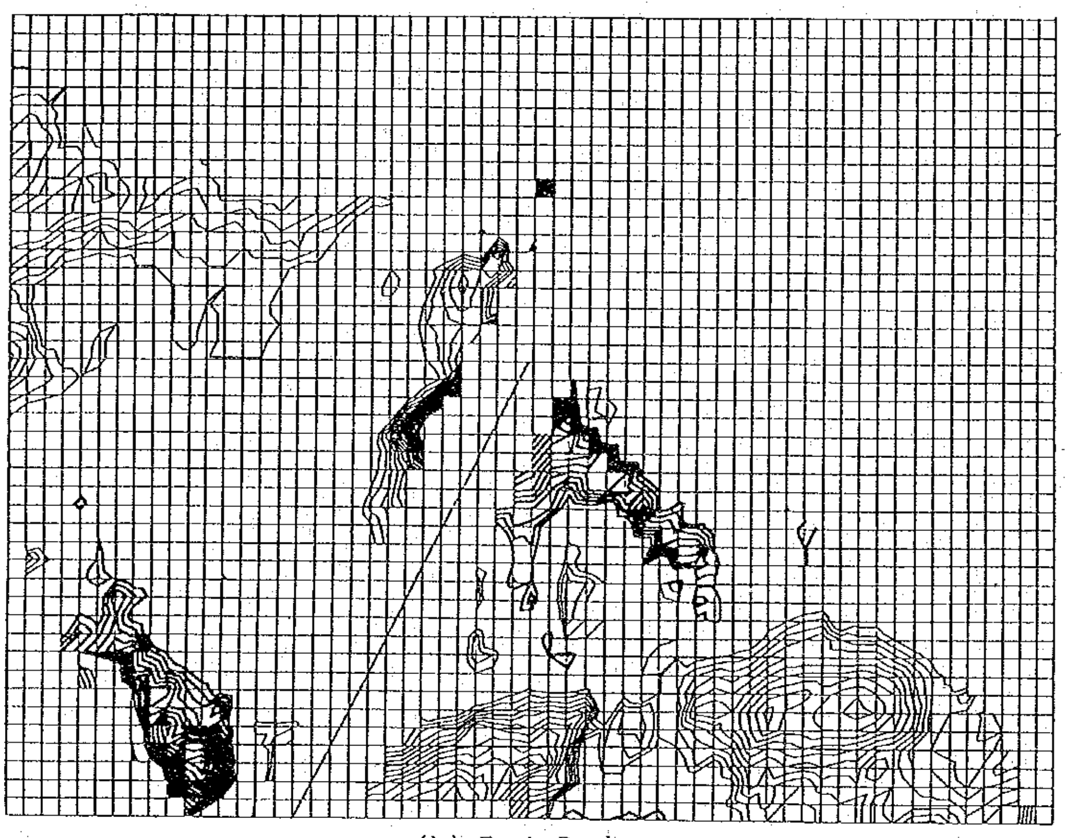
3-1-2 Microscopic Geography

Among the most characteristic and important features of the bottom contours are the shallow banks formed to the west of the inlet of the channel. There are two hills between Spots 10,500 and 13,000 as seen in Fig. II.3.1-6. The longitudinal and lateral cross sectional profiles are re-drawn in Fig. II.3.1-7 (1) and (2). The upper one of the above-mentioned hills extends into the channel and constitutes a submerged dam at around Spot No.12,300 behind which a fluid mud layer of around 2 meters in thickness covers the rest of the channel. This



(a) West Bank

(1905 : thin line, 1989 : thick line)



(b) East Bank

(Thin line : Accretion, thick line : Erosion, more than 60cm)

Fig. II.3.1-3 Comparison of Depth Contours between those of Chart around 1905 and Survey in 1989

(Depth in meter from CDL, Distance of each mesh in 463m) fact strongly suggests that the channel is influenced directly from the west at around Spots 11,000 and 12,300.

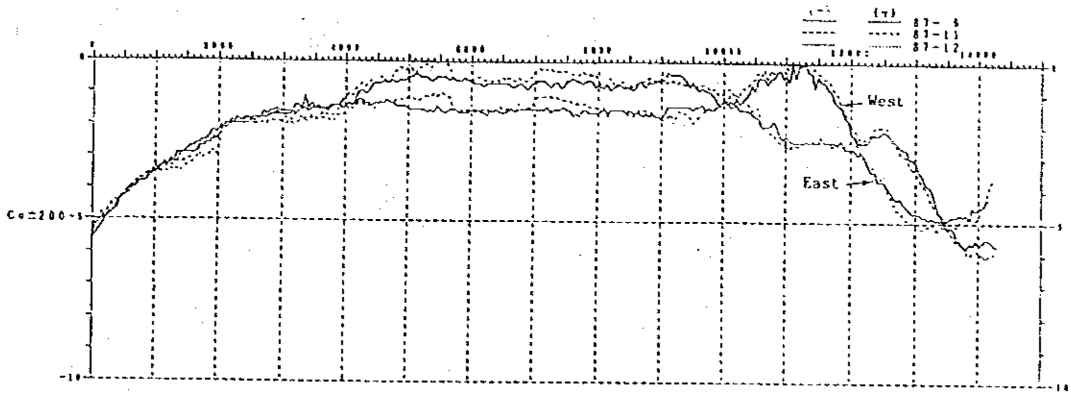


Fig. II.3.1-4 Comparison of the Seabed Levels between both Sides of the Channel (each 200m apart from the channel center)

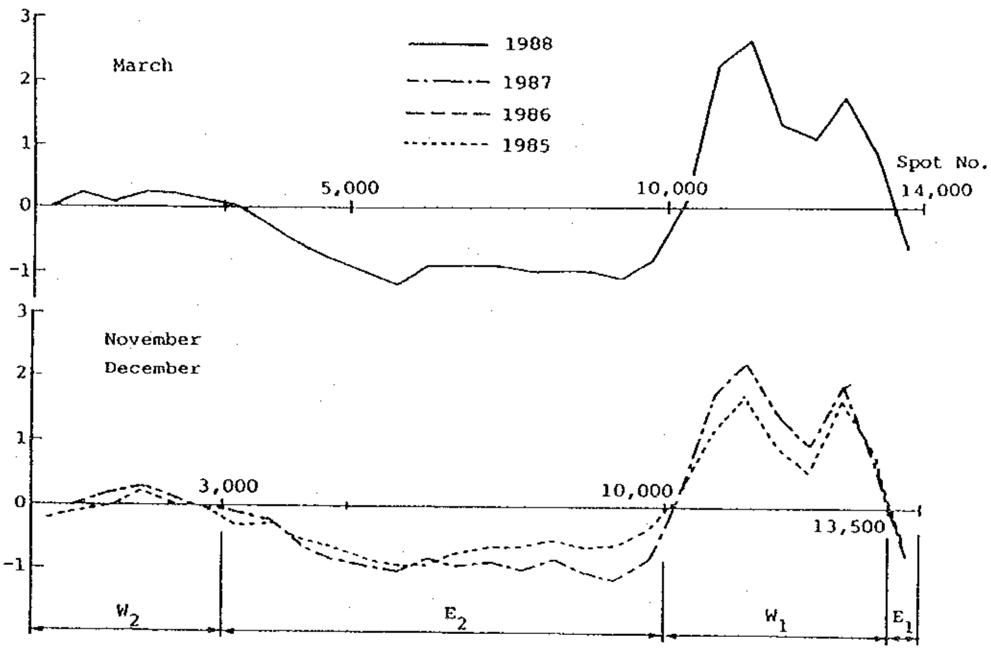


Fig. II.3.1-5 Sea Bed Level Difference between the West and East Side of the Channel (each 200m apart from the channel center)

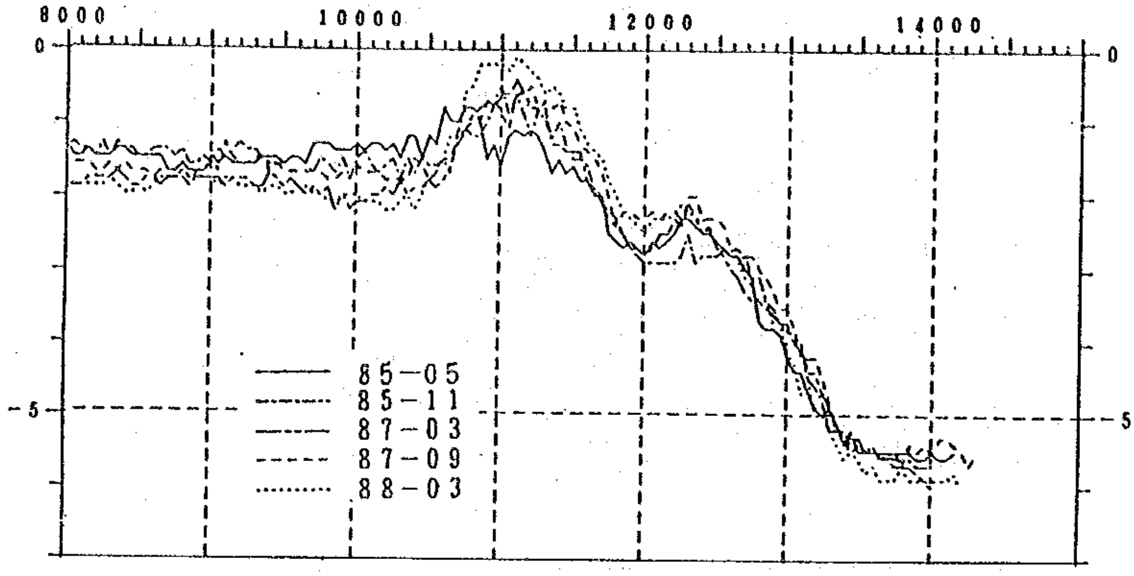


Fig. II.3.1-6 Shallow Banks to the West of the Channel
(Longitudinal profile along 100m west of the channel center)

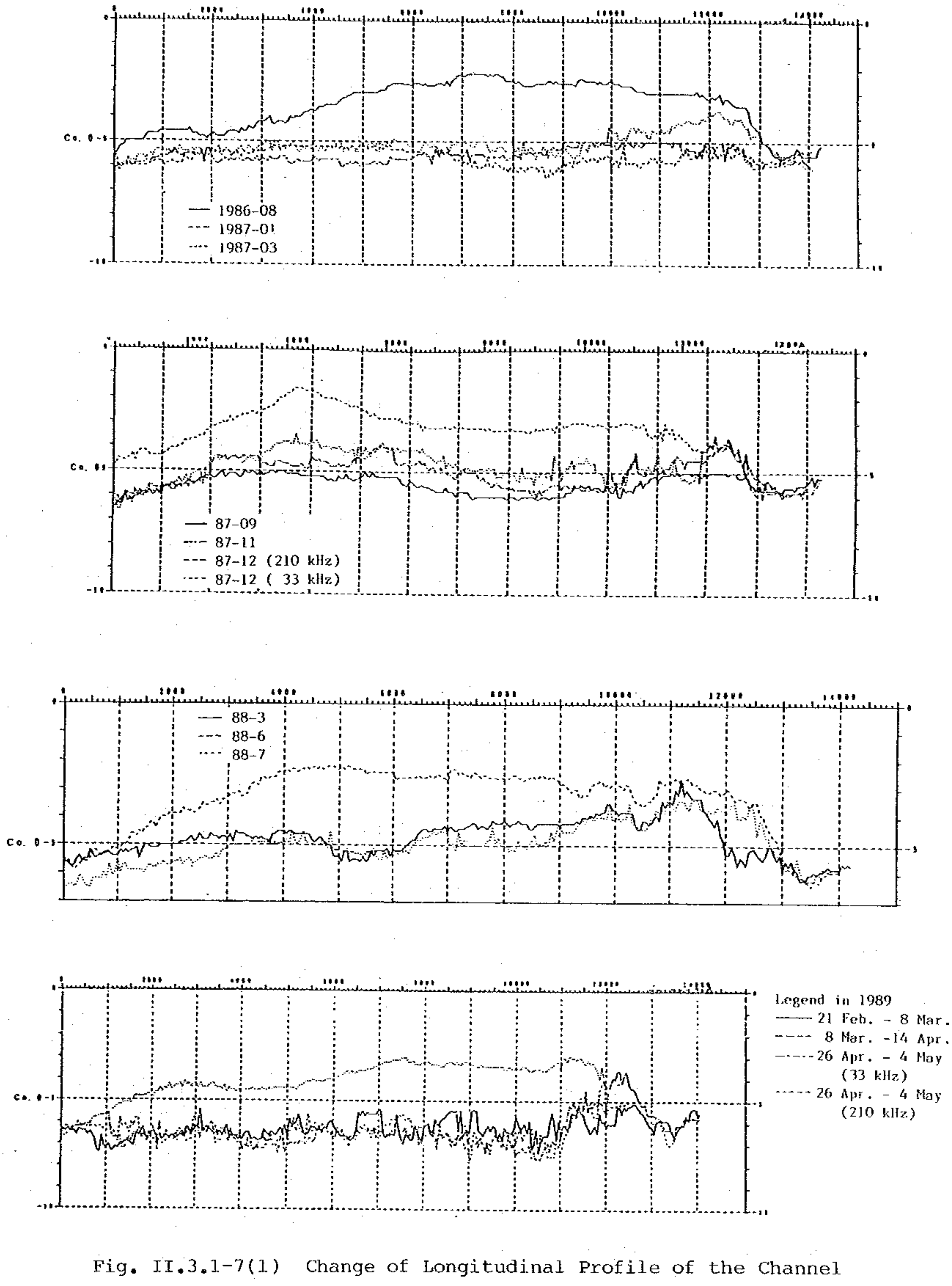


Fig. II.3.1-7(1) Change of Longitudinal Profile of the Channel Center Line

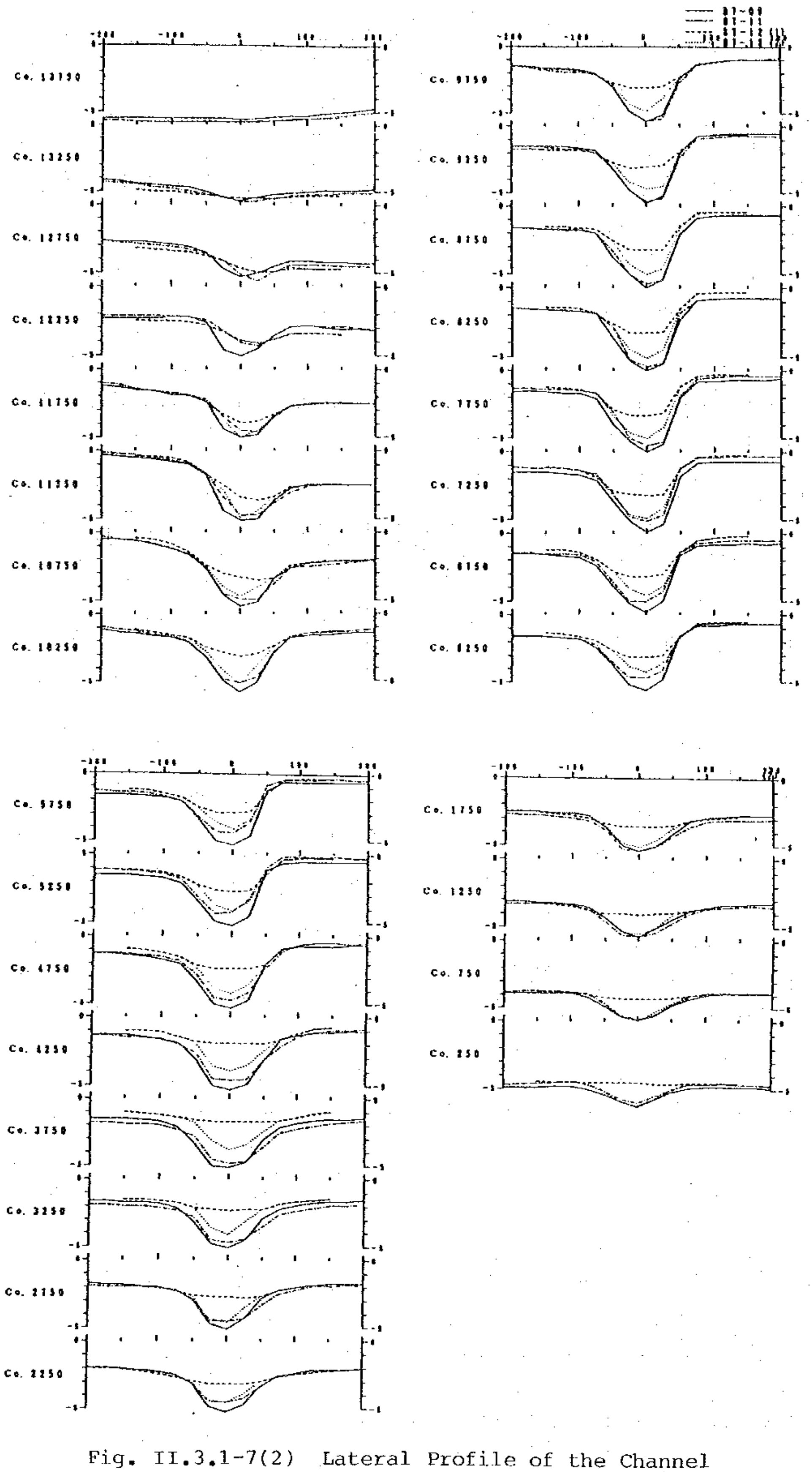


Fig. II.3.1-7(2) Lateral Profile of the Channel
(September to December, 1987)

3-2 Siltation Volume of the Access Channel

3-2-1 Past Records and Estimates of Siltation

In the past after the capital dredging in 1975 to 1976, efforts were made to estimate the siltation volume based on echo-sounded records.

During the capital dredging, considerable over-depth and width dredging was carried out, i.e., dredged depth was 7 to 8 m and width was 120 to 170 m. The siltation volume was equivalent to more than 5 million m^3 per year. In the Supervision Report in May 1987, Pacific Consultant International (PCI) estimated a volume of 3.5 million m^3 for a condition of -6 m depth and 100 m bottom width.

This estimate was reviewed in the Study Report on Dredging of Access Channel of Banjarmasin Port in March 1988 to be 5.26 million m^3, taking account of echo-sounded record with a frequency of 33 KHz measured in December 1987. At the same time, an estimate of 2.21 million m^3 was proposed in the report for a channel condition of -6 m depth and 60 m width, assuming use of a 33 KHz echo-sounder.

In the Supervision Report of semi-capital dredging in May 1990, a siltation volume of 1.52 million m^3 during the semi-capital dredging from March 1988 to March 1989 (360 days) was reported in addition to that of 3.48 million m^3 during a maintenance dredging from September 1986 to November 1987 (449 days). Taking these records into account, the PCI forecast a volume of 2.00 million m^3 per year for the channel with -6 m in depth, 60 m in width and 1/8 in side slope, and under a condition of the execution of dredging works by trailing suction hopper dredgers. It is noted that an assumed deviation of 20% is expected. The report also proposed introducing conversion rates of x 1.7 (or 3.4 million m^3 per year) for dredging work by cutter suction dredgers, x 1.9 (or 3.8 million m^3 per year) for no dredging activity, and x 1.5 (or 3.0 million m^3 per year) for 100 m bottom width.

3-2-2 Discussions on Siltation Volume

In spite of every effort of the study team, estimating the annual volume of actual siltation in the channel from the past sounding records has been unsuccessful because of the ambiguity involved by continuous maintenance dredging. Assessment of the siltation rate (m^3/month) from succeeding sounding records and dredged volume from February 1985 to 1989 sometimes gave inconceivable figures throughout the dredging periods excepting the few occasions when no dredging work was carried out.

Table II.3.2-1 shows the results of estimates of the siltation rate during all the dredging intermission periods. There are three figures from March to June, i.e., 240, 750 and 860 thousand m^3 per month; one for September to November, i.e. 240 thousand m^3 per month; and one for November to December, i.e. 2,020 thousand m^3 per month, all taken by 210 KHz echo records. However, the volumes measured by 33 KHz echo were about 1/5 to 1/2 of those taken by 210 KHz records.

Table II.3.2-1 Estimate of Siltation Rate from Sounding Records

210 kHz echo
(33 kHz echo)

Date of Survey	Interval (Months)	Volume Difference (Th.m^3)	Siltation Rate (Th.m^3/Month)
16-17 Mar. to 8-16 Jun'87	2.88	2,170 *) (-)	750 *) (-)
3-10 Sep. to 18-25 Nov.'87	1.48	350 (-)	240 (-)
Ditto to 22-27 Dec.'87	1.08	2,180 (1,230)	2,020 (1,140)
6-15 Mar. to 13-19 Jun.'88	3.21	790 (app.300)	240 (app.40)
21 Feb-8 Mar.to 26 Ap -4 May.'89	2.01	1,730 (320)	860 (160)

*) Upper figures are obtained from 210 kHz echo-sounding records, whereas the lower ones in parentheses are from 33 kHz records.

Thus, the siltation rate varies year by year as much as three times even in the same season, which might depend on the yearly variation of rainfall, river discharge, wind, waves, current, previous history of dredging, channel width and depth, and others. Nevertheless, we could expect the highest siltation in December, a considerably high one in March to June, and relatively small one in September, judging not only from the above records of siltation, but the following findings on the natural conditions from September 1988 to September 1989:

1) River discharge and sediment transport volume marks a peak in December - January and a hollow in August - September, i.e. a difference of 6 times.

2) The average water level also recorded its maximum in December and minimum in September, i.e. a 30 cm difference at the Pilot Station.

3) Waves are higher from November to March from S to SW direction than the other months.

3-3 Characteristics of Siltation in the Access Channel

3-3-1 Distribution of Siltation and Dredging Volume.

Fig. II.3.3-1 shows the longitudinal distribution of siltation volume in the channel calculated from sounding records with a frequency of 210 kHz. It signifies clear differences in the degree of siltation by area.

a.	Spot No.	0 to around 2,000
b.		4,000 to 9,000
c.		9,250 to 12,500
d.		12,500 to 14,000

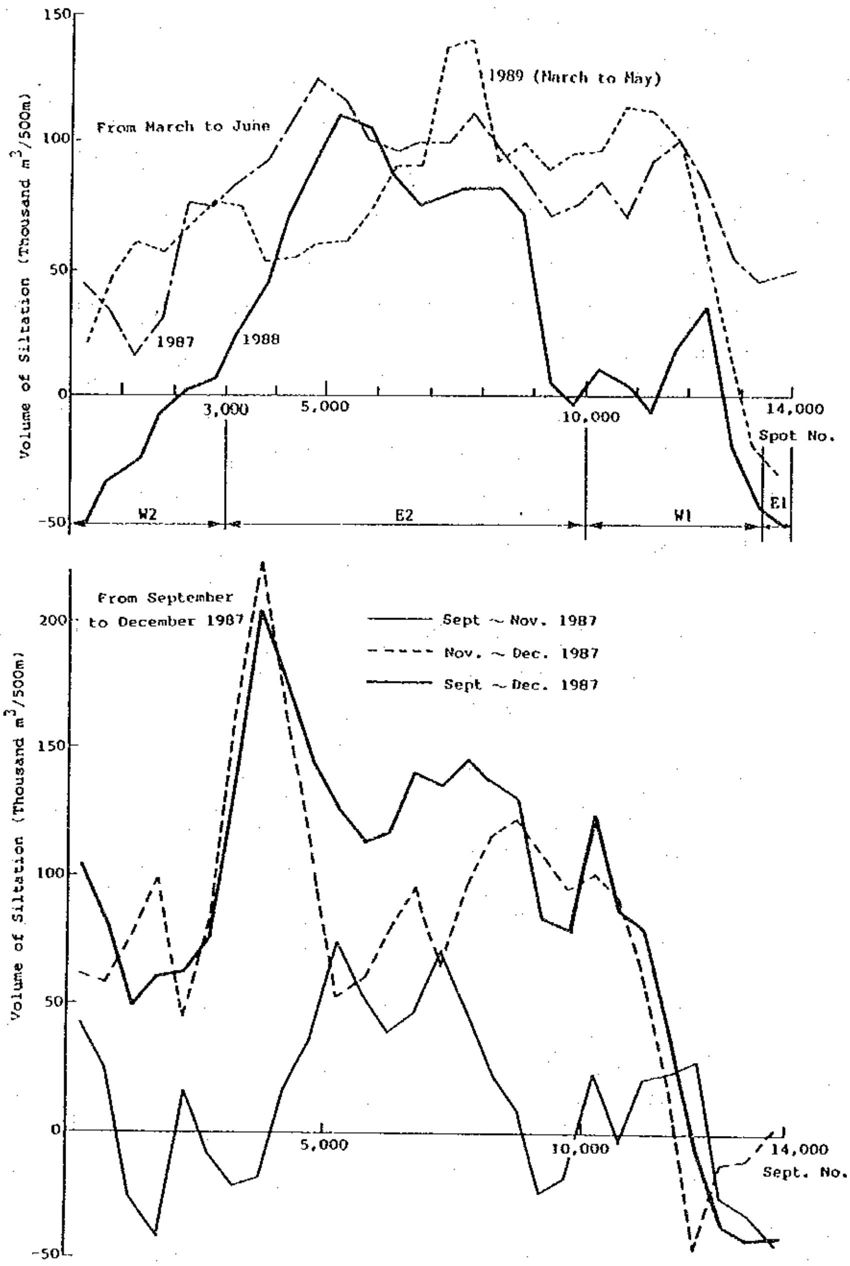


Fig. II.3.3-1 Siltation Volume in the Channel

The most severe siltation occurs in area b., which usually has two peaks at around Spots No.5,000 and 7,500. The second significant siltation area is c., where there are also two peaks around Nos. 10,250 and 12,000. In area a. either siltation or erosion could take place. It is characteristic that siltation in area d. was less serious and sometimes erosion took place.

Local distribution of maintenance dreding volume is further evidence suggesting the degree of siltation. Fig. V.2.1-4 presents the dredging volume in Areas A to D and by cross-sectional strip in each area. The strip of the most heavy burden for dredging is the western portion in Area D. The next is the western and eastern portions of Area B.

3-3-2 Cross Sectional Change and Fluid Mud

Examples of longitudinal and lateral cross-sectional change of channel profiles have already been illustrated in Fig.II.3.1-7(1) and (2).

There always appears a dam-like hill, between 11,500 to 13,000, which consists of relatively sandy material. Behind the dam, a fluid mud layer of more than 2 meters in thickness covers the rest of the channel.

The existence of fluid mud on the channel bottom was first reported as early as December 1976, in the the OECF Supervisory Mission Report. The vertical hydraulic profile of the fluid mud, however, had not been revealed until May 1990 when the study team was successful in samplings and measurements. An example of the results is introduced in Fig. A II.3.3-1. Taking the other measurements of sea bed characteristics into account, a vertical structure model of fluid mud is constructed in terms of the vertical distribution of bulk density as shown in Fig. II.3.3-2. Here, the upper surface of fluid mud is defined at SS> 10,000 ppm as proposed by KRONE (1962), whereas the lower surface is supposed to have $\gamma t = 1.30\ t/m^3$ after KIRBY and PARKER (1974). The nautical bottom of $\gamma t = 1.22\ t/m^3$ is assumed, applying the result of KERCHEART, ET AL. (1985), which is shown in Fig. A II.3.3-2, to an average mud content of 84%.

Fluid mud moves due to the shear stress of current, and changes in its thickness. The 210 kHz echo surface, which lies close to the upper surface of fluid mud, also varies from time to time.

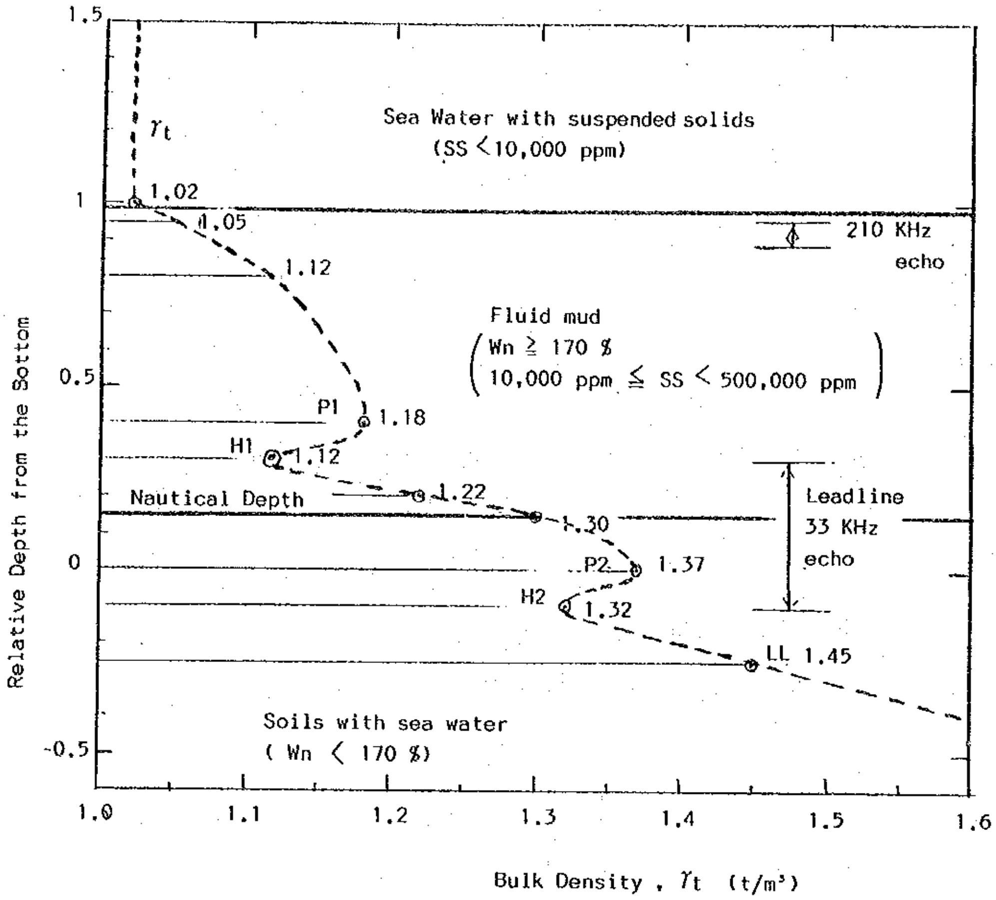


Fig. II.3.3-2 A Vertical Structure Model of Bottom Soils in Banjarmasin Channel

3-3-3 Change with the Lapse of Time

The passenger ship KELIMUTU has been taking echo-sounding data (frequency 200 kHz) whenever it passes the channel. The results are presented in Fig. II.3.3-3. There were two periods of time when no dredging work was performed, i.e., from March to June 1988 and March to May 1989. During these periods, the siltation rate could be examined and the results were:

From 12 Mar. to 9 May 1988 2.0cm/day at Buoy No.1,
2.0cm/day at Buoy No,2,

From 25 Feb. to 6 May 1989   2.9cm/day at Buoy No.1 and
to 8 May 1989   3.1cm/day at Buoy No.2.

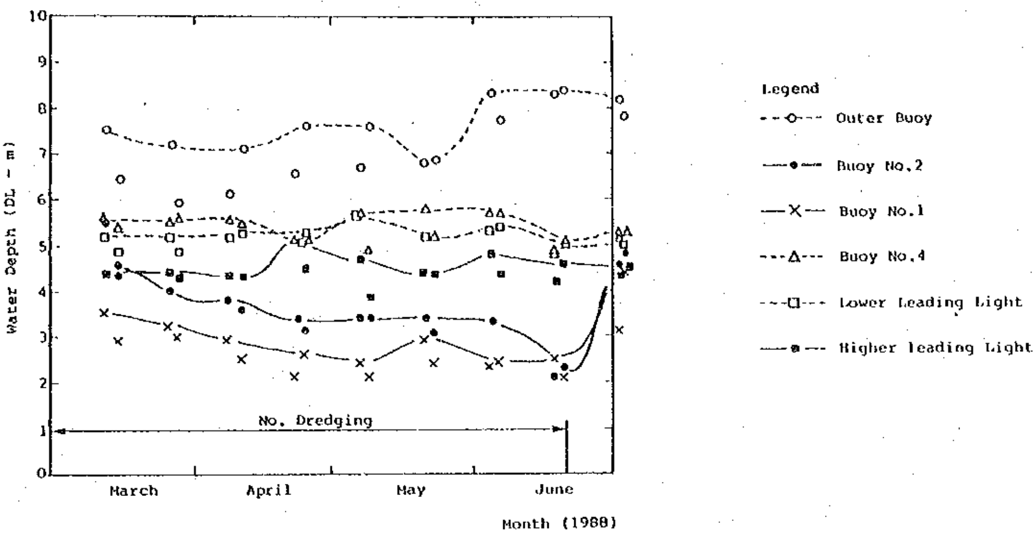
The decrease of water depth due to siltation was quite linear at Buoy No.1 and 2, particularly in the latter case.

3-3-4 Sediment Formation

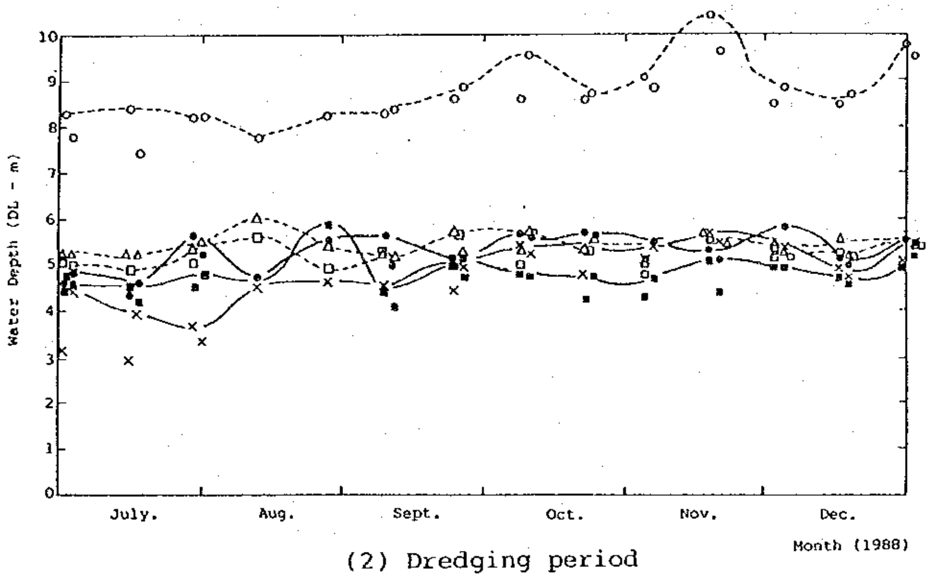
During the intermission period of dredging from March to May 1989, the siltation process was monitored by means of a echo-sounder with 210 kHz and 33 kHz.

The results shown in Fig.II.3.3-4 revealed some important facts on sediment formation. The dam located at Spots 11,000 to 13,500 is initially formed accompanied with a secondary peak at about 3 km downstream. Then, the fluid mud grows up in the downstream areas of the dam.

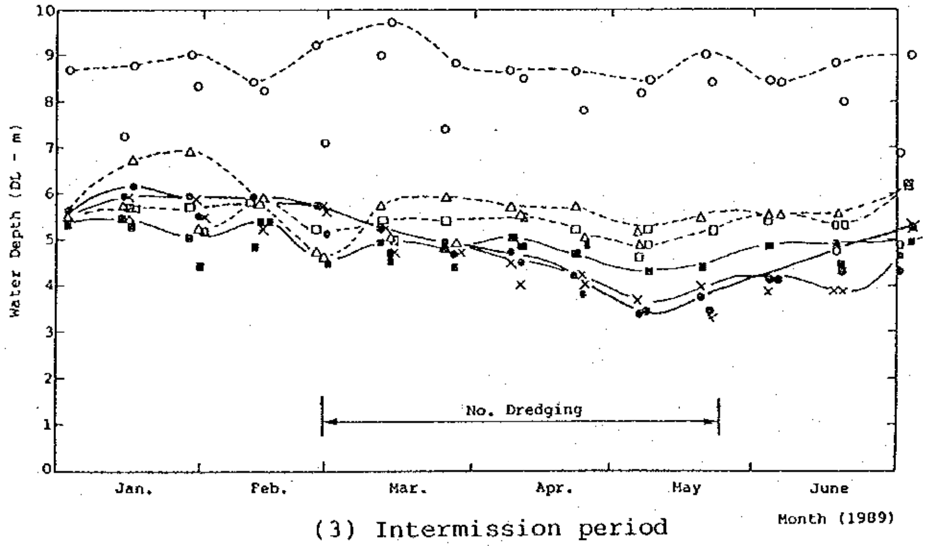
The total volume of siltation during the period was about 1,730,000 m^3 within a width of 100m. The amount of harder materials detected by 33 kHz, however, was rather small: 320,000 m^3 in total, of which approximately 150,000 m^3, or 46% of the total, was between Spots 11,000 and 13,000.



(1) No dredging period



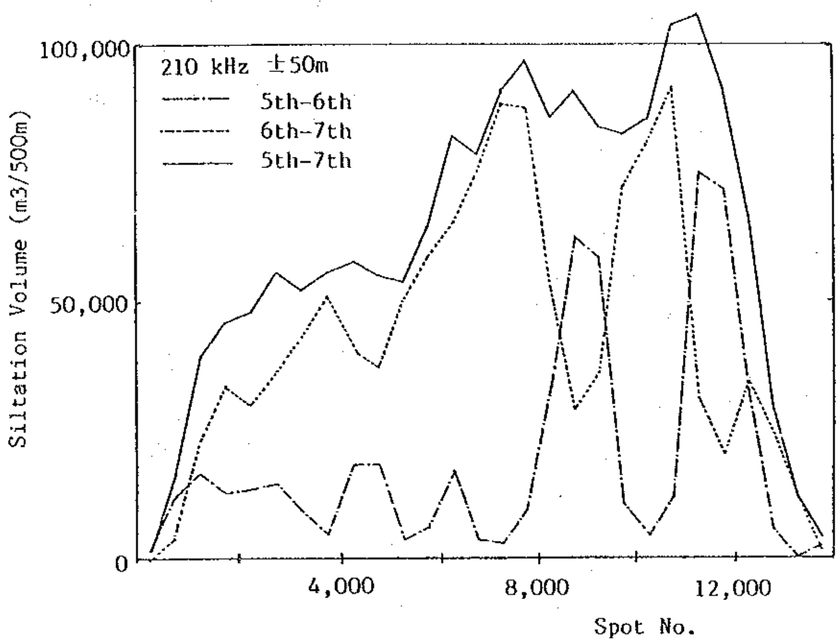
(2) Dredging period



(3) Intermission period

Fig. II.3.3-3 Water Depth Observed by KELIMUTU (200 kHz echo sounder)

Source: P.T. Pelni



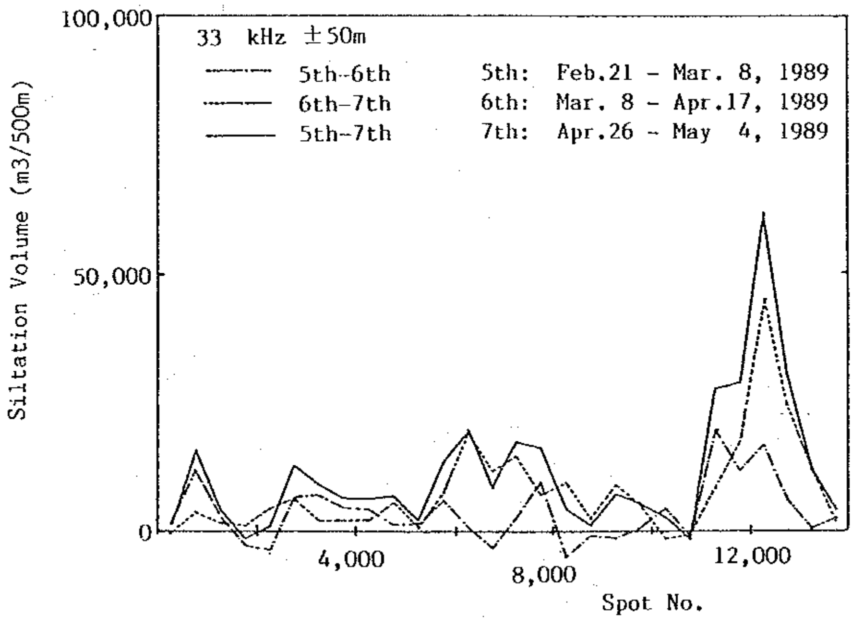


Fig. II.3.3-4 Process of Siltation along the Channel Axis (width ± 50m)

Chapter 4 The Present Condition of Navigation Channel Dredging

4-1 Related Organizations Involved in Maintenance Dredging

Maintenance dredging of the navigation channel is under the control of the Ministry of Communications (MOC), and many other organizations are also involved with the planning and execution of the dredging such as the Directorate General of Sea Communications (DGSC), the Regional Offices of MOC (KANWIL DEPHUB), the Perum Pengerukan(Perumpen) and the Perum Pelabuhan (Perumpel). A brief explanation of these organizations is presented below.

4-1-1 The Ministry of Communications (MOC)

The basic departmental structure is defined by Presidential Decree (Keppres) 44/74, and the basic organization units are set up as follows:

- The Minister
- The Secretariat General
- The Directorate General
- The Inspectorate General
- The National Owned Enterprise Board

The MOC is responsible for provision of communications facilities and services. It covers the development of sea, land, air, inland waterways, ferry transport and other services, as well as the regulation of communications services and tariffs.

The basic organization of the Ministry is defined in Presidential Decrees (Keppres) 45/74 and 15/84.
The present basic organization of MOC is shown in Fig. A II.4.1-1.
The principle organization within MOC which is concerned with maintenance dredging is the Directorate General of Sea Communications (DGSC).

4-1-2 The Directorate General of Sea Communications (DGSC)

The Directorate General of Sea Communication consists of the Secretariat of the DGSC, six Directorates (see: Fig. A II.4.1-2) and the Maritime Safety Technology Centre.

The main functions of the DGSC are formulating technical policy, rendering guidance and administering licences in conformity with the sectorial policy of sea communications as determined by the Minister. The personnel of the DGSC are classified by the classification of the Indonesian government officers, which are divided into 4 grades, with each grade divided into 4 levels.

The personnel of each division of DGSC totals 1,774, is shown in Table A II.4.1-1.

The Directorate of Ports and Dredging plays an important role in maintenance dredging in the DGSC.

1) Directorate of Ports and Dredging

The directorate possesses the overall objective of planning, regulating and supervising services in Indonesian ports, including pilotage services, and planning port facilities and equipment as well as necessary dredging measures to support the sea-transportation sector.

This directorate comprises the following Sub-Directorates (see: Fig. A II.4.1-3) :

- Sub-Directorate Port Facilities & Equipment
- Sub-Directorate Port Services
- Sub-Directorate Dredging
- Sub-Directorate Pilotage
- Sub-Directorate Manpower and Warehousing
- Administration Division

The Sub-Directorate Dredging plays an especially important role in maintenance dredging and its main objective is the planning and supervision of dredging measures to guarantee the safe voyage of vessels in sea and in ports. Its main functions are as follows:

- planning of dredging programs for the channels and port areas;
- planning of standard regulations for dredging vessels and related equipment;
- establishment of dredging budget;
- supervision of dredging performance.

4-1-3 The regional offices of the Ministry of Communications (KANWIL DEPHUB)

Nine Maritime District Offices (KANWIL) were set up in nine areas to act as regional representatives of the DGSC.
However, the KANWIL have changed their function and structure since uniting with the MOC and are subordinated and accountable to the Ministry by the Ministerial decree No. KM 64/1988 dated Sept.28, 1988.

KANWIL DEPHUB has the task of carrying out part of the main tasks and functions of MOC and its functions are as follows:

- to collect and process data draw up communication working programs in the region;
- to draw up policies for the realization of communications in the provinces;
- to coordinate, give guidance to and evaluate the carrying out of tasks in the field of land communications;
- to coordinate, give guidance to and evaluate the carrying out of tasks in the field of sea communications;
- to coordinate, give guidance to and evaluate the carrying out of tasks in the field of air communications;
- to coordinate administrative, meteorological and geophysical activities;
- to handle and take care of the administrative affairs of a KANWIL DEPHUB.

KANWIL DEPHUB are set up in 27 regional offices of the MOC and are classified into 5 types: A1, A2, B1, B2 and C, based on their volume and burden of work, as shown in Table A II.4.1-2. The type at KANWIL

DEPHUB of Banjarmasin is B1.

4-1-4 Perum Pengerukan (Perumpen)

Perum Pengerukan (Perumpen: Dredging State Enterprise) was established to set up dredging programs and for the physical execution of all dredging work in the port areas and the entrance channels.

The principle references for the management of Perumpen are as follows:

- Government Regulation No. 18/1983, regarding the establishment of Perumpen
- Minister of Communications Decree No. KM.202/OT.001/PHB-83, regarding the organization of Perumpen
- Minister of Communications Decree No. KM.203/OT.001/PHB-83, regarding the organization of branches of Perumpen

Ministerial Decree No. KM.202/OT.001/PHB-83 states the following principles:

- Perumpen is a state-owned company under the Department of Communications, directed by a Board of Management, which is responsible to the Minister of Communications;
- The Minister of Communications gives directions to the Perumpen assisted by the Director General of Sea Communication in accordance with the authority delegated by the Minister of Communications;
- The Board of Supervisors of Perumpen is responsible to the Minister of Communications, who supervises the management of Perumpen, including the implementation of work plans and budgets of Perumpen in accordance with the law in force.

The Perumpen is a state-owned company under the MOC and acts as an autonomous entity responsible for the following functions:

- setting up dredging programs for ports and entrance channels;
- calculation of dredging quantities;
- execution of dredging (by own vessels or subcontractors);
- monitoring of dredging performance;
- sea surveys after dredging and mapping of dredged areas;

- coordination of dredging activities;
- planning of necessary equipment;
- preparation of dredging budgets.

The organization of Perumpen is composed of the head office, three branches and five bases. The head office is in Jakarta and is comprised of the following (See: Fig. A II.4.1-4):

- Managing Director
- Internal Audit Unit
- Planning, Information and Development Centre
- Director of Commerce
- Director of Fleet
- Director of Administration and Finance

The Banjarmasin Base is under the management of the Surabaya Branch. The personnel of Perumpen is as follows:

Table II.4.1-1 Personnel Composition of Perumpen 1988-1989

	1988			1989		
	Organized	Non Organized	Total	Organized	Non Organized	Total
Head Office	141	59	200	147	61	208
Tg. Priok Branch	433	112	545	422	111	633
Surabaya Branch	236	133	369	238	134	372
P. Batam Branch	0	0	0	4	0	4
Belawan base	72	63	135	67	63	130
Palembang Base	31	7	38	29	7	36
Semarang Base	66	11	77	64	11	75
Banjarmasin Base	13	21	34	12	21	33
Samarinda Base	45	1	46	45	1	46
Grand Total	1,037	407	1,444	1,028	409	1,437

Source: Perumpen

4-1-5 Perum Pelabuhan (Perumpel)

Perum Pelabuhan was established to carry out the management and related planning for the four Perumpels. Each of these Perumpel manage a group of ports as follows (see: Fig. A II.4.1-5) :

- Perumpel I, located in Medan, manages 21 posts in the provinces of Aceh, North and West Sumatra and Riau
- Perumpel II, located in Jakarta, manages 17 ports in the provinces of Jambi, South Sumatra, Bengkulu, Lampung, DKI, West Java and West Kalimantan
- Perumpel III, located in Surabaya, manages 36 ports in the provinces of Central and East Java, South East Kalimantan, Bali, West and East Nusatenggara and East Timor
- Perumpel IV, located in Ujung Pandang, manages 17 ports in the provinces of South, South East, Central and North Sulawesi, Maluku and Irian Jaya.

Ministerial decree No. KM.194/OT.001/PHB-13 states the following principles :

1) The ports are owned, regulated and operated by the government;
2) The Minister of Communications transfers the planning, developing, operating and controlling of ports to the Perumpel.
3) The Minister of Communications appoints the President Director of each Perumpel.
4) The Perumpel acts as autonomous entities responsible for the following functions:
   - Planning and development of port facilities
   - commercialization of facilities and services
   - establishment of individual port tariffs (to be approved by the Minister)
   - financing of investment.

The Perumpel has now also become one of the important organizations for maintenance dredging.
According to Ministerial decree, Perumpel is responsible for managing ports. This means Perumpel should maintain the water depth at port basins except for entrance channels.

However, in 1986/1987 and 1987/1988, Perumpel covered the maintenance dredging budget for entrance channels because the governmental budget (DIP) was decreased less than constant.

4-2 Management and Operation of Maintenance Dredging

4-2-1 Present Allocation of Functions

As mentioned above, the management and operation of maintenance dredging is presently performed by five organizations: MOC, DGSC, KANWIL DEPHUB, Perumpen and Perumpel.

The main existing allocation of functions of the five organizations concerning management and operation of maintenance dredging is summarized in Table II.4.2-1.

Table II.4.2-1 Present Allocation of Functions for Management and Operation of Maintenance Dredging

Function \ Organization	MOC	DGSC	KANWIL	Perum Pengerukan	Perum Pelabuhan
Research on water depth requirements for all ports and entrance channels		✓	✓	✓	✓
Preparation of dredging programs for ports and channels		✓	✓		✓
Approval of dredging programs	✓	✓			✓
Calculation of dredging volume		✓	✓	✓	✓
Execution of dredging				✓	
Monitoring of dredging performance		✓	✓	✓	✓
Post dredging, water depth, and siltation surveys		✓	✓	✓	✓
Appointment of private companies for execution work				✓	
Coordination of dredging activities		✓	✓	✓	✓
Preparation of crew standards and equipment standards	✓	✓		✓	
Approval of new investment plans for equipment and installation	✓	✓			
Equipment preparation		✓		✓	
Budget preparation	✓	✓	✓	✓	✓
Budget approval	✓	✓		✓	✓
Budget control		✓		✓	✓
Administration of overall dredging activities		✓		✓	✓

4-2-2 Procurement of Dredging Equipment

The necessary items for maintenance dredging fleet are decided based on field survey reports by the Directorate of Commerce of Perumpen.

The procedure used by Perumpen for purchasing spare parts is as follows:

- Purchase orders requested by Site Manager, Project Manager or Branch Manger.
- This request is reported to the Directorate of Fleet of the head office.
- Spare parts are purchased through tendering.
  Spare Parts are often purchased from foreign countries.

Spare parts are purchased under the government budget, which is exceeded 100 million Rupiah, and the Dredging Fleet Advisory Section of Sub Directorate Dredging Division of DGSC is responsible. This section evaluates the purchase order request from the Perumpen and reports to MOC.

4-2-3 Budget Control

(1) Dredging Program

The basic dredging program is considered at the planning of PELITA (Five Year National Development Plan). However, the yearly dredging programme is decided according to REPELITA from year to year.

The channels to be dredged are selected according to the dredging priority. The dredging priority is decided by DGSC (see: Table A II.4.2-1), and requests for the dredging are sent to MOC or DGSC from many organizations such as governors, BAPPEDA (Provincial Development and Planning Board), KANWIL DEPHUB, Perumpel and Perumpen.

Maintenance dredging of the entrance channel of Banjarmasin is ranked as a top priority.

However, the Dredging Program was not maintained because the DIP has decreased year by year.

(2) Determining Process of Budget

Most infrastructure investment is carried out by DIP, and foreign funds are used for projects which require large amounts of funds. Maintenance dredging and the development of pioneer ports, etc., are carried out by DIP.

However, the simple construction and maintenance of ports are carried out under the Perumpel budget.

The fiscal year of Indonesia begins in April and ends in March. The DIP is determined at the BAPPENAS (National Economic Development Board) before the beginning of the new fiscal year. The procedure of the budget is shown as Fig. A II.4.2-1.

When the maintenance dredging budget is not sufficient, it is covered by the Presidential Aid and the budget of Perumpel.

In 1987/1988 and 1988/1989, the DIP of ports concerned was decreased, and maintenance dredging of the entrance channel of Banjarmasin was carried out using foreign funds.

(3) Dredging Unit Price

The dredging budget of the DIP comprises the dredging fee and the survey fee. The dredging fee consists of the dredging unit price and the dredging volume. The survey fee consists of the survey unit price and the dredging volume and includes supervision.

The unit price of dredging and surveys is determined between the MOT and DGSC according to the Perumpen's unit price request (see: Table II.4.2-2).

Table II.4.2-2 Unit Price of the Maintenance Dredging

($/m^3$), 1988/1989

	Rupiah
<u>Hopper</u>	
- Channel (Full Cost)	981,-
- Basin (including 5% of profit)	1,290,-
<u>Non Hopper</u>	
- Channel (Full Cost)	1,970,-
- Basin (including 5% of profit)	2,050,-

The unit price of dredging is estimated from the direct expenses of each dredger and production volume per year. The direct expenses of each dredger are as follows:

- Crew: Salary, etc.
- Operation fee: Fuel Oil, etc.
- Maintenance fee: Docking, Repair
- Overhead: General Administration
- Depreciation.

4-3 Dredging Equipment

4-3-1 Dredging Fleet

(1) Outline of Dredgers

The present dredgers of Perumpen are shown in Table II.4.3-1. The fleet consists of 13 trailing suction hopper dredgers, 3 cutter suction dredgers, 3 bucket dredgers, and 8 grab dredgers. Photographs of each of these four types are shown in Figs. II.4.3-1 through II.4.3-4. As for trailing suction hopper dredgers, there are 5 different hopper capacities, with two 4,000 m^3, four 3,000 m^3, two 2,000 m^3, three 1,000 m^3, and one 750 m^3 unit. Concerning cutter suction dredgers, there is one 24 inch unit and two 30 inch units built in the U.S.A. The grab capacities of the three bucket dredgers

Table II.4.3-1 Present Dredging Fleet of Perumpen (1/2)

TRAILING SUCTION HOPPER DREDGER

No.	Name of Ship	Overall Length	Moulded Breadth	Moulded Depth	Loaded Draught	Gross Tonnage (Ton)	Net Tonnage (Ton)	Output of Propulsion Machinery	Power of Dredge-Pumps	Dredging Depth	Hopper Capacity	Shipyard	Speed (Knot)	Dreg Position	Base Port	Price (Mill.Rp)
1.	LOMBOK	64.90M	13.00M	5.46M	3.50M	1660.37	560.45	2x 750 HP	1x 700 HP	10M	750M³	IHI/JAPAN/1974	9	PS	TG.PRIOK	1,129
2.	SULAWESI II	92.50M	16.00M	8.00M	7.33M	4179.00	1170.00	2x1900 HP	2x 900 HP	20M	3000M³	IHC/HOLLAND/1975	11	BS	PALEMBANG	1.431
3.	JAWA	92.00M	16.00M	8.00M	7.33M	3932.00	1179.00	2x1900 HP	2x 900 HP	20M	3000M³	IHC/HOLLAND/1977	11	BS	SURABAYA	5.544
4.	SUMBAWA	85.00M	16.42M	6.22M	4.00M	2838.72	1301.29	2x1600 HP	2x 350 HP	20M	1000M³	IHI/JAPAN/1978	11	BS	TG.PRIOK	4.010
5.	TIMOR	95.00M	18.40M	7.00M	5.00M	4145.34	1989.34	2x2100 HP	2x 550 HP	20M	2000M³	IHI/JAPAN/1980	12	BS	TG.PRIOK	10,503
6.	IRIAN JAYA	109.88M	18.04M	8.05M	7.33M	5179.20	2469 08	2x1795 HP	2x 898 HP	20M	4000M³	O&X/W.GERMANY/1981	12	BS	BELAWAN	17,500
7.	SERAM	92.00M	16.00M	8.00M	7.30M	3932.00	1179.00	2x2100 HP	2x 900 HP	20M	3000M³	IHC/HOLLAND/1981	11	BS	SURABAYA	13,567
8.	FLORES	95.00M	18.40M	7.00M	5.00M	4145.34	1989.34	2x2100 HP	2x 550 HP	20M	2000M³	IHI/JAPAN/1983	12	BS	BANJARMASIN	12,457
9.	BANDA	71.10M	14.00M	4.90M	4.05M	1629.34	797.80	2x 846 HP	1x 438 HP	14M	1000M³	IHC/HOLLAND/1982	9	SS	SAMARINDA	10,481
10.	HALMAHERA	92.50M	16.00M	8.00M	7.33M	3932.00	1179.00	2x2000 HP	2x 900 HP	20M	3000M³	IHC/HOLLAND/1983	11	BS	BELAWAN	16,598
11.	KALIMANTAN II	109.88M	18.04M	8.05M	7.33M	5097.52	2469.08	2x1795 HP	2x 898 HP	20M	4000M³	O&X/W.GERMANY/1983	12	BS	TG.PRIOK	20,440
12.	NATUNA	71.10M	14.00M	4.90M	4.05M	1629.34	797.80	2x 846 HP	1x 438 HP	14M	1000M³	IHC/PT.DOK/IND/1984	9	SS	TG.PRIOK	10,813
13.	NIAS	71.10M	14.00M	4.90M	4.05M	1629.34	797.80	2x 846 HP	1x 438 HP	14M	1000M³	IHC/PT.DOK/IND/1984	9	SS	TG.PRIOK	10,813

CUTTER SUCTION DREDGER

No.	Name of Ship	Overall Length	Moulded Breadth	Moulded Depth	Diameter of Suction Pipe	Dredging Depth	Power of Dredge Pumps	Shipyard	Capacity (M³/HR)	Gross Ton. (Ton)	Base Port	Price (Mill.Rp)
1.	MAHAKAM	41.45M	13.41M	2.90M	24 INCH	17.68 M	2 x 1225 HP	ELLICOTT/USA/1976	500	-	SAMARINDA	2,921
2.	MUSI	41.45M	13.41M	2.90M	30 INCH	17.68 M	1 x 3600 HP	ELLICOTT/USA/1977	600	1348	TG.PRIOK	2,921
3.	KAPUAS	41.45M	13.41M	2.90M	30 INCH	17.68 M	1 x 3600 HP	ELLICOTT/USA/1977	600	1348	SURABAYA	2,921

Table II.4.3-1 Present Dredging Fleet of Perumpen (2/2)

BUCKET DREDGER

No.	Name of Ship	Overall Length	Moulded Breadth	Moulded Depth	Bucket Capacity	Dredging Depth	Tumbler Diesel Engine	Shipyard	Capa-city (M³/HR)	Gross Ton. (Ton)	Base Port	Price (Mill.Rp)
1.	SINGGALANG	52.02M	11.02M	3.70M	700 Lt	15.00 M	1 x 375 HP	LMG/WEST GERMANY/1963	-	-	SURABAYA	-
2.	MERAPI	48.10M	14.66M	4.10M	700 Lt	18.00 M	1 x 375 HP	O&K/WEST GERMANY/1981	700	515	TG. PRIOK	5.339
3.	AGUNG	48.10M	14.66M	4.10M	700 Lt	18.00 M	1 x 368 HP	O&K/WEST GERMANY/1981	700	515	BELAWAN	5.339

GRAB DREDGER

No.	Name of Ship	Over Deck Length	Moulded Breadth	Moulded Depth	Grab Capacity	Dredging Depth	Machinery for Grab	Shipyard	Capa-city (M³/HR)	Gross Ton. (Ton)	Base Port	Price (Mill.Rp)
1.	MANINJAU	25.92M	9.13M	2.03M	3.50 M³	7.00 M	1 x 211 HP	SINGAPORE/1976	150	-	SURABAYA	-
2.	TOWUTI	26.00M	13.00M	1.60M	2.50 M³	12.00 M	1 x 160 HP	PT. DOK/IND/1977	100	-	SURABAYA	266
3.	SINGKARAK	26.00M	11.00M	2.50M	5.50 M³	14.00 M	1 x 325 HP	INDONESIA/1981	200	-	TG. PRIOK	964
4.	TOBA	26.00M	11.00M	2.50M	5.50 M³	14.00 M	1 x 325 HP	PELITA BAHARI/IND/1981	200	-	SAMARINDA	964
5.	TONDANO	28.00M	13.00M	2.60M	7.00 CbY	20.00 M	1 x 455 HP	PELITA BAHARI/IND/1985	300	333	SURABAYA	1179
6.	RANAU	28.00M	13.00M	2.60M	7.00 CbY	20.00 M	1 x 455 HP	PELITA BAHARI/IND/1985	300	333	TG. PRIOK	1179
7.	POSO	28.00M	13.00M	2.60M	7.00 CbY	20.00 M	1 x 455 HP	PELITA BAHARI/IND/1985	300	333	TG. PRIOK	1179
8.	SATUR	28.00M	13.00M	2.60M	7.00 CbY	20.00 M	1 x 455 HP	PELITA BAHARI/IND/1985	300	333	SURABAYA	1179

SOURCE : PERUM PENGERUKAN

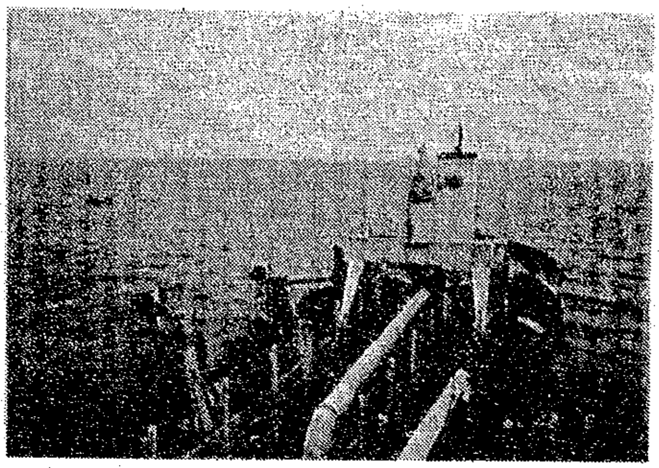


Fig. II.4.3-1 Trailing Suction Hopper Dredger

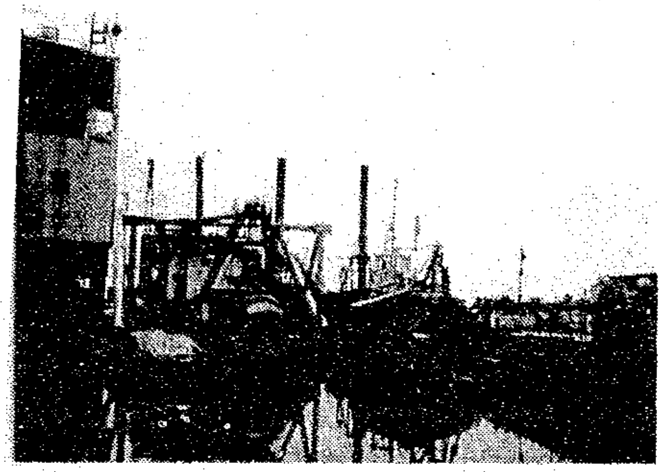


Fig. II.4.3-2 Cutter Suction Dredger

Fig. II.4.3-3 Bucket Dredger

Fig. II.4.3-4 Grab Dredger

are the same, but "Singgalang" is old and has not been operating in recent years. The grab dredgers have three grab capacities, with six 5.5 m^3, one 3.5 m^3, and one 2.5 m^3 units. Four of the 5.5 m^3 grab dredgers were built at PT Pelita Bahari Shipyard in 1985.

(2) Dredging Capacity of Each Type of Dredger

Perumpen calculates the annual dredging capacity of each dredger every year in order to hold discussions with DGSC to fix the unit cost of dredging projects under the budget of DIP and Perumpel. In the following sub paragraphs, the estimated capacities are summarized.

(a) Trailing Suction Hopper Dredgers

The working conditions assumed for the estimation are as follows:

- daily cycles: 12 nos
- monthly working days: 24 days
- annual working months: 9 months
- concentration ratio: 40%

The above figures are multiplied by the hopper capacity of each dredger. For example, the estimated annual dredging capacity of a 4,000 m^3 trailing suction hopper dredger is:

$$4,000 \times 12 \times 24 \times 9 \times 0.4 = 4,147,200 \ m^3/year$$

The annual capacities of 5 different size hoppers are calculated in the same way and the results are as follows:

Hopper size	Annual Capacity
- 4,000 m^3	4,147,200 m^3/year
- 2,900	3,006,720
- 2,000	2,073,600
- 1,000	1,036,800
- 750	777,600

Based on the above estimates the total annual capacity of the 13 dredgers is 29,393,280 m^3/year.

(b) Estimated Total Dredging Capacity

The estimated annual capacities of the Perumpen dredgers are listed in Table II.4.3-2, and the total estimated capacity of the 27 dredgers is approximately forty million cubic meters per year. The annual capacities of each dredger type as a proportion of the total annual capacity of all dredgers are as follows:

- trailing suction hopper dredgers: 73.49%
- cutter suction dredgers: 13.61
- bucket dredgers: 5.52
- grab dredgers: 7.38

It is said that the actual dredging volume of trailing suction hopper dredgers is roughly the same as the estimated capacity. However, the actual volumes of the other three types of dredgers are much less than the estimated capacities. The total maintenance dredging requirement is around 27 million cubic meters, based on old data. Based on this figure, the present capacity of the dredging fleet seems to be satisfactory.

Table II.4.3-2 Estimated Dredging Capacity

No.	Type of Dredger	Nos.	Yearly Dredging Capacity of Each Dredger (m^3)	Yearly Dredging Capacity (m^3)
1.	Trailing Suction Hopper Dredgers			
	4,000 m^3	2	4,147,200	8,294,400
	2,900 m^3	4	3,006,720	12,026,880
	2,000 m^3	2	2,073,600	4,147,200
	1,000 m^3	4	1,036,800	4,147,200
	750 m^3	1	777,600	777,600
	Sub Total	13	-	29,393,286
2.	Cutter Suction Dredgers			
	24 inch	1	1,555,200	1,555,200
	30 inch	2	1,944,000	3,888,000
	Sub Total	3	-	5,443,200
3.	Bucket Dredgers			
	0.7 m^3 (old)	1	561,600	561,600
	0.7 m^3	2	823,680	1,647,360
	Sub Total	3	-	2,208,860
4.	Grab Dredgers			
	5.5 m^3	6	414,612	2,487,672
	3.5 m^3	1	263,989	263,989
	2.5 m^3	1	198,000	198,000
	Sub Total	8	-	2,949,661
	Grand Total	27		39,995,101

Note: Type and numbers of dredger is based on Table II.4.3-1

Source: DGSC

4-3-2 Supporting Equipment

Supporting equipment includes tugboats, hopper barges, water barges, fuel barges, crew barges, anchor boats, flat top barges, survey boats, communication boats, pontoons and discharging lines. Tugboats and hopper barges are indispensable for the operation of non-propelled bucket dredgers and grab dredgers. The existing tugboats and dump hopper barges are listed in Table A II.4.3-1 and Table A II.4.3-2 respectively. The present conditions presented in these two tables are judgement by Perumpen's Staff.

According to the current governmental regulation, ships built before 1960 are to be scrapped. There are 10 tugboats built before 1960 and 18 tugboats built after 1960. The average operational condition of the first group is around 50% and that of the second group is 60%. This difference is very small and this result shows that the present conditions of tugboats are poor. Even for the newest ones built in 1981, the operating condition is estimated at 60%. So, replacement of several tugboats should be considered.

As shown in Table A II.4.3-2, there are 10 non-propelled and 8 self-propelled dump hopper barges. The average age of the barges is 12 years and 8 years for non-propelled and self-propelled vessels, respectively. The operating condition is approximately 60% for both types.

4-3-3 Survey Instruments

Major survey instruments of Perumpen such as mini-ranger systems, echo sounders, theodolites, etc., are monitored by computer to keep track of the latest conditions. This is a good system.

However, there is a problem with the maintenance and repair of these electronic instruments. Repairs are dependent on outside companies, and are often executed abroad or by foreign engineers. Nearly half the control display units and transponders are out of order, and quite a few reference transmitter units and echo souders need repairs.

4-4 Dredging Activities

4-4-1 Present Situation

(1) Planning

The main element of planning is to know the dredging requirements. Hydraulic survey drawings are the key data for the estimates of dredging requirements and these are sent from several offices such as Perumpel I to IV, Maritime District Office 1-9, Governors and Port Administrators, etc. to DGSC. Based on these dredging requirements, DGSC prepares dredging plans which are approved by BAPPENAS. The maintenance dredging plans for main access channels are as shown in Table II.4.4-1. In this table, siltation ratios and dredged volumes in recent years are listed. Ports suffering from heavy siltation are Belawan, Pontianak, Palembang, Banjarmasin, and Samarinda. At these ports, the annual dredging requirements are over two million cubic meters.

(2) Execution

Dredging for navigation channels is the responsibility of the government (DGSC), and Perumpel is responsible for dredging in basins. Dredging works are executed by Perumpen using its dredging fleet. Maintenance dredging of navigation channels is carried out mainly by trailing suction hopper dredgers and maintenance dredging of basins is executed mainly by bucket and grab dredgers. Cutter suction dredgers are used mainly for capital dredging and rarely for maintenance dredging. Auxiliary equipment for dredging such as flow meters, draft meters, concentration meters, pressure gauges, etc. are often out of order and the operation of dredgers is dependent on the experience of the dredging crew. Furthermore, mini-ranger systems are often out of order, and trailing hopper suction dredgers are operating using few leading markers. The position of the dredgers is not assured in this case.

Maintenance dredged volume for navigation channels in each fiscal year is shown in Table II.4.4-2. Maintenance dredging target at present for navigation channels by DGSC is listed in Table A II.4.2-1 of the appendices for information.

Table II.4.4-1 Siltation Ratio and Maintenance Dredged Volume in Main Access Channels

No.	Location	Slope	Siltation Ration in Access Channel(%)	Maintenance Dredged Volume (1,000 m^3)								Maintenance Dredging Plan as of May, 1990	
				1983/1984	1984/1985	1985/1986	1986/1987	1987/1988	1988/1989	1989/1990	Yearly Average	Design Depth (m LWS)	Dredging Volume (1000 m^3)
1.	Belawan	1 : 5	15	3,546	3,296	2,580	1,655	1,612	1,568	1,615	2,268	- 9.5	2,500
2.	Kuala Langsa	1 : 7	10	-	-	125	-	-	-	-	18	- 5.0	200
3.	Tg. Priok	1 : 4	5	552	350	146	-	153	62	-	180	-11.0	200
4.	Sunda Kelapa	1 : 4	10	232	175	77	-	-	-	-	69	- 4.0	100
5.	Cirebon	1 : 4	10	229	279	101	-	320	352	286	257	- 7.0	350
6.	Jambi	1 : 8	20	734	653	1,236	-	-	-	580	458	- 4.5	500
7.	Pontianak	1 : 6	20	712	957	1,056	2,025	893	2,045	1,521	1,342	- 5.5	2,000
8.	Ketapang	1 : 5	15	-	-	195	650	129	-	-	139	-	-
9.	Palembang	1 : 6	15	3,267	3,323	2,665	3,552	344	2,683	2,709	2,649	- 6.0	2,500
10.	Semarang	1 : 10	10	408	340	1,137	-	-	-	201	298	- 9.5	77
11.	Juana	1 : 8	25	66	-	128	-	-	-	369	81	-	-
12.	Banjarmasin	1 : 8	30	2,365	2,515	2,075	3,573	1,643	3,075	2,156	2,486	- 5.5	2,793
13.	Samarinda	1 : 6	20	1,172	1,317	1,188	-	705	1,415	2,462	1,180	- 6.0	2,000

Note: Maintenance dredging plan is only draft.

Source: DGSC

Supplying of fuel oil, fresh water, and foodstuffs is important for execution. Data for these supplies are shown in Table A II.4.4-1 of the appendices.

(3) Control

Similar to other construction works, dredging operations are controlled in terms of quality, progress, safety, and cost. The quality of dredging works is usually checked by a series of surveys including pre-dredge, progress, and post-dredge surveys. Pre-dredge surveys and post-dredge surveys are carried out by and under the responsibility of DGSC and/or Perumpel. The contractor, Perumpen, executes progress surveys and often assists in pre-dredge and post-dredge surveys.

As for progress control, bar charts, graphs, drawings, etc., are used. These means are generally satisfactory.

Safety control is very important. There are many moving parts and dangerous areas inside dredgers. The main task of project managers and captains is to train site people to be aware of the safety factor.

It is natural that management staff consider the cost at first and the Perumpen staff is no exemption. It should be kept in mind that cost is affected by the above three controls.

The dredged volume is the most important factor for dredging works. Using this data many analyses can be done. The following formula is used in the calculations of dredged mud volume by trailing hopper suction dredgers:

$$Vb = V(ph-pw)/(r-pw) \quad (m^3)$$

where,

Vb = In situ volume of dredged material (m^3)

V = Total dredged volume in a hopper (m^3)

ph = Wet bulk density of soil in a hopper (t/m^3)

pw = Density of sea water (t/m^3)

r = In situ wet bulk density of soil (t/m^3)

Table II.4.4-2 Maintenance Dredged Volume in Access Channels

Unit: m^3

No.	Location	1983 - 1988									
		1983/1984		1984/1985		1985/1986		1986/1987		1987/1988	
		Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
1	2	3	4	5	6	7	8	9	10	11	12
1.	BELAWAN	3,515.000	3,545.575	3,100.000	3,295.750	2,576.585	2,579.600	1,657.573	1,655.000	1,600.000	1,612.000
2.	KUALA LANGSA	-	-	-	-	124.673	-	-	-	-	-
3.	SIBOLGA	-	-	-	-	-	-	-	-	100.000	330.000
4.	TG. PRIOK	700.000	551.800	350.000	350.000	143.154	146.000	-	-	153.000**	153.000**
5.	SUNDA KELAPA	230.000	232.242	165.000	174.957	72.532	77.200	-	-	-	-
6.	CIREBON	215.000	229.057	165.000	279.000	81.121	101.200	-	-	320.400**	320.400**
7.	JAMBI	650.000	733.850	650.000	652.500	800.000	1,235.650	-	-	-	-
8.	PONTIANAK	600.000	711.700	600.000	956.870	954.362	1,055.800	2,191.600	2,205.000	893.106**	893.106**
9.	KETAPANG	-	-	-	-	190.872	194.980	550.000**	650.300**	129.024**	129.024**
10.	TELUK BAYUR	150.000	184.430	-	-	-	-	-	-	31.367**	31.367**
11.	PALEMBANG	3,250.000	3,266.840	3,250.000	3,322.520	2,480.000	2,664.600	3,000.000* 550.000**	3,001.692* 550.000**	344.317**	344.317**
12.	PANGKAL BALAM	-	-	200.000	255.500	-	-	-	-	-	-
13.	MUARA PADANG	-	-	-	-	-	-	-	-	-	-
14.	BENGKULU	-	-	-	-	-	-	-	304.005	704.290**	704.290**
15.	SEMARANG	385.000	407.809	300.00	339.500	880.000	1,136.663	296.000	-	-	-
16.	TEGAL	-	-	-	-	-	-	-	-	-	-
17.	JUANA	58.000	66.285	-	-	128.000	128.000	-	-	701.155	-
18.	SURABAYA	2,300.000	2,648.035	710.400	718.200	-	-	-	-	-	704.700
19.	GRESIK	140.000	168.950	-	-	-	-	-	-	-	-
20.	PANARUKAN	-	-	-	-	-	-	-	-	-	-
21.	PASURUAN	-	-	-	-	-	-	-	-	-	-
22.	PROBOLINGGO	-	-	-	-	-	-	-	-	-	-
23.	BENOA	-	-	-	-	-	-	-	-	-	-
24.	AMBON	-	-	-	-	-	-	-	-	-	-
25.	BANJARMASIN	2,200.000	2,364.800	2,300.000	2,514.500	1,920.000	2,075.000	2,822.600 750.000**	2,844.868 751.300**	1,300.000 277.000ABT 1,557.000	1,344.070 299.000ABT 1,643.070
26.	PULANG PISAU	-	-	-	-	-	-	-	-	-	-
27.	SAMARINDA	1,204.000	1,171.646	1,200.000	1,316.600	1,145.235	1,184.579	-	-	646.463	704.990
28.	MENADO/BITUNG	60.000	60.001	40.000	40.542	-	-	-	-	-	-
	TOTAL	15,657.000	16,343.020	13,030.400	14,186.449	11,416.534	12,582.272	11,317.773	11,972.165	7,200.122	7,570.264

NOTES: * Stands for budget from Presidential budget

** Stands for budget from Perumpel

SOURCE: DGSC

The hopper capacity of a dredger is considered as V and r is usually calculated using soils attached to the drag head. 1.025 is mainly used for pw. The decision of the mixture percentage, that is (ph-pw) /(r-pw) is made every week or two weeks in the presence of the employer and the contractor. In addition, this investigation is made when the dredging location changes.

In the case of sandy materials, the in situ volume of dredged materials is calculated from the total volume (soil + water) minus the estimated water volume by physical sounding (by means of hand lots).

4-4-2 Record and Activities of Dredgers

(1) Dredging Record

The total dredged volume has increased remarkably since 1984 when Perumpen was established as a state-owned enterprise, and this increase is due to a remarkable increase of works in foreign countries, especially in Singapore, and works in the domestic market.

The volume dredged by each dredger during four recent years is shown in Table A II.4.4-2. Trailing suction hopper dredgers have played a major role, dredging nearly 90% of the total dredged volume. The average dredged volume per year and proportions by type of dredger during four recent years are as follows;

- trailing suction hopper dredgers	23,168,000 m^3/y	87.8 %
- cutter suction dredgers	1,541,000	5.8
- bucket dredgers	489,000	1.9
- grab dredger	1,177,000	4.5

(2) Non-operation

Except for the non-operation records of a project at the access channel of Banjarmasin Port, detailed records are not available. The only available data are annual non-operation records of ten dredgers during 1985 and 1986 as shown in Table A II.4.4-3. The days stated as "others" comprise the major portion, and therefore reasons for non-operation is not clear. But it is considered that days spent waiting for new jobs represent the main loss of time. Based on this table, the number of non-operation days due to repair at dock, accidents, and bad weather was not so great.

4-5 Maintenance and Repairs

4-5-1 Outline

Most of the repairs and maintenance are being executed at Perumpen's own facilities at Tanjung Priok, Jakarta and Tanjung Perak, Surabaya. The repairs and maintenance of the underwater parts of working vessels beyond dock capacity are carried out at several shipyards owned by the state. Perumpen repair facilities are shown in Table II.4.5-1 and the main shipyards in Indonesia are listed in Table II.4.5-2. Recent maintenance and repair records by Perumpen and shipyards are shown in Table A II.4.5-1 and Table A II.4.5-2 respectively. The managerial staff of Perumpen are aware of the importance of actual dredging hours and try their best to reduce idle time due to maintenance and repairs as much as possible. All the people concerned are working very hard. In order to smooth maintenance and repair works, guidelines are prepared and this repair list is based on the check list of regular surveys by Biro Klasifikasi Indonesia (BKI).

The most crucial item is spare part supply. Due to budget limitations and the need to purchase from abroad, etc., it often happens that dredgers are compelled to stand by just waiting for the arrival of spare parts.

4-5-2 Perumpen Facilities

As shown in Table II.4.5-1, there is one dry dock at Tanjung Priok and three dry docks at Tanjung Perak. The layouts of the Jakarta Branch Office including the Head Office and the Surabaya Branch Office are illustrated in Fig. II.4.5-1 and Fig. II.4.5-2 respectively. There is one old slipway which has not been used for a long time at Tanjung Priok. Most of the vessels except big work vessels are repaired at these facilities. Floating repairs are being carried out for all vessels.

Table II.4.5-1 Perumpen Repair Facilities

Location	Dock Type	Dock Capacity(DWT)	Dimension L x B x D (m)	Other Facilities
Jl. Seram No.1 Tanjung Priok Jakarta	Dry dock	500	50 x 15	One 3 ton capacity dock crane
	Slipway (Old and not used)	60	50 x 12	One 15 ton capacity mobile crane
Jl. Prapat Kurung Utara No. 58 Surabaya	Dry dock No. 1	350	45 x 12 x 4	3 sets of 2 ton capacity mobile crane
	Dry dock No. 2	450	45 x 15 x 4	
	Dry dock No. 3	450	45 x 15 x 4	

Source: Perumpen

4-5-3 Main Shipyards

Among the 15 main shipyards listed in Table II.4.5-2, 11 shipyards located at Jakarta, Surabaya, and Palembang were visited by the Study Team.

4-5-4 BKI

BKI is a state-owned company operating in the field of classification and registration of vessels, inspection, and consultancy of marine, industry, offshore and laboratory operating for the public's sake in which safety purpose is emphasized. Most of the dredging fleet of Perumpen is of the BKI class. Among rules for the classification and construction of seagoing steel ships, the following rules are important for the dredging fleet:

- The Ministry of Communications issued decrees requiring Indonesian flag vessels of 100 gross tons or larger, 100 BHP or more, or 20m or longer, to be classed with BKI.

- Annual Surveys are to be carried out every year.
- Intermediate Surveys are to be carried out between Special Surveys.
- Special Surveys of the hull and the machinery installations are to be carried out every four years.
- According to the government's rules, for Indonesian flag ships bottom surveys are to be carried out at intervals of one year.

Table II.4.5-2 Main Shipyards in Indonesia

No.	Name	Capacity	Location
*1.	PT. Dok Tanjung Priok	BB 5,000 DWT D 20,000 DWT	Tanjung Priok, Jakarta
*2.	PT. Pelita Bahari	BB 55,000 DWT D 8,000 DWT	Cilincing, Jakarta
3.	PT Kodja I	BB 3,500 DWT D -	Tanjung Priok Jakarta
4.	PT. Dok dan Galangan Kapal "NUSANTARA"	BB 3,000 DWT D -	Jakarta, Cirebon Semarang, Ciracap
5.	PT. Inggom	BB 1,000 DWT D -	Ancol, Jakarta
6.	PT. Adhiguna	BB 1,000 DWT D 500 DWT	Ancol, Jakarta
7.	PT. Indomaine	BB 1,000 DWT D -	Ancol, Jakarta
*8.	PT. Pabrik Kapal Indonesia	BB 1,000 DWT D 20,000 DWT	Surabaya, East Java
*9.	PT. Dok Tanjung Perak	BB 2,000 DWT D 6,000 DWT	Surabaya, East Java
10.	PT. Kodja III	BB 1,000 DWT D -	Palembang, South Sumatera
11.	PT. Intan Sengkunyit	BB 6,000 DWT D	Palembang, South Sumatera
12.	PT. Menara	BB 1,700 DWT D 400 DWT	Tegal, Central Java
13.	PT. Jasa Wahana Tirta Samodra	BB 1,000 DWT D 75,200,500 11,000 DWT	Semarang, Central Java
14.	PT. I.K.I	BB 500 DWT D 500 DWT	Ujung Pandang, South Sulawesi
15.	PT. Surya Karya	BB 700 DWT D 1,200 DWT	Menado, North Sulawesi

Note: (1) BB : Building capacity
D : Dry Dock
(2) * : Shipyard having experience for maintenance/repair of dredgers
Source: Field survey

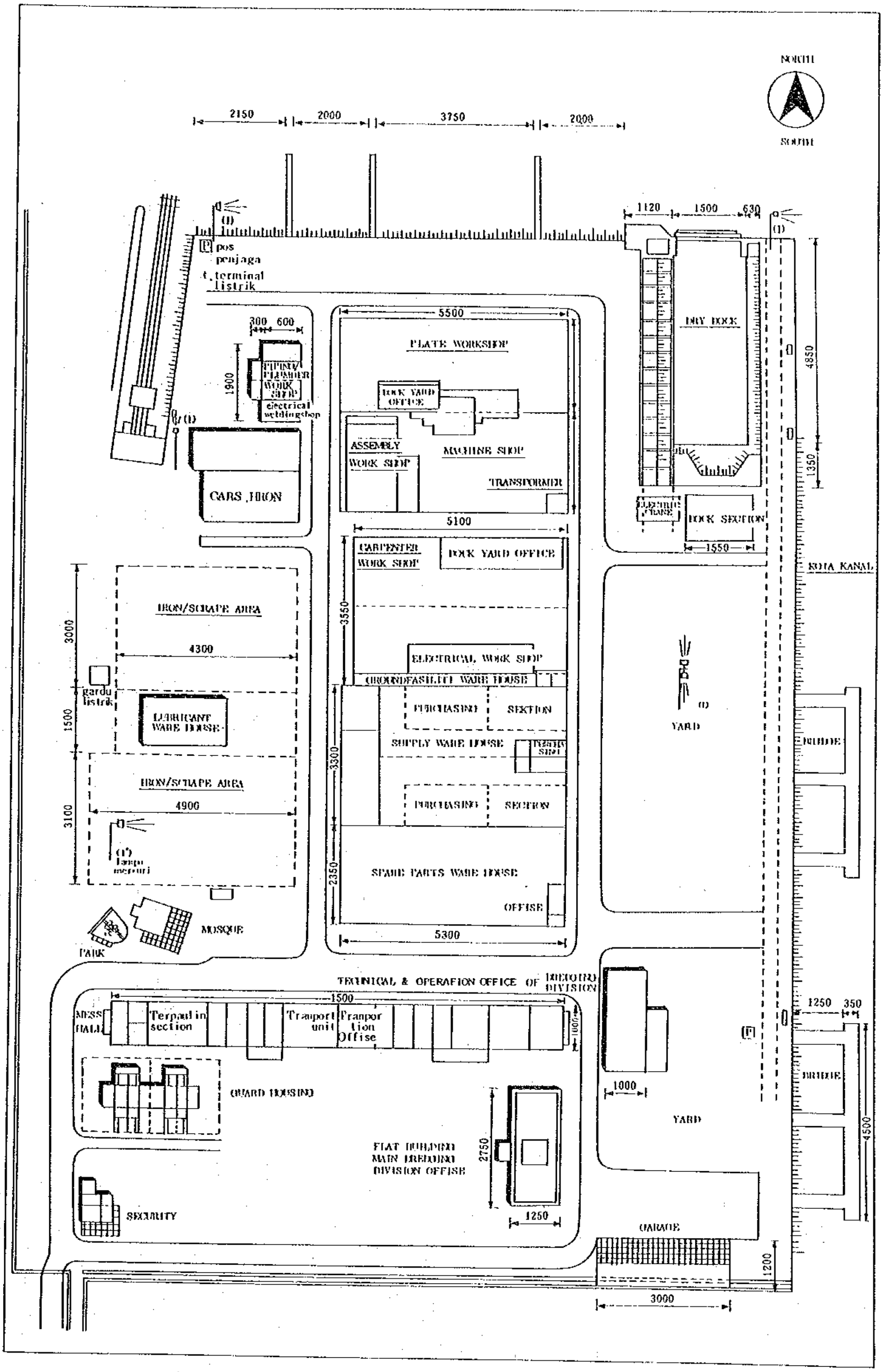


Fig. II.4.5-1 Layout of Perumpen Head Office
Source: Perumpen

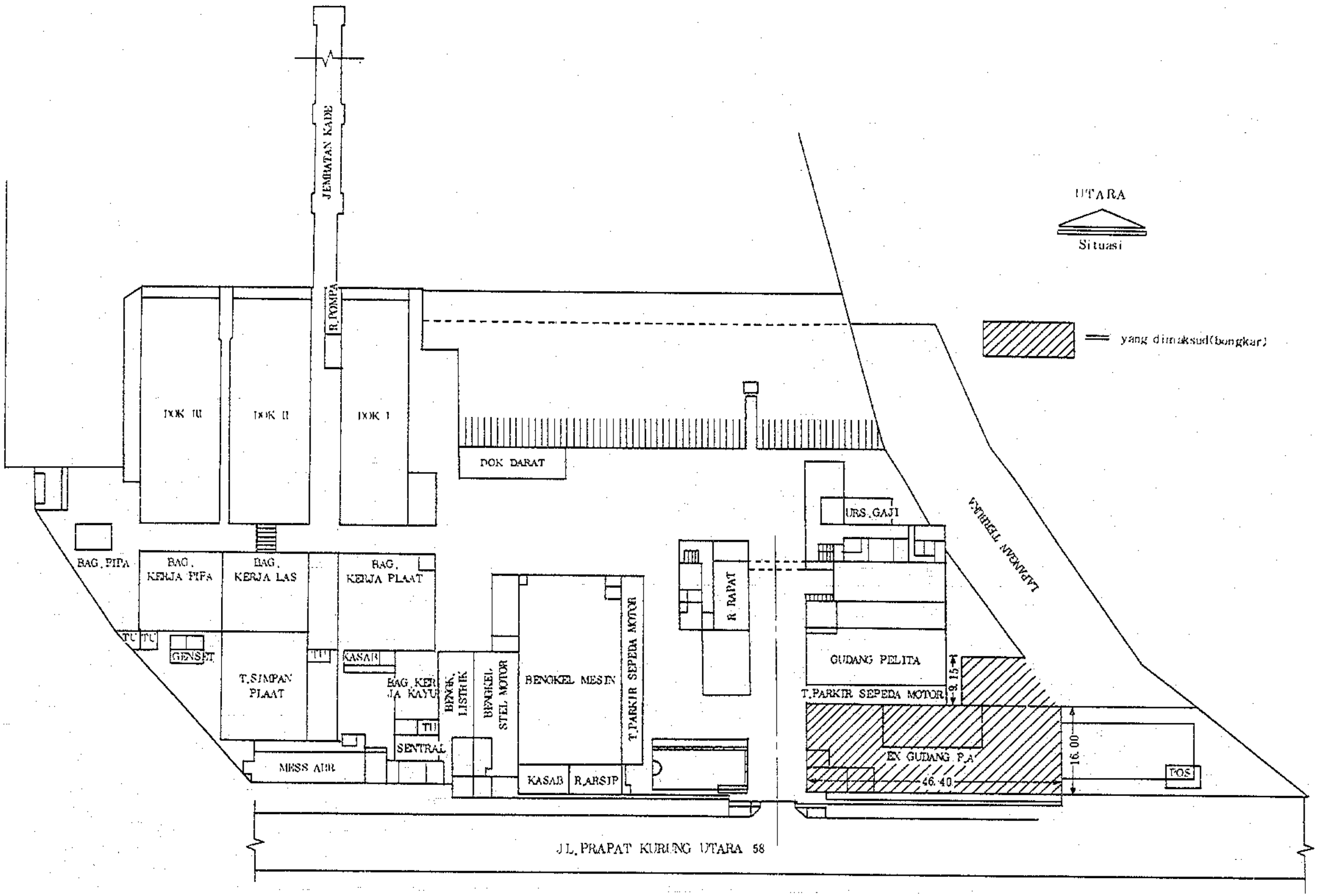


Fig. II.4.5-2 Layout of Perumpen Surabaya Branch Office
Source: Perumpen

Chapter 5 Present Activities and Utilization of the Port

5-1 Traffic of Vessels

5-1-1 Type and Size of Vessels

There are 7 major categories of ships listed in the shipping administration and port statistics which call on Banjarmasin Port. Their characteristics are explained below.

(1) Oceangoing Vessels (Samudera, O.G.)

They voyages from/to Indonesian ports to/from foreign ports on tramper/liner basis. This type of ships is further divided into two categories by flag:

a. Indonesian vessels (Nasional, liner 94% in 1989)
b. Foreign Vessels (Asing, tramper 77% in 1989)

The biggest ship to call before March 1988 was of 47,000 DWT (29,300 GRT) with a length of 224 m.

(2) Interisland Vessels (Nusantara, I.I.)

The majority (84% in 1989) have fixed-schedule voyages (Regular Liner Service, RLS) between ports in Indonesia. As any foreign flag ship, unless chartered by Indonesian companies, is not allowed to participate in this kind of services, virtually all of them are Indonesian vessels.

The biggest cargo ship was of 10,100 DWT (6,050 GRT) with 128 meters in overall length and 7.7 m in draft. One of the most important ships in this category is the passenger ship "Kelimutu" which has 5,685 GRT (1,411 DWT) with 99.80 m in overall length and 4.20 m in draft.

(3) Local Vessels (Lokal, Loc.)

These vessels travel among the ports in Indonesia in order to support Samudera and Nusantara, normally using ships of 500 m^3 (or 175 GRT) and under. The maximum size of ships of this type is about 40 m in length and 3.8 m in draft. Maximum-sized local ships have a GRT of around 750.

(4) Sailing Vessels (Rakyat or PL/PLM, Sail.)

These vessels engage in interisland services. There are two types; one is with engine (PLM) and the other without (PL). The maximum size of PLM called at Banjarmasin was of 258 GRT with a length of 41 m. The maximum PL was, in terms of GRT, 36 tons and, in terms of length, 20 m.

(5) Specialized Vessels (Khusus Industri, S.I.)

These vessels are for domestic and/or international services on liner (84%)/tramper (16%) basis, using specialized ship to transport industrial products, including log carriers, fishing vessels, mining industry vessels, barges (Tongkang, TKG), landing crafts type (LCT), tugs (TB), etc.

(6) Tankers (Tanker, KMT, Tank.)

These vessels are oil tankers and are divided into national and foreign vessels, although the majority are the former ones operated by/for PERTAMINA in Banjarmasin.

The biggest national tanker to have called at Banjarmasin was of 3,500 DWT (2,700 GRT) with a length of 90 m, and the biggest foreign one was of 5,949 DWT (3,585 GRT) with 101 m in length.

(7) Pioneer Vessels (Perintis)

They are vessels of less than 700 DWT specially assigned to provide regular service for remote islands. They seldom call on Banjarmasin.

Particulars of major types of the above ships are presented in Table A II.5.1-1 and Fig. A II.5.1-1 to 6.

5-1-2 Shipping Service Routes

Main shipping service routes to/from Banjarmasin Port are shown in Fig. II.5.1-1. Major ports of origin/destination to/from Banjarmasin are:

1) Surabaya
   Incoming and outgoing general cargoes, movement of passengers, etc.
2) Tg. Priok
   Incoming general cargoes, in and out of containers, etc.
3) Balikpapan
   Incoming oil products.
4) Semarang
   Movement of passengers, Incoming and outgoing general cargoes.
5) Palangka Raya
   Incoming logs, movement of passengers, etc. through canals.
6) Foreign ports including Singapore, Hong Kong, etc.

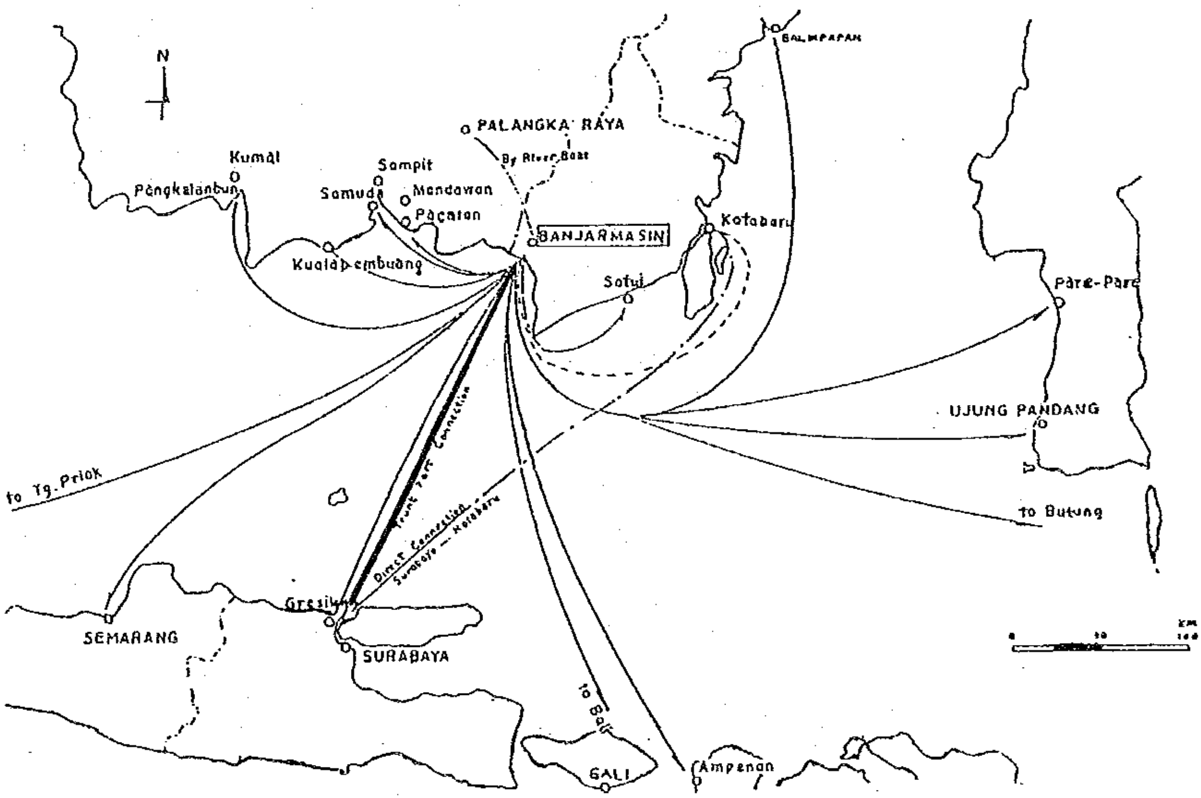


Fig. II.5.1-1 Major Shipping Service Routes of Banjarmasin Port

(Source) Perum Pelabuhan III Banjarmasin Branch Office
Peranan Terminal Sei Martapura dalam Pengembangan Pelabuhan Banjarmasin Kal-Sel, October 1985

5-1-3 Statistics on Ships Calling at Banjarmasin

Statistics for the past seven years on ships calling at Banjarmasin Port and handled cargo volume by type of ship are summarized in Table II.5.1-1(1) to (6).

During this period, the total number of ship calls has been steadily increasing with an average annual growth rate of 10.2% from 4,953 ships in 1983 to 8,040 ships in 1988.

The number in 1989, however, decreased 22% from 1988 due to a decrease of special industry ships. One of the most important facts is the decline of sailing vessels, i.e., 2,763 (56%) of total 4,953 calls in 1983 and 1,666 (27%) among 6,253 calls in 1989.

The total GRT was 2.22 times larger in 1989 than in 1983, owing to the increase in the number of oceangoing and special industry ships.

Cargo volume brought in 1989 was 41% by oceangoing, 23% by sailing, 14% by local, 9% by interisland, 8% by tanker and 5% by special industry ships.

Average payload or consignment volume is very high for sailing and local vessels, i.e., 3.9 and 2.8 ton/m^3 respectively, per GRT of ship, which implies fully loaded operations.

The locational distribution of size (and number) of ships that called at Banjarmasin from January to March 1988 were as follows: at Martapura wharf the majority are sailing and local ships and less than 200 GRT (187 ships). At Trisakti wharf and River Basin, ship sizes are widely distributed, from 300 to 7,000 GRT (120 ships). Ships moored at offshore basin were of between 10,000 and 30,000 GRT and on average 17,300 GRT (30 ships).

Table II.5.1-1 Past Records of Shipping by Ship Type at Banjarmasin Port

(1) Number of Calls

Ship Type	1983	1984	1985	1986	1987	1988	1989
Oceangoing	206	216	340	435	424	423	617
Interisland	169	290	275	298	218	212	191
Local	993	1,044	787	950	1,081	1,096	973
Sailing	2,763	2,501	2,417	2,256	1,827	1,643	1,666
Special	595	591	2,131	2,774	3,713	4,411	2,565
Tanker	227	223	210	217	217	255	241
Total	4,953	4,865	6,160	6,930	7,480	8,040	6,253

(2) Total GRT

(Thousands of ton)

Ship Type	1983	1984	1985	1986	1987	1988	1989
Oceangoing	1,332	1,784	1,996	3,534	3,331	3,168	3,371
Interisland	296	318	193	431	271	204	180
Local	139	149	90	158	167	172	181
Sailing	268	256	209	292	182	169	204
Special	355	325	489	943	1,231	1,477	1,567
Tanker	234	246	104	212	229	267	312
Total	2,624	3,080	3,082	5,571	5,412	5,457	5,815

(3) Average Ship Size (GRT/Ship)

Ship Type	1983	1984	1985	1986	1987	1988	1989
Oceangoing	6,500	8,300	5,900	8,100	7,900	7,500	5,500
Interisland	1,750	1,100	700	1,400	1,200	1,000	940
Local	140	140	110	170	150	160	190
Sailing	100	100	90	130	100	100	120
Special	600	550	230	340	330	330	610
Tanker	1,000	1,100	1,000	1,000	1,000	1,000	1,300

(4) Total in and Out Cargo Volume

(Thousands of ton/m^3)

Ship Type	1983	1984	1985	1986	1987	1988	1989
Oceangoing	764	727	-	1,042	1,153	1,156	1,142
Interisland	143	174	-	137	207	241	321
Local	132	181	-	243	252	256	504
Sailing	570	646	-	746	558	577	797
Special	278	53	-	487	473	445	208
Tanker	308	290	(303)	243	261	280	276
Total	1,993	2,074	(2,340)	2,894	2,902	2,954	3,548

(5) Average Cargo Volume Per Ship

(Total of in and Out)

(ton/m^3 per ship)

Ship Type	1983	1984	1985	1986	1987	1988	1989
Oceangoing	3,710	3,368	(1,949)	2,396	2,719	2,733	2,337
Interisland	844	604	(576)	460	954	1,135	1,681
Local	134	174	(182)	256	232	233	518
Sailing	206	259	(247)	331	305	351	478
Special	467	90	(197)	176	127	101	81
Tanker	1,355	1,302	(1,444)	1,121	1,201	1,097	1,145

(6) Average Payload

(ton/m^3 per GRT of a ship)

Ship Type	1983	1984	1985	1986	1987	1988	1989
Oceangoing	0.574	0.408	(0.332)	0.295	0.346	0.365	0.428
Interisland	0.483	0.547	(0.818)	0.318	0.764	1.181	1.785
Local	0.950	1.215	(1.596)	1.538	1.509	1.488	2.785
Sailing	2.127	2.523	(2.839)	2.555	3.066	3.414	3.907
Special	0.783	0.163	(0.860)	0.516	0.384	0.301	0.133
Tanker	1.316	1.719	(1.444)	1.146	1.140	1.049	0.885

(Source) Annual Reports, Banjarmasin Office, Perumpel III

(Notes) "Interisland" excludes the passenger ship KELIMUTU (5685 GRT, capacity 920 psns) which had 43, 52, and 47 calls in 1987, '88, and '89, respectively.

5-2 Cargoes and Passengers

5-2-1 Cargo Throughput

The cargo volume dealt at Banjarmasin Port in the past seven years is summarized by commodity in Table II.5.2-1.

It is to be noted first that the unit of cargo volume employed in the statistics is (tons/m^3), or mixed with tons and m^3. (Ton) is applied for heavy cargoes such as petroleum products, molasses, rice, flour and others, whereas (m^3) is for massive cargoes such as wood products including plywood, sawn timber, molding and dowel, frozen shrimp, machines, cigarettes and others. Some items such as food/drink, soap and others are counted in either tons or m^3. The unit of "others" is literally (ton/m^3) mixed. In Japan, cargoes are measured using a feet-ton system in the official statistics based principally on a conversion rate of 1.133 m^3 = 40 ft^3 = 1 ton. Hence, cargo volume measured in m^3 gives approximately a 10% higher figure in Indonesia than that registered in ton in Japan.

(1) Foreign Trades

Foreign trade volume increased by 2.2 times from 1983 to 1989 or 13.9% p.a. The most characteristic feature is the predominance of exports. The share of imports has been minimal, i.e. 4.5% in 1985 and 2.7% in 1989.

One of the most remarkable changes in the export structure at Banjarmasin Port was that log exports virtually vanished in 1985, due to the Government policy of increasing exports of value-added products. In fact, exports of plywood have been drastically increasing since 1983; the volume of plywood in 1989 was 6 times as much as their volumes in 1983. Sawn timber volume was twice as much in 1987 as in 1983 and started to decrease in 1988. These two commodities constitute 98% of total export volume.

Table II.5.2-1(1) Export and Import

(Unit in tons/m³)

	1983	1984	1985	1986	1987	1988	1989
I. **Export**							
1) Logs	275,053	88,818	5,847	-	-	-	-
2) Sawn Timber	93,106	119,574	119,808	165,369	194,676	163,948	161,060
3) Plywood/Veneer	203,821	390.450	567.985	581.289	747.926	794,480	1,219,717
4) Rubber	51,841	49.564	41.509	6.220	18.589	17,383	10,847
5) Rattan	1,697	624	387	37	-	-	-
6) Rattan Carpet	-	-	28	-	1.114	511	48
7) Frozen Shrimp	1,579	1,815	1,373	2,076	2,581	1,900	3,601
8) Others	2,248	174	391	16,406	1,913	30,950	7,336
9)							
	629,345	651.019	737.328	771.397	966.799	1,009,172	1,402,609
II. **Import**							
1) Chemicals	4,304	6,758	14,841	12,143	18,340	5,650	7,224
2) Machine & Spare Parts	4,844	3,067	1,838	3,512	4,686	9,918	10,454
3) Asphalt	350	1,400	8,579	19,917	9,318	6,043	21,003
4) Car & Vehicles	19	196	3	139	888	-	-
5) Heavy Equipment	3,862	8,387	6,218	5,112	4,887	8,380	578
6) Rice	9,226	4,531	-	-	-	-	-
7) Fertilizer	3,542	326	-	-	-	-	-
8) Cement	3.400	-	-	-	-	-	-
9) Others	361	20	1,917	9,831	1,215	1,052	215
Sub-Total	29,908	24,685	33,396	50,654	39,334	31,043	39,473
T o t a l	659,253	675,704	770,724	822,051	1,006,133	1,040,215	1,442,082

Source : Annual Report Perum Pelabuhan III, Banjarmasin Branch Office 1983 - 1989

Table II.5.2-1(2) Outgoing and Incoming

(Unit in tons/m³)

	1983	1984	1985	1986	1987	1988	1989
I. **Outwards**							
1) Logs	98.604	24.427	76.152	124.192	32.850	56,655	
2) Sawn Timber	352,734	404,477	302,749	353.692	264,486	265,528	353,439
3) Plywood	23,675	20,865	21,300	20,422	20,561	24,784	19,312
4) Rubber	420	55	6,316	25,142	33,747	37,638	56,429
5) Petroleum Products	26,307	29,337	28,107	7,225	8,547	19,273	10,614
6) Fertilizer	2,373	7,381	8,714	6,491	6,081	7,795	5,109
7) Rattan	4,825	6,382	7,531	6,621	6,314	6,426	24,540
8) Rattan Mat & Rush Mat	2,020	2,207	3,315	9,371	17,013	12,427	7,695
9) Others	24,357	32,603	33,366	38,619	54,439	85,814	175,009
Sub-Total	535,315	527,734	487,550	591,775	444,038	516,340	652,147
II. **Inwards**							
1) Rice	50,301	56,900	58,117	63,608	83,693	65,572	48,019
2) Sugar	49,725	53,822	47,654	49,516	44,974	47,774	22,128
3) Wheat Flour	26,091	27,365	29,497	31,985	31,615	33,917	27,166
4) Fertilizer	19,492	25,269	46,862	57,367	77,377	80,066	103,567
5) Cement	60,518	67,731	61,584	66,434	61,916	75,456	98,029
6) Food/Drinks	8,968	11,024	22,165	45,955	17,104	41,196	83,657
7) Car/Vehicles	9,950	9,752	8,265	23,865	22,791	19,420	32,244
8) Construction Materials	22,844	25,196	32,325	18,202	14,185	22,384	72,446
9) Logs	-	-	285,845	498,814	462,864	316,156	1,219
10) Petroleum & Products	307,633	290,347	303,194	243,215	260,572	279,819	276,335
11) Others	243,140	308,461	186,597	381,492	375,106	415,462	688,970
(exclude logs)			(796,260)	(981,639)	(989,333)	(1,081,066)	(1,452,561)
Sub-Total	798,662	875,867	1,082,105	1,480,453	1,452,197	1,397,222	1,453,780
T o t a l	1,333,977	1,403,601	1,596,655	2,072,228	1,896,235	1,913,562	2,105,927

Source : Annual Paper Perum Pelabuhan III, Banjarmasin Branch Office 1983 - 1989

Rubber is the third-ranked commodity, but it seems to be decreasing in volume.

With regard to rattan, export as raw material decreased rapidly from 1,700 tons in 1983 to zero in 1987. Instead, export of rattan carpet substituted and recorded 1,100 m^3 in 1987, although the share against the total export is only 0.1% as far as its volume is concerned and recorded a sharp drop in 1988 and 1989.

Exports of frozen shrimp have been steadily increasing up to 3,601 ton in 1989, which constitute 0.3% of total export in weight.

Import commodities are mainly manufactured products. Import of such fundamental goods as rice, fertilizer and cement disappeared by 1985. This seems due to increased domestic production and hence those cargoes moved to the category of domestic cargoes.

The most dominant import cargo is now chemicals, of which the majority is glue for processing plywood. Keeping pace with the increase of plywood export, imports of glue also increased.

Asphalt, which ranks second, increased quite drastically up to 1986, but decreased in 1987. Its annual growth rate was quite higher than that of the construction sector's GRDP, which was already shown in Table A II.1.1-3.

Machines & spare parts as well as heavy equipment have total volume of about 10,000 m^3 per year. Their volume experienced increase and decrease in seven years.

(2) Domestic Trades

Commodity and volume of outward and inward cargoes are given in Table II.5.2-1(2). The volume of outward cargoes has tendency of fluctuation around 500 thousand ton/m^3.

Outward bound shipments of logs and sawn timber have been the major items, but log exports stopped in 1989. Sawn timber and plywood volume kept at an almost constant level of about 300,000 and 20,000 m^3, respectively. Rubber marked a great increase. Rattan mats and rush mats increased rather remarkably until 1987 and after that decreased, possibly due to the market.

One of the noteworthy outward cargoes is coal supplying to Gresik from 1988, although the volume is still limited.

Inward cargo has been the most dominant category in the past. One of the most important changes in the domestic trade structure of Banjarmasin Port was the start of inward transport of logs in 1985. This might correspond to the drastic increase in plywood exports.

Incoming shipments of rice steadily increased at a rate of 12% p.a. until 1987. Sugar was almost constant until 1988 and decreased in 1989. Cement had been stable but increased in 1989. Wheat flour increased slightly.

Incoming shipments of fertilizer recorded a great increase throughout this period, i.e., 32% p.a. Car/vehicles showed a jump in 1986.

One of the characteristics of incoming shipments is that petroleum products have not been increasing, but slightly decreasing as a whole, keeping at a level between 240,000 and 300,000 ton p.a.

5-2-2 Containerization

In Banjarmasin, containerization began only in 1987. The container throughput is shown in Table II.5.2-2. The growth in the past three years was dramatic, and, in 1989 the total throughput was 4,180 TEU. The major cargoes are rattan carpets, molding and dowels for export and machine, spare parts and chemicals for imports. Plywood and general cargoes are still on a very limited scale.

Table II.5.2-2 Past Records of Container Throughput

(share, %) <Annual Growth Rate, %>

Year	1987			1988			1989		
	Box	Ton	Ton/Box	Box	Ton	Ton/Box	Box	Ton	Ton/Box
Inward									
Filled	193 (49)	1,447	7.5	167 (25) <-13>	2,967 <105>	17.8 <137>	1,063 (71) <537>	10,937 <269>	10.3 <-42>
Empty	203 (51)	-	-	490 (75) <141>	-	-	428 (29) <-13>	-	-
Sub-Total	396(100)	1,447	3.7	657(100) <66>	2,967 <105>	4.5 <22>	1,491(100) <127>	10,937 <269>	7.3 <62>
Outward									
Filled	369(100)	2,997	8.1	580 (83) <57>	5,482 <83>	9.5 <17>	2,002 (74) <245>	16,126 <194>	8.1 <-15>
Empty	- (0)	-	-	122 (17) <->	-	-	687 (26) <463>	-	-
Sub-Total	369(100)	2,997	8.1	702(100) <90>	5,482 <83>	7.8 <-4>	2,689(100) <283>	16,126 <194>	6.0 <-23>
Total									
Filled	562(73)	4,444	7.9	747(55) <33>	8,449 <90>	11.3 <43>	3,065 (73) <389>	27,063 <220>	8.8 <-22>
Empty	203(27)	-	-	612(45) <201>	-	-	1,115 (27) <82>	-	-
Total	765(100)	4,444	5.8	1,359(100) <78>	8,449 <90>	6.2 <7>	4,180(100) <208>	27,063 <220>	6.5 <5>

(Source) : Annual Reports, Banjarmasin Office, Perumpel III

The transport of containers was done by LCT until 1989 and is now carried out by a semicontainer ship, the "Gemah Ripah (500 GRT)" to/from Tj. Priok and a general cargo ship "Kaltim Mas" to/from Surabaya. Gemah Ripah called three times a month and brought 40 TEU per one-way trip on the average in 1989.

There is an unusual imbalance between the in and out total number of boxes in the 1989 statistics. This is because the number of transhipment, i.e., 2,032 TEU in 1989 which is not classified into incoming or outgoing, is totally included in the outgoing category.

5-2-3 Passengers' Traffic

The passenger traffic in the past seven years at Banjarmasin Port is shown in Table II.5.2-3 for those at Trisakti and Martapura.

The number increased greatly and reached the order of 100,000 in 1987, which is 2.5 times larger than that in 1983, and is still increasing.

One of the reasons is, besides the potential demands of people for cheap transportation, the commission of a modern passenger ship "Kelimutu" in 1986 which contributed to attract potential passengers. She is operated twice every other week always with passengers over the capacity. P.T PELNI is planning introduction of another passenger ship to the Kalimantan region.

Table II.5.2-3 Interisland Passenger Traffic Records

(persons)

Year	Direction	Trisakti	Martapura	Sub-Total	Total
1983	Embark Disembark	13,470 17,655	7,767 4,053	21,237 21,708	42,945
1984	Embark Disembark	18,696 20,077	14,728 4,408	33,424 24,485	57,909
1985	Embark Disembark	21,500 23,458	14,920 3,993	36,420 27,451	63,871
1986	Embark Disembark	11,972 7,506	21,538 13,027	33,510 20,533	54,043
1987	Embark Disembark	39,054 45,117	13,725 9,307	52,779 54,424	107,203
1988	Embark Disembark	50,987 56,779	15,045 6,478	66,032 63,257	129,289
1989	Embark Disembark	55,481 52,061	24,893 14,586	80,374 66,647	147,021

(Source) Annual reports, Banjarmasin Office, Perumpel III

5-3 Condition of Ships' Movement

5-3-1 Arrival Distribution of the Vessels

The number of vessels which called at Banjarmasin Port every day from the beginning of January to March 1988 was analyzed based on the records provided by Perumpel III Banjarmasin Office. The result is illustrated in Fig.II.5.3-1 after statistical arrangement. It is to be remembered that the overall average of all types of vessels was 22.2 ships per day for the whole year of 1988.

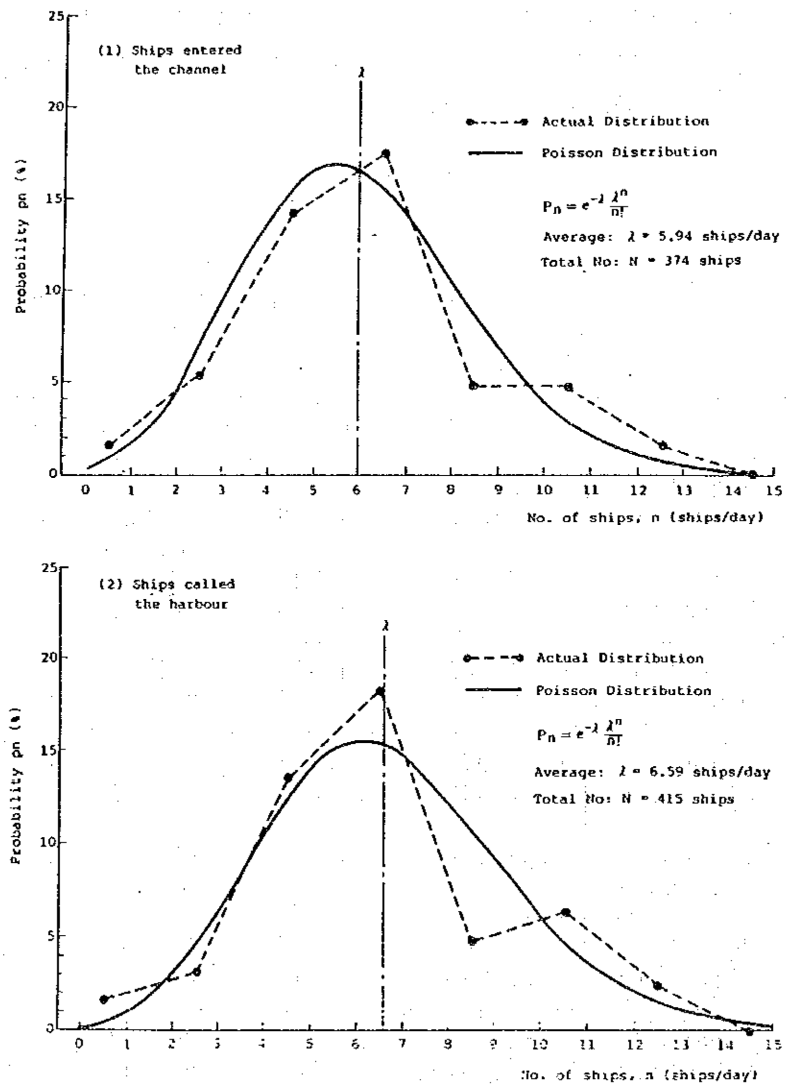


Fig. II.5.3-1 Distribution of Arrived Ships
(From January 1 to March 3, 1988, excluding tug boats, barges, and sailing boats)

Except for tug boats, barges and sailing boats, the average number of ships which arrived in a day was 6.6 ships per day among which 5.9 ships entered the channel into the Barito river. The remaining 0.65 ships per day stayed at the off-shore basin.

It is characteristic that those statistical distribution coincide with the so-called Poisson distribution fairly well in spite of the very limited number of days analyzed, i.e. 63 days. This coincidence implies that, although many of these vessels are operated on a regular service basis, we can consider theoretically that the overall arrival pattern of the ships is random.

5-3-2 Efficiency of Shipping

Based on the data collected from January to March 1988, the relationship among ship size in GRT, cargo volume handled, and the amount of time spent in the harbour is analyzed taking account of commodity and the place of cargo handling for oceangoing vessels, interisland vessels, local vessels and tankers, and the results for oceangoing vessels are shown in Fig.II.5.3-2.

(1) Oceangoing Vessels

Oceangoing vessels include general cargo ships and bulk carriers of various sizes which engage in foreign trade.

Fig. II.5.3-2 (1) shows export cargo volume by vessel expressed in GRT with additional information on major commodity handled and the place where they berthed. Ships which loaded plywood and sawn timber sometimes took rubber on the same ship, which is not specified in the Figure.

One of the most important features we can read from the Figure is that the bigger vessels of more than 6,300 GRT stayed off-shore without exception. The cargo volume loaded at Banjarmasin Port seems to be proportional to the ship size up to around 0.5 m^3/GRT. Ships less than 6,300 GRT entered the channel and moored in the river or, in the case of the ships less than 2,000 GRT, berthed at Trisakti Wharf.

Some of the ships between 4,800 and 5,500 GRT loaded cargoes both in the river and off-shore. There was a 3,400 GRT ship which shifted and took plywood at the Wharf and river basin as well as at the off-shore basin. This shift is because of draft restrictions in the channel.

It seems that those ships which enter the channel tend to load fully up to more than 1.0 m^3/GRT. As the unit weight of plywood is about 1.6 tons/m^3 and dead weight tonnage, DWT, is about 1.5 to 1.7 tons/GRT, they might be almost fully loaded with Banjarmasin's cargo.

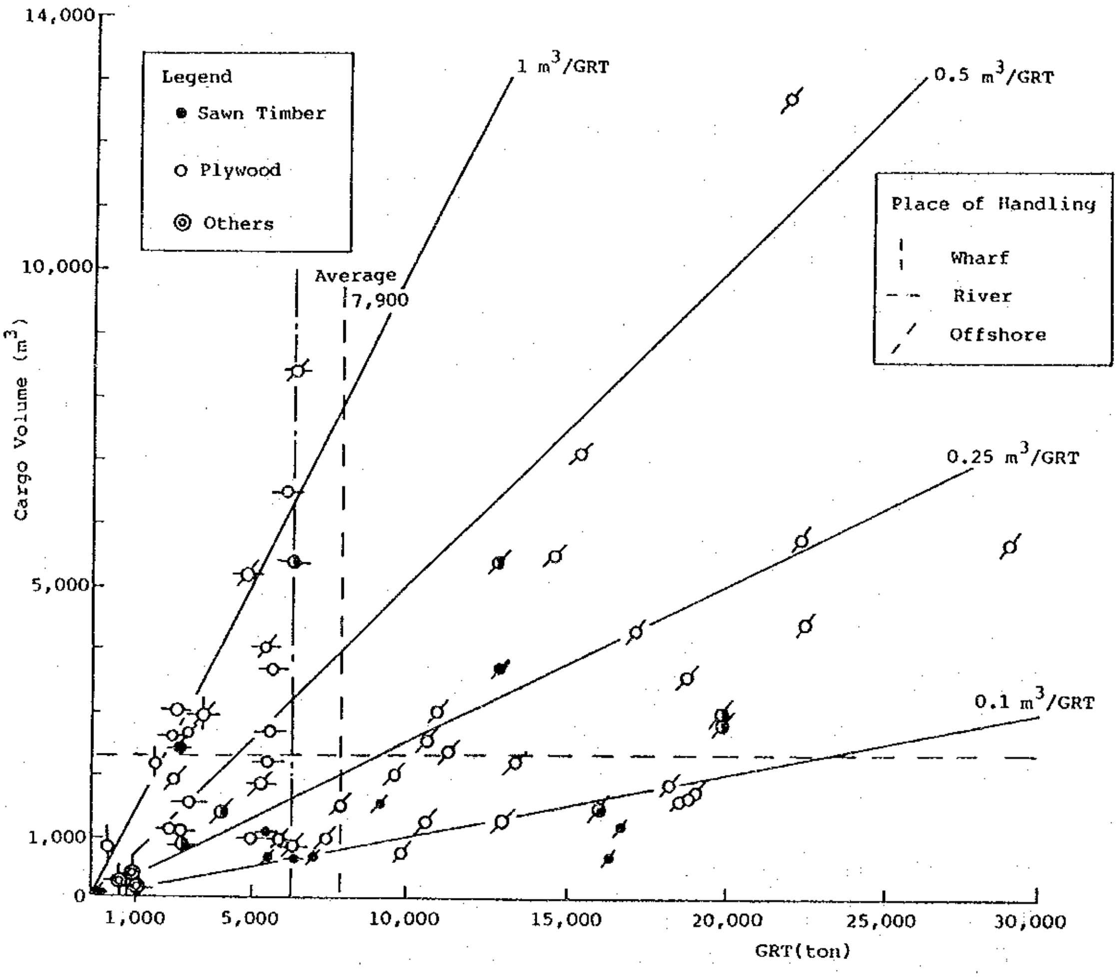


Fig. II.5.3-2(1) GRT and Loaded Cargo Volume of Oceangoing Ships
(Source) Banjarmasin Office, Prumpel III

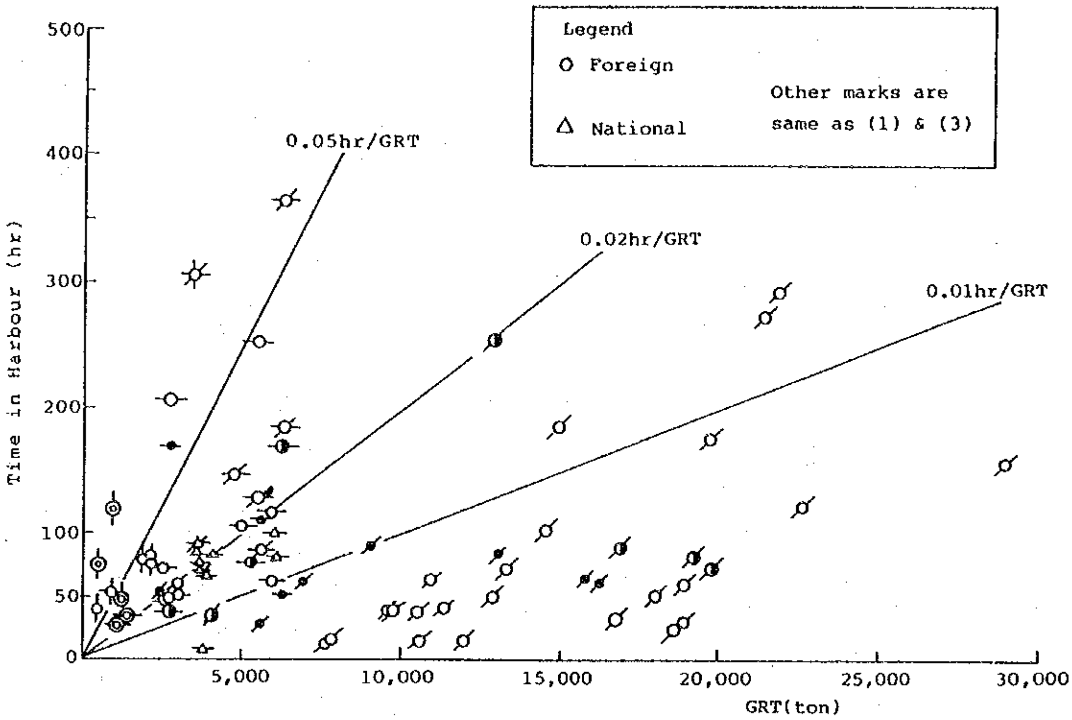


Fig. II.5.3-2(2) GRT and Time in Harbor of Oceangoing Ships

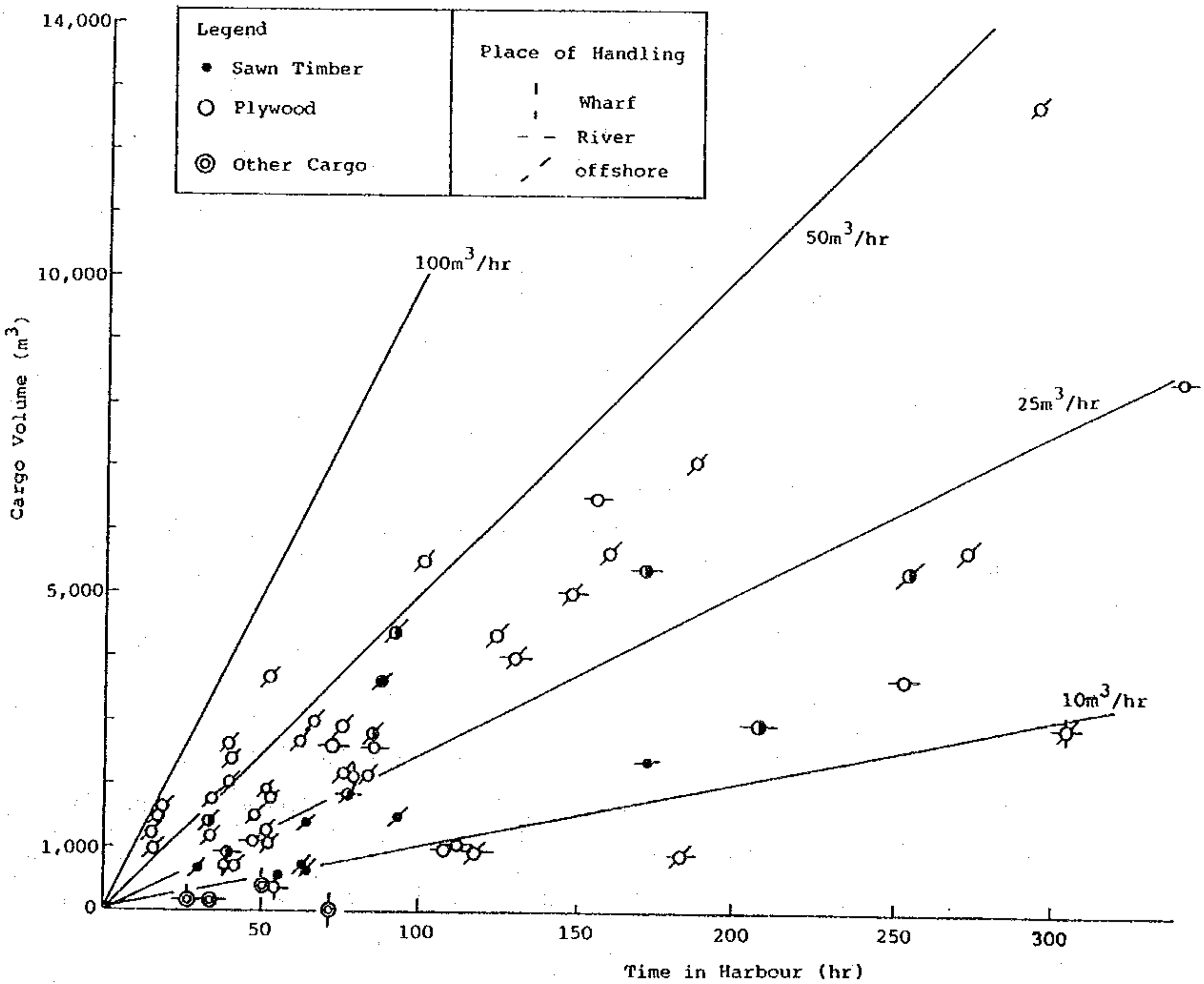


Fig. II.5.3-2(3) Time in Harbor and Cargo Volume of Oceangoing Ships

From Fig. II.5.3-2 (2) we understand that the national oceangoing ships entered the channel and many of them shifted to the off-shore basin to load additional plywood. It is quite interesting that those ships which entered the channel stayed longer in the harbour than those which remained off-shore.

Cargo handling efficiency measured by a ratio of cargo volume divided by time in the harbour is, generally speaking, higher at the off-shore basin than at the river basin, which is shown in Fig. II.5.3-2 (3). Furthermore, ships which shifted from the river to the off-shore basin show the lowest efficiency.

(2) Interisland Vessels

Interisland vessels deal with various kind of incoming and outgoing general cargoes. Counterpart ports include Surabaya, Ujung Pandang, Semarang, Tanjung Priok and many other ports. They always enter the channel and berth at Trisakti Wharf.

Cargo handling efficiency relative to the time in the harbour was 10 to 20 tons per hour at the most. Time in the harbour is less than 230 hours and tends to be short in the case of larger ships. The extreme case is KELIMUTU which stays in the harbour 10 hours on average (6 to 14 hours), adjusting the time of her passing through the channel to catch the high tide.

(3) Local Vessels

Local vessels along with sailing boats carry a variety of break bulk cargoes. They use Martapura Wharf with few exceptions.
They usually stay in the harbour one to three days. Some of them stay more than one week.

(4) Tankers

Oil products flow into Banjarmasin mainly from Balikpapan on PERTAMINA tankers. The tankers unload at the PERTAMINA Wharf in Banjarmasin Port. Some other ports of origin include Pulang Pisau (Kalimantan), Teluk Semangka (Sumatra), Plaju (Sumatra), Jakarta and Bali. The major group of 1,000 GRT tankers sometimes call with a full load (2.0

ton/GRT). But the bigger the ship size the smaller the load factor and the shorter the time in the harbour.

The cargo handling efficiency is reasonable, ranging from 20 to 150 tons per hour, but the port time efficiency in terms of the time at berth (ab. 20 hours) over time in the harbour (ab. 2 days) is rather low at a level of 0.423 on the average. In general, port time efficiency must increase and approach 1.0, parallel with the increase of the time in the harbour. It seems, however, that the efficiency decreases when the harbour time increases. This might be possibly an effect of the draft restriction in the channel again.

5-4 Utilization of Berthing Facilities

5-4-1 Cargo Volume Handled by Each Wharf and Berth Throughput

(1) Cargo Volume Handled by Each Wharf

The share of each wharf did not change very much from 1983 to 1987, except for PERTAMINA's slight decrease. The shares on the average for the five years are as follows:

Trisakti Wharf:	8%
Martapura Wharf:	18%
PERTAMINA Berth:	12%, and
Other private berths and Anchorages (Seas & Rivers):	62%

Almost 2/3 of cargoes were handled at other private berths and anchorages. Martapura Wharf has a much higher share than Trisakti Wharf.

(2) Unit Berth Throughput

The length of Trisakti Wharf was 200 m until 1983 and afterward 320 m. Martapura Wharf had 428 m length for the same period.

Then the berth throughput per unit meter length per one year recorded the highest values of 2,027 t/m/year at Trisakti Wharf in 1989 and 1,725 ton/m/year at Martapura Wharf in 1986. These are admirable results, specifically that for Martapura Wharf, if we consider the limited water depth, or the fact that only small local and sailing ships can berth there, and the labour-intensive cargo handling system.

5-4-2 Efficiency of Berth Utilization

(1) Effective Number of Berths

In order to evaluate the efficiency of berth utilization in detail, the effective number of berths at Trisakti and Martapura Wharves is calculated.

First, the average ship length weighted by their berthing time, Lav, is assessed, and the result is that the average ship lengths berthed at Trisakti and Martapura Wharves were about 60 and 30 m, respectively.

Then, the effective number of berth, S eff, at Trisakti and Martapura Wharves are calculated by dividing the actual lengths of these berths by the above Lav.

These Wharves have the following effective number of berths:

Trisakti Wharf:	5 berths, and
Martapura Wharf:	16 berths.

(2) Berth Occupancy

As the berth number cannot be defined a priori due to the limited length of berths and the variety of ship size, the berth occupancy rate, ρ, is defined by:

$$\rho = \sum_{j=1}^{M} (Nj \times \overline{Lj} \times \overline{tbj})/(1 \times 365 \times 24)$$

where,

- M : Number of types of ship,
- N : Number of ships of each type,
- $\overline{L}$: Average length of each type of ship (m),
- $\overline{tb}$: Average berthing time of each type of ship (hour), and
- l : Total length of a wharf (m).

At Trisakti Wharf, ρ was 100% in 1983, which is theoretically impossible to achieve without very long queuing of waiting ships for berthing. In recent years, ρ was about 75% and 86% in 1984, which is still very high.

At Martapura Wharf ρ had extraordinary figures of 200 to 300%, which means more than double-row berthing of ships at a time. In fact, four-row berthing has not been uncommon at this very busy Wharf.

The above facts suggest that Trisakti Wharf is now going to be saturated and Martapura Wharf has already been over-utilized.

5-4-3 Berthing Efficiency for Ships

(1) Service Ratio

In order to evaluate the berthing efficiency for ships whether they were to wait for berthing a long time relative to berthing time, service ratio of the both Wharves, which can be defined as a ratio of waiting time, Wq, over berthing time $1/\mu$, was calculated from 1983 to 1987. It is to be noted that the smaller the ratio is, the better.

In the case of Trisakti, interisland ships have the lowest ratio of 7%, which might be acceptable. Oceangoing ships, however, have a very high value of 50%. At Martapura Wharf, local ships have 17%, and sailing vessels have a value as high as 85%, which is normally considered not to be acceptable for ships.

(2) Idle Berthing Time Ratio

The next interesting point with regard to berthing efficiency for ships is the effective time of berthing. It can be measured by knowing the idle time ratio, ri, which is defined as the ratio between idle time without cargo handling and berthing time.

At Trisakti Wharf, interisland ship showed a great improvement from 75% in 1983 to 24% in 1987. The value of 24% is an excellent one. But oceangoing and special ships have figures of more than 50%, which could be reduced by improving cargo handling efficiency and through other measures.

At Martapura Wharf, it seems that the conditions deteriorated gradually in the past few years. Both local and sailing ships had idle time ratios of over 80%, which implies very inefficient utilization of the berths.

It can be concluded that the results of the above analyses done so far show the necessity of development of berthing facilities in addition to the improvement of related matters including the cargo-handling system, etc.

5-5 Present Navigational Safety Conditions

(1) Access Channel

The entrance of the Barito River is marked by an entrance buoy situated at Lat. 03-39-36 S, Long. 114-25-45 E.

All vessels entering Banjarmasin Port have to pass through a 14 km long narrow access channel, which was dredged to a depth of 6m from LWS and which had a bottom width of 100m.

But the depth and width of the channel have not been well-maintained since its development in 1976 due to heavy siltation and insufficient maintenance dredging. It was only 50-60 m wide and 2.5 m LWS water depth according to the survey report carried out in March 1988.

(2) Navigational Control System

There is presently no special control system in the Port of Banjarmasin.

Navigational safety thus relies on the activities of the Pilot Division in cooperation with the Harbour Master Division and the Coast Guard Division.

Normally, in accordance with the request for pilots and the sailing and arriving notices received from shipping agencies 12 hours prior to entry and 6 hours prior to departure, a ship's movement schedule is made by the chief pilot one day before entering or leaving the port except in cases where urgent movement of ships is required.

Currently, the following safety measures are in force:

- compulsory pilotage system for ships of more than 105 GRT
- use of tug boats is compulsory for ships with a length of more than 71 meters
- monitoring system by the Harbour Master and Coast Guard as necessary
- the maximum sailing draught is decided by ship masters in consultation with pilots
- towing boats need to report their schedule of movements to the Harbour Master
- the maximum sailing speed in the port area is 6 knots
- sailing is in one direction only, and the interval between ships should be at least one nautical mile
- passing is not allowed in the access channel
- fishing is not allowed in the access channel

(3) Navigational Aids

There are 4 light buoys, 2 leading lights and 4 light beacons in the port of Banjarmasin, including the access channel, as follows:

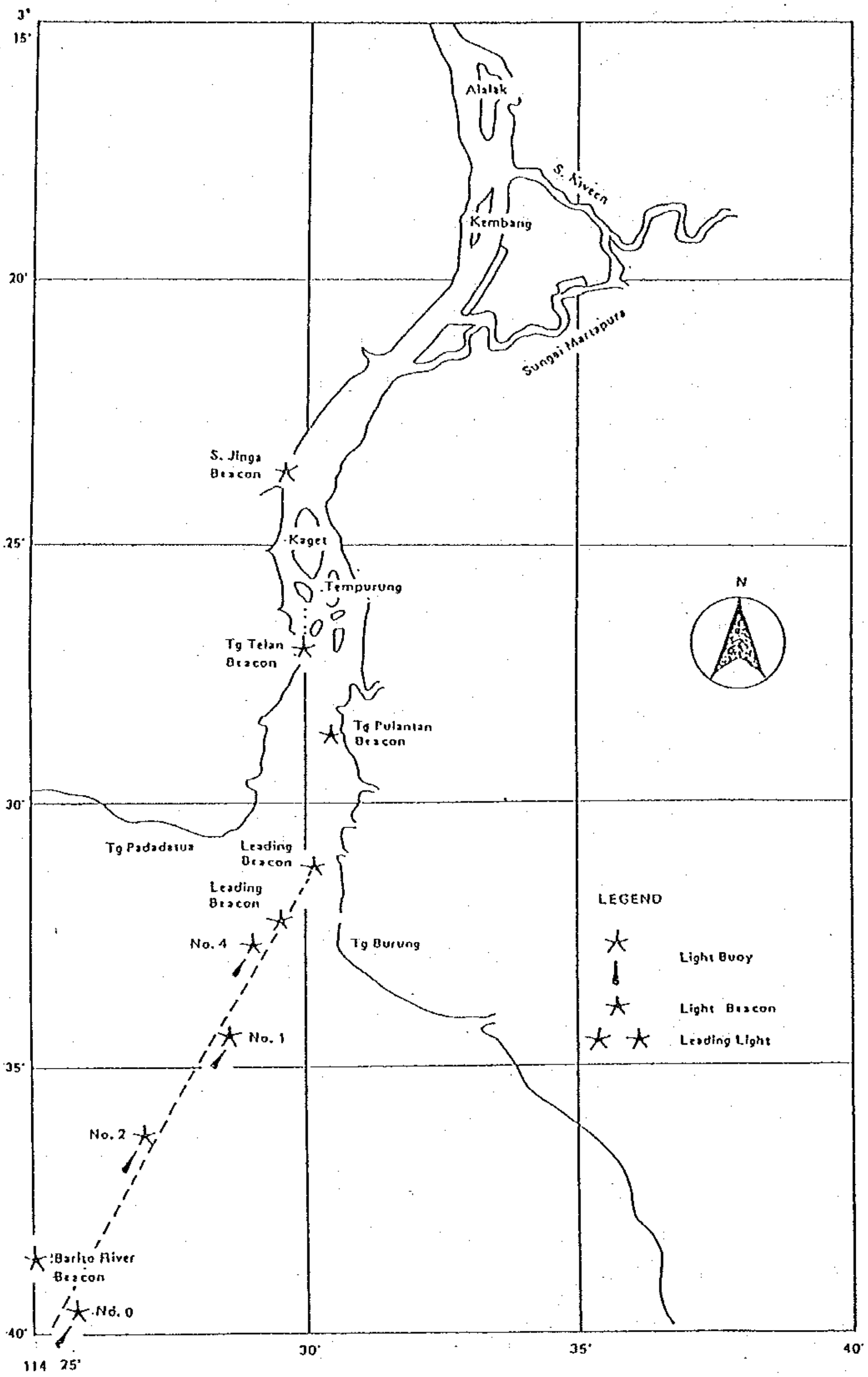


Fig. II.5.5-1 Navigational Aids in the Barito River and the Access Channel

Table II.5.5-1 Navigational Aids in the Barito River

No.	IND L OF L NUMBER/DISCRIPTION LIGHT BEACON & LIGHT BUOY	POSITION	LIGHT CHARACTER ELEVATION/RANGE	SOURCE
1.	Nr.4360 (Barito River) RWVS light buoy with red sphere top mark	03-39-36S 114-25-45E	L.FL.W. 10s, 6M	A
2.	Nr. 4370 (Barito River) Red light buoy Nr.2 with red can top mark	03-36-48S 114-27-07E	FL.R. 5s, 4M	A
3.	Nr. 4380 (Barito River) Groen light buoy Nr.1 with green cone to mark	03-34-30S 114-28-27E	FL.G. 3s, 4M	A
4.	Nr.4390 (Barito River) Red light buoy Nr.4 with red can top mark	03-32-28S 114-29-12E	FL.R. 5s, 6M	A
5.	Nr.4362 (Barito River) BWRB light leading beacon with W.top mark(FRONT)	03-31-54S 114-29-48E	FL.W. 3s, 11m, 9M	EB
6.	Nr.4363 (Barito River) BWHB light leading beacon with W.top mark(REAR)	03-30-59S 114-30-18E	OC.W. 3s, 25m, 10M	EB
7.	Nr.4361 (Barito river) BWHB light beacon	03-38-30S 114-25-00E	FL.W. 4s, 15m, 13M	EB
8.	Nr.4400 (Tg. Pulantan) BW chaq beacon	03-28-30S 114-30-30E	FL.G.(2)10s, 6m, 7M	A
9.	Nr.4410 (Tg. Telon) Red light beacon	03-27-00S 114-30-00E	FL.R. 5s 6.5m, 6M	A
10.	Nr.4420 (Jingga Besar) Red light beacon	03-24-00S 114-29-40E	FL.R. 5s, 5m, 5M	A

To ensure the safety of navigation in the access channel, good operation and maintenance are indispensable and should be carried out systematically and on a timely basis. But in the port of Banjarmasin, less-than-adequate maintenance is carried out because of limitations in the Governmental schedule and/or budget.

Thus the number of buoys and location are quite different from the light list and the harbour chart. Also, some of the lights are left as damaged or in an extinguished condition for long periods.

The topographic conditions are changing day by day due to heavy siltation, and not all the navigational aids are allocated to check the center line of the access channel. Also, two of the leading lights are not conspicuous until the half-way point of the access channel.

Statistics regarding accident occurrence at navigational aids from 1986 to 1987 are as follows:

Table II.5.5-2 Statistics of Accident Occurrence at Navigational Aids (1986-1987)

CONDITIONS KEADAAN	1986						1987					
	LIGHT BUOYS				LEADING LIGHT		LIGHT BUOYS				LEADING LIGHT	
	0	2	1	4	FRONT GUIDE	REAR GUIDE	0	2	1	4	FRONT GUIDE	REAR GUIDE
1. DRIFT/ HANIUT	-	-	-	-	--	--	-	-	-	-	--	--
2. DAMAGE/ RUSAK	-	-	-	1X	--	--	-	1X	1X	3X	--	--
3. EXTINCT/ PADAM	2	-	9	2	2	3	36	23	3	18	5	1
4. SHIFT/ BERGESER	-	-	-	-	--	--	-	-	-	-	--	--
5. OTHER/	-	-	-	-	--	--	-	-	-	-	8	5
LAIN-LAIN	-	-	-	-	1X	--	-	-	-	-	--	--

Source: Navigation Sub-District

(4) Accidents in the Access Channel

The Accident records of commercial vessels for 1984-1988 were provided by the Coast Guard Division in our first field survey and also additional accident records from January to September in 1989 were provided in the second field survey.

Generally, the Coast Guard has used the findings of these investigations to establish standards and determine the need for legislation to improve the protection of life and property at sea.

But these accident records did not include the details of accidents according to the IMO standard for casualty reports shown in Table A II.5.5-1 of the appendices.

The yearly statistics from the accident records are as follows:

Table II.5.5-3 Number of Accidents by Year

Kind / Year	Grounding	Collision	leak	Others	Total
1984-1985	2 (sank-1)	1	0	0	3 (sank-1)
1985-1986	1	4	1 (sank)	0	6 (sank-1)
1986-1987	1	3	3 (sank-1)	0	7 (sank-3)
1987-1988	2 (sank-2)	0	1 (sank)	2	5 (sank-3)
Total	6 (sank-3)	8	5 (sank-3)	2	21 (sank-6)

Table II.5.5-4 Kinds and Numbers of Accidents from 1984 to 1988

Year		1984/1985				1985/1986				1986/1987				1987/1988				G.Total			
Kind	Ship	out	in	unk	total	out	in	unk	total	out	in	unk	total	out	in	unk	total	out	in	unk	total
	KLM	1			1				0			1	1			2*	2	1	0	3	4
	PLM*	1*			1*				0				0				0	1	0	0	1
	TB				0	1			1				0				0	1	0	0	1
Grounding	KM				0				0				0				0				0
Total		2			2	1			1			1	1			2	2	3		3	6
	KK/MT	1			1	1			1			1	1				0	2		1	3
	KM/KLM				0	1			1				0				0	1			1
	KK/BB				0	1			1				0				0	1			1
	KK/KM				0	1			1				0				0	1			1
	KM/MT				0				0		1		1				0	1			1
Collision	LCT/KLM				0				0		1		1				0	1		1	1
Total		1			1	4			4		2	1	3				0	7		1	8
	PLM				0	1*			1*		1,1*		2				0	1	2		3
	KM				0				0		1		1				0		1		1
Leak	KLM				0				0				0			1*	1			1	1
Total					0	1			1		3		3			1	1	1	3	1	5
Eng.Trouble	KLM				0				0				0			1	1			1	1
Others	TKG				0				0				0			1	1			1	1
Total					0				0				0			2	2			2	2
G.Total					3				6				7				5				21

* : Ship sank after accident
out: Ship going out
in : Ship entering
unk: Unknown

Table II.5.5-5 Accidents from 20 April to 15 May 1988

Date	Ship's Name	GRT	Kind	Draft
1) 09:00	23 April KM, KELIMUTU Engine trouble and grounding, one hour later afloat and proceeded to port	5,588	PASSENGER	4.2m
2) 23:00	1 May NAUTILUS TERT 10. Grounding at North of Buoy No.2 at the time of leaving Banjarmasin.	3,743	C.CARGO	4.80m
3) 07:30	7 May Sailing Ship Grounding at West Side of channel, North Buoy No.2	-	CARGO	-
4) 15:00	10 May KM MORAKOT Grounding North of Buoy No.2, one hour later afloat and went out.	-	CARGO	-

Table II.5.5-6 Kinds and Numbers of Accidents (Jan. - Sept. 1989)

Year / Kind	Ship	Jan.-Sept. 1989				Location, etc.
		out	in	unk	total	
Grounding	MT			1	1	Eastern side of channel, 3 Mar. Fog & strong wind
Total				1	1	
Collision	TKG/PLM			1	1	10 Jan.
	PLM/KM			1	1	15 July
Total				2	2	
Leak	KM		1		1	Bar of near channel 1 Feb. Leak & sank
Total			1		1	
G.Total			1	3	4	

Table II.5.5-7 Additional Accident Reports (Jan. - Sept. 1989)

DATE	NAME	PLACE	KIND OF ACCIDENT	KIND OF SHIP	SIZE (m^3)	REMARKS DRAFT
10-1-1989	TKG.CONTINER FURTUNE.	OUTER BARITO RIVER.	COLLISION	BARGE	2,733.82	-
10-1-1989	PLM. BINTANG SETIA	OUTER BARITO RIVER.	COLLISION	SAILING BOAT	396.23	-
01-2-1989	KM.PULAU MUTIARA	OUTER BARITO RIVER.	SINKING	CARGO SHIP.	1,414.17	-
03-3-1989	MT. MINAS P.35	OUTER BARITO	RAN AGROUND	TANKER	7,651.36	5.2m
15-7-1989	PLM.HAJRA	OUTER BARITO RIVER.	COLLISION	SAILING BOAT.	492.77	-
15-7-1989	KM.TAUPIQ	OUTER BARITO RIVER.	COLLISION	CARGO SHIP.	9,170.16	-

(5) Survey of Channel Users

A questionnaire was distributed to and interviews were conducted with relevant parties including sea pilots and masters of vessels entering Banjarmasin Port through the access channel.

Below are the summaries of the comments received from users in the field survey:

<u>Channel Dimensions</u>

1) Width and depth of the channel in LWS
   depth: always less than 5 m
   width: always less than 100 m
2) Channel is shallow and narrow
3) Channel is not well-maintained continuously
4) Channel should be surveyed and maintained according to the conditions outlined in the plan
5) Various proposed dimensions by users
   Width: 50m, 60m, 80m, 100m
   Depth: 5m, 6m, 8m, 10m (LWS)
6) Average proposal: Depth 6m (LWS), Width 100m

Dangerous Area*

1) Between buoy No.4 and the outer buoy;, i.e., all through the access channel
2) Between buoys No.1 and No.2
 * No problem in the Barito River

Navigational Aids

1) More conspicuous leading lights and marks should be established with racon
2) Access channel light buoys should be laid according to the IALA Standard as well as a pair buoy system every mile or so
3) Buoys and beacons should be mounted with radar reflectors
4) More beacons should be established on both sides of the channel

Others

1) The miscellaneous small boats in the channel should be controlled by law.
2) Navigation control of sailing boats is necessary
3) Navigation of towing barges in the channel should also be controlled
4) The access channel should be well-maintained
5) The leading line should be marked clearly

Additional survey and interviews were conducted in our second field survey and the summary is shown in Table II.5.5-8.

Table II.5.5-8 Additional Interview Survey Report

Ship Name (Flag)	Ship Type	Ship Size m^3/GRT DWT	Ship Size LOA × B × d (m × m × m)	Origin/Destin. From (Frequency)	Origin/Destin. To	Navigation in Channel Speed (kt)	Draft (m)	Pilot attend	Accident	Request
Crane Alpha (Panama)	Chemical tanker (KMT)	3,795GRT 8,700DWT	107×16.0×6.9	Japan Taiwan Singapore Java (Surabaya) (Tramper)	Philippines (Iloilo) Japan (Shimizu, Keihin)	5-6 -	4.6 5.1	Yes Yes	No -	More buoys Depth -9m
Percasa 04 and Cebo Giant (Singapore)	Tug (TB) Barge (TKG)	265GRT (3,000HP) 7,540GRT	34.6×9.8×4.4 75×23×4.5	Java (Cilacap) (Tramper)	Java (Surabaya, Semarang)	3-4 -	4.5 5.1	No No	No -	Depth -5m Width 75-100m
Sepanjang Tanpangan (Indonesia)	Local (KM)	446m^3 158GRT	35.1×6.0×2.0	Surabaya (Liner: 4/month)	Surabaya	5	2.0	No	No	More buoys
Kumalaski (Indonesia)	Local (KM)	493m^3 174GRT	36.5×7.5×3.0	Surabaya (Liner: 5/month)	Surabaya	7	-	Sometimes	Sometimes grounded near Bouy #2	Wider width for crossing
Bimas Jaya II (Indonesia)	Local (KM)	493m^3 174GRT	38×7.1×2.4	Surabaya (Liner: 7/month)	Surabaya	7	-	Sometimes	Sometimes grounded near Bouy #2	Deeper depth Wider width
Karya Baru (Indonesia)	Local (KM)	875m^3 309GRT	38×10×5.2	Jakarta (Liner: 1/month)	Jakarta	4	-	No	Grounded everytime	Width 60m Depth 6m
Dharma Bahari (Indonesia)	Sailing Moter (PLM) 120HP	245m^3 168GRT	35×-×4	Surabaya (Liner: 1/month)	Surabaya	3	-	No	Sometimes grounded near Buoy #2	
Fajar Dua Sekawan (Indonesia)	Sailing Motor (PLM)	468m^3 165GRT	40×11×5	Jakarta (Liner: 1/month)	Jakarta	-	-	No (Enters the channel anytime it arrives)	Usually grounded (at spot #5,000 on 10/17)	
Jasa Mulia (Indonesia)	Sailing motor (PLM) 150HP	244m^3 86GRT	34× - ×4	Surabaya (Liner: 1/month)	Surabaya	-	-	No	Grounded when passing by big ships	
Negara Bahari Indah (Indonesia)	Sailing Motor (PLM)	400m^3 145GRT	33× - ×5	Surabaya (Liner: 1/month)	Surabaya	2		No	Sometimes grounded between Buoy #2 and 4	

Chapter 6 Dredging Operation at the Access Channel of Banjarmasin Port

6-1 Related Oganizations

Concerning the maintenance dredging of navigation channels, the related organizations and their responsibilities for maintenance dredging are shown in Table II.4.2-1.

The maintenance dredging at the access channel of Banjarmasin is executed by DIP, and work performed by the related organizations is shown in Fig. II.6.1-1. The activities and responsibilities of each organization are as follows:

6-1-1 The Directorate of Ports and Dredging

This directorate possesses the overall objective of planning, regulating and supervising services in Indonesian ports.

Especially, the Sub-Directorate Dredging plays an important role for maintenance dredging projects, and the main works of this directorate are as follows:

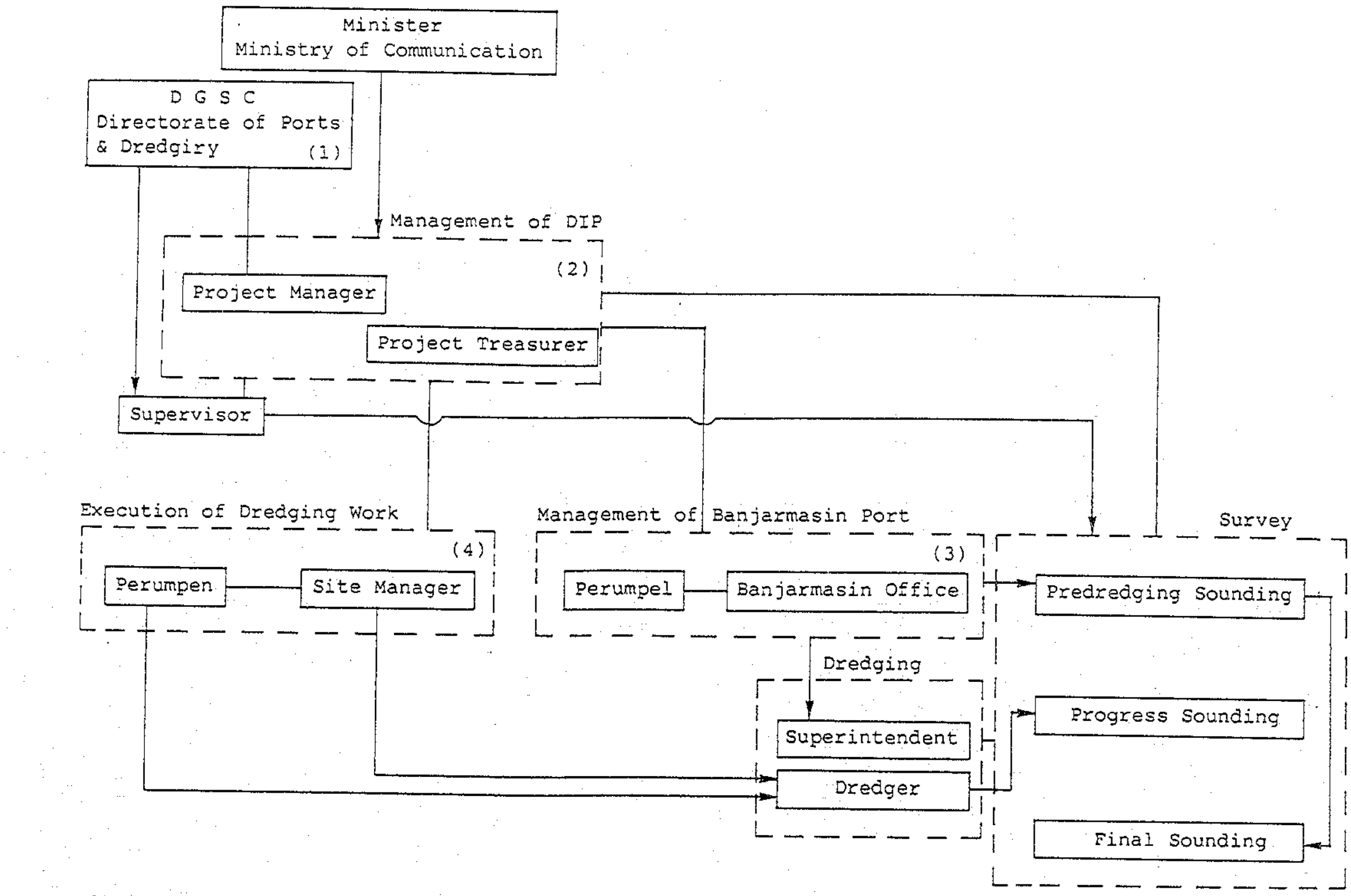
1 Preparation and planning of dredging work
2 Contracts and calculation methods of dredging volume
3 Mobilization and operation of dredgers

The supervisor in charge of controlling and supervision of dredging activities is appointed by this directorate.

6-1-2 Organization of Management for Implementation of DIP

This organization consists of the Project Manager/Sub Project Manager, Project Treasurer/Sub Project Treasurer and supporting staff.

The Project Manager/Sub Project Manager and Project Treasurer/Sub Project Treasurer are appointed officially by the Minister and supporting staff are appointed by the Project Manager.



←: direct concerned

Fig. II.6.1-1 Related Organization of the Maintenance Dredging at Banjarmasin

Together, the team is responsible for the smooth implementation, administration and management of dredging projects.

The Project Manager forms an action committee for tender/procurement. The committee is responsible for finance, maintenance and procurement. They make and deliver documents and reports regularly to DGSC as follows:

1 Contracts
2 Monthly reports of the physical and financial condition of the project
3 Letters of responsibility
4 Quarterly reports
5 Sounding reports: predredging, progress and final
6 Report of work completion (completed minutes are approved by the supervisor)
7 Report of financial position

6-1-3 Perumpel III

Perumpel III is responsible for managing Banjarmasin port including maintenance of the water depth at the port basin.

At present, Perumpel has also been covering the maintenance dredging budget for the access channel of Banjarmasin.

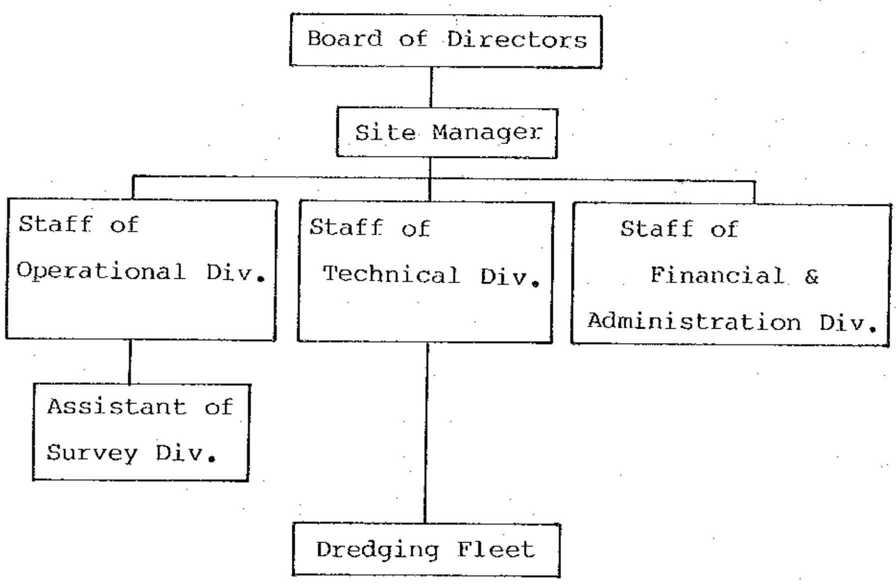
Predredging and final soundings of the maintenance dredging at the channel of Banjarmasin are carried out by a team from Perumpel witnessed by the supervisor and superintendent, and the expenses are paid by Perumpel.

The superintendent is appointed by Perumpel and collects samples from the hopper of dredgers or from the bottom of channels for the calculation of the dredged material standard.

6-1-4 Perumpen

The main responsibility of Perumpen is the execution of dredging. The maintenance dredging at the channel of Banjarmasin has been carried out by Perumpen as a contractor.

The organization of project sites is decided at the head office of Perumpen, however, the organization of dredging at Banjarmasin is the same as for the capital dredging as follows:



Source: Perumpen

Fig. II.6.1-2 Organizational Chart at Banjarmasin

The dredging work at Banjarmasin is performed according to the regulations of the DGSC. Progress sounding is carried out by a survey team from Perumpen at least once every two weeks.

The site manager submits daily and weekly reports of the dredging work to the Project Manager.

The site manager also joins in the predredging and final soundings as a witness together with the supervisor.

6-2 Management and Operation

6-2-1 Instructions for Execution of Dredging Work

The related organizations have executed the maintenance dredging according to the new Instruction of the DGSC of Development and Controlling of Dredging Work of Navigation Channels and Basins (No. PP. 74/1/6-90 10 April 1990).

The contents of this instruction are summarized as follows:

Administrative Preparation

1) Necessary documents and technical data
2) Regulation of dredgers
3) Form of agreement
4) Regulation of dredging location

Basic Preparation

1) Predredging sounding
   Scale of drawing : 1/2,500 (navigation channel), 1/1,000 (Basin)
2) Implementation of predredging sounding
3) Signal for dredging work
4) Appointment of site manager and decision of dredging equipment
5) Regulation of preparation and planning

Implementation of Dredging

1) Superintendent
2) Dredger
3) Progress sounding
4) Collection of dredging material
5) Condition of completion of dredging work
   The result of dredging is considered to be completed in case all works have been in accordance with specified design.
6) Qualification of project manager
7) Qualification of supervisor

Reports

1) Regulations on submission of reports

2) Kinds of reports

6-2-2 Dredging Contract

In general, maintenance dredging has been executed in accordance with uniform contract agreement and supplement.

The implementation of maintenance dredging has been carried out by Perumpen exclusively without tendering a contract. However, the tender of contract for dredging including private companies financed by DIP or Perumpel will start in April 1991 according to Ministry of Communication Decree No.KM.20A 1989.

6-2-3 Dredging Budget

The maintenance dredging for the access channel of Banjarmasin is ranked as a top priority project. The budget has been obtained yearly as follows:

Table II.6.2-1 Dredging Budget and Volume at Banjarmasin

	1985	1986	1987	1988	1989
Budget('000 Rp)	960,000	1,712,947 442,500 3)	3,816,000 1) 199,440 2)	1,960,000 1) 2)	1,862,000 2)
Volume (m3)	1,920,000	3,622,600	5,300,000 1) 270,000 2)	2,000,000	1,900,000

Source: Perumpel III, Perumpen

Notes : 1) including capital dredging using foreign funds

2) maintenance using foreign funds

3) Perumpel funds

In recent years, the maintenance dredging at Banjarmasin has been executed using funds from Perumpel and from foreign countries.

6-3 Dredging Equipment

As shown in Fig. II.6.3-1, nine trailing suction hopper dredgers, comprising four separate types of dredgers as defined by capacity, have been utilized in the maintenance dredging in the access channel of Banjarmasin Port. One reason for the variety of dredgers is the agitation dredging executed at the initial stage of the project. In most cases, dredgers used in agitation work are not employed for normal dredging operations. Therefore, two dredgers are usually deployed for one project. Dredgers used in agitation dredging have a shallower draft than dredgers used afterward.

In case of severe backlogs, cutter suction dredgers have been used. At the end of 1984 the dredger MAHAKAM was mobilized to the Barito River and started operation. Unfortunately she was hit by another ship and could not continue her operation. Then the self-propelled cutter suction dredger TAURUS belonging to a dredging contractor in Holland was operated during August and September of 1985.

The draft of dredgers does not meet the design depth of 6 m below LWS and they are not able to operate with a full load. Dredgers having hoppers of 3,000 m^3 and 4,000 m^3 are especially unsuitable. Also the drag arm of dredgers is too long to dredge to the depth of 6 m LWS and the intermediate part of the drag arm contacts the sea bottom and is thus worn down. Periodic cleaning of the sea chest of dredgers is inevitable and even the dredgers TIMOR and FROLES which use a system of sea water intake for cooling water which is well considered to meet the conditions in this channel sometimes are compelled to clean the sea chest.

Unit: m^3

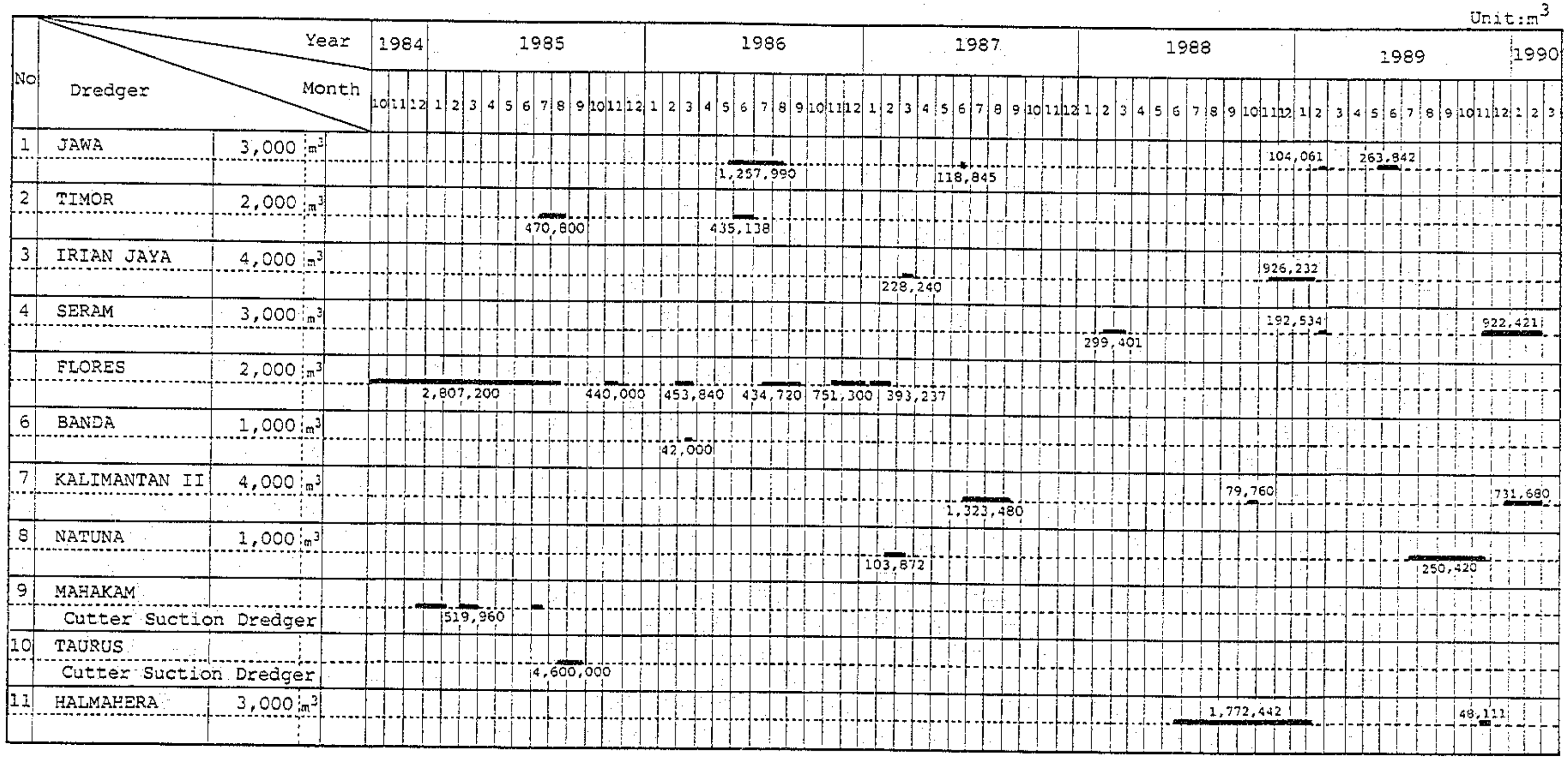


Fig. II.6.3-1 Record of Dredger Used in the Access Channel of Banjarmasin Port

6-4 Record of Dredging Activities

6-4-1 Dredging Record

Capital dredging in the access channel of Banjarmasin Port was carried out by a Japanese cutter suction dredger from September 1975 to September 1976. The actual dredged volume reached twice the estimated volume of 6.3 million cubic meters due to siltation during operations.

The dredged volume records from 1983/1984 through 1987/1988 are shown in Table II.4.4-2 together with the target volumes. The annual volume ranged between around 2.0 million cubic meters and 3.6 million cubic meters. In fiscal year 1986/1987, 21% of the dredged volume was covered by the budget from Perumpel and in the year 1987/1988, 18% of the total volume was carried out by the ABT budget that is additional to DIP. These trends shows that the maintenance dredging of this channel cannot be carried out using only the DIP budget.

There are some points to be considered for the above record. The actual dredging period is often different from the period of the fiscal year. For example, in the year 1985/1986 some works were carried out under the budget of 1984/1985. Secondly the dredged volume of trailing suction hopper dredgers is based on the dredged volume calculated from the formula shown in Section 4-4-1 of Chapter 4 of Part II. That is, the dredged volume by agitation is not included. Thirdly a fixed siltation rate during operation is used.

Analysis of dredging records of trailing suction hopper dredgers is made based on Table A II.6.4-1 of the appendices and the result is shown in Table II.6.4-1. FLORES built especially for Banjarmasin is one of the best dredgers among the present dredging fleet. Based on the past daily report, the dredging records of cutter suction dredgers is also summarized in Table A II.6.4-2 of the appendices.

Table II.6.4-1 Analysis of Dredging Record

No.	ITEM \ DREDGER		JAWA	TIMOR	IRIAN JAYA	SERAM	FLORES	BANDA	KALIMANTAN II	NATUNA
1	Operation days/Total days	(%)	90	93	100	100	87	100	90	96
2	Operation hours/Total hours	(%)	71	78	90	74	74	87	69	69
3	No.of cycle/Operation days	(nos/day)	9	10(4)	11	8	11	10	9	8
4	Dredging time/Operation days	(min/day)	287	289	337	292	284	300	362	195
5	Sailing time/Operation days	(min/day)	845	918	965	779	936	901	735	845
6	Operation time/Operation days	(min/day)	1,132	1,207	1,302	1,071	1,221	1,201	1,097	1,040
7	Loaded Volume/Operation days	(m^3/day)	15,300	11,500	28,500	11,500	12,700	6,000	20,400	4,300
8	Dredging time/No.of cycle	(min)	31	21	30	36	26	30	38	25
9	Sailing time/No.of cycle	(min)	91	91	86	96	84	90	78	110
10	Operation time/No.of cycle	(min)	122	112	116	132	110	120	116	135
11	Fuel Consumption/Operation days	(l/day)	9,700	9,200	7,500	8,600	8,000	5,700	11,700	3,800

Note: (1) This table is based on Table AII.6.4-1 of the appendices.

(2) Period is from 1984 to 1987.

6-4-2 Analysis of Semi-capital Dredging

(1) Outline of Semi-capital Dredging

As one of the six contracts of the 8th project under the ADB loan, the semi-capital dredging of the access channel was planned. The design depth is 6 m below LWS and the width is 60 m. The contract was amended on the 14th of December,1988, and the period was extended from 180 days to 255 days. The actual dredging works were completed on the last day of February of 1988, one day before the expiration of the contract. The estimated volume was about three million cubic meters and the in situ dredged volume measured by hopper volume and concentration ratio was 3,075,029 m^3.

Five trailing suction hopper dredgers were used in this project. HALMAHERA with 2,900 m^3 hopper capacity and IRIAN JAYA with 4,000 m^3 hopper capacity were mainly used and their total output was around 90% of total dredged volume. Because of the deployment plan of Perumpen, KALIMANTAN II operated only nine days in the middle of October 1988 and IRIAN JAYA was employed on the 7th of November. During the latter stage of the project, IRIAN JAYA and HALMAHERA suffered from mechanical troubles and they were replaced by SERAM and JAWA. All the dredgers other than HALMAHERA had previously been operated in the access channel as shown in Fig. II.6.3-1.

(2) Dredging Record

The dredging method executed at this channel is divided into hopper dredging and agitation dredging. In the case of agitation dredging, data on the relation between agitation operation and dredged volume are not available and the cycle time is far different from hopper dredging. Therefore, the study team reviewed all the daily dredging reports of each dredger and separated the hopper dredging and agitation dredging. The result is summarized in Table II.6.4-2. Records of HALMAHELA and IRIANA JAYA are useful because they were engaged in this project for nearly eight months and three months, respectively. On the contrary, the dredging periods of KALIMANTAN II, SERAM and JAWA were less than three weeks. So, their results were mostly examined to analyze dredger performance. Combining the five dredgers into one set, the monthly record is summarized in Table II.6.4-3.

Table II.6.4-2 Monthly Dredging Record of Semi-capital Dredging by Each Dredger

Name & Month	Hopper: No. of cycles	Hopper: Dredging time	Hopper: Sailing time	Hopper: Total cycle time	Agitation: No. of cycles	Agitation: Dredging time	Agitation: Sailing time	Agitation: Total cycle time	Total: No. of cycles	Total: Dredging time	Total: Sailing time	Total: Total cycle time	Intermission time	Dredged volume	Hopper volume
	no.	min.	min.	min.	no.	min.	min.	min.	no.	min.	min.	min.	min.	cu.m.	cu.m.
HALMAHERA															
6/88	73	2190	5380	7570	82	6350	755	7105	155	8540	6135	14675	1165	89990	211700
7/88	171	5070	13200	18270	29	1705	135	1840	200	6775	13335	20110	24530	212444	495900
8/88	238	7195	23510	30705	0	0	0	0	238	7195	23510	30705	13935	292744	690200
9/88	203	7605	21865	29470	0	0	0	0	203	7605	21865	29470	13730	241466	588700
10/88	160	5490	17550	23040	0	0	0	0	160	5490	17550	23040	21600	210154	464000
11/88	200	7445	22100	29545	0	0	0	0	200	7445	22100	29545	13655	268601	580000
12/88	176	7175	17260	24435	100	3815	835	4650	276	10990	18095	29085	15555	189817	510400
1/89	195	8610	19235	27845	63	2300	715	3015	258	10910	19950	30860	13780	212663	565500
2/89	63	2755	7450	10205	0	0	0	0	63	2755	7450	10205	5635	54563	182700
Total	1479	53535	147550	201085	274	14170	2440	16610	1753	67705	149990	217695	123595	1772442	4289100
KALIMANTAN II															
10/88	36	1720	4205	5925	1	30	0	30	37	1750	4205	5955	7005	79760	144000
IRIAN JAYA															
11/88	100	3975	12375	16350	34	815	260	1075	134	4790	12635	17425	17135	239240	400000
12/88	161	7195	15915	23110	24	1025	365	1390	185	8220	16280	24500	20140	303040	644000
1/89	206	8875	20995	29870	2	80	30	110	208	8955	21025	29980	14660	343308	824000
2/89	27	1355	3815	5170	0	0	0	0	27	1355	3815	5170	3470	40644	108000
Total	494	21400	53100	74500	60	1920	655	2575	554	23320	53755	77075	55405	926232	1976000
SERAM															
2/89	179	6860	18265	25125	0	0	0	0	179	6860	18265	25125	6555	192534	519100
JAWA															
2/89	96	3565	9730	13295	0	0	0	0	96	3565	9730	13295	5425	104061	278400
Grand Total	2284	87080	232850	319930	335	16120	3095	19215	2619	103200	235945	339145	197975	3075029	7206600

Table II.6.4-3 Monthly Dredging Record of Semi-capital Dredging

Month	Hopper: No. of cycles	Hopper: Dredging time	Hopper: Sailing time	Hopper: Total cycle time	Agitation: No. of cycles	Agitation: Dredging time	Agitation: Sailing time	Agitation: Total cycle time	Total: No. of cycles	Total: Dredging time	Total: Sailing time	Total: Total cycle time	Intermission time	Dredged volume	Hopper volume
	no.	min.	min.	min.	no.	min.	min.	min.	no.	min.	min.	min.	min.	cu.m.	cu.m.
6/88	73	2190	5380	7570	82	6350	755	7105	155	8540	6135	14675	1165	89990	211700
7/88	171	5070	13200	18270	29	1705	135	1840	200	6775	13335	20110	24530	212444	495900
8/88	238	7195	23510	30705	0	0	0	0	238	7195	23510	30705	13935	292744	690200
9/88	203	7605	21865	29470	0	0	0	0	203	7605	21865	29470	13730	241466	588700
10/88	196	7210	21755	28965	1	30	0	30	197	7240	21755	28995	28605	289914	608000
11/88	300	11420	34475	45895	34	815	260	1075	334	12235	34735	46970	30790	507841	980000
12/88	337	14370	33175	47545	124	4840	1200	6040	461	19210	34375	53585	35695	492857	1154400
1/89	401	17485	40230	57715	65	2380	745	3125	466	19865	40975	60840	28440	555971	1389500
2/89	365	14535	39260	53795	0	0	0	0	365	14535	39260	53795	21085	391802	1086200
Total	2284	87080	232850	319930	335	16120	3095	19215	2619	103200	235945	339145	197975	3075029	7286600

Note: This table is based on Table II.6.4-2.

(3) Dredging Areas and Lines

Using the daily reports of each dredger by Perumpen, monthly dredging cycles by each dredger are obtained by each area and line. In case one dredger dredged more than two areas, the cycles are counted in each area.

The accumulated hopper dredging cycles in each area are shown in Fig. A II.6.4-1 and the accumulated agitation dredging cycles in each area are shown in Fig. A II.6.4-2 of appendicies. The proportion of hopper dredging cycles is 12%, 23%, 24%, and 42% respectively for area A, area B, area C, and area D. Since September 1988 dredging at area D increased. After November 1988, the monthly portion of each area is almost the same. The proportions of agitation dredging cycles are 21%, 23%, 23%, and 33% for areas A, B, C, and D. During November 1988, agitation dredging was executed only at area D, and after that most frequently also at area D. For reference, accumulated hopper dredging cycles by each line and accumulated agitation dredging cycels by each line are shown in Fig. A II.6.4-3 and Fig. A II.6.4-4 of the appendices respectively. It can be said that hopper dredging was most frequent at the west side of the channel and agitation dredging was executed near the center of the channel most frequently.

(4) Dredged Volume

Using "Production Record 6, Hopper Volume Concentration and In Situ Dredged Volume" by Pacific Consultants International of March 1989, the study team calculated dredged volume by each dredger, area and line as shown in Table II.6.4-4. The monthly dredged volume by each area and line was also set using Table II.6.4-4 and is shown in Table II.6.4-5. The proportion is calculated based on this table and the dredged volume by each area and the dredged volume by each line are shown in Fig. A II.6.4-5 and Fig. A II.6.4-6, respectively.

Table II.6.4-4 Monthly Dredged Volume of Semi-capital Dredging by Each Dredger, Area and Line

unit : m3

No.	Name of Dredger & Dredging Period	A (0 - 3,500)						B (3,500-7,000)						C (7,000-10,500)						D (10,500-14,000)						Total volume
		W	HW	CL	HE	E	TOTAL	W	HW	CL	HE	E	TOTAL	W	HW	CL	HE	E	TOTAL	W	HW	CL	HE	E	TOTAL	
1	HALMAHERA																									
	6 / 88			42804			42804			31668			31668			15498			15498						0	89970
	7 / 88		23055	3828	35525		62408		54317	3828	44544		102689		19691	2349	18328		40368				6902		6902	212367
	8 / 88	5191	1276		1334	1334	9135	34104	10063		68005	11903	123975	30972	21982	1160	56112	1131	111357		35148	5945	6003	1189	48285	292752
	9 / 88						0		1305		9077	6438	16820	4640	1131		49155	1160	56086		6061	8497	152801	1189	168548	241454
	10 / 88	4138				1375	5513	8265	2627			6885	17777	7407	3840		2451	1250	14948	19253	73002		76366	1299	169920	208158
	11 / 88	12804				1540	14344	28623	2354			4060	35537	31178	8144			16739	57061	36270	33716		1357	24337	161680	268622
	12 / 88	14894				13784	28678	24293				18519	42812	12299				9912	22211	75384				19952	95836	189537
	1 / 89	6148				9706	15854	10063				8944	19007	25537	1465			21115	48117	37728	3248			38654	129630	212608
	2 / 89	1241					1241	5208	1186			3976	10370	1769				2680	4449	36154	1024			1276	38454	54514
	Sub-total	44416	24331	46632	36859	27739	179977	110556	72352	35496	121626	60625	400655	113802	57253	19007	126046	53987	370095	255289	218199	14442	243429	87896	819255	1769982
2	KALIMANTAN II																									
	10 / 88									9012			9012			37708			37708			33008			33008	79728
3	IRIAN JAYA																									
	11 / 88	4948					4948	29076		2348		4692	36116	47612		2372		40376	90360	79108		2384		26300	107792	239216
	12 / 88	23184				16500	39684	56344		3652		125792	185788	13404				7300	20704	44244				12584	56828	303004
	1 / 89	49392				47272	96664	44372				48308	92680	8636				51824	60460	44368				49120	93488	343292
	2 / 89						0	1556				3960	5516						0	19020				16112	35132	40648
	Sub-total	77524	0	0	0	63772	141296	131348	0	6000	0	182752	320100	69652	0	2372	0	99500	171524	186740	0	2384	0	104116	293240	926160
4	SERAM																									
	2 / 89	12206				20364	32570	16205				16791	32996	12966				74504	87470	26399		1032		12183	39614	192650
5	JAWA																									
	2 / 89	1038	1288		2265	1183	5774	5240	15472		7485	2717	30894	2236	6328		19566	2343	30473	11298	17780		5478	2378	36934	104075
	Grand Total	135184	25619	46632	39124	113058	359617	263349	87824	50508	129091	262885	793657	198656	63581	59087	145612	230334	697270	479726	235979	50866	248907	206573	1222051	3072595
	Proportion (%)	4	1	2	1	4	12	9	3	2	4	9	26	6	2	2	5	7	23	16	8	2	8	7	40	100

Table II.6.4-5 Monthly Dredged Volume of Semi-capital Dredging by Each Area and Line

unit : m3

Dredging Period	A (0 - 3,500)						B (3,500-7,000)						C (7,000-10,500)						D (10,500-14,000)						Total volume
	W	HW	CL	HE	E	TOTAL	W	HW	CL	HE	E	TOTAL	W	HW	CL	HE	E	TOTAL	W	HW	CL	HE	E	TOTAL	
6 / 88			42804			42804			31668			31668			15498			15498						0	89970
7 / 88		23055	3828	35525		62408		54317	3828	44544		102689		19601	2349	18328		40368				6902		6902	212367
8 / 88	5191	1276		1334	1334	9135	34104	10063		68005	11903	123975	30972	21982	1160	56112	1131	111357		35148	5945	6003	1189	48285	292752
9 / 88						0		1305		9077	6438	16820	4640	1131		49155	1160	56086		6061	8497	152801	1189	168548	241454
10 / 88	4138				1375	5513	8265	2627	9012		6885	26789	7407	3840	37708	2451	1250	52656	19253	73002	33008	76366	1299	202928	287886
11 / 88	17752				1540	19292	57699	2854	2348		8752	71653	78790	9144	2372		57115	147421	115378	99716	2384	1357	50637	269472	507838
12 / 88	38078				30284	68362	80637		3652		144311	228600	25703				17212	42915	120128				32536	152664	492541
1 / 89	55540				56978	112518	54435				57252	111687	34173	1465			72939	108577	132096	3248			87774	223118	555900
2 / 89	14485	1288		2265	21547	39585	28209	16658		7465	27444	79776	16971	6328		19566	79527	122392	92871	18804	1032	5478	31949	150134	391887
Total	135184	25619	46632	39124	113058	359617	263349	87824	50508	129091	262885	793657	198656	63581	59087	145612	230334	697270	479726	235979	50866	248907	206573	1222051	3072595
Proportion (%)	4	1	2	1	4	12	9	3	2	4	9	26	6	2	2	5	7	23	16	8	2	8	7	40	100

(5) Concentration Ratio

The mean monthly concentration ratio of semi-capital dredging by each dredger, area, and line is calculated based on "Production Record 6, Hopper Volume Concentration and In Situ Dredged Volume" by PCI of March 1989. The result is isted in Table II. 6.4-6. The concentrations by HALMAHERA was calculated from her draft and the concentration of the other four dredgers were calculated from measuring the weight of the muddy water inside hoppers.

(6) Findings from Semi-capital Dredging Analyses

(a) Comparison of the Five Dredgers

Though the working conditions and hopper capacities of five dredgers are different, the analyses are made from the same conditions. Hopper dredging operations are mainly analyzed using Table II.6.4-2 and Table II.6.4-6. The results are summarized in Table II.6.4-7.

Table II.6.4-6 Mean Monthly Concentration Ratio of Semi-capital Dredging by Each Dredger, Area and Line

unit : %

No.	Name of Dredger & Dredging Period	A (0 - 3,500)						B (3,500-7,000)						C (7,000-10,500)						D (10,500-14,000)						Total
		W	HW	CL	HE	E	TOT	W	HW	CL	HE	E	TOT	W	HW	CL	HE	E	TOT	W	HW	CL	HE	E	TOT	
1	HALMAHERA																									
	6 / 88			43.4			43.4			43.7			43.7			38.2			38.2							42.5
	7 / 88		44.2	44.0	43.8		43.9		43.6	44.0	43.9		43.7		39.9	40.5	39.5		39.8				39.7		39.7	42.8
	8 / 88	44.8	44.0		46.0	46.0	45.0	45.2	43.4		45.1	45.2	45.0	39.6	39.9	40.0	39.5	39.0	39.6		41.8	41.0	41.4	41.0	41.6	42.2
	9 / 88								45.0		44.7	44.4	44.6	40.0	39.0		39.4	40.0	39.5		41.8	41.9	41.5	41.0	41.5	41.2
	10 / 88	47.6				47.4	47.5	47.5	45.3			47.5	47.2	42.6	44.1		42.3	43.1	43.0	44.3	45.8		43.9	44.8	44.7	44.9
	11 / 88	49.1				53.1	49.5	47.0	49.2			46.7	47.1	44.8	45.0			44.4	44.7	44.7	47.8		46.8	44.2	46.5	48.3
	12 / 88	36.7				39.6	38.0	38.1				39.9	38.9	35.3				34.2	34.8	36.3				38.2	36.7	37.1
	1 / 89	42.4				41.8	42.1	43.4				44.1	43.7	40.0	50.5			42.8	41.5	34.0	37.3			38.1	35.2	37.6
	2 / 89	42.8					42.8	44.9	40.9			45.7	44.7	30.5				23.1	25.6	28.3	17.7			22.0	27.6	29.8
	Sub-total	42.5	44.2	43.5	43.8	41.6	43.1	43.8	43.8	43.7	44.6	43.6	44.0	40.5	41.1	38.6	39.5	39.6	40.0	35.5	45.3	41.5	42.2	39.4	40.2	41.3
2	KALIMANTAN II																									
	10 / 88									56.3			56.3			55.5			55.5			55.0			55.0	55.4
3	IRIAN JAYA																									
	11 / 88	61.9					61.9	60.6		58.7		58.7	60.2	59.5		59.3		59.4	59.4	59.9		59.6		59.8	59.9	59.8
	12 / 88	48.3				45.8	47.2	48.6		45.7		46.9	47.4	47.9				45.6	47.1	48.1				39.3	45.8	47.1
	1 / 89	47.5				42.2	44.8	48.2				43.1	45.4	43.2				38.1	38.8	39.2				37.2	37.7	41.7
	2 / 89							38.9				49.5	46.0							36.6				36.6	36.6	37.6
	Sub-total	48.5				43.1	45.9	50.5		50.0		46.1	47.9	54.4		59.3		45.2	48.7	47.6		59.6		41.3	45.3	46.9
4	SERAM																									
	2 / 89	42.1				41.3	41.6	42.5				38.6	40.4	37.3				35.2	35.5	35.0		35.6		35.0	35.0	37.1
5	JAWA																									
	2 / 89	35.8	44.4		39.1	40.8	39.8	36.1	41.0		42.9	31.2	39.5	38.6	36.4		35.5	40.4	36.2	35.4	36.1		37.8	41.0	36.4	37.4
	Total Average	45.1	44.2	43.5	43.5	42.2	43.7	46.1	43.3	45.7	44.5	44.4	44.9	43.3	40.6	47.4	38.9	39.5	41.0	38.6	44.5	48.9	42.1	39.8	41.0	42.2

Note: This table is prepared by the study team based on "Production Rocord 6, Hopper Volume Concetnration and In site Dredged Volume" by Pacific Consultants International, March 1989.

Table II.6.4-7 Comparison of Five Dredgers in Semi-capital Dredging

No.	Item	HALMEHERA	KALIMANTAN II	IRIAN JAYA	SERAM	JAWA
1	Operation days / Total days	5	1	4	3	1
2	Operation hours / Total hours	3	5	4	1	2
3	Dredging hours / Operation hours	3	1	1	3	3
4	No. of cycle / Operation days	2	4	3	1	2
5	Dredging hours / Operation days	3	5	4	1	2
6	Sailing hours / Operation days	3	1	2	5	4
7	Operation hours / Operation days	3	5	4	1	2
8	Dredging hours / No. of cycle	1	5	4	3	2
9	Sailing hours / No. of cycle	1	5	4	3	2
10	Operation hours / No. of cycle	1	5	4	3	2
11	Fuel consumption / Operation days	4	–	1	2	3
12	Dredged volume / No. of cycle	3	1	2	5	4
13	Mean concentration ratio	3	1	2	5	4

Note: (1) This rank is judged from Table II.6.4-2 and Table II.6.4-6.

(2) Only hopper dredging operation is considered except items No.1, No.2, and No.11.

(b) Comparison with Previous Dredging Record

Comparing Table II.6.4-1 with the analyses of semi-capital dredging, many differences are found. Except for fuel oil consumption by IRIAN JAYA, all items of Table A II.6.4-1 are better than those of Table II.6.4-7. The accuracy of the previous data is not clear. Therefore it might be better to use the analyses of the semi-capital dredging to know the actual conditions for maintenance dredging at present.

(c) Estimated Dredging Capacity

The working conditions assumed for the estimation by DGSC are as follows:

-daily cycles: 12

-monthly working days: 24 days

-concentration ratio: 40%

The estimated monthly dredging capacity of HALMAHERA with 2,900m^3 hopper capacity is:

$$2,900 \times 12 \times 24 \times 0.4 = 334,080 \ m^3/\text{month}$$

The same estimation for IRIAN JAYA with 4,000m^3 hopper capacity is:

$$4,000 \times 12 \times 24 \times 0.4 = 460,800 \ m^3/\text{month}$$

On the other hand, capacity can be estimated from the results of the semi-capital dredging excluding the effects of the agitation dredging. HALMAHERA dredged 1,772,442m^3 during 237 calender days, so her monthly dredged volume is:

$$1,772,442 / 237 \times 30 = 224,360\ m^3/\text{month}$$

This capacity is only 67% of the estimation by DGSC. IRIAN JAYA dredged 926,232m3 during 92 calendar days. Therefore, her monthly dredged volume is:

$$926,232 / 92 \times 30 = 302,032\ m^3/\text{month}$$

This is only 66% of the estimation by DGSC.

Due to the JICA monthly surveys, dredging operations were compelled to stop a few days per month. On these days, the dredging crew took holidays and supply of fuel oil, fresh water, and foodstuffs were carried out. If dredging works could be executed during half of these idle days caused by the JICA survey, the monthly dredged volume of HALMAHERA and IRIAN JAYA would be as follows:

$$1,772,442 / (237-8) \times 30 = 232,198\ m^3/\text{month}$$
$$926,232 / (92-6) \times 30 = 323,104\ m^3/\text{month}$$

HALMAHERA's dredged volume is thus 69.5% and IRIAN JAYA's dredged volume is 70.1% of the estimation by DGSC.

From these results, the standard dredging capacity estimation by DGSC should be carefully considered in the case of dredging at the access channel of Banjarmasin. It seems that the present transported volume by the present dredging fleet of Perumpen is around 70% of the standard estimated capaity by DGSC in case of maintenance dredging in the access channel of Banjarmasin Port unless the effect of the agitation dredging is considered.

6-4-3 Main Reasons for Non-operation

Trailing suction hopper dredgers have been mainly used for the maintenance dredging, so the reasons for non-operation are geared to this type of dredger. Using the day for supplying fuel oil, fresh water and food, the dredging crew can take holidays approximately every ten days. The conditions of the supply of these indispensable materials has been improving. However, fuel oil supply is limited to 100 kiloliters per day by Perutamina at Banjarmasin.

The capacities of the fuel tanks of dredgers holding over 2,000 m^3 hopper are between 400 kl and 840 kl. If there were no restriction on the fuel oil supply, the number of operating days could increase one or two days per month considering the necessary holidays for the crew. Fresh water is very important around Banjarmasin. In the worst case, Perumpen should go to get water upstream the Barito River, especially in dry seasons.

According to the past daily report of dredgers, the main reasons for non-operation are:

- frequent cleaning of sea chest
- not sailing due to low tide
- waiting for the sailing of other vessels

Because of the local characteristics of the Barito River including muddy water, frequent cleaning of the sea chest is inevitable. Because mud sticks to the sea-water intake, the engine may suddenly stop and the vessels are frequently grounded alongside the access channel. At the design stage of the dredgers TIMOR and FROLES, this point was well considered, and therefore the non-operation hours of these two dredgers are less than for other dredgers. Due to the physical conditions (draft) of dredgers, dredgers must stand by during low tide at the initial stage of each project. Sometimes dredgers control the loading volume of fuel oil and water to reduce their draft. But this increases non-operation time due to the need to supply these materials. According to the regulations, dredgers are given the priority of navigation during dredging projects. However, in order not to hinder the port operation, dredgers often wait outside the channel when they encounter other vessels.

6-5 Dredging Execution

6-5-1 Execution Method

The unusal feature of dredging operations in the Barito River is the widespread use of agitation. The depth of the channel before maintenance dredging usually ranges from 2 m to 4 m below LWS. Therefore, agitation dredging is necessary to secure the navigation of the dredger itself. This procedure is applied to the whole length of the access channel of 14 km. It takes about 10 days for agitation dredging. In case of high tide which allows navigation of dredgers in full loaded, the offshore part of this channel is dredged by normal dredging procedures. The direction of this normal dredging is one-way from upstream to downstream.

Following this agitation dredging, normal dredging operations take place. That is, the dredged material is poured into the hopper and the dredger sails to the dumping area and dumps it at a fixed dumping area. It takes about two hours for one cycle. Dredging time is 30 minutes including overflowing time. The location of the dumping area is 03-41-00 S and 114-29-00 E and its depth is approximately 20 m. Sailing time from the outer buoy to the dumping area is about 15 minutes and dumping time is only 5 minutes. Dredging speed is around 4 knots and average sailing speed is approximately 10 knots.

To know the ship position, a mini-ranger system is used. In case the system is out of order, two leading markers are used. Dredging lines are divided into the nine lines: B, 3/4B, 1/2B, 1/4B, AS, 1/4T, 1/2T, 3/4T, and T. Here B means west, AS means center, and T means east. Dredging of both ends of the bottom is difficult for trailing suction hopper dredgers and the width of the channel varies. Without mini-ranger systems dredging of the area near the slope cannot be executed.

The effect of agitation dredging is not confirmed due to the lack of data. The siltation of the material discharged by agitation should be traced by frequent surveys. But this is very difficult in actual practice, because normal dredging is executed concurrently. If the material dredged by agitation returns to the channel and accumulates, the agitation dredging is in vain.

This channel is long and narrow, so it is very difficult to turn trailing suction hopper dredgers inside the channel. This increases the unproductive sailing time.

The slope of the channel has not been maintained. Trailing suction hopper dredgers are not suitable for slope dredging. Cutter suction dredgers are suitable, but they disturb the navigation of other vessels.

Dredging works are often executed with positioning by visual means only using the two existing leading markers and navigation lights. It is feared that this causes a V-shaped approach channel and the drag head moves on the same tracks.

6-5-2 Control

The control of the dredging operation at Banjarmasin by Perumpen is as shown in Fig. II.6.5-1. Though there is a chief of the Banjarmasin Base of Perumpen, one project manger is dispatched from the head office or branch office because of the size of the project. This project manager controls the dredging operations under the direct control from the head office. Daily operations are reported to the head office and branch office by wireless communications and daily reports and monthly reports are prepared.

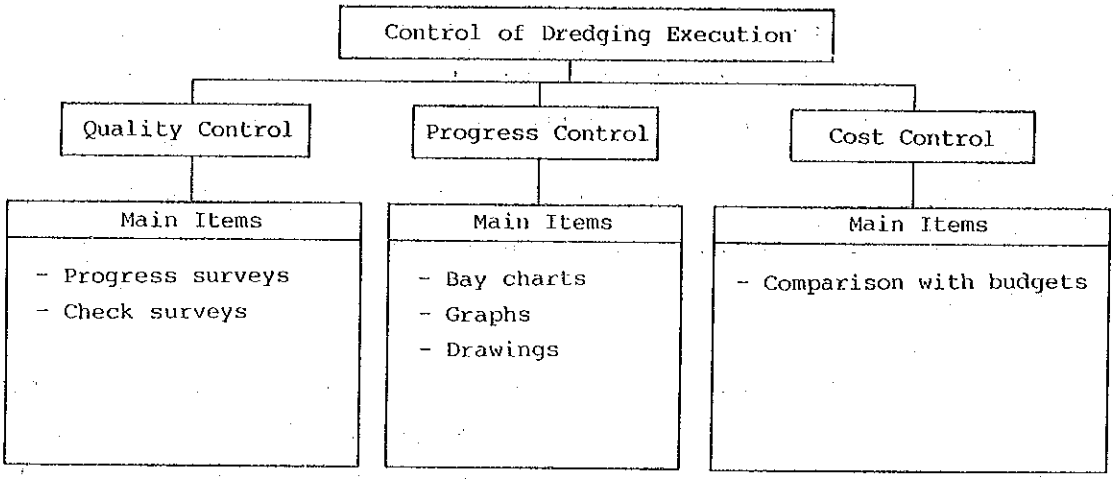


Fig. II.6.5-1 Control of Dredging Execution by Perumpen
Source : Field survey

6-6 Maintenance and Repairs

Maintenance and repairs of dredgers on site are mainly for the dredging equipment parts which are listed in the guideline of Perumpen. There is no repair facility for dredgers around Banjarmasin. Therefore, dredgers must sail to Surabaya when repairs are necessary. Furthermore, delivery of spare parts required for maintenance and repairs on site depends on the Surabaya Branch Office of Perumpen. When there are no spares in Surabaya, they must wait for the delivery from Jakarta or abroad. The mini-ranger system often require repairs and it generally takes a long time to repair the system.

There is nothing particular for the maintenance and repairs of dredgers operating at this channel. Frequent cleaning of the sea chest and sea water cooling lines is a remarkable feature. If spare parts are supplied smoothly, the dredging operation will proceed well.

PART III STUDY ON THE ACCESS CHANNEL PLAN AND MAINTENANCE DREDGING DEVELOPEMENT MEASURES

Chapter 1 Channel Planning

1-1 Socio-Economic Framework

1-1-1 Forecast of Population

The population of all Indonesia increased 2.39% p.a. from 1971 to 1980 and 2.15% from 1980 to 1985 as shown in Table A III.1.1.-1. According to the latest forecast, the World Bank (IBRD) projects a lower growth rate of 2.0% p.a. during 1985 to 1990, 1.8% p.a. from 1990 to 1995 and 1.6% p.a. throughout the rest of this century. These rates are employed in this study.

The population growth rate in South Kalimantan has been lower than that of all Indonesia, even when the growth due to transmigration is taken into account. The future projection of the South Kalimantan population is assumed to be:

1.94% p.a. in 1985 - 1990,
1.62% p.a. in 1990 - 1995, and
1.44% p.a. in 1995 - 2000,

multiplying the ratio of the actual growth rates in South Kalimantan by the forecast national increase.

The population growth rate in Central Kalimantan has always been higher than that of all Indonesia, i.e. 3.55% p.a. in 1971 - 1980 and 4.91% in 1980 - 1985. This is because of the influx of transmigration from Java, i.e., 20 thousand to 30 thousand persons every year. Presently a considerable decrease in transmigration is anticipated due to the decline of oil prices and subsequently of the government budget. Therefore, the forecast future population growth in Central Kalimantan is set as:

3.7% in 1985 - 1990,
3.5% in 1990 - 1995, and
3.2% in 1995 - 2000,

taking into account transmigration of about 10 thousand persons p.a.

Finally, the future population in the hinterland of Banjarmasin Port is forecast based on the above projections. The hinterland is defined to be all of South Kalimantan except for Sub-region Kotabaru and most of Central Kalimantan excluding the Sub-regions of Ktw. Barat and Ktw.Timur. This hinterland includes 88% and 62% of the population of the respective provinces in 1985. Introducing these percentages, the future population growth in the hinterland becomes

2.34% p.a. in 1985 - 1990,
2.14% p.a. in 1990 - 1995, and
1.95% p.a. in 1995 - 2000,

The result of the projection is shown in Table III.1.1-1

In April 1989, the Government of the Republic of Indonesia began a new five-year development plan named REPELITA V, which will last until 1993.

The plan assumed future population growth rates of 1.90, 1.71 and 2.97% p.a. until 1993 for all Indonesia, South and Central Kalimantan, respectively. The projection coincides very well with that of the study team except for Central Kalimantan. The average annual growth rates have a difference of 0.2% resulting in a 0.1 million person difference for the 1993 population in South and Central Kalimantan, which is allowable for the purpose of the cargo forecast.

1-1-2 Forecast of Economic Development

The development of the Indonesian economy has stagnated since the decline of oil prices in 1985. With regard to future economic development, several organizations concerned such as IBRD, BAPPENAS and BAPPEDA have made forecasts and unanimously presume that the economy of Indonesia will be continuously stagnant in the rest of the 1980's and recover to 4 to 5% annual growth in the 1990's.