REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS

DIRECTORATE GENERAL
OF
WATER RESOURCES DEVELOPMENT

NEGARA RIVER BASIN
OVERALL IRRIGATION DEVELOPMENT
PLAN STUDY

ANNEXES

JUNE 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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ABBREVIATIONS

AAETE	Agency for agricultural Education, Training and Extension
AARD	Agricultural Research and Development
APBN	Central Government Budget
ARR	Automatic Rain Recorder
AWLR	Automatic Water Level Recorder
B and C	Benefit(s) and Cost(s)
B/C	Benefit-cost Ratio
BAPENAS	Badan Perencanaan Pembangunan Nasional - National Development Planning Agency
BAPPEDA	Badan Perencanaan Pembangunan Daerah -- Regional Development Planning Agency
BARIF	Banjarbaru Sub-station of Research Institute for Food Crops
BI	Bank Indonesia
BI	Fry Production Center
BIMAS	Bimbingan Massal Swa Sembada Bahan Makanan, "Mass Guidance for Self-Sufficiency in Foodstuffs"
BKK	Bank of the Kecamatan Credit
BNA	Basic Need Approach
BPD	Bank Pembangunan Daerah
BPTP VIII	Balai Proteksi Tanaman Pangan VIII - Food Crops Protection Center
BRI	Bank Rayat Indonesia
BULOG	Badan Urusan Logistik - National Food Logistic Agency
CBS	Central Bureau of Statistics
DAB	Directorate Air Bersih
DCF	District Coordination Forum
DGWRD	Directorate General of Water Resources Development
DINAS	Provincial Agricultural Service
DOLOG	Depot Logistik - Provincial Food Depot of BULOG
DPMA	Direktorat Penyelidikan Masalah Air
DPP	Directorate Planning and Programing
DPU	Department Pekerjaan Umum
DPUP	Dinas Pekerjaan Umum - Provincial Department Office of Public Works
EIRR	Economic Internal Rate of Return
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
HPPS	Hydropower Potentials Study
IBRD	International Bank for Reconstruction and Development
IKK	Ibu Kota Kecamatan
INPRES	Revenue sharing grant programs from the Government to provincial, district and village authorities

IUIDP	Integrated Urban Infrastructure Development Programme Preparation
JICA	Japan International Cooperation Agency
KANWIL	Kantor Wilaya - Provincial Department of the Central Ministry
KCl	Potassium Chloride
KIK	Small Investment Credit
KMKP	Permanent Working Capital Credit
KUD	Koperasi Unit Desa - Village Unit Cooperative
KUPEDES	General Rural Credit
KUT	Integrated Farmer Credit
MOA	Ministry of Agriculture
MSY	Maximum Sustenance Yield
NES	Nucleus Estates and Smallholder
O&M	Operation and Maintenance
OTCA	Overseas Technical Cooperation Agency
P3SA	Proyek Perencanaan Pengembangan Sumber-Sumber Air
P4S	Proyek Pembukaan Persawahan Pasang Surut
PCF	Provincial Coordination Forum
PDAM	Regional Corporation of Water Supply
PLN	Perusahaan Umum Listrik Negara - National Power Corporation
PMU	Project Management Unit
PPL	Penyuluh Pertanian Lapangan - Field Extension Worker
PPM	Penyuluh Pertanian Madya - Field Extension Supervisor
PPS	Penyuluh Pertanian Spesialis - Agricultural Extension Specialist
PPSAB	Supervision of Extension Water Supply Project Office
PPW	Program Pengembangan Wilaya - Rural Development Programme
PUSDATA	Pusat Pengolahan Data
REC	Rural Extension Center
RMU	Rice Mill Unit
RSS	Ribbed Smoked Sheets
SCF	Standard Conversion Factor
SDO	Subsidi Dearah Otonomi - Routine expenditure grant from the Government to provincial authorities
TSP	Triple Superphosphate
UNLAM	Agricultural Faculty of Lambung Mangkurat University
VRSS	Veterinary Research Sub-station

ABBREVIATIONS OF MEASUREMENT

Length

mm = millimeter
cm = centimeter
m = meter
km = kilometer

Area

cm^2 = square centimeter
m^2 = square meter
ha = hectare
km^2 = square kilometer

Volume

cm^3 = cubic centimeter
lit = liter
m^3 = cubic meter

Weight

mg = milligram
g = gram
kg = kilogram
ton = metric ton

Time

s = second
min = minute
h = hour
d = day
y = year

Electrical Measures

V = Volt
A = Ampere
W = Watt
kW = Kilowatt
MW = Megawatt
GW = Gigawatt

Other Measures

% = percent
PS = horsepower
° = degree
' = minute
" = second
°C = degree centigrade
10^3 = thousand
10^6 = million
10^9 = billion (milliard)
ppm = parts per million
pH = scale for acidity

Derived Measures

m^3/s = cubic meter per second
micromhos/cm = Scale for electrical conductivity
kWh = kilowatt hour
MWh = Megawatt hour
GWh = Gigawatt hour
kWh/y = kilowatt hour per year
kVA = kilovolt ampere

Money

Rp = Rupiah
US$ = US dollar (US$1 = Rp 1,730)

ANNEX A
SOCIO-ECONOMY

ANNEX A   SOCIO-ECONOMY

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1. INTRODUCTION

The socio-economic study aims at understanding present conditions and projections of socio-economic characteristics such as population, food balance and public investment for agricultural development at the national, regional and Study Area levels. These characteristics are indispensable for other sectoral studies, as functioning the basic framework for the overall irrigation development plan.

The collection of the existing data was mainly done from the following government authorities concerned and private institutions.

National level:

    a.   National Development Planning Agency (BAPENAS)
    b.   Directorate General of Water Resources Development, Ministry of Public Works
    c.   Central Bureau of Statistics (CBS)
    d.   National Logistic Board (BULOG)

Province and Kabupaten level:

    a.   Provincial Development Planning Agency (BAPPEDA), South Kalimantan
    b.   Provincial Public Works, South Kalimantan
    c.   Kanwil Agriculture, South Kalimantan
    d.   Kanwil Transmigration, South Kalimantan
    e.   Regional Logistic Depot (DOLOG), South Kalimantan
    f.   Public Corporation of Electricity (PLN), Banjarubaru
    g.   Statistics Office, South Kalimantan
    h.   Kabupaten Offices in Tabalong, Hulu Sungai Utara, Hulu sungai Tengah, Hulu Sungai Selatan and Tapin

2. SOCIO-ECONOMIC BACKGROUND

2.1 Land and Population

The Republic of Indonesia is located between latitude 6°08' north and 11°15' south, and between longitude 94°45' and 141°05' east with an area of about 1.92 million km². The Indonesia comprises a great diversity of culture and languages in an archipelago consisting of about 13,700 islands stretching over a distance of 5,200 km from east to west.

According to the data obtained from the Central Bureau of Statistics (CBS), the total population in Indonesia was about 164 million in 1985. Out of this, about 100 million or more than 60% lived in Java island with land area only about 7% of the total areas of Indonesia as shown in Table 2.1. Accordingly, Java island had the highest population density of 753 persons/km² in 1985. On the contrary, the population density in Off-Java regions was only 36 persons/ km².

The South Kalimantan Province is 37,000 km² in area and the minimum among four provinces in Kalimantan. Its population is 2.3 million in 1985 next to that of the West Kalimantan Province. Therefore, population density is 63 persons/km² and far beyond the average population density of 14 persons/km² in Kalimantan island.

Such inequitable distribution of land and population among the Indonesia's regions can be summarized as follows:

	Area Distribution (%)	Population Distribution (%)	Population Density (Persons/km²)
Java	6.9	60.7	753
Off-Java	93.1	39.3	36
Kalimantan	28.1	4.8	14
South Kalimantan	1.9	1.4	63
Indonesia	100.0	100.0	85

The population and growth rates by Island and province are presented in Table 2.2. In Indonesia as a whole, the population growth rate is about 2.1% p.a. during the period from 1980 to 1985. During the same period, the growth rate in Kalimantan island is comparatively higher at about 3.0% p.a. This growth rate is the next highest to that in Sumatra island (3.1% p.a.). Most provinces in these islands have received a large number of transmigrant and this is the main reason of the comparatively higher population growth rates in recent years in these islands. The population growth in densely populated Java island is lower at 1.7% p.a. during the 1980-1985 period.

In response to the said inequitable distribution of land and population, the transmigration program took place in 1905 in Indonesia. In the program, as shown in Table 2.3, Sumatra and Sulawesi had been the key base for promoting the transmigration program since the Repelita I was commenced. In the Repelita III, however, Kalimantan took the place of Sulawesi for receiving transmigrant from Java. During the past 18 years, a total of around 230,000 families transmigrated to Kalimantan, corresponding to 23% of the transmigrant in the whole country. In South Kalimantan, however, this program has become slowing down in recent years, because the areas suitable for agriculture are almost fully utilized by the transmigrant who has resettled before the regular promotion of this program in 1950. This higher level of land exploitation is considered as one of the main reasons of relatively higher population density in South Kalimantan among the Off-Java regions.

2.2 National Economy

The economic development in Indonesia has linked closely up with the price trend in the international oil market. Indonesia's real gross domestic product (GDP) grew at an average rate of 8.1% p.a. during 1970s. In 1971, GDP at 1973 constant price was Rp.5.5 trillion

and it increased to Rp.11.2 trillion in 1980. During this period, per capita GDP at 1973 constant price raised from Rp.46,500 to Rp.75,700. As for the real growth rate by sector, the construction and manufacturing sectors showed the highest levels of 15.8% p.a. and 15.2% p.a., respectively, as tabulated in Table 2.4. The agriculture sector experienced a slower but steady growth of 3.8% p.a. Table 2.5 indicates contribution to GDP by sector for 1970s. The contribution of agricultural sector sharply dropped from 44.0% to 24.6% for this 10 years, while the mining and quarrying sector drastically increased its share in GDP from 9.9% to 24.1% through earnings from the oil export. This fact proves conversion of economic structure placing main reliance on oil export for revenue.

Since the early 1980s when oil and other commodity prices began to fall, however, Indonesian economy faced a worsening external environment such as increase in interest payment and capital repayment for foreign debts borne from the positive development policy in 1970s, diminution of revenue due to decrease in oil export earnings, and pressure upon balance of international payments. The real growth of GDP was stagnant in 1982 and 4.5% p.a. on an average during the Repelita III period from 1979 to 1983. This actual result was below the target annual growth rate of 6.5%.

In the Repelita IV from 1984 to 1988, therefore, the Government of Indonesia has given the priority to promote non-oil exports by revision of policy on economic development relying on oil export earnings. In 1984, the first year of the Repelita IV, the manufacturing sector grew 19.0% p.a. in real GDP and also the agricultural sector grew steady by 4.2% p.a. As a result, the growth of real GDP attained to 6.0% p.a. Due to sharp drop of international oil market prices, however, Indonesian economy was again forced to deal with the worst crisis from 1985 to 1986. To overcome structural defect in Indonesia's economy, the Government of Indonesia devised a series of countermeasures comprising devaluation of domestic currency, acceleration of non-oil export, encouragement of direct investment from foreign countries and drastic cut of financial budget. Through execution of such countermeasures, the annual growth rate of real GDP increased slightly from 2.3% in 1985 to 3.2% in 1986. This basic economic condition has been maintained in 1987 and 1988 and Indonesian economy becomes gradually prosperous. As shown in Table 2.6, real GDP at 1983 constant price grew Rp.66.7 trillion in 1980 to Rp.82.5 trillion in 1986. During the same period, per capita real GDP at 1983 constant price went up from Rp.0.45 million to Rp.0.49 million.

2.3   Regional Economy

2.3.1   Economy of Kalimantan

Gross regional domestic product (GRDP) by major island is tabulated in Table 2.7. In Kalimantan as a whole, GRDP at current market prices was Rp. 2.1 trillion in 1978 and Rp. 6.0 trillion in 1983. The current GRDP during this period increased by 2.8 times in Kalimantan, while 3.2 times in Java and 3.8 times in Sumatra. Accordingly, contribution of Kalimantan to Indonesia's current GRDP reduced from 10.2% in 1978 to 8.7% in 1983.

Because of depopulated area, per capita GRDP becomes maximum in Kalimantan. In 1983, its per capita GRDP at current prices was Rp.770,000 exceeding the national average of Rp.420,000; Java's average of Rp.340,000 and Sumatra's average of Rp.670,000. This was derived from earning by oil and natural gas production in the East Kalimantan Province. In 1983, GRDP of non-agricultural sectors in the East Kalimantan Province amounted to 60% of the total GRDP in Kalimantan.

Current GRDP in the agriculture sector increased by 2.6 times in Java, 3.0 times in Sumatra, 2.3 times in Sulawesi, 2.6 times in other islands and also 2.6 times in Indonesia as a whole from 1978 to 1983, but it increased by 2.1 times in Kalimantan. As a result, the share of Kalimantan in the agricultural GDP of Indonesia dropped from 7.9% in 1978 to 6.4% in 1983.

The 1983 current agricultural GRDP per farm household was about Rp 1.0 million in Sumatra, Kalimantan and Sulawesi as shown in Table 2.7, while it decreased to Rp.740,000 in Java due to its dense population.

2.3.2 Economy of South Kalimantan

The South Kalimantan Province contributed to 14% of the 1983 current GRDP of Kalimantan as shown in Table 2.7. This level is next to the East Kalimantan's contribution of 65%. In the agricultural sector, its contribution is 27% and on the same level of the East and West Kalimantan provinces. During the period from 1978 to 1983, the current GRDP in South Kalimantan increased by 3.3 times in total and 2.4 times in the agricultural sector, achieving the highest growth in Kalimantan.

In the economy of South Kalimantan, the agriculture sector accounted for about 31% of GRDP in 1985, followed by trade (20%), services (19%), manufacturing (14%) and transportation (10%) as shown in Table 2.8. Shares of mining and utilities in GRDP are both less than 1.0%. Compared with the national level, the shares of agriculture, transportation and trade in GRDP were larger than those in GDP. On the contrary, the shares of mining and construction in GRDP are smaller than those in GDP as shown in Table 2.9.

The overall GRDP in South Kalimantan grew at 6.8% p.a. during the 1980-1985 period. This growth was remarkably higher than that at national level (3.7% p.a.). The construction and manufacturing sectors performed particularly higher growth at 30.5% p.a. and 14.5% p.a., respectively, during the period, if compared with other economic sectors in South Kalimantan as shown in Table 2.11.

2.4 Central and Local Government Budgets

2.4.1 Central government budget

The Indonesia's budgetary conditions, i.e. central government budget summary, government receipts, expenditures, development expenditures and development expenditures by sector, are tabulated from Tables 2.12 to 2.16.

In 1986/87, the Indonesia's domestic revenues were about Rp.16,141 billion, which fell by about 16% from that peak of Rp.19,205 billion in 1984/85. This sharp decline arose largely from the decrease of oil/LNG tax revenues, although non-oil taxes showed increasing tendency in recent years through the series of reforms introduced in 1984 to 1986 to enhance the efficiency of tax revenue collections (through simplification of the tax code and a broadening of the revenue base).

The central government development and routine expenditures were about Rp.8,330 billion and 13,560 billion, respectively, in 1986/87. The share of development expenditures in the total expenditures declined from 50% in 1980/81 to 38% in 1986/87, while that of routine expenditures expanded from 50% to 62% during the same period.

The shares of total transfers to local governments in the development expenditures were almost the same in the recent seven years, ranging from 14% in 1980/81 to 18% in 1986/87. On the contrary, the department expenditures, which were assigned to the ministries for their national projects execution, declined those shares sharply from 43% in 1980/81 to 24% in 1986/87. Among the total transfers to local governments, sectoral INPRES programs, which consist of INPRES primary schools, INPRES health, INPRES markets, INPRES replanting/reforestation and INPRES roads, had the highest share of about 49% in 1986/87 followed by the general INPRES programs (39%), which consist of INPRES Dati I, INPRES Dati II and INPRES Desa. More discussions on these development expenditures are made in Section 2.4.2 below.

It should be noted that the fertilizer subsidy alone had a relatively large share in recent years (about 6% in the total development expenditures in 1986/87). The Government of Indonesian, however, intended to decrease this share to less than 3% in 1987/88 and 1988/89 budget years.

The development expenditures by sector from 1980/81 to 1988/89 are presented in Table 2.16. The expenditures for education sector were the largest in 1986/87 (Rp. 1,184 billion or 14.2% of the total development expenditures) followed by transportation and tourism (Rp. 1,131 billion or 13.6%), electric power (Rp. 960 billion or 11.5%), regional development (Rp. 939 billion or 11.3%) and agriculture and irrigation (Rp. 890 billion or 10.7%). The share of agriculture and irrigation sector reduced remarkably. In 1980/81, expenditures of this sector was Rp. 926 billion and had the highest share of about 16% within the total development expenditures.

2.4.2 Local government budget

(1) Structure and role of local governments

Indonesia has a four-tier hierarchy of local governments, comprising 27 provinces (level I), 292 districts or municipalities (Kabupaten or Kotamadya; level II), 3,500 sub-districts (Kecamatan; level III) and 64,000 rural or urban villages (Desa or Kelurahan; level IV).

The functions of central and regional governments are defined in Law No.5 of 1974, which distinguishes between those services provided directly by central government sector departments and those which are assigned to regional governments. Under the law, a wide range of functions is decentralized to the local level. Provincial governments have such duties as the operation and maintenance of major road and irrigation networks. Similarly, level II governments are responsible for local services such as local roads, drainage, water supply and solid waste collection. However, the development of major infrastructures in all sectors is made under the responsibility of central government sector departments or public enterprises. To provide these central government services at local level, most central government ministries have regional branch offices throughout the country known as "Kanwils". While, regional service departments known as "Dinas" which form part of the regional governments have functions as their local counterparts.

(2) Local government revenue

There are four sources of revenue for services provided by local governments as below:

1) Central government grants,

2) Assigned revenue, levied by the central government but assigned wholly or partly to regional government,

3) Revenue from local taxes and service charges, and

4) Funds channeled through the banking system.

Among the above, central government grants are the most important sources of revenue for local governments. The central government grants are sub-divided into two programs, SDO (Subsidi Daerah Otonomi) which is routine expenditure grant mainly for payment of civil servants salaries at the regional level and INPRES programs which are the grant by presidential instruction for development expenditures. The INPRES comprises two sets of programs. The general grant program which comprises grants for three different levels of local government: INPRES Dati I (level I), INPRES Dati II (level II) and INPRES Desa (level IV). And the specific grant program which comprises grants specifically directed to four different sectors: INPRES Primary schools, INPRES health, INPRES replanting and reforestation and INPRES roads. In addition to these two sets of INPRES programs, there is a third program of INPRES market which is a loan subsidy scheme available to local governments to reduce their costs of borrowing for market development.

2.4.3 Local government budget in South Kalimantan

(1)   Comparison with other regions

Based on the financial data obtained from CBS, comparison of the local government receipts in level I and level II are made among the selected five different areas, i.e. Java, Off-Java, Kalimantan, South Kalimantan and Indonesia as a whole as shown in Table 2.17.

According to this comparison, the status of local government receipts of South Kalimantan can be summarized as follows:

1)   In terms of per capita receipts, the local government receipts of South Kalimantan were the second highest after Kalimantan among the selected areas both in 1980/81 and 1985/86. This order was the same on the level II government receipts in 1980/81, but it became the third in 1985/86. Accordingly, in brief, it can be said that the local government receipts of South Kalimantan were comparatively well on level I government, but those on level II government were still behind the Off-Java's average in 1985/86.

2)   In the comparison of the share of local government receipts of South Kalimantan in total Indonesia with that of population, it became clear that:

-    Both the level I and level II government receipts for development expenditures (2.9% in level I and 2.4% in level II) were larger than the population share of South Kalimantan (1.4%) in 1985/86.

-    These situations were the same on the receipts for routine expenditures at the level I government in 1985/86 (2.1%), but at the level II government, these (1.0%) were smaller than the population share of South Kalimantan in the same year. Accordingly, it can be said that it is needed to increase the receipts for routine expenditures particularly at the level II government.

(2)   Budget for development expenditures in South Kalimantan

The sources of finance for the development expenditures in South Kalimantan are summarized together with those in the whole Indonesia in Table 2.18.

In South Kalimantan, though these funds are not included in the local government budget in practice, the most important sources for the development expenditures are the sectoral funds which are assigned from the central government sector departments or public enterprises for the execution of central government-based projects in South Kalimantan. On an average, the sectoral funds accounted for about 66% of the development expenditures in South Kalimantan in recent five years from 1982/83 to 1986/87. Due to the Indonesia's financial austerity, these funds were cut drastically in 1983/84 and in 1986/87. The share of these funds in the Indonesia's total sectoral funds were higher than that of population of South

Kalimantan, ranging from 1.6% to 2.5% or 2.0% on an average in recent five years from 1982/83 to 1986/87.

The sectoral INPRES programs in South Kalimantan accounted for about 20% of the region's development expenditures, and these had a share of 2.9% in those of total Indonesia on an average in recent five years from 1982/83 to 1986/87. The general INPRES programs accounted for about 16% of the development expenditures, having the share of 3.1% in those of total Indonesia on an average during the same period. Among these programs, the share of INPRES Dati II was relatively small at 1.4%, and the share of INPRES roads was relatively large at about 5.2% in those of total Indonesia.

(3)   Budgetary allocation of development expenditure

The budgetary allocation of sectoral funds by central government sector department in South Kalimantan is summarized as shown in Table 2.19. The public works had the highest shares in the total sectoral funds ranging from 18% to 45% in recent three years from 1985/86 to 1987/88. In the 1988/89 budget, about Rp.37,340 million or 37.1% of the sectoral funds were allocated for the public works. This amount was also the highest among the sectoral funds. The sectors which had relatively large shares in the region's sectoral funds were education and culture and communications. The share of agriculture were relatively small at about 6% (Rp.2,230 million) in 1986/87 and 1.3% (Rp.690 million) in 1987/88, and it is estimated at about 2% (Rp.1,690 million) for 1988/89 budget.

The budgetary allocation of INPRES Dati I in South Kalimantan is also tabulated together with the region's original funds as seen in Table 2.20. Among these funds, the public works also had relatively higher shares of about 32% (Rp.3,400 million) in 1985/86 and 35% (Rp.4,310 million) in 1986/87. It is noteworthy that the Pengairan (water resources development services) alone had a share of about 24% in the total INPRES Dati I plus original funds in 1985/86. The agricultural service had shares of about 5% both in 1985/86 and 1986/87 (Rp.572 million and Rp.577 million, respectively) in the total INPRES Dati I plus original funds. Among the funds allocated for the agricultural service, food crops alone had the share of more than the half of these funds.

Table 2.21 summarizes the development expenditures particularly for the water resources development in South Kalimantan. In the total development expenditures of South Kalimantan, these expenditures had the shares ranging form 6.0% in 1986/87 to 3.9% in 1983/84 and 4.5% on an average during 1980/81-1986/87 period. The proportion of external loans within the development expenditures for water resources development was increased from 27% (Rp. 1,650 million) in 1984/85 to 51% (Rp. 2,240 million) in 1986/87.

3. SOCIO-ECONOMIC SITUATIONS IN THE STUDY AREA

3.1 Administrative Division

The South Kalimantan Province administratively falls in 10 Kabupatens, 109 Kecamatans and 2,369 Desas. The Study Area consists of five Kabupatens such as Tabalong, Hulu Sungai Utara, Hulu Sungai Tengah, Hulu Sungai Selatan and Tapin. These five Kabupatens are further sub-divided into 51 Kecamatans and 1,375 Desas, and have a total land area of 12,655 km^2 corresponding to 34% of the territory of the South Kalimantan Province. The following shows the area, number of Kecamatan and Desa, and capital town of each Kabupaten related to the Study Area.

Kabupaten	Area (km^2)	No. of Kecamatan	No. of Desa	Capital Town
Tabalong	3,946	11	183	Tanjung
H.S. Utara	2,771	12	397	Amuntai
H.S. Tengah	1,472	8	435	Barabai
H.S. Selatan	1,803	10	228	Kandangan
Tapin	2,663	10	132	Rantau
Total	12,655	51	1,375	

3.2 Population and Transmigration

3.2.1 Population

The total population of the five Kabupatens as of 1985 was about 890,200 or 38% of the population of South Kalimantan as shown in Table 3.1 according to the data collected from the Provincial Statistics Office. The population comprised 48% of male and 52% of female, showing the female rate of 1.08 in 1985. The total number of households was about 209,700 of which 158,700 or 76% were the farm households, and the average family size was 4.25 persons per household in 1985.

The population density in the Study Area is estimated at about 70 persons/km^2 which is above the average of South Kalimantan Province, 63 persons/km^2 in 1985. The population densities in Kabupatens Hulu Sungai Tengah and Hulu Sungai Selatan are 140 persons/km^2 and 101 persons/km^2, respectively, as farmland concentrates in these two Kabupatens. On the contrary, the population density lowers to 34 persons/km^2 in Kabupaten Tabalong where the mountainous area predominates and also to 45 persons/km^2 in Kabupaten Tapin with a wide extent of the swamp areas. The distribution of population density by Kecamatan in the Study Area is shown in Table 3.2.

The population growth rate during the period from 1980 to 1985 was 0.96% p.a. on an average in the Study Area. This was less than the half of that in South Kalimantan. As shown in Table 3.1, the population growth rate in such densely populated zones was low ranging between 0.49% p.a. and 0.78% p.a. as Kabupaten Hulu Sungai Utara, Hulu Sungai Tengah and Hulu Sungai Selatan. On the contrary, that in such sparsely populated areas was rather high, 1.57% p.a. to 2.13% p.a., as Kabupatens Tabalong and Tapin. Such low population growth rate indicates population outflow from the Study Area to other areas inside and outside of the South Kalimantan Province. It also causes farm labor shortage in the Study Area.

3.2.2   Transmigration

The transmigrant to the Study Area totaled to 2,131 families since the Repelita I. The annual achievements were 970 families in 1973/74, 661 families in 1974/75 and 500 families in 1977/78. The South Kalimantan Province has received 60,405 families in total since 1969/70. This big difference in the actual results is caused by such facts that aborigines and spontaneous transmigrant developed the Study Area for a long time before starting the regular promotion of the Government transmigration program in 1950. In connection with this transmigration performance, suitable land for the agricultural use had almost developed and new land resources for the sponsored transmigration program were hardly acquired.

4.   SOCIO-ECONOMIC PROJECTION

4.1   Population

Based on the results of the population projection made by CBS and the relevant study reports, the future population for the year 1998, 2008 and 2018 are projected for the five different areas, i.e. Indonesia, Java, Off-Java, South Kalimantan and the Study Area. As projection of population increase rates after 2000 is not available in the above references, however, the projected increase rate for the 1995-2000 period is referred to and directly adopted to project population for the 1998-2018 period.

The projected population increase rates adopted for the present Study are as follows:

(Unit: % p.a.)

	1985-1998	1998-2018	1985-2018
Indonesia	2.01	1.90	1.94
Java	1.26	1.19	1.22
Off-Java	3.03	2.64	2.79
South Kalimantan	2.08	1.95	2.00
Study Area	0.74	0.59	0.65

As a result, the future population to 2018 in each area is as shown below:

(Unit: 1000)

	1985	1998	2008	2018
Indonesia	163,876	212,260	256,220	309,280
Java	99,502	117,090	131,800	148,350
Off-Java	64,374	94,890	123,140	159,800
South Kalimantan	2,315	3,025	3,670	4,450
Study Area	890	980	1,036	1,102

As for the Study Area, the population projection is made for each Kecamatan according to the data obtained from the Statistics Office South Kalimantan (Population and Labor Force Projection 1980-2000) as shown in Table 4.1.

Labor force projection for the Study Area is not available in the said data. However, it is estimated by applying the projected rate of labor force to the total population in South Kalimantan to the projected population in the Study Area as shown below:

(Unit: 1000)

	1985	1988	2008	2018
Workable population	356	392	415	441

4.2　Food Balance

The food balance projection for the present Study is carried out by referring to the following report and data:

1) Price and Investment Policies in the Indonesian Food Crop Sector, August 1987, (PIPF report) International Food Policy Research Institute, Washington, D.C. and Center for Agro-Economic Research, Bogor, Indonesia

2) Food Balance Sheet in Indonesia 1983, CBS

3) Food Balance Sheets 1979-81 Average, FAO

The PIPF report has examined prices and investment policies for major food commodities in Indonesia, including rice, maize, soybeans, cassava, sugar and wheat. The study has included an assessment of regional trends in production and consumption for these food commodities; examined the regional costs of production and comparative advantage for these crops (though South Kalimantan has not been included in the study); and analyzed fertilizer subsidy and rice price policy, and irrigation investment policy using a multi-market food crop supply/demand model. In the present Study, therefore, food balance projection

for rice, maize, soybeans, and cassava is carried out largely depending on this supply/demand model.

Because no reliable data on food balance projection are available for other food commodities, the supply projection is made based on the government's target on standard requirements for meat, milk and fishes (information from the Dinas Livestock and Fisheries in South Kalimantan), the past trends of production for sweet potato and coconuts (data from CBS) and the Food Balance Sheets 1979-81 Average, FAO for vegetables, fruits and eggs. While in the demand projection, the Food Balance Sheets 1979-81 Average, FAO is referred to for vegetables, fruits, meat, eggs, milk and fishes, and the past trends of production are for sweet potato and coconuts.

The present level of per capita consumption and the rate for waste and other use including the demand for seeds and manufacture are estimated based on the Food Balance Sheet in Indonesia 1983, CBS for the selected all food commodities.

4.2.1 Production

The projected increase rates of major agricultural production to 2018 are as shown in Table 4.2. By applying these rates to each crop production in the base year of 1985, domestic supply in the year 1998, 2008 and 2018 is projected for Indonesia, South Kalimantan and the Study Area. The production of each crop in the base year is its 1981-85 average for Indonesia and 1982-86 average for South Kalimantan and the Study Area.

It should be noted that, in the PIPF report, an annual net increase of 80,000 ha (of which 24,000 ha on Java and 56,000 ha on Off-Java) of new irrigated area harvested is one of the important assumptions in the rice supply projection. This area increase has been obtained from the assumption of annual increase of 8,000 ha in each Java regions and from 6,200 to 13,200 ha in the Off-Java regions depending on the existing irrigation base and future potential. This does not represent net additions to total rice area harvested, but the combination of increased cropping intensity, extension of new irrigation to previously non-irrigated paddy field, and the opening of some additional areas from new construction.

4.2.2 Demand

The demand projection is made through the following steps of procedure:

1) The Indonesia's total demand of food crops in the base year is estimated for each crop by applying data of per capita consumption and rate of waste and other use.

2) Based on the above mentioned report and data, the rate of demand increase is projected for each crop as shown in Table 4.3.

3) Applying the estimated Indonesia's total demand in the base year and the rates of demand increase for each crop, the Indonesia's total demand in 1998, 2008 and 2018 is projected.

4) In order to estimate the Indonesia's per capita consumption by crop in the respective years of 1998, 2008 and 2018, the projected demand of each crop is divided by the projected population. This per capita consumption by crop is as shown in Table 4.4.

5) The demand projection for South Kalimantan and the Study Area is made by applying the above projected Indonesia's per capita consumption and the projected total population in the respective areas.

4.2.3 Food balance projection

Based on the above mentioned figures, the projection of food balance in the year 1998, 2008 and 2018 are made for Indonesia, South Kalimantan and the Study Area as shown in Tables 4.5, 4.6 and 4.7, respectively.

In order to know the status of future food balance more clearly, the supply/demand balance of each crop in the respective years is evaluated by applying the following criteria:

1) Large surplus (+); The crops which would have supply/demand ratio of more than 1.10.

2) Large shortage (-); The crops which would have supply/demand ratio of less than 0.89.

3) Nearly balanced (o); The crops which would have supply/demand ratio within the range of 0.90 to 1.09.

As a result, the future supply/demand balance of each crop in the respective years for Indonesia, South Kalimantan and the Study Area is evaluated as shown below:

	Indonesia			South Kalimantan			Study Area		
	1998	2008	2018	1998	2008	2018	1998	2008	2018
Rice	o	o	o	+	+	+	+	+	+
Maize	o	+	+	-	-	-	-	-	-
Cassava	o	o	o	-	-	-	-	-	-
Sweet potato	o	o	o	-	-	-	-	-	-
Soybeans	-	-	-	-	-	-	-	-	-
Groundnuts	-	-	-	o	-	-	+	+	+
Coconuts	o	o	o	+	+	+	+	+	+
Vegetables	o	o	o	-	-	-	-	-	-
Fruits	o	o	o	-	-	-	-	-	-
Meat	o	-	-	-	-	-	+	+	+
Eggs	o	o	o	+	+	o	+	+	+
Milk	-	-	-	-	-	-	-	-	-
Fishes	o	o	o	+	+	+	+	+	+

According to the above presented projection, the future food balance in Indonesia, South Kalimantan and the Study Area can be summarized as follows:

1) In Indonesia as a whole, the crops which would have almost balanced tendency are rice, cassava, sweet potato, coconuts, vegetables, fruits, eggs and fishes. While, the crops which would have continuous shortages are soybeans, groundnuts and milk. As for rice, though this crop is evaluated as almost balanced, about 3% to 5% of its total domestic production would be required to import continuously.

2) South Kalimantan would produce surpluses on rice, coconuts and fishes. However, the supply of all palawija crops, vegetables, fruits and milk would not cover the demand.

3) In the Study Area, the future trend of food balance would be almost the same with that in South Kalimantan except for groundnuts and meat. The production of these crops would have surpluses in the Study Area, and cover the shortages in South Kalimantan.

4.2.4 Food balance of rice in Kalimantan

In the same manner, supply/demand projection for rice alone is carried out for the four provinces in Kalimantan island in order to know the food balance of rice in the island. This projection is made as shown in Table 4.8.

As seen Table 4.8, it is evaluated that rice production in Central and East Kalimantan, which are the neighbor provinces of South Kalimantan, is not sufficient for meeting the present demand of each province, and sufficient rice surplus from South Kalimantan is playing an important role in fulfilling local demands in these provinces. According to the projection, it is also evaluated that such situation would not be changed in the future. Rice surplus from South Kalimantan would continuously supplement its shortage in the neighbor provinces.

4.3 Public Investment for Agricultural Development

4.3.1 Public investment for agricultural development in South Kalimantan

The projection of the future public investment for agricultural development at the level of regional government of South Kalimantan is carried out throughout the period of 30 years up to the end of Repelita X (2018/19). This projection is made through the following steps of procedure:

1) The total development expenditures at current prices in South Kalimantan during the period from 1980/81 to 1987/88 are converted to those at 1988 constant prices by applying the Indonesia's implicit deflators for gross

domestic investment. The annual average of the said period at 1988 constant prices is, then, calculated at about Rp. 105.0 billion as shown in Table 4.9.

2) This amount is assumed to be the total public investment available in South Kalimantan in 1987/88. To this amount of total public investment, the estimated rates of the past development expenditures for agricultural sector to those for South Kalimantan are applied by referring to figures in Tables 2.18 to 2.21. Then, the public investment assigned for DPUP, Sub-Dinas Water Resources Development and Agriculture in 1987/88 is estimated as shown below:

	Rate of Assignment (%)	Public Invest- ment in 1987/88 (Rp. billion)
South Kalimantan total	100.0	105.0
DPUP	15.7	16.5
Sub-Dinas Water Resources Development	4.4	4.6
Agriculture	4.5	4.7

3) The projection of public investment to be available for DPUP, Sub-Dinas Water Resources Development and Agriculture in the Province is, then, made to 2018/19 by applying the growth rate of fixed public investment to the above estimated 1987/88 public investment. The projection is made for the following four cases which have respective growth rates during the period from 1987/88 to 2018/19. In this projection, the rate, 7.0% shown in IBRD Report[1] is assumed as the basic number, and Case 1 as the higher value and Cases 3 and 4 as the lower ones.

	(unit: % p.a.)
	Growth Rate 1987/88 - 2018/19
Case 1	10.0
Case 2	7.0
Case 3	5.0
Case 4	2.5

The result of the projection is presented in Table 4.10, and, for example, the total public investment for the next 30 years to be available for Sub-Dinas Water Resources Development by case is summarized as follows:

[1] Indonesia Adjustment, Growth, and Sustainable Development, IBRD, May 2, 1988, P.26

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Case 1   :   Rp. 836.0 billion
Case 2   :   Rp. 467.0 billion
Case 3   :   Rp. 323.3 billion
Case 4   :   Rp. 207.9 billion

4.3.2   Public investment for agricultural development in the Study Area

Based on the results obtained in Section 4.3.1, projection of the public investment for the agricultural development in the Study Area is carried out. In the projection, the ratio of population in the Study Area to the whole South Kalimantan (38.5% in 1985) is applied to DPUP, and the ratio of farm households in the Study Area to the whole South Kalimantan (47.5% in 1985) is applied to Sub-Dinas Water Resources Development and Agriculture in all the cases. As a result, the total public investment to be available for the next 30 years for the agricultural development in the Study Area is projected as shown in Table 4.11. The investment for the Sub-Dinas Water Resources Development for the water resources development in the Study Area can be summarized as follows:

Case 1   ;   Rp. 397,080 million
Case 2   ;   Rp. 221,805 million
Case 3   ;   Rp. 153,090 million
Case 4   ;   Rp.   98,753 million

TABLES

Table 2.1   Distribution of Area, Population and Population Density
by Island and Province in Indonesia in 1985

Region/ Province	Area (km2)	Percentage of Total Area(%)	Population 1985 ('000)	Percentage of Total Popula.(%)	Population Density (prs/km2)
Java	132,187	6.9	99,502	60.7	753
Sumatra	473,606	24.7	32,667	19.9	69
Kalimantan	538,786	28.1	7,808	4.8	14
West Kalimantan	146,760	7.6	2,815	1.7	19
Central Kalimantan	152,600	8.0	1,140	0.7	7
* South Kalimantan	36,989	1.9	2,315	1.4	63
East Kalimantan	202,440	10.6	1,538	0.9	8
Sulawesi	189,216	9.9	11,597	7.1	61
Other Islands	584,974	30.5	12,328	7.5	21
Total or Average	1,918,769	100.0	163,876	100.0	85

Remarks: *; Statistics Office, South Kalimantan Province, Banjarmasin

Source: Central Bureau of Statistics except for South Kalimantan

Table 2.2   Population and Growth Rates by Island and Province in Indonesia

Island/ Province	Population ('000)					Average Growth Rate (% p.a.)			
	1930	1961	1971	1980	1985	1930-61	1961-71	1971-80	1980-85
Java	41,718	63,059	76,086	91,270	99,502	1.34	1.90	2.04	1.74
Sumatra	8,255	15,739	20,809	28,017	32,667	2.10	2.83	3.36	3.12
Kalimantan	2,170	4,102	5,155	6,723	7,808	2.08	2.31	2.99	3.04
West Kalimantan	802	1,581	2,020	2,486	2,815	2.21	2.48	2.33	2.52
Central Kalimantan	203	497	702	954	1,140	2.93	3.51	3.47	3.63
* South Kalimantan	836	1,473	1,699	2,063	2,315	1.84	1.44	2.18	2.33
East Kalimantan	329	551	734	1,218	1,538	1.68	2.91	5.79	4.78
Sulawesi	4,231	7,079	8,528	10,409	11,597	1.67	1.88	2.24	2.19
Other Islands	4,219	7,106	8,630	11,071	12,302	1.70	1.96	2.81	2.13
Total Indonesia	60,593	97,085	119,208	147,490	163,876	1.53	2.07	2.39	2.13

Remarks: *; Statistics Office, South Kalimantan Province, Banjarmasin

Source: Central Bureau of Statistics, Population Census Reports, 1961, 1971 and 1980;
Statistical Yearbook of Indonesia, 1986

Table 2.3 Number of Families Moved to the Receiving Area Under Transmigration Program

Unit: No. of household

Year	Sumatera	Sulawesi	Other Islands	Kalimantan					National Total
				Total	West	Central	East	South	
Total Repelita I	26,283	12,665	450	6,870	952	1,253	2,475	2,190	46,268
1969/70	2,493	900	0	540	102	98	200	140	3,933
1970/71	1,928	1,605	50	855	200	105	400	150	4,438
1971/72	2,000	1,146	0	1,025	150	300	175	400	4,171
1972/73	7,000	2,514	200	1,600	300	600	400	300	11,314
1973/74	12,862	6,500	200	2,850	200	150	1,300	1,200	22,412
Total Repelita II	49,859	17,000	1,000	15,100	4,100	1,200	3,500	6,300	82,959
1974/75	6,950	2,550	200	1,300	300	200	500	300	11,000
1975/76	3,800	2,700	100	1,500	500	0	0	1,000	8,100
1976/77	7,450	4,050	110	2,300	300	500	500	1,000	13,910
1977/78	13,359	4,000	90	5,500	1,000	0	2,500	2,000	22,949
1978/79	18,300	3,700	500	4,500	2,000	500	0	2,000	27,000
Total Repelita III	304,351	51,015	27,360	117,271	28,122	22,692	33,765	32,692	499,997
1979/80	31,548	4,641	4,001	11,795	515	1,010	2,967	7,303	51,985
1980/81	46,301	11,106	4,129	16,820	4,351	4,171	2,119	6,179	78,356
1981/82	65,208	11,533	4,634	19,177	4,774	7,419	3,899	3,085	100,552
1982/83	80,109	11,110	6,724	30,027	10,098	6,585	7,320	6,024	127,970
1983/84	81,185	12,625	7,872	39,452	8,384	3,507	17,460	10,101	141,134
Total Repelita IV	217,574	29,960	18,515	87,852	24,358	24,212	20,059	19,223	353,901
1984/85	58,110	8,282	5,550	29,946	8,473	8,889	6,918	5,666	101,888
1985/86	110,052	13,883	8,749	33,663	9,994	6,766	7,254	9,649	166,347
1986/87	49,412	7,795	4,216	24,243	5,891	8,557	5,887	3,908	85,666
Ground Total	598,067	110,640	47,325	227,093	57,532	49,357	59,799	60,405	983,125
(% of National Total)	(60.8)	(11.3)	(4.8)	(23.1)	(5.9)	(5.0)	(6.1)	(6.1)	(100)

Source: Ministry of Transmigration

Table2.4　Growth Rates of GDP by Sector in Indonesia

	a/ Average 1971-80	b/ Average 1980-86	1980 a/	1981 a/	1982 a/	1983 b/	1984 b/	1985 b/	1986 c/
1. Agriculture	3.8	3.1	6.9	4.8	2.1	1.9	4.2	4.2	2.5
- Farm food crops	4.2	3.8	9.1	10.1	1.5	3.0	4.9	2.6	1.9
- Farm non-food crops	3.7	6.8	10.7	9.4	6.7	12.9	2.4	9.6	5.7
- Estate crops	4.7	0.5	6.0	4.0	16.8	-36.6	18.7	14.7	0.2
- Livestock products	3.2	4.8	10.1	2.2	4.5	3.4	7.7	7.7	3.0
- Forestry	2.0	-12.4	-9.8	-34.9	-20.3	-15.3	-11.2	-5.1	-1.1
- Fishery	3.7	3.8	6.7	2.0	5.2	4.6	2.7	7.0	4.3
2. Mining & Quarring	7.3	-1.7	-0.1	1.6	-12.1	0.7	5.9	-5.8	4.2
3. Manufacturing	15.2	7.3	22.7	7.9	1.2	3.0	19.0	8.3	5.5
4. Electricity, Gas & Water	13.5	12.5	17.7	15.6	17.8	24.4	5.0	8.1	6.5
5. Construction	15.8	2.6	17.9	13.5	5.3	4.3	-4.6	2.6	-0.2
6. Trade	8.0	3.9	13.2	8.3	5.7	2.2	1.3	1.7	3.0
7. Transport & Communication	12.6	7.7	9.0	13.7	5.9	12.4	11.7	0.9	1.3
8. Banking, etc.	14.0	12.9	-8.9	57.3	11.7	0.2	18.8	0.3	5.3
9. Ownership of Dwellings	15.3	4.7	7.0	8.3	5.0	4.4	5.6	3.5	3.5
10. Public Admini. & Defence	12.9	8.1	9.7	13.0	3.6	8.5	5.0	7.4	2.5
11. Other Services	2.5	3.5	3.2	4.8	2.2	5.3	3.9	2.0	2.8
Gross Domestic Product	8.1	3.6	7.9	7.4	2.2	3.3	6.0	2.3	3.2

Note:　a/; 1973 constant price series
　　　　b/; 1983 constant price series
　　　　c/; Preliminary estimates

Source:　Central Bureau of Statistics

Table 2.5   Sectoral Shares of GDP in Indonesia

	1971 a/	1974	1980	1981	1982	1983	1984	1985	1986 b/
1. Agriculture	44.0	38.7	24.6	24.0	24.3	24.0	23.6	24.0	23.9
- Farm food crops	25.9	23.1	14.5	14.9	15.0	15.0	14.8	14.9	14.7
- Farm non-food crops	5.4	4.2	2.8	2.8	2.8	3.1	3.0	3.2	3.3
- Estate crops	2.8	2.4	0.7	0.7	0.8	0.5	0.6	0.6	0.6
- Livestock products	2.9	2.6	2.4	2.3	2.4	2.4	2.4	2.5	2.5
- Forestry	4.7	4.5	2.6	1.8	1.6	1.3	1.1	1.1	1.0
- Fishery	2.4	1.9	1.7	1.6	1.6	1.7	1.6	1.7	1.7
2. Mining & Quarring	9.9	11.8	24.1	22.8	19.4	19.0	18.9	17.5	17.7
3. Manufacturing	8.8	10.4	11.0	11.0	11.2	11.1	12.5	13.2	13.5
4. Electricity, Gas & Water	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.8
5. Construction	3.1	4.4	5.8	6.1	6.2	6.2	5.6	5.6	5.5
6. Trade	16.7	16.8	15.2	15.3	16.5	16.3	15.6	15.5	15.4
7. Transport & Communcation	3.8	4.0	4.4	4.6	5.0	5.4	5.7	5.6	5.5
8. Banking, etc.	1.2	1.2	1.9	2.7	2.9	2.8	3.1	3.0	3.1
9. Ownership of Dwellings	1.7	2.4	2.5	2.5	2.6	2.7	2.7	2.7	2.7
10. Public Admini. & Defence	5.9	6.1	6.2	6.5	7.4	7.7	7.7	8.1	8.0
11. Other Services	4.5	3.7	4.0	3.9	4.0	4.1	4.0	4.0	4.0
Gross Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: a/; 1973 constant price series for 1971-79 and 1983 constant price series for 1980-86
      b/; Preliminary estimates

Source: Central Bureau of Statistics

Table 2.6 GDP by Industrial Origin at 1983 Constant Market Prices in Indonesia

(Unit: Rp. billion)

	1978	1979	1980	1981	1982	1983	1984	1985	1986
1. Agriculture	14,381	15,338	16,399	17,187	17,371	17,696	18,431	19,209	19,687
- Farm food crops	8,400	8,856	9,661	10,639	10,736	11,057	11,599	11,895	12,117
- Farm non-food crops	1,443	1,659	1,837	2,010	2,033	2,295	2,349	2,576	2,722
- Estate crops	438	470	498	518	592	375	446	511	512
- Livestock products	1,248	1,440	1,586	1,621	1,696	1,754	1,890	2,037	2,097
- Forestry	1,871	1,867	1,701	1,261	1,146	994	894	851	842
- Fishery	983	1,046	1,116	1,139	1,167	1,220	1,253	1,341	1,398
2. Mining & Quarring	16,364	16,093	16,078	16,340	13,876	13,968	14,789	13,981	14,572
3. Manufacturing	5,108	5,952	7,304	7,878	7,973	8,211	9,770	10,579	11,162
4. Electricity, Gas & Water	244	265	312	361	422	524	550	595	634
5. Construction	2,904	3,266	3,850	4,368	4,409	4,597	4,394	4,508	4,498
6. Trade	8,232	8,934	10,112	10,950	11,757	12,009	12,160	12,363	12,730
7. Transport & Communication	2,506	2,670	2,911	3,309	3,540	3,978	4,442	4,482	4,542
8. Banking, etc.	1,122	1,344	1,234	1,941	2,035	2,039	2,422	2,431	2,559
9. Ownership of Dwellings	1,462	1,573	1,683	1,823	1,879	1,962	2,072	2,145	2,221
10. Public Admini. & Defence	3,385	3,762	4,128	4,665	5,266	5,712	5,997	6,439	6,601
11. Other Services	2,484	2,581	2,663	2,792	2,851	3,001	3,117	3,180	3,270
Gross Domestic Product	58,190	61,777	66,675	71,613	71,377	73,698	78,144	79,911	82,475

Source: Central Bureau of Statistics

Table 2.7   Comparison of GRDP by Region in 1978 and 1983 at Current Market Prices

Region/ Province		GRDP 1,978 (Rp. billion)	GRDP 1,983 (Rp. billion)	Shares 1978 (% of total)	Shares 1983 (% of total)	Rate of Increase (1978=100)	Population in 1985 ('000)	GRDP Per Capita in 1983 (Rp.'000)	Farm Household in 1983 ('000)	Agri.GRDP Per F.house hold in 1983 (Rp.'000)
Java	GRDP	10,729	34,180	50.63	49.91	319	99,852	342		
	Agri.a/	3,342	8,600	54.89	54.54	257			11,569	743
Sumatra	GRDP	5,844	21,913	27.58	32.00	375	32,603	672		
	Agri.	1,301	3,863	21.36	24.50	297			3,852	1,003
Kalimantan	GRDP	2,164	5,966	10.21	8.71	276	7,764	768		
	Agri.	480	1,004	7.89	6.37	209			968	1,038
- West Kalimantan	GRDP	299	760	1.41	1.11	254	2,819	270		
	Agri.	156	286	2.55	1.81	184			382	749
- Central Kalimantan	GRDP	152	484	0.72	0.71	318	1,118	433		
	Agri.	80	163	1.32	1.03	203			151	1,079
- South Kalimantan	GRDP	258	842	1.22	1.23	326	2,315	364		
	Agri.	114	272	1.87	1.72	238			319	852
- East Kalimantan	GRDP	1,455	3,880	6.86	5.67	267	1,512	2,566		
	Agri.	131	284	2.15	1.80	217			115	2,466
Sulawesi	GRDP	1,171	3,056	5.53	4.46	261	11,554	264		
	Agri.	598	1,345	9.82	8.53	225			1,447	930
Other Islands	GRDP	1,283	3,369	6.05	4.92	263	12,316	274		
	Agri.b/	368	957	6.04	6.07	260			1,207	797
Total Indonesia	GRDP	21,191	68,484	100.00	100.00	323	164,089	417		
	Agri.	6,089	15,768	100.00	100.00	259			19,037	828

Remarks: a/; GRDP in Agricultural Sector
b/: Maluku, Irianjaya and East Timor are not included because no data available

Source: Provincial Income in Indonesia 1978-1983, Central Bureau of Statistics

Table 2.8 Sectoral Share of GRDP in South Kalimantan

Unit: %

Sector/Year	a/ 1975	1978	1979	1980	1981	1982	1983	1984	1985
1. Agriculture	40.1	38.7	37.5	36.1	35.0	32.8	31.2	31.6	31.3
- Farm food crops	21.5	21.8	20.1	20.2	20.0	18.3	17.8	17.7	17.4
- Farm non-food crops	3.2	2.4	2.4	2.5	2.5	2.4	2.2	2.3	2.1
- Livestock products	3.8	4.8	3.4	2.6	2.5	3.0	3.1	3.0	3.6
- Forestry	3.2	2.6	3.2	3.4	2.6	1.6	1.9	2.2	2.3
- Fishery	8.3	7.0	8.3	7.3	7.5	7.5	6.1	6.4	5.9
2. Mining & Quarring	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.5
3. Manufacturing	4.6	4.3	4.6	5.0	5.0	6.3	6.2	12.9	14.4
4. Electricity, Gas & Water	0.4	0.6	0.7	0.8	0.8	0.7	0.7	1.0	0.9
5. Construction	1.3	1.9	2.4	2.7	4.0	6.1	7.1	3.6	3.5
6. Trade	21.6	21.2	23.0	21.9	20.6	20.2	21.6	20.4	20.2
7. Transport & Communicat	8.8	11.6	10.9	12.2	12.3	11.0	11.1	11.2	10.3
8. Banking, etc.	2.0	2.2	2.5	2.2	2.3	2.9	3.0	3.1	3.2
9. Ownership of Dwellings	7.2	5.7	5.5	5.4	5.2	4.9	4.7	4.6	4.4
10. Public Administration	9.6	10.1	9.2	10.2	10.7	11.1	10.6	8.9	9.2
11. Other Services	3.8	3.2	3.1	3.0	3.4	3.3	3.1	2.2	2.2
Gross Regional Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Remarks: a/; 1975 constant price series for 1975-83 and 1983 constant price series for 1984 and 1985

Source: Statistics Office, South Kalimantan Province

Table 2.9 Sectoral Shares of GDP and GRDP in South Kalimantan

	Indonesia			South Kalimantan		
	Shares of GDP a/		Growth b/ Rate	Shares of GDP c/		Growth d/ Rate
	1980 (%)	1985 (%)	1980-85 (% p.a.)	1980 (%)	1985 (%)	1980-85 (% p.a.)
Primary						
- Agriculture	24.6	24.0	3.2	37.3	31.4	3.2
- Mining	24.1	17.5	-2.8	0.6	0.5	4.6
Secondary						
- Manufacturing	11.0	13.2	7.7	10.1	14.4	14.5
- Construction	5.8	5.6	3.2	1.3	3.5	30.5
Tertiary						
- Transportation	4.4	5.6	9.0	11.7	10.3	4.0
- Utilities	0.5	0.7	13.8	0.9	0.9	8.4
- Trade	15.2	15.5	4.1	20.0	20.2	7.0
- Services	14.6	17.8	7.9	18.1	18.8	7.6
Total	100.0	100.0	3.7	100.0	100.0	6.8

Source: a/; Table 2.5
          b/; Table 2.6
          c/; Table 2.8
          d/; Table 2.10

Table 2.10   GRDP by Industrial Origin at 1983 Constant Market Prices in South Kalimantan

Unit: Rp.billion

Sector/Year	1978	1979	1980	1981	1982	1983	1984	1985
1. Agriculture	247	259	261	269	262	269	284	305
- Farm food crops	127	123	129	137	133	140	160	169
- Farm non-food crops	15	16	17	18	19	18	20	20
- Livestock products	26	20	15	16	20	23	27	35
- Forestry	28	38	41	34	22	28	19	23
- Fishery	51	63	58	64	68	59	58	58
2. Mining & Quarring	3	3	4	4	4	5	5	5
3. Manufacturing	56	62	71	75	102	107	116	140
4. Electricity, Gas & Water	5	6	6	7	7	7	9	9
5. Construction	6	8	9	15	24	31	32	34
6. Trade	123	141	140	141	147	170	183	196
7. Transport & Communication	72	71	82	89	85	93	101	100
8. Banking, etc.	12	14	13	15	19	22	28	31
9. Ownership of Dwellings	36	37	38	39	39	40	41	42
10. Public Administration	55	53	61	69	76	78	80	89
11. Other Services	14	14	15	18	19	19	20	21
Gross Regional Domestic Product	627	669	700	741	785	840	900	972

Source: Statistic Office, South Kalimantan Province

Table 2.11   Growth Rate of GRDP by Sector in South Kalimantan

Unit: %

Sector/Year	a/ 1975-80	1980-85	1981	1982	1983	1984	1985
1. Agriculture	6.0	3.2	3.9	-0.2	2.5	5.8	7.4
- Farm food crops	6.9	5.6	5.9	-2.6	5.0	13.9	5.6
- Farm non-food crops	3.2	3.3	6.4	1.8	-0.6	10.1	0.0
- Livestock products	0.3	18.5	3.4	26.8	13.1	19.4	29.6
- Forestry	9.4	-12.3	-16.2	-36.8	31.3	-31.0	21.1
- Fishery	5.6	0.0	9.5	6.6	-12.9	-2.2	0.0
2. Mining & Quarring	12.3	4.6	4.0	9.3	15.3	3.8	0.0
3. Manufacturing	10.2	14.5	6.4	34.8	5.1	8.6	20.7
4. Electricity, Gas & Water	24.6	8.4	12.0	-3.5	8.2	20.1	0.0
5. Construction	24.3	30.5	59.7	63.7	25.4	4.9	6.3
6. Trade	8.5	7.0	0.8	4.7	15.0	8.0	7.1
7. Transport & Communication	15.4	4.0	8.2	-4.8	9.0	9.1	-1.0
8. Banking, etc.	11.0	19.0	12.4	30.0	14.0	24.9	10.7
9. Ownership of Dwellings	2.2	2.0	2.2	2.0	2.6	2.0	2.4
10. Public Administration	9.5	7.8	13.0	9.9	2.7	3.0	11.3
11. Other Services	3.3	7.0	19.9	5.7	1.5	5.6	5.0
Gross Regional Domestic Product	8.3	6.8	7.1	6.5	7.7	7.1	8.0

Remarks: a/; 1975 constant price series for 1975-83 and 1983 constant price series for 1984-85

Source: Statistics Office, South Kalimantan Province

Table 2.12 Central Government Budget Summary, 1980/81 - 1988/89

(Unit: Rp. billion)

	Actual							Budget	
	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1. Domestic Revenues	10,227	12,213	12,418	14,433	15,906	19,253	16,141	17,236	21,803
2. Routine Expenditures a/	5,800	6,978	6,996	8,412	9,429	11,952	13,559	15,027	20,066
3. Government Saving (1-2)	4,427	5,235	5,422	6,021	6,477	7,301	2,581	2,210	1,737
4. Development Expenditures	5,916	6,940	7,360	9,899	9,952	10,873	8,332	7,757	8,898
5. Balance (3-4)	-1,489	-1,705	-1,938	-3,878	-3,475	-3,572	-5,751	-5,547	-7,161
Financed by:									
6. Counterpart Funds b/	64	45	15	15	69	69	1,958	121	1,163
7. Project Aid	1,430	1,664	1,925	3,868	3,409	3,503	3,795	5,426	5,998
8. Change in Balance (- = increase)	-5	-4	-2	-4	-3	-1	-2	0	0

Note: a/; Includes debt service payments
     b/; Program aid

Source: Ministry of Finance

Table 2.13 Central Government Receipts, 1980/81 - 1988/89

	Actual							Budget		Actual (% of total revenues)							Budget	
(Unit: Rp. billion)	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
Taxes on Income	8,230	10,100	10,010	11,605	12,847	13,525	8,798	10,529	12,940	70.2	72.6	69.7	53.4	66.3	59.7	40.2	46.2	44.7
Income tax	164	207	289	399	451	675	2,271	3,316	3,762									
Corporate tax a/	448	559	675	757	1,670	1,638	-	-	-									
Corporate tax on oil	7,020	8,628	8,170	9,520	10,430	11,144	6,338	6,939	8,856									
Witholding tax b/	434	513	542	628														
IPEDA/property tax c/	97	95	105	132	157	168	190	274	322									
Others d/	78	99	129	168	138	-	-	-	-									
Taxes on Domestic Consumption	733	888	1,137	1,392	1,510	3,479	5,156	4,926	6,391	6.3	6.4	7.9	7.6	7.8	15.2	23.6	21.6	22.1
Sales/value added tax	266	311	477	575	637	2,327	2,900	3,546	4,788									
Excises	438	544	620	773	873	944	1,056	1,076	1,332									
Other oil revenues e/	0	0	0	0	0	0	1,010	114	0									
Miscellaneous levies	29	33	41	44	0	208	190	190	272									
Taxes in International Trade	948	888	835	916	862	658	1,039	733	1,213	8.1	6.4	5.8	5.0	4.4	2.9	4.7	3.2	4.2
Import duties	448	536	522	557	530	607	960	662	1,068									
Sales tax on imports f/	195	223	231	255	241	-	-	-	-									
Export tax	305	128	83	104	91	51	79	71	144									
Nontax Receipts	316	336	436	520	687	1,492	1,147	1,049	1,259	2.7	2.4	3.0	2.3	3.5	6.5	5.2	4.6	4.3
Domestic Revenue	10,227	12,213	12,418	14,453	15,906	19,253	16,141	17,236	21,803	87.3	87.7	86.5	78.8	82.1	84.3	73.7	75.7	75.3
Development Funds	1,494	1,709	1,940	3,882	3,478	3,573	5,752	5,547	7,161	12.7	12.3	13.5	21.2	17.9	15.7	26.3	24.3	24.7
Program aid	64	45	15	15	69	69	1,958	121	1,163									
Project aid g/	1,430	1,664	1,925	3,868	3,409	3,503	3,795	5,426	5,998									
Total Revenues	11,721	13,922	14,358	18,315	19,384	22,825	21,893	22,783	28,964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: a/: Since 1986/87 included in income tax
b/: Since 1984/85, witholding tax eliminated as separate category and combined with income tax
c/: Since January 1986, IPEDA replaced by property tax
d/: Classification changed to other tax (included in miscellaneous levies which consist of other taxes and stamp duty)
e/: Oil subsidies shown as Government expenditures; for 1986/87 and 1987/88, included in income tax
f/: Since 1984/85, classification changed to value added tax and tax on luxury goods
g/: Includes commercial bank and suppliers' credits for development projects

Source: Ministry of Finance

Table 2.14 Central Government Expenditures, 1980/81 - 1988/89

	Actual							Budget		Actual							Budget	
	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
	(Unit: Rp. billion)									(% of total expenditures)								
Personnel Expenditures	2,023	2,278	2,418	2,757	3,047	4,018	4,311	4,317	4,816	17.3	16.4	16.8	15.1	15.7	17.6	19.7	18.9	16.6
Wages and salaries	1,483	1,650	1,749	1,996	2,207	3,073	3,330	3,276	3,739									
Rice allowance	252	253	290	346	407	402	406	483	483									
Food allowance	193	241	255	261	271	300	288	315	323									
Other	61	80	79	88	90	161	177	118	141									
External	34	43	46	66	72	82	110	125	131									
Material Expenditures	671	922	1,041	1,057	1,183	1,367	1,367	1,175	1,333	5.7	6.6	7.3	5.8	6.1	6.0	6.2	5.2	4.6
Domestic	638	891	1,007	1,007	1,134	1,310	1,294	1,086	1,222									
External	33	32	34	50	49	58	73	89	111									
Subsidies to Region a/	976	1,209	1,315	1,547	1,883	2,489	2,650	2,649	2,893	8.3	8.7	9.2	8.4	9.7	10.9	12.1	11.6	10.0
Irian Jaya	34	42	43	42	0	0	0	0	0									
Other region	942	1,167	1,272	1,505	1,883	2,489	2,650	2,649	2,893									
Debt Service Payments	785	931	1,225	2,103	2,777	3,323	5,058	6,805	10,648	6.7	6.7	8.5	11.5	14.3	14.6	23.1	29.9	36.8
Internal	31	16	20	30	39	0	0	40	40									
External	754	915	1,205	2,073	2,737	3,303	5,058	6,765	10,608									
Other Expenditures	1,345	1,637	997	948	540	754	174	80	376	11.5	11.8	6.9	5.2	2.8	3.3	0.8	0.4	1.3
Food subsidy	282	224	1	0	0	0	29	0	267									
Oil subsidy	1,022	1,316	962	928	507	374	0	0	0									
Others	42	97	34	20	33	380	145	80	109									
Routine Expenditures	5,800	6,978	6,996	8,412	9,429	11,952	13,559	15,027	20,066	49.5	50.1	48.7	45.9	48.7	52.4	61.9	66.0	69.3
Development Expenditures	5,916	6,940	7,360	9,899	9,952	10,873	8,332	7,757	8,898	50.5	49.9	51.3	54.1	51.3	47.6	38.1	34.0	30.7
Total Expenditures	11,716	13,918	14,356	18,311	19,381	22,825	21,891	22,783	28,964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: a/ Since 1984/85, this item is sub-divided into wage/salary and non wage/salary expenditures without identifying regions

Source: Ministry of Finance

Table 2.15 Central Government Development Expenditures, 1980/81 - 1988/89

	Actual (Unit: Rp. billion)							Budget		Actual (% of total)							Budget	
	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
Departments	2,533	2,725	3,261	3,220	3,474	4,467	2,004	752	1,120	42.8	39.3	44.3	32.5	34.9	41.1	24.0	9.7	12.6
General INPRES Programs																		
Subsidies to provinces (Dati I)	337	448	535	539	540	575	568	605	703	5.7	6.5	7.3	5.4	5.4	5.3	6.8	7.8	7.9
Subsidies to Kabupaters (Dati II)	167	215	253	253	253	287	293	280	324	2.8	3.1	3.4	2.6	2.5	2.6	3.5	3.6	3.6
Subsidies to Kabupaters (Dati II)	119	153	194	194	195	189	188	226	267	2.0	2.3	2.6	2.0	2.0	1.7	2.3	2.9	3.0
Subsidies to villages (Dati IV)	51	71	88	92	93	99	86	99	112	0.9	1.0	1.2	0.9	0.9	0.9	1.0	1.3	1.3
Sectoral INPRES Programs																		
Primary schools	377	585	444	771	824	754	721	326	403	6.4	8.4	6.0	7.8	8.3	6.9	8.6	4.2	4.5
Health	250	375	267	549	572	526	496	101	113	4.2	5.4	3.6	5.5	5.7	4.8	6.0	1.3	1.3
Markets	50	79	80	87	65	111	108	76	91	0.9	1.1	1.1	0.9	0.6	1.0	1.3	1.0	1.0
Replanting	3	6	5	11	26	4	12	3	3	0.0	0.1	0.1	0.1	0.3	0.0	0.1	0.0	0.0
Reforestation	49	70	50	59	61	43	31	16	15	0.8	1.0	0.7	0.6	0.6	0.4	0.4	0.2	0.2
Roads	26	55	42	65	101	70	75	130	180	0.4	0.8	0.6	0.7	1.0	0.6	0.9	1.7	2.0
IPEDA	97	95	105	132	157	168	171	247	261	1.5	1.4	1.4	1.3	1.6	1.5	2.1	3.2	2.9
Irian Jaya and East Timor	6	7	6	5	4	7	7	5	6	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Sub-total of Transfers to local governments	808	1,134	1,090	1,448	1,526	1,503	1,467	1,183	1,373	13.7	16.3	14.8	14.6	15.3	13.8	17.6	15.2	15.4
Fertilizer Subsidy	284	371	420	324	752	477	467	204	200	4.8	5.4	5.7	3.3	7.4	4.4	5.6	2.5	2.2
Government Capital Participation (PMP)	477	481	337	592	336	412	86	83	88	8.1	6.9	4.6	6.0	3.4	3.8	1.0	1.1	1.0
Others	386	565	327	449	475	511	514	109	119	6.5	8.1	4.4	4.5	4.8	4.7	6.2	1.4	1.3
Sub-total	4,486	5,276	5,435	6,032	6,543	7,370	4,537	2,331	2,900	75.8	76.0	73.8	60.9	65.7	67.8	54.5	30.1	32.6
Project Aid	1,430	1,664	1,925	3,868	3,409	3,503	3,795	5,426	5,998	24.2	24.0	26.2	39.1	34.3	32.2	45.5	69.9	67.4
Total	5,916	6,940	7,360	9,899	9,952	10,873	8,332	7,757	8,898	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Ministry of Finance

Table 2.16 Central Government Development Expenditures by Sector, 1980/81 - 1988/89

	Actual							Budget		Actual (% of total)							Budget	
	(Unit: Rp. billion)									(% of total)								
	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
Agriculture and Irrigation	929	954	931	913	1,699	1,137	890	1,181	1,300	15.7	13.7	12.7	9.2	17.1	10.5	10.7	15.2	14.6
(of which fertilizer subsidy)	(284)	(371)	(420)	(324)	(732)	(477)	(467)	(204)	(200)	(4.8)	(5.4)	(5.7)	(3.3)	(7.4)	(4.4)	(5.6)	(2.6)	(2.2)
Industry and Mining	491	827	913	2,153	839	1,189	681	350	374	8.3	11.9	12.4	21.8	8.4	10.9	8.2	4.5	4.2
Electric Power	431	530	758	660	911	1,447	960	1,009	1,087	7.3	7.6	10.3	6.7	9.2	13.3	11.5	13.0	12.2
Transportation and Tourism	781	807	876	1,528	1,428	1,484	1,151	1,288	1,654	13.2	11.6	11.9	15.4	14.4	13.7	13.6	15.6	18.6
Manpower and Transmigration	326	417	436	456	422	665	292	157	147	5.5	6.0	5.9	4.6	4.2	6.1	3.5	2.0	1.7
Regional Development	432	616	711	749	791	850	939	874	1,032	8.2	8.9	9.7	7.6	7.9	7.8	11.3	11.3	11.6
Education	575	726	703	1,032	1,231	1,413	1,184	1,022	1,076	9.7	10.5	9.6	10.4	12.4	13.0	14.2	13.2	12.1
Health	218	286	259	279	320	398	326	208	289	3.7	4.1	3.5	2.8	3.2	3.7	3.9	2.7	3.3
Housing and water supply	191	166	151	221	224	335	337	412	438	3.2	2.4	2.0	2.2	2.3	3.1	4.0	5.3	4.9
General Public Services a/	699	800	786	899	927	977	769	569	648	11.8	11.5	10.7	9.1	9.3	9.0	9.2	7.3	7.3
Gov. Capital Participation	389	389	281	234	292	221	211	191	208	6.6	5.6	3.8	2.4	2.9	2.0	2.5	2.5	2.3
Others b/	404	423	555	776	868	758	611	497	545	6.8	6.1	7.5	7.8	8.7	7.0	7.3	6.4	7.2
Total Develop. Expenditures	5,916	6,940	7,360	9,899	9,952	10,873	8,332	7,757	8,898	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total (excluding fertilizer subsidy)	5,632	5,569	6,940	9,575	9,220	10,396	7,865	7,553	8,698									

Note: a/ Law and order, defence and security, government apparatus
      b/ Trade and cooperatives, religion, information and science, natural resource development and environment

Source: Ministry of Finance

Table 2.17 Local Government Receipts in 1980/81 and 1985/86

	1980/81 (Rp billion)				1985/86 (Rp billion)				1980/81 (%)				1985/86 (%)			
	Routine	Development	Total	Total Per Capita (Rp)	Routine	Development	Total	Total Per Capita (Rp)	Routine	Development	Total	Total Per Capita (Indo.=100)	Routine	Development	Total	Total Per Capita (Indo.=100)
Level I Government Receipts																
Java	739.8	102.4	842.2	9,227	1,507.6	161.1	1,668.8	16,771	57.3	28.2	50.9	82.2	65.0	29.3	58.1	95.8
Off-Java	552.2	261.3	813.5	14,469	813.3	387.9	1,201.3	18,661	42.7	71.8	49.1	128.9	35.0	70.7	41.9	106.6
Kalimantan	73.5	106.3	179.7	26,735	159.0	90.8	249.8	32,096	5.7	29.2	10.9	238.2	6.8	16.5	8.7	183.3
South Kalimantan	23.8	13.0	36.8	17,824	47.7	15.7	63.5	27,419	1.8	3.6	2.2	158.8	2.1	2.9	2.2	156.6
Indonesia	1,291.9	363.7	1,655.6	11,225	2,321.0	549.0	2,870.0	17,513	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Level II Government Receipts																
Java	185.6	127.0	312.6	3,426	420.0	181.8	601.9	6,049	41.3	42.8	41.9	67.7	37.5	33.8	36.3	59.8
Off-Java	264.3	169.6	433.9	7,718	699.8	356.6	1,056.3	16,409	58.7	57.2	58.1	152.5	62.5	66.2	63.7	162.2
Kalimantan	26.7	35.4	62.1	9,231	51.7	51.1	102.8	13,206	5.9	11.9	8.3	182.4	4.6	9.5	6.2	130.5
South Kalimantan	6.2	11.0	17.2	8,335	11.4	13.0	24.4	10,527	1.4	3.7	2.3	164.7	1.0	2.4	1.5	104.0
Indonesia	450.0	296.6	746.6	5,062	1,119.8	538.4	1,658.2	10,119	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Memo item Population																
Java											61.9				60.7	
Off-Java											38.1				39.3	
Kalimantan											4.6				4.7	
South Kalimantan											1.4				1.4	
Indonesia											100.0				100.0	

Note: a/ Estimated population (000) is as follows:

	1980	1985
Java	91,270	99,502
Off-Java	56,220	64,374
Kalimantan	6,723	7,782
South Kalimantan	2,063	2,315
Indonesia	147,490	163,876

Source: Monthly Statistical Bulletin, January 1988, CBS

Table 2.18   Development Expenditures in South Kalimantan and Indonesia, 1980/81-1987/88

	1980/81		1981/82		1982/83		Actual 1983/84		1984/85		1985/86		1986/87		Budget 1987/88		5 Years Average 1982/83 - 86/87	
	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)	(Rp. BN)	(%)

SOUTH KALIMANTAN
1. Sectoral Funds
2. General INPRES Programs
 - INPRES Dati I a/
 - INPRES Dati II
 - INPRES Desa
3. Sectoral INPRES Programs
 - INPRES Primary schools
 - INPRES Health
 - INPRES Replanting/reforestation
 - INPRES Roads
 - INPRES Markets
4. Total INPRES Programs (2+3)
5. Total (1+4)

INDONESIA
1. Sectoral Funds b/
2. General INPRES Programs
 - INPRES Dati I
 - INPRES Dati II
 - INPRES Desa
3. Sectoral INPRES Programs
 - INPRES Primary schools
 - INPRES Health
 - INPRES Replanting/reforestation
 - INPRES Roads
 - INPRES Markets
4. Total INPRES Programs (2+3)
5. Total (1+4)

SHARE OF SOUTH KALIMANTAN (Indonesia = 100)
1. Sectoral Funds
2. General INPRES Programs
 - INPRES Dati I
 - INPRES Dati II
 - INPRES Desa
3. Sectoral INPRES Programs
 - INPRES Primary schools
 - INPRES Health
 - INPRES Replanting/reforestation
 - INPRES Roads
 - INPRES Markets
4. Total INPRES Programs (2+3)
5. Total (1+4)

Note: a/ Includes original Sources from local taxes collected by the local government
b/ Excludes project aids, only departments' development expenditures
Source: Basic Strategy and Macro Targets for Repelita V, 1988, BAPPEDA, South Kalimantan
A Mid-term Review of Implementation and Achievement of Repelita IV, 1987, BAPPEDA, South Kalimantan
Data on South Kalimantan from Repelita I to III, 1982, BAPPEDA, South Kalimantan
Ministry of Finance

Table 2.19 Budgetary Allocation of Sectoral Funds in South Kalimantan, 1985/86-1988/89

Departments	1985/86 (Rp.million)	(%)	1986/87 (Rp.million)	(%)	1987/88 (Rp.million)	(%)	1988/89 (Rp.million)	(%)
1. Attorney General	262.9	0.4	137.3	0.4	31.3	0.1	33.2	0.0
2. Home Affairs	1,119.7	1.6	667.1	1.8	116.5	0.2	657.7	0.7
3. Non Ministry Institutes	102.8	0.1	100.7	0.3	62.6	0.1	73.6	0.1
4. Justice	500.2	0.7	376.2	1.0	179.3	0.3	170.5	0.2
5. Information	505.4	0.7	944.6	2.6	201.2	0.4	277.8	0.3
6. Finance	186.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
7. Finance and Calcu-lation Division	1,151.7	1.6	1,040.7	2.8	905.8	1.7	1,187.1	1.2
8. Trade	396.0	0.6	394.8	1.1	44.0	0.1	107.4	0.1
9. Cooperative	691.1	1.0	295.0	0.8	133.3	0.3	191.8	0.2
10. Agriculture	5,010.4	7.0	2,231.9	6.1	686.8	1.3	1,688.7	1.7
11. Forestry	1,171.1	1.6	2,231.9	6.1	1,065.0	2.0	279.4	0.3
12. Industry	511.1	0.7	79.3	0.2	99.2	0.2	180.3	0.2
13. Mines and Energy	11,810.7	16.4	79.3	0.2	32.0	0.1	35,322.1	35.1
14. Public Works	14,604.6	20.3	6,695.8	18.2	23,411.2	44.6	37,335.5	37.1
15. Communications	3,846.1	5.3	4,863.3	13.2	6,447.0	12.3	9,833.6	9.8
16. Tourism, Post and Telecommunications	308.5	0.4	77.1	0.2	0.0	0.0	0.0	0.0
17. Education and Culture	11,762.4	16.4	6,451.5	17.5	8,258.6	15.7	6,255.3	6.2
18. Health	2,284.3	3.2	1,615.2	4.4	1,465.0	2.8	1,013.4	1.0
19. Religion	1,497.8	2.1	1,065.0	2.9	258.9	0.5	340.3	0.3
20. Manpower	4,214.9	5.9	1,991.0	5.4	7,548.8	14.4	3,420.0	3.4
21. Transmigration	8,314.6	11.6	4,626.4	12.6	1,126.9	2.1	1,746.2	1.7
22. Social Affairs	1,661.8	2.3	816.5	2.2	397.9	0.8	389.4	0.4
Total	71,914.2	100.0	36,780.7	100.0	52,471.3	100.0	100,503.5	100.0

Source: BAPPEDA, South Kalimantan Province

Table 2.20   Budget Allocation of INPRES Dati I and Original Funds
in South Kalimantan in 1985/86 and 1986/87

(Unit: Rp million)

Service/Institute	1985/86				1986/87			
	INPRES Dati I	Original	Total	(%)	INPRES Dati I	Original	Total	(%)
1. Regional Secretariat	4,646	481	5,127	(47.8)	2,567	1,679	4,246	(34.1)
2. Puplic Works Service	3,400	0	3,400	(31.7)	3,751	560	4,311	(34.7)
- Pengairan	2,550	0	2,550	(23.8)	694	n.a	694	(5.6)
- Binamarga a/	850	0	850	(7.9)	3,057	n.a	3,057	(24.6)
3. Agricultural Service	572	0	572	(5.3)	560	16	577	(4.6)
- Food crops	322	0	322	(3.0)	311	11	322	(2.6)
- Estate crops	50	0	50	(0.5)	45	5	50	(0.4)
- Forestry	75	0	75	(0.7)	48	0	48	(0.4)
- Livestok	50	0	50	(0.5)	94	0	94	(0.8)
- Fishery	75	0	75	(0.7)	62	0	62	(0.5)
4. Industrial Service	68	0	68	(0.6)	37	0	37	(0.3)
5. Education/Culture Service	100	0	100	(0.9)	100	25	125	(1.0)
6. Social Affairs Service	212	0	212	(2.0)	174	0	174	(1.4)
7. Health Service	90	0	90	(0.8)	198	0	198	(1.6)
8. Tourism Service	70	0	70	(0.7)	41	25	66	(0.5)
9. Regional Dev. Directorate	207	0	207	(1.9)	197	8	205	(1.6)
10. BAPPEDA	185	0	185	(1.7)	149	0	149	(1.2)
11. Education/Training Board	0	0	0	0.0	125	14	139	(1.1)
12. Others	522	165	687	(6.4)	1,685	531	2,216	(17.8)
Total	10,072	646	10,718	(100.0)	9,584	2,858	12,442	(100.0)

Note: a/: Includes Cipta Karya

Source: A Mid-term Review of Implementation and Achievement of Repelita IV, 1987, BAPPEDA,
South Kalimantan

(Unit: Rp. million)

	Actual								Budget
	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
KALSEL Irrigation a/									
- APBN c/	1,423.1	1,738.0	1,803.7	1,465.0	1,579.5	1,476.0	538.0	32.8	72.9
- Loan d/	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	907.6
Riam Kanan Irrigation									
- APBN	139.9	347.9	387.8	514.0	962.6	680.5	323.7	850.0	46.8
- Loan	0.0	0.0	0.0	0.0	0.0	204.0	2,243.0	3,476.0	13,234.0
Biniang Irrigation									
- APBN	459.0	460.0	293.0	237.9	0.0	0.0	0.0	0.0	0.0
- Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tidal & Swamp Development									
- APBN	597.0	600.0	850.0	770.0	700.0	697.0	195.0	18.7	70.0
- Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Resources Planning									
- APBN	260.0	159.0	282.5	195.0	195.5	194.6	33.6	17.7	77.7
- Loan b/	0.0	0.0	0.0	0	1,649.0	393.8	0.0	0.0	2,714.3
Hydrology									
- APBN	64.0	59.0	70.0	74.0	69.7	76.8	41.0	10.7	0.0
- Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
River Development									
- APBN	16.0	60.0	100.0	99.8	100.0	100.0	44.5	6.0	5.6
- Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tidal & Swamp Rehabilitation									
- APBN	0.0	0.0	0.0	0.0	150.0	150.0	146.2	134.0	189.5
- Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.0	55.6
Exploitation & Maintenance									
- APBD e/	300.0	500.0	700.0	500.0	500.0	600.0	500.0	500.0	500.0
River Improvement & Maintenance									
- APBD	70.0	200.0	260.0	160.0	260.0	290.0	300.0	300.0	300.0
Total									
- APBN	2,959.0	3,423.9	3,787.0	3,355.7	3,757.3	3,374.9	1,322.0	1,069.9	462.5
- Loan	0.0	0.0	0.0	0.0	1,649.0	597.8	2,243.0	3,546.0	16,911.5
Sub-total (Sectoral Funds)	2,959.0	3,423.9	3,787.0	3,355.7	5,406.3	3,972.7	3,565.0	4,615.9	17,374.0
- APBD	370.0	700.0	960.0	660.0	760.0	890.0	800.0	800.0	800.0
- Total	3,329.0	4,123.9	4,747.0	4,015.7	6,166.3	4,862.7	4,365.0	5,415.9	18,174.0

Note: a/ Middle scale, small scale and tertiary works in South Kalimantan
　　　b/ Includes grant from JICA
　　　c/ Sectoral funds from Central Government through the Ministry of Public Works, but not includes the funds from
　　　　external loans
　　　d/ Funds from external loans
　　　e/ Allocated funds from Central Government to the regional government

Source: Sub-Dinas Water Resources Development, DPU, South Kalimantan, 1988

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Table 3.1 Population, Growth Rates, Distribution by Sex, Density and Households in the Study Area

Kabupaten	Area (km2)	Population (000)			Average Growth Rate (% p.a.)			Distribution by Sex, 1985 (%)			Density in 1985 (prs/km2)	Total Households in 1985 (No.)	Average Family Size in 1985 (prs/family)	Farm Households in 1985 (No.)	Percent of Farm H.Hold (%)
		1971	1980	1985	1971-80	1980-85	1971-85	Males	Females	Total					
Study Area	12,655	731.7	848.6	890.2	0.92	0.96	0.93	48.0	52.0	100.0	70	209,690	4.25	158,700	75.7
Tapin	2,653	84.3	108.4	120.4	2.84	2.13	2.58	48.9	51.1	100.0	45	29,046	4.15	22,900	78.8
H.S. Selatan	1,803	165.5	175.7	182.7	0.56	0.78	0.71	48.0	52.0	100.0	101	46,506	3.93	30,520	65.6
H.S. Tengah	1,472	196.0	200.4	205.4	0.25	0.49	0.53	46.9	53.1	100.0	140	48,380	4.24	39,080	80.8
H.S. Utara	2,771	220.9	239.5	247.1	0.90	0.62	0.80	48.0	52.0	100.0	89	55,207	4.48	44,630	80.8
Tabalong	3,946	115.0	124.6	134.7	0.90	1.57	1.14	49.0	51.0	100.0	34	30,632	4.40	21,570	70.4
South Kalimantan	36,936	1,699	2,063	2,315	2.18	2.33	2.23	49.8	50.2	100.0	63	509,520	4.54	334,400	65.6
Total Indonesia	1,918,769	119,208	147,490	163,876	2.39	2.13	2.30	50.2	49.8	100.0	85	35,889,000	4.57	20,344,500	56.7

Source: Statistics Office, South Kalimantan, Banjarmasin and Statistical Yearbook of Indonesia 1986, CBS

Table 3.2 Population Density in the Study Area by Kecamatan in 1985

Kabupaten/ Kecamatan	Area a/ (km2)	Population in 1985 b/	Population Density (Prn/km2)
1. Tapin			
Binuang	342	25,500	74.5
Bakarangan	108	7,970	74.1
Piani	112	3,940	35.3
Tapin Tengah	322	15,280	47.4
Tapin Selatan	366	17,880	48.9
Tapin Utara	72	15,650	218.9
Candi Laras Selatan	328	9,850	30.0
Candi Laras Utara	731	11,380	15.6
Bungur	149	6,910	46.4
Lokpa Ikat	134	6,040	45.1
Sub-total	2,663	120,410	45.2
2. H.S.Selatan			
Kandangan	145	39,040	269.2
Angk Inang	68	15,460	227.4
Telaga Langsat	100	8,360	83.6
Simpur	122	13,270	108.8
Kalumpang	100	7,050	70.5
Daha Selatan	396	34,800	87.9
Daha Utara	363	26,150	72.0
Padang Batung	194	15,630	80.6
Loksado	228	6,550	28.7
Sungai Raya	87	16,350	187.9
Sub-total	1,803	182,670	101.3
3. H.S.Tengah			
Barabai	55	37,210	681.5
Pendawan	144	25,410	176.2
Batu Benawa	291	26,150	89.9
Haruyan	149	18,110	121.9
Batang Alai Utara	147	23,950	162.6
Batang Alai Selatan	438	26,380	60.3
Labuan Amas Selatan	87	23,270	269.0
Labuan Amas Utara	162	24,860	153.6
Sub-total	1,472	205,350	139.5
4. H.S.Utara			
Amuntai Tengah	137	45,900	335.3
Amuntai Selatan	44	17,960	407.3
Amuntai Utara	109	30,040	276.9
Sungai Pandan	182	36,000	198.1
Danau Panggang	268	18,800	70.1
Babirik	183	16,400	89.7
Lampihong	285	12,760	44.8
Paringin	382	18,920	49.6
Batu Mandi	283	12,310	43.5
Awayan	328	15,250	46.5
Juai	213	11,170	52.4
Halong	358	11,590	32.3
Sub-total	2,771	247,100	89.2
5. Tabalong			
Tanta	172	11,720	68.1
Haruai	861	16,390	19.0
Muara Uya	924	12,830	13.9
Banua Lawas	162	14,640	90.6
Kelua	116	15,600	134.7
Tanjung	323	21,390	66.2
Murung Pudak	119	18,360	154.6
Jaro	819	8,060	9.8
Upau	323	4,760	14.7
Muara Harus	63	5,380	85.5
Pugaan	64	5,580	87.1
Sub-total	3,946	134,710	34.1
Total or Average	12,655	890,230	70.4

Source: a/; Governor's Office, South Kalimantan
b/; Statistical Yearbook of South Kalimantan 1986,
Statistics Office, South Kalimantan

Table 4.1   Population Projection by Kecamatan in the Study Area, 1985 - 2018

(Unit: '000)

Kabupaten/ Kecamatan	1985 b/	1990 c/	1995 c/	1998 c/	2000 c/	2008 a/	2018 a/
1. Tapin							
Binuang	25.50	28.94	32.65	34.81	36.33	43.11	53.38
Bakarangan	7.97	9.05	10.21	10.89	11.36	13.48	16.69
Piani	3.94	4.47	5.05	5.38	5.61	6.66	8.25
Tapin Tengah	15.28	17.35	19.57	20.87	21.78	25.84	31.99
Tapin Selatan	17.88	20.30	22.90	24.42	25.49	30.24	37.44
Tapin Utara	15.65	17.77	20.04	21.37	22.30	26.46	32.77
Candi Laras Selatan	9.85	11.18	12.62	13.45	14.04	16.66	20.63
Candi Laras Utara	11.38	12.92	14.57	15.54	16.22	19.24	23.83
Bungur	6.91	7.85	8.85	9.44	9.85	11.69	14.47
Lokpa Ikat	6.04	6.86	7.74	8.25	8.61	10.21	12.65
Sub-total	120.41	136.69	154.20	164.41	171.59	203.59	252.09
2. H.S.Selatan							
Kandangan	39.04	39.89	40.39	40.45	40.49	40.65	40.85
Angk Inang	15.46	15.79	15.99	16.02	16.03	16.10	16.18
Telaga Langsat	8.36	8.54	8.65	8.66	8.67	8.71	8.75
Simpur	13.27	13.56	13.73	13.75	13.76	13.82	13.89
Kalumpang	7.05	7.21	7.30	7.31	7.31	7.34	7.38
Daha Selatan	34.80	35.56	36.00	36.06	36.09	36.24	36.42
Daha Utara	26.15	26.72	27.05	27.09	27.12	27.23	27.36
Padang Batung	15.63	15.97	16.17	16.20	16.21	16.28	16.36
Loksado	6.55	6.69	6.78	6.79	6.79	6.82	6.85
Sungai Raya	16.35	16.71	16.92	16.94	16.96	17.03	17.11
Sub-total	182.67	186.63	188.97	189.26	189.45	190.21	191.16
3. H.S.Tengah							
Barabai	37.21	38.42	39.35	39.62	39.81	40.54	41.49
Pendawan	25.41	26.23	26.87	27.05	27.18	27.68	28.32
Batu Benawa	26.15	26.99	27.65	27.84	27.97	28.49	29.15
Harnyan	18.11	18.70	19.15	19.29	19.37	19.73	20.19
Batang Alai Utara	23.95	24.73	25.33	25.50	25.62	26.10	26.70
Batang Alai Selatan	26.38	27.24	27.90	28.09	28.22	28.75	29.41
Labuan Amas Selatan	23.27	24.03	24.61	24.78	24.89	25.36	25.94
Labuan Amas Utara	24.86	25.67	26.29	26.47	26.59	27.09	27.72
Sub-total	205.35	212.01	217.15	218.65	219.65	223.73	228.93
4. H.S.Utara							
Amuntai Tengah	45.90	47.41	48.63	48.99	49.24	50.23	51.50
Amuntai Selatan	17.96	18.55	19.03	19.17	19.27	19.66	20.15
Amuntai Utara	30.04	31.03	31.83	32.06	32.23	32.88	33.71
Sungai Pandan	36.00	37.19	38.15	38.44	38.63	39.41	40.40
Danau Panggang	18.80	19.42	19.92	20.07	20.17	20.58	21.10
Babirik	16.40	16.94	17.38	17.51	17.60	17.95	18.40
Lampihong	12.76	13.18	13.52	13.62	13.69	13.97	14.32
Paringin	18.92	19.54	20.04	20.19	20.30	20.70	21.23
Batu Mandi	12.31	12.71	13.04	13.14	13.21	13.47	13.81
Awayan	15.25	15.75	16.16	16.28	16.36	16.69	17.11
Juai	11.17	11.54	11.84	11.93	11.99	12.23	12.54
Halong	11.59	11.97	12.28	12.37	12.43	12.68	13.00
Sub-total	247.10	255.23	261.81	263.77	265.09	270.44	277.28
5. Tabalong							
Tanta	11.72	12.12	12.45	12.56	12.63	12.92	13.30
Haruai	16.39	16.94	17.40	17.55	17.65	18.06	18.59
Muara Uya	12.83	13.27	13.62	13.74	13.82	14.14	14.56
Banua Lawas	14.64	15.13	15.54	15.68	15.77	16.14	16.61
Kelua	15.60	16.13	16.56	16.70	16.80	17.19	17.70
Tanjung	21.39	22.11	22.71	22.90	23.04	23.58	24.27
Murung Pudak	18.36	18.98	19.49	19.66	19.77	20.24	20.83
Jaro	8.06	8.34	8.56	8.64	8.69	8.89	9.15
Upau	4.76	4.92	5.06	5.10	5.13	5.25	5.40
Muara Harus	5.38	5.57	5.71	5.76	5.80	5.93	6.11
Pugaan	5.58	5.77	5.92	5.97	6.01	6.15	6.33
Sub-total	134.71	139.28	143.01	144.26	145.10	148.50	152.86
Total Study Area	890.23	929.84	965.14	980.35	990.89	1,036.46	1,102.32

Note: a/; The same growth rates from 1995 to 2000 projected by c/ are applied.
   b/; Statistical Yearbook of South Kalimantan 1986, Statistics Office, South Kalimantan
   c/; Population and Labor Force Projection 1980-2000, Statistics Office, South Kalimantan

Table 4.2 Projected Increase Rates of Production of Major Agricultural Products to 2018 in Indonesia, South Kalimantan and the Study Area

(Unit: % p.a.)

		Indonesia		South Kalimantan		Study Area	
		1985-1998	1998-2018	1985-1998	1998-2018	1985-1998	1998-2018
Rice	a/	2.05	2.05	3.09	2.05	2.05	2.05
Maize	a/	4.11	4.11	3.76	3.76	3.76	3.76
Cassava	a/	1.50	1.50	2.45	1.50	2.45	1.50
Sweet potato	b/	1.56	1.56	5.84	1.56	3.30	1.56
Soybeans	a/	1.96	1.96	3.03	1.96	3.03	1.96
Groundnuts	c/	1.96	1.96	3.03	1.96	3.03	1.96
Coconuts	b/	2.71	2.71	3.70	2.71	2.20	2.20
Vegetables	d/	4.51	4.51	4.51	4.51	4.51	4.51
Fruits	d/	4.31	4.31	4.31	4.31	4.31	4.31
Meat	e/	6.00	6.00	6.00	6.00	6.00	6.00
Eggs	d/	7.01	7.01	3.29	3.29	3.29	3.29
Milk	e/	3.48	3.48	3.48	3.48	3.48	3.48
Fishes	e/	6.07	6.07	6.07	6.07	6.07	6.07
Memo. item							
Population		2.01	1.90	2.08	1.95	0.74	0.59

a/: These figures are obtained from the base simulation model studied in the report a/ below.
This base simulation model is made based on the following assumptions:
(1) Constant real 1986 crop prices, fertilizer prices and wage rates.
(2) Growth rates in area under intensification and modern rice varieties are equal to 1982-85 rates of growth.
(3) Area harvested under irrigation for rice is assumed to increase by 80,000 ha per year (24,000ha on Java and 56,000 ha on Off-Java).
However, projected increase rates for the period of 1995-2000 are directly adopted for the period of 1998-2018, because no projection is available after 2000 in the said report.
b/: Indonesia's average increase rates from 1981 to 1985 are applied.
c/: The same rates with soybeans are adopted.
d/: Malaysian's per capita consumption level during 1979-81 is assumed to be supplied in 2018, i.e. 33.3 kg for vegetables, 47.5 kg for fruits and 7.4 kg for eggs.
e/: The required increase rates which may cover the Government's standered requirements in 1998 are applied. These per capita requirements are 6.0 kg for meat, 4.0 kg for milk and 18.0 kg for fishes.
Source: a/: Price and Investmant Policies in the Indonesian Food Crop Sector Aug. 1987, International Food Policy Research Institute, Washington, D.C. and Center for Agro Economic Research, Bogor, Indonesia
b/: Supplement to the President's Report to Parliament, August 1986, and Draft State Budget, 1986/87
d/: Food Balance Sheets 1979-81 Average, FAO

Table 4.3 Projected Increase Rate of Commodity Demand to 2018 in Indonesia

(Unit: % p.a.)

		1985-1998	1998-2018
Rice	a/	2.22	2.16
Maize	a/	2.86	3.23
Cassava	a/	1.78	1.70
Sweet potato	b/	1.56	1.56
Soybeans	a/	3.54	3.73
Groundnuts	c/	3.54	3.73
Coconuts	b/	2.71	2.71
Vegetables	d/	4.51	4.51
Fruits	d/	4.31	4.31
Meat	d/	7.13	7.13
Eggs	d/	7.01	7.01
Milk	d/	7.67	7.67
Fishes	d/	6.44	6.44

a/: These figures are obtained from the base simulation model studied in the report a/ below. This base simulation model is made based on the following assumptions;

(1) Constant real 1986 crop prices, fertilizer prices and wage rates.

(2) Growth rates in area under intensification and modern rice varieties are equal to 1982-85 rates of growth.

(3) Area harvested under irrigation for rice is assumed to increase by 80,000 ha per year (24,000 ha on Java and 56,000 ha on Off-Java). However, the increase rates projected for 1995-2000 in the report a/ are directly adpoted for 1998-2018, because no projections are available after 2000 in the said repot.

b/: Indonesia's production increase rates from 1982 to 1986 are applied.

c/: The same rates with soybeans are adopted.

d/: Malaysian's per capita consumption level during 1979-81 is assumed to be required in 2018, i.e. 33.3kg for vegetables, 47.5 kg for fruits, 7.4 kg for eggs, 18.8kg for meat, 20.2kg for milk and 45.1 kg for fishes.

Source:

a/; Price and Investment Policies in the Indonesian Food Crop Sector Aug. 1987, International Food Policy Research Institute, Washington, D.C. and Center for Agro Economic Research, Bogor Indonesia

b/; Statistical Yearbook of South Kalimantan, 1983...1986, Statistics Office, South Kalimantan

d/; Food Balance Sheets 1979-81 Average, FAO

Table 4.4 Projected Per Capita Consumption of Food Crops to 2018 in Indonesia

	a/ 1985 (kg/year)	1998 (kg/year)	2008 (kg/year)	2018 (kg/year)	Ratio of a/ Other Use & Waste
Rice	145.21	149.16	153.00	156.94	1.03
Maize	26.60	29.63	33.73	38.40	1.21
Cassava	57.41	55.75	54.67	53.60	1.26
Sweet potato	12.46	11.76	11.38	11.00	1.10
Soybeans	4.45	5.40	6.45	7.71	1.10
Groundnuts	3.00	3.64	4.35	5.20	1.10
Coconuts	5.00	5.47	5.92	6.40	2.22
Vegetables	14.62	20.03	25.79	33.21	1.16
Fruits	22.26	29.75	37.58	47.47	1.12
Meat	3.65	6.90	11.38	18.77	1.10
Eggs	1.49	2.78	4.53	7.38	1.25
Milk	3.32	6.70	11.62	20.16	1.03
Fishes	10.83	18.82	29.11	45.00	1.18

Source: a/ Food Balance Sheet in Indonesia 1983, CBS

Table 4.5 Food Balance Projection to 2018 in Indonesia

(Unit: 1000 tons)

	Base				1998				2008				2018			
	Supply a/	Demand b/	Balance c/	S/D Ratio d/	Supply c/	Demand f/	Balance	S/D Ratio	Supply c/	Demand f/	Balance	S/D Ratio	Supply c/	Demand f/	Balance	S/D Ratio
Rice	24,320	24,510	(190)	0.99	31,662	32,607	(946)	0.97	38,785	40,376	(1,591)	0.96	47,511	49,996	(2,485)	0.95
Maize	4,535	5,275	(740)	0.86	7,656	7,610	46	1.01	11,453	10,458	995	1.10	17,133	14,372	2,761	1.19
Cassava	13,326	11,854	1,472	1.12	16,172	14,910	1,262	1.08	18,768	17,648	1,120	1.06	21,781	20,888	893	1.04
Sweet potato	2,073	2,246	(173)	0.92	2,535	2,747	(212)	0.92	2,960	3,207	(247)	0.92	3,455	3,743	(288)	0.92
Soybeans	679	802	(123)	0.85	874	1,261	(387)	0.69	1,061	1,819	(757)	0.58	1,288	2,623	(1,334)	0.49
Groundnuts	490	541	(51)	0.91	631	850	(219)	0.74	766	1,226	(460)	0.62	930	1,768	(838)	0.53
Coconut	1,737	1,819	(82)	0.95	2,459	2,575	(116)	0.95	3,213	3,365	(152)	0.95	4,198	4,396	(198)	0.95
Vegetables	2,734	2,779	(45)	0.98	4,851	4,931	(80)	0.98	7,541	7,666	(125)	0.98	11,722	11,916	(194)	0.98
Fruits	4,439	4,086	353	1.09	7,683	7,071	612	1.09	11,716	10,783	933	1.09	17,867	16,444	1,422	1.09
Meat	685	658	27	1.04	1,461	1,611	(150)	0.91	2,617	3,207	(591)	0.82	4,686	6,387	(1,701)	0.73
Eggs	324	305	19	1.06	782	736	45	1.06	1,539	1,450	89	1.06	3,031	2,855	176	1.06
Milk	143	560	(417)	0.26	223	1,465	(1,242)	0.15	314	3,067	(2,753)	0.10	442	6,421	(5,979)	0.07
Fish	2,156	2,094	62	1.03	4,638	4,714	(76)	0.98	8,361	8,799	(438)	0.95	15,073	16,424	(1,351)	0.92

a/: Average figures from 1981 to 1985
c/: Figures in parentheses indicate minus balance.
d/: Supply/demand ratio

Source: a/ Supplement to the President's Report to Parliament, August 15 1986, and Draft State Budget, 1986/87
b/ Food balance Sheet in Indonesia 1983, CBS
c/ Table 4.2
f/ Table 4.3

Table 4.6 Food Balance Projection to 2018 in South Kalimantan

(Unit: 1000 tons)

	Base				1998				2008				2018			
	Supply a/	Demand b/	Balance c/	S/D Ratio d/	Supply c/	Demand f/	Balance	S/D Ratio	Supply c/	Demand f/	Balance	S/D Ratio	Supply c/	Demand f/	Balance	S/D Ratio
Rice	586.2	346.2	240.0	1.69	870.7	464.7	406.0	1.87	1,066.6	578.3	488.2	1.84	1,306.5	719.4	587.2	1.82
Maize	6.5	74.5	(68.0)	0.09	10.5	108.5	(97.9)	0.10	15.2	149.8	(134.6)	0.10	22.0	206.8	(184.7)	0.11
Cassava	56.1	167.5	(111.4)	0.33	76.8	212.5	(135.7)	0.36	89.1	252.8	(163.7)	0.35	103.4	300.5	(197.1)	0.34
Sweet potato	10.5	31.7	(21.2)	0.33	22.0	39.1	(17.2)	0.56	25.6	45.9	(20.3)	0.56	29.9	53.9	(23.9)	0.56
Soybeans	2.0	11.3	(9.3)	0.18	3.0	18.0	(15.0)	0.16	3.6	26.0	(22.5)	0.14	4.4	37.7	(33.4)	0.12
Groundnuts	8.3	7.6	0.7	1.09	12.2	12.1	0.1	1.01	14.9	17.6	(2.7)	0.85	18.1	25.4	(7.4)	0.71
Coconut	30.7	25.7	5.0	1.19	49.2	36.7	12.5	1.34	64.2	48.2	16.0	1.33	83.9	63.3	20.7	1.33
Vegetables	10.7	39.3	(28.5)	0.27	19.0	70.3	(51.3)	0.27	29.6	109.8	(80.2)	0.27	46.0	171.5	(125.5)	0.27
Fruits	29.3	57.7	(28.4)	0.51	50.7	100.8	(50.1)	0.50	77.3	154.5	(77.1)	0.50	117.9	236.6	(118.7)	0.50
Meat	8.6	9.3	(0.7)	0.93	18.4	23.0	(4.5)	0.80	33.0	45.9	(13.0)	0.72	59.0	91.9	(32.9)	0.64
Eggs	14.1	4.3	9.8	3.28	21.5	10.5	11.0	2.05	29.7	20.8	9.0	1.43	41.1	41.1	0.0	1.00
Milk	0.0	7.9	(7.9)	0.00	0.0	20.9	(20.8)	0.00	0.1	43.9	(43.9)	0.00	0.1	92.4	(92.3)	0.00
Fish	96.8	29.6	67.3	3.27	208.3	67.2	141.2	3.10	375.6	126.0	249.5	2.98	677.0	236.3	440.7	2.86

a/: Average figures from 1981 to 1985
c/: Figures in parentheses indicate minus balance.
d/: Supply/demand ratio

Source: a/ Supplement to the President's Report to Parliament, August 15 1986, and Draft State Budget, 1986/87
b/ Food balance Sheet in Indonesia 1983, CBS
c/ Table 4.2
f/ Table 4.3

Table 4.7 Food Balance Projection to 2018 in the Study Area

(Unit: 1000 tons)

| | Base | | | | 1998 | | | | 2008 | | | | 2018 | | | |
	a/ Supply	b/ Demand	c/ Balance	S/D d/ Ratio	e/ Supply	Demand	f/ Balance	S/D Ratio	e/ Supply	Demand	f/ Balance	S/D Ratio	e/ Supply	Demand	f/ Balance	S/D Ratio
Rice	283.9	133.1	150.8	2.13	369.6	150.5	219.1	2.46	452.8	163.3	289.5	2.77	554.6	178.1	376.5	3.11
Maize	2.0	28.7	(26.7)	0.07	3.2	35.1	(31.9)	0.09	4.7	42.3	(37.6)	0.11	6.7	51.2	(44.5)	0.13
Cassava	12.4	64.4	(52.0)	0.19	17.0	68.8	(51.8)	0.25	19.7	71.4	(51.6)	0.28	22.9	74.4	(51.5)	0.31
Sweet potato	5.3	12.2	(6.9)	0.43	8.1	12.7	(4.6)	0.63	9.4	13.0	(3.6)	0.73	11.0	13.3	(2.4)	0.82
Soybeans	0.6	4.4	(3.8)	0.13	0.8	5.8	(5.0)	0.14	1.0	7.4	(6.3)	0.14	1.2	9.3	(8.1)	0.13
Groundnuts	3.3	2.9	0.4	1.13	4.9	3.9	1.0	1.24	5.9	5.0	1.0	1.20	7.2	6.3	0.9	1.14
Coconut	14.5	9.9	4.6	1.47	19.3	11.9	7.4	1.62	23.9	13.6	10.3	1.76	29.8	15.7	14.1	1.90
Vegetables	4.7	15.1	(10.4)	0.31	8.3	22.8	(14.4)	0.37	12.9	31.0	(18.1)	0.42	20.1	42.5	(22.3)	0.47
Fruits	9.4	22.2	(12.8)	0.42	16.3	32.6	(16.4)	0.50	24.8	43.6	(18.8)	0.57	37.9	58.6	(20.7)	0.65
Meat	4.4	3.6	0.8	1.24	9.4	7.4	2.0	1.27	16.9	13.0	3.9	1.30	30.2	22.8	7.5	1.33
Eggs	8.1	1.7	6.4	4.88	12.3	3.4	8.9	3.62	17.0	5.9	11.2	2.91	23.5	10.2	13.4	2.31
Milk	0.0	3.0	(3.0)	0.00	0.0	6.8	(6.7)	0.00	0.0	12.4	(12.4)	0.00	0.0	22.9	(22.8)	0.00
Fish	39.8	11.4	28.4	3.50	85.6	21.8	63.8	3.93	154.3	35.6	118.7	4.34	278.1	58.5	219.6	4.75

a/: Average figures from 1981 to 1985
c/: Figures in parentheses indicate minus balance.
d/: Supply/demand ratio

Source: a/: Supplement to the President's Report to Parliament, August 15 1986, and Draft State Budget, 1986/87
b/: Food balance Sheet in Indonesia 1983, CBS
e/: Table 4.2
f/: Table 4.3

Table 4.8 Projected Food Balance of Rice in Kalimantan Island to 2018

	Base			1998			2008			2018		
	a/ Popu-lation ('000)	a/ Per Capita Consump. (kg/year)	c/ Demand/ Produc. ('000tons)	a/ Popu-lation ('000)	a/ Per Capita Consump. (kg/year)	c/ Demand/ Produc. ('000tons)	a/ Popu-lation ('000)	a/ Per Capita Consump. (kg/year)	c/ Demand/ Produc. ('000tons)	a/ Popu-lation ('000)	a/ Per Capita Consump. (kg/year)	c/ Demand/ Produc. ('000tons)
Demand												
South Kalimantan	2,306	145.21	345.0	3,000	149.16	460.9	3,700	153.00	583.1	4,400	156.94	711.3
Central Kalimantan	1,140	145.21	170.5	1,831	149.16	281.2	2,220	153.00	349.9	2,694	156.94	435.4
East Kalimantan	1,538	145.21	230.0	2,613	149.16	401.4	3,169	153.00	499.4	3,844	156.94	621.4
West Kalimantan	2,815	145.21	421.0	3,726	149.16	572.4	4,520	153.00	712.3	5,483	156.94	886.2
Total	7,799		1,166.5	11,169		1,716.0	13,609		2,144.7	16,420		2,654.3
Production b/												
South Kalimantan			560.5			832.4			1,019.7			1,249.1
Central Kalimantan			148.4			220.4			270.0			330.8
East Kalimantan			103.5			153.7			188.3			230.7
West Kalimantan			413.2			613.7			751.8			920.9
Total			1,225.5			1,820.3			2,229.8			2,731.5
Balance												
South Kalimantan			215.5			371.5			436.6			537.9
Central Kalimantan			-22.1			-60.8			-79.9			-104.6
East Kalimantan			-126.5			-247.7			-311.1			-390.8
West Kalimantan			-7.9			41.3			39.5			34.7
Total			59.0			104.3			85.1			77.2

a/: Population increase rates applied are as follows:

	1985-1998	1998-2018
South Kalimantan	2.08	1.95
Central Kalimantan	3.71	1.95
East Kalimantan	4.16	1.95
West Kalimantan	2.18	1.95

b/: Base year productions are 1981-1985 averages.
c/: Population x Per capita consumption x 1.03 (rate of seed, waste, etc.)

Source: a/ Population Projection 1980-2000, Provincial Statistics Office, South Kalimantan
Final Report on the National Urban Development Strategy Project, September 1985, Directorate of City and Regional Planning,
Directorate General of Human Settlements, Dept. of Public Works, UNDP and UNCHS
b/ Statistical Yearbook of Indonesia 1986, CBS and Table 4.2
d/ Food Balance Sheet in Indonesia 1983, CBS

Table 4.9 Estimate of Development Expenditures at 1987 Constant Prices
in South Kalimantan, 1980/81 - 1987/88

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	Average 1980/81-1987/88
Development Expenditures									
- at current prices b/	84.5	95.3	116.1	106.0	109.6	112.1	73.0	78.7	96.9
- at 1987 constant prices	93.8	132.2	155.3	112.1	98.9	100.3	68.7	78.7	105.0
Implicit deflator for Gross Domestic Investment									
- 1980 = 100 a/	100	80	83	105	123	124	118	111	-
- 1987 = 100 a/	90	72	75	95	111	112	106	100	-

Note: a/; Assumed that fisical year equals calender year.

Source: a/; Estimated based on the document of the World Bank, Adjustment Growth and
Sustainable Development, 1988
b/; Table 2.18

Table 4.10 Projection of Public Investment for Agricultural Development in South Kalimantan to 2018/19

(Unit: Rp billion)

	% to be Assigned (%)	Base 1987/88	1988/89	Repelita V (1989/90 - 93/94)		Repelita VI (1994/95 - 98/99)		Repelita VII + VIII (1999/00 - 2008/09)		Repelita IX + X (2009/10 - 18/19)		Total Repelita V - X
				Total	Annual	Total	Annual	Total	Annual	Total	Annual	
Case 1												
S.Kalimantan total	100.0	105.0	105.0	705.1	141.0	1,135.6	227.1	4,774.5	477.4	12,383.8	1,238.4	18,999.1
DPUP	15.7	16.5	16.5	110.7	22.1	178.3	35.7	749.6	75.0	1,944.3	194.4	2,982.9
Sub-Dinas WRD	4.4	4.6	4.6	31.0	6.2	50.0	10.0	210.1	21.0	544.9	54.5	816.0
Agriculture	4.5	4.7	4.7	31.7	6.3	51.1	10.2	214.9	21.5	557.3	55.7	855.0
Case 2												
S.Kalimantan total	100.0	105.0	105.0	646.1	129.2	906.2	181.2	3,053.6	305.4	6,006.8	600.7	10,612.7
DPUP	15.7	16.5	16.5	101.4	20.3	142.3	28.5	479.4	47.9	943.1	94.3	1,666.2
Sub-Dinas WRD	4.4	4.6	4.6	28.4	5.7	39.9	8.0	134.4	13.4	264.3	26.4	467.0
Agriculture	4.5	4.7	4.7	29.1	5.8	40.8	8.2	137.4	13.7	270.3	27.0	477.6
Case 3												
S.Kalimantan total	100.0	105.0	105.0	609.2	121.8	777.5	155.5	2,258.8	225.9	3,679.4	367.9	7,324.9
DPUP	15.7	16.5	16.5	95.6	19.1	122.1	24.4	354.6	35.5	577.7	57.8	1,150.0
Sub-Dinas WRD	4.4	4.6	4.6	26.8	5.4	34.2	6.8	99.4	9.9	161.9	16.2	322.3
Agriculture	4.5	4.7	4.7	27.4	5.5	35.0	7.0	101.6	10.2	165.6	16.6	329.6
Case 4												
S.Kalimantan total	100.0	105.0	105.0	565.7	113.1	640.1	128.0	1,543.5	154.3	1,975.8	197.6	4,725.0
DPUP	15.7	16.5	16.5	88.8	17.8	100.5	20.1	242.3	24.2	310.2	31.0	741.8
Sub-Dinas WRD	4.4	4.6	4.6	24.9	5.0	28.2	5.6	67.9	6.8	86.9	8.7	207.9
Agriculture	4.5	4.7	4.7	25.5	5.1	28.8	5.8	69.5	6.9	88.9	8.9	212.6

Note: a/; Assumed that the public investment in 1988/89 is equal to that in 1987/88.
b/; Growth rates applied during the period from 1989/90 to 2018/19 are as follows;

Case 1 : 10.0% p.a.
Case 2 : 7.0% p.a.
Case 3 : 5.0% p.a.
Case 4 : 2.5% p.a.

Table 4.11   Projection of Public Investment for Agricultural Development in the Study Area to 2018/19

(Unit: Rp. million)

	Total a/ in South Kalimantan 1987/87	Base b/ 1987/88	1988/89	Repelita V (1989/90 - 93/94)		Repelita VI (1994/95 - 98/99)		Repelita VII + VIII (1999/00 - 2008/09)		Repelita IX + X (2009/10 - 18/19)		Total Repelita V - X
				Total	Annual	Total	Annual	Total	Annual	Total	Annual	
Case 1												
DPUP	16,485	6,347	6,347	42,622	8,524	68,643	13,729	288,594	28,859	748,539	74,854	1,148,398
Sub-Dinas WRD	4,620	2,195	2,195	14,737	2,947	23,735	4,747	99,787	9,979	258,821	25,882	397,080
Agriculture	4,725	2,244	2,244	15,072	3,014	24,274	4,855	102,055	10,205	264,704	26,470	406,105
Case 2												
DPUP	16,485	6,347	6,347	39,053	7,811	54,774	10,955	184,573	18,457	363,083	36,308	641,483
Sub-Dinas WRD	4,620	2,195	2,195	13,503	2,701	18,939	3,788	63,820	6,382	125,543	12,554	221,805
Agriculture	4,725	2,244	2,244	13,810	2,762	19,370	3,874	65,270	6,527	128,396	12,840	226,846
Case 3												
DPUP	16,485	6,347	6,347	36,823	7,365	46,997	9,399	136,534	13,653	222,399	22,240	442,753
Sub Dinas WRD	4,620	2,195	2,195	12,732	2,546	16,250	3,250	47,209	4,721	76,899	7,690	153,090
Agriculture	4,725	2,244	2,244	13,022	2,604	16,619	3,324	48,282	4,828	78,646	7,865	156,569
Case 4												
DPUP	16,485	6,347	6,347	34,194	6,839	38,688	7,738	93,296	9,330	119,426	11,943	285,604
Sub-Dinas WRD	4,620	2,195	2,195	11,823	2,365	13,377	2,675	32,259	3,226	41,294	4,129	98,753
Agriculture	4,725	2,244	2,244	12,092	2,418	13,681	2,736	32,992	3,299	42,232	4,223	100,997

Note: b/ Estimated based on the population share of the Study Area in South Kalimantan (38.5%) and the farm household share (47.5%).

Source: a/ Table 4.10

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ANNEX B
HYDROLOGY
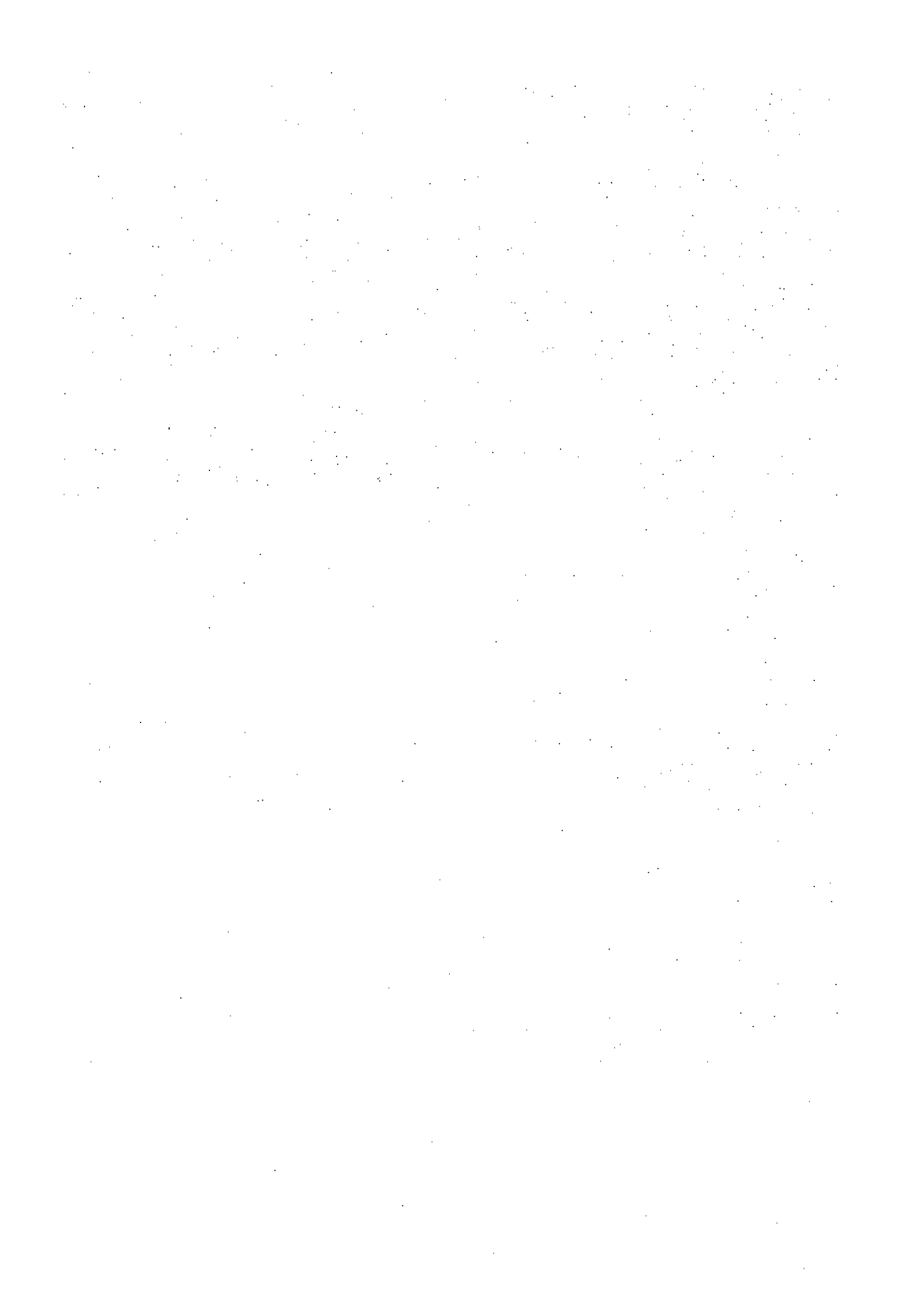
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1. INTRODUCTION

The Negara river is one of the large tributary of the Barito river system having about 11,000 km² of drainage area. This basin is geographically located between 114°45' and 115°50' of east longitude and between 1°20' and 3°10' of south latitude in the Kalimantan island and administratively located over five Kabupatens i.e. Tabalong; Hulu Sungai Utara, Hulu Sungai Tengah, Hulu Sungari Selatan and Tapin.

According to the DPU regulation, the whole Indonesia is divided into 90 river basins. The Barito river basin is one of them and further divided into seven sub-basins i.e. S. Barito, S. Kapuas, S. Murung, S. Martapura, S. Riam Kanan, S. Riam Kiwa and S. Negara.

The Negara River Basin Overall Irrigation Development Plan Study means that of almost Negara sub-basin itself which should be treated as the main individual river system instead of a tertio-system of Barito river system.

In this Study, a river system of the Negara river tertio-system is divided into seven sub-systems and further into 24 tertio-systems according to the data obtained from P3SA and taking the water level station point, confluence point, etc. into account as shown in Figure 1.1 and these sub-systems are named as follows:

River Basin	Sub-basin/System	Sub-system	Tertio-system
Barito	Negara	Tabalong Kiwa	1, 2, 3
		Tabalong Kanan	4, 5, 6
		Tabalong	7, 8, 9
		Balangan	10, 11, 12, 13, 14
		Batang Alai	16, 17, 18, 19
		Tapin	21, 22, 23
		Negara	15, 20, 24

The configuration of this Negara river system is shown in Figure 1.2.

1.1 Data

The meteoro-hydrological data observed in and around the Study Area are collected to reveal a meteoro-hydrological condition of the Study Area for assessing water resource development potential. Those data have been observed by P3SA, BPTP VIII[1], P4S[2], etc.

Most of data are obtained from P3SA. P3SA under DPUP in Banjarmasin is a principal agency to record meteoro-hydrological data in South Kalimantan. BPTP VIII have been

---

[1] BPTP VIII : Balai Proteksi Tanaman Pangan VIII - Food Crops Protection Center

[2] P4S : Proyek Pembukaan Persawahan Pasang Surut

collected meteoro-hydrological data (mainly rainfall data) in Kal Sel from a era of Holland occupation. P4S under Directorate of Sawa, have been collected water level of major river in the Kalimantan such as the Barito, the Kapuas, the Kahayan, etc. DPMA[1] has carried out hydrological analysis and prepare reports to contribute hydrological study of the country. DPMA prepared reports on various aspects, water quality, sediment analysis, river discharge, flood analysis, etc.

Following table shows the number of observatory in the Study Area by kinds of station and list of table numbers.

Station	Number	Observed by	List of Table
Meteorological Station	7	P3SA	Table 1.1
Meteorological Station	1	BPTP VIII	Table 1.1
Automatic Rainfall Recorder	19	P3SA	Table 1.2
Standard Type Rainfall Station	24	P3SA	Table 1.2
Standard Type Rainfall Station	17	BPTP VIII	Table 1.2
Automatic Water Level Recorder	25	P3SA	Table 1.3
Staff Gauge Station	17	P3SA	Table 1.3
Automatic Water Level Recorder	2	P4S	

Meteorological Data

Data of five stations out of seven meteoro stations are available for a period of 1975-1987. Observation items of each meteoro station are tabulated below.

| Observation Item | Station | | | | |
	Sei Malang	Tatakan	Juai	Batu Mandi	Pantai Hambawang
Air temperature	o	o	o	o	o
Relative humidity	o	o	o	o	o
Water temperature	o	x	o	o	x
Evaporation	o	o	o	x	x
Wind speed	o	o	o	o	o
Sunshine duration	o	o	o	x	x
Rainfall	o	o	o	o	o

Figure 1.3 shows the availability of those meteoro data of each station. Location of these stations are shown in Figure 1.4.

1/ DPMA : Directorat Penyelidikan Masalah Air

Rainfall

The daily rainfall data are collected at all P3SA's standard type stations and 18 out of 19 P3SA's ARR type stations in the Study Area. Monthly rainfall data are collected at 17 BPTP's stations in the Study Area. In addition to above data, long-term monthly rainfall records are collected at 19 BMG's stations in the Negara and Barito river basins. In the Study Area, nine stations have been operated by two agencies i.e. BPTP and BMG[1] mutually. There are 72 rainfall stations in the Study Area in total including 7 meteoro stations.

The data periods of daily and monthly rainfall are shown in Figures 1.5 and 1.6. Figure 1.4 shows location of rainfall stations of P3SA and BPTP. Figure 1.7 shows location of BMG's rainfall stations.

Water Level

All available staff gauge records at 17 stations are collected in daily base. Daily records of 17 stations out of 25 AWLR stations are also collected. The processing work (reading original chart) have not been carried out yet by P3SA for remaining eight AWLR stations.

The data periods of daily water level and location are shown in Figure 1.8 and 1.9 respectively. In addition to above P3SA's records, water level records on the Barito river measured by P4S are also collected at two stations. Location of these two P4S's stations are also shown in Figure 1.9 by the name of BAR.

Flow Measurement

Flow measurement works have been carried out by P3SA with assistance of DPMA since 1976 at 19 AWLR stations. No flow measurement works have been done at staff gauging stations. From these measurement records, rating table or curve were prepared by DPMA at eight stations, i.e. station Nos. 5, 6, 7, 11, 12, 14, 15 and 16 of AWLR stations.

Sediment Load Measurement

Sediment load measurement records are collected at 17 locations in the Negara river tertio-system. These measurings were carried out by P3SA/DPMA during the 1979-1984 period. Figure 1.10 shows location of these samplings.

Water Quality

Water quality data measured in 1985-1986 are collected at 53 locations. Figure 1.11 shows location of these observation points. Salinity condition of the Barito river are also obtained from P3SA.

1/   BMG   :   Badan Meteorologi dan Geofisika

2. CLIMATE

2.1 Climate Feature

The climate in the Study Area is characterized by typical tropical monsoon climate. The northwest monsoon gives heavy rainfall to the Study Area from November to April (wet season). Dry months occur between May and October by influence of southeast monsoon (dry season).

Rainfall

The isohyetal map of the Study Area is developed as shown in Figure 2.1 based on the long-term rainfall records. Average annual rainfall of about 60 stations in the Study Area varies from 2,000 to 2,500 mm. Table 2.1 shows average monthly rainfall and the monthly rainfall pattern of some gauging stations are shown below:
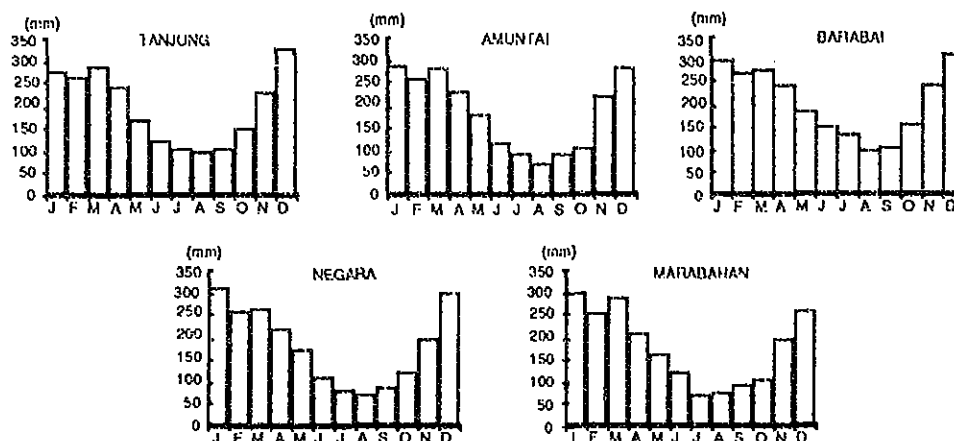
The maximum annual rainfall of 4,504 mm was observed at Amuntai in 1956 and the minimum of 437 mm was observed at also Amuntai in 1982. The maximum daily rainfall of 600 mm was recorded at Kandangan in April 1919.

Temperature

Annual mean temperature observed at four meteoro stations varies from 25.9°C to 27.8°C. However, Batumandi station records rather low annual mean temperature of 20°C.

Seasonal variation is very little raging 1.1°C to 3.2°C. Table 2.2 shows mean monthly temperature for six meteoro station in the Study Area.
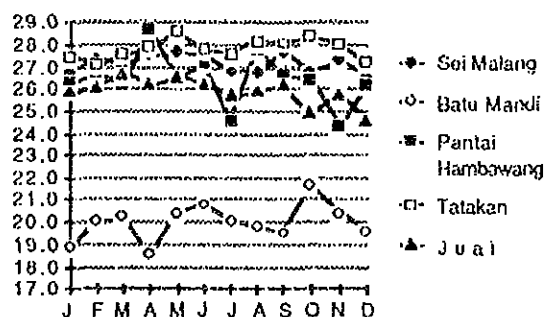
Relative Humidity

In the Study Area, high humidity values have been observed. Maximum mean monthly humidity of 99% was observed at Juai station in 1983, 1984, 1985 and 1986. Annual humidity varies from 77% to 92% in the Study Area as shown in Table 2.3.

- ◆- Sol Malang
- ○- Batu Mandi
- ■- Pantai Hambawang
- □- Tatakan
- ▲- Juai
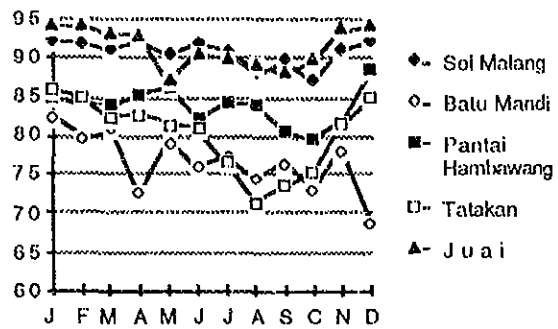
Evaporation

Four stations have observed daily evaporation by A-pan. Observation period of the Batumandi station is only 4 months and other three station have 7 to 13 years observation period.
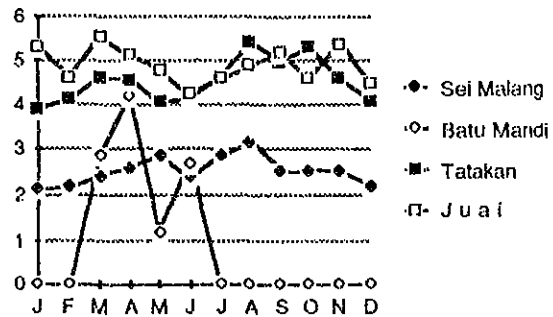
The annual mean daily evaporation is 2.5 mm at Sei Malang, 4.5 mm at Tatakan and 4.9 mm at Juai as shown in Table 2.4.

- ◆- Sei Malang
- ○- Batu Mandi
- ■- Tatakan
- □- Juai

Wind Speed

The maximum mean daily wind speed of 140 km/day was observed at Tatakan station in 1976 and the minimum of 1 km/day was observed at Sei Malang in 1983 as shown in Table 2.5. Annual wind speed varies from 20 km/day to 69 km/day.

- ◆- Sei Malang
- ○- Batu Mandi
- ■- Tatakan
- □- Juai
- ▲- Pantai Hambawang
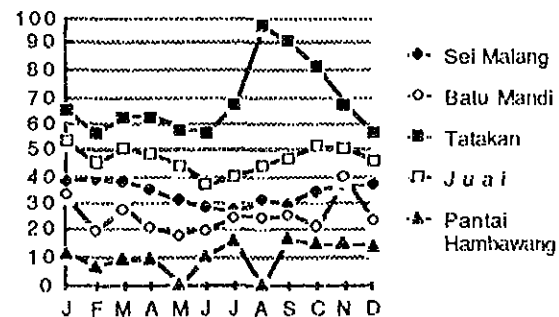
Sunshine Duration

The longest mean daily sunshine of 73% was observed at Tatakan in August 1981. The annual average daily duration is about 40% in the Study Area as shown in Table 2.6.

- ◆- Sei Malang
- ○- Tatakan
- ■- Juai
- □- Pantai Hambawang
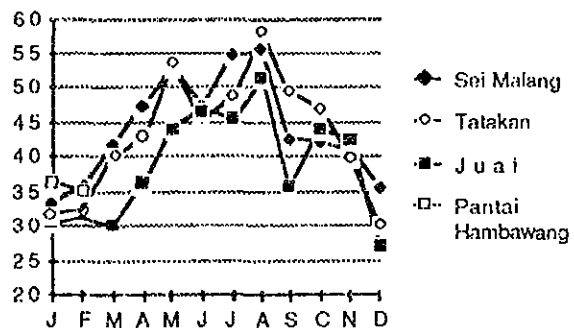
2.2 Agroclimate

For determining the agroclimatic suitability for specific crops in a specific area, the Central Research Institute of Agriculture has prepared a series of agroclimatic maps covering the whole Indonesia. A classification system in this map is made taking the length of the wet and dry seasons into account. Namely, five main agroclimatic zones are defined according to the length of the wet season as shown below:

Zone A   :   More than nine consecutive wet months. Wetland paddy can be cultivated at any time of the year.

Zone B   :   Seven to nine consecutive wet months. Wetland paddy can be cultivated twice during this period.

Zone C   :   Five to six consecutive wet months. Wetland paddy can be cultivated twice if the first crop is planted or sown as dry land crop so-called geogovancal system.

Zone D   :   Three to four consecutive wet months. Single cropping of wetland paddy is generally possible.

Zone E   :   Less than three consecutive wet months. Without additional water supply by means of irrigation, wetland paddy is not recommended.

These classes are then subdivided based on the length of the dry season:

Sub 1   :   Less than two dry months. No restrictions are expected with regard to available water.

Sub 2   :   Two to three dry months. Careful planning is needed to grow crops throughout the year.

Sub 3   :   Four to six dry months. A fallow period is part of the rotation system because of water constrains.

Sub 4   :   Seven to nine dry months. Only one crop can successfully be cultivated. The remainder of the year is too dry to grow crop.

Sub 5   :   More than nine consecutive dry months. Area in this sub-zone is generally not suitable for any cultivation of arable crops.

According to this agroclimatic maps, the Study Area is almost classified into Zone C2 and the remaining part falls into Zone B1 or Zone B2 as illustrated in Figure 2.2.

Zone B1 : Covers 10% of the Study Area. It is found in northern part along the Tabalong Kiwa river.

Zone B2 : Covers about 20% of the Area located north east part of a mountain range.

Zone C2 : Covers around 70% of the Area. This largest zone include whole swamp area and hilly area.

3. RUNOFF ANALYSIS

Runoff analysis is carried out in order to estimate the available river runoff to formulate water resources development plan in the Study Area. Since the period of water level records is insufficient to estimate the probable low flow in the Study Area, the long-term runoff is estimated by applying the Tank Model using long-term rainfall records.

3.1 Data

Available runoff records in the Study Area are at 14 stations out of 25 AWLR stations. Observation period, however, is less than 10 years and records are fragmentary, as shown in Figure 1.8.

These data has not sufficient period to analyze available water for irrigation and others. On the other hand, rainfall records are available for more than 30 years which is deemed to be sufficient for runoff analysis. Then the long-term rainfall records are converted into river runoff by applying runoff simulation model of the Tank Model.

3.1.1 River discharge

Actual river runoff at each gauging station is estimated from water level record by applying rating curve or table which is developed from flow measurement records. DPMA has been prepared rating tables for eight gauging stations i.e. station Nos. 5, 6, 7, 11, 12, 14, 15 and 16. For other 11 stations, rating curves are developed from discharge measurement record carried out by P3SA and DPMA between 1977 and 1986 assuming quadratic equation as shown below:

$$Q = a + b \cdot H + c \cdot H^2$$

where, Q : discharge (m³/sec)
H : water level (m)
a, b, c : constants

Constants of a, b and c are determined by the least square method and results are shown below:

AWLR No.	a	b	c
8	6.395636	5.488947	8.840321
9	8.502542	-42.2817	90.05121
10	4.212764	-12.4780	11.90380
13	-1.04678	17.11630	5.011358
17	1.521097	8.722833	3.067875
22	3.069318	-10.6529	27.53924
23	-8.77501	18.47191	4.446618
25	-5.26967	18.04355	7.480720
28	2.789382	-10.7459	22.36904
30	8.603701	4.860289	5.650989
31	-2.37825	16.99812	1.015292

Table 3.1 shows estimated monthly river mean runoff at 14 stations using water level record and developed rating curve or rating table and summarized below:

(Unit: m³)

AWLR Station No.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
5	23.9	21.2	17.7	23.9	14.1	9.5	8.3	3.9	3.4	4.4	7.9	14.6	12.6
6	14.7	15.6	14.0	18.8	12.1	9.3	5.7	4.2	3.0	2.6	4.8	13.8	9.9
7	40.3	41.2	37.8	39.7	36.4	29.4	18.0	12.8	10.7	12.2	19.8	36.1	27.9
8	46.7	36.4	33.3	36.2	32.4	23.9	15.6	10.2	10.0	9.8	18.9	34.8	25.7
9	21.9	22.5	22.9	26.5	21.1	16.4	11.5	9.0	7.5	6.7	12.2	19.9	16.5
10	7.8	5.6	4.1	4.8	4.3	4.1	3.1	2.5	2.5	2.2	4.8	9.0	4.6
11	17.7	9.7	9.7	12.9	8.9	8.1	6.7	4.5	4.2	4.5	9.4	15.8	9.3
12	231.3	222.5	194.8	194.9	163.5	128.5	89.8	53.8	34.8	37.0	92.1	186.6	135.8
13	84.8	64.3	82.3	65.6	51.5	37.1	32.2	13.9	10.9	11.6	35.1	54.2	45.3
14	-	194.1	154.3	161.5	106.4	80.0	71.0	41.6	27.0	18.3	46.9	110.3	-
15	135.5	74.7	33.1	199.6	126.8	122.6	24.0	24.3	11.6	9.7	18.5	116.2	74.7
16	6.7	7.3	8.0	7.7	5.7	5.7	4.3	1.9	2.2	1.6	2.7	6.1	5.0
17	88.2	81.1	75.2	73.7	61.1	38.8	28.5	19.3	13.6	20.4	41.7	68.6	50.9
26	26.0	24.0	24.0	23.1	20.6	15.2	10.2	5.4	6.1	5.7	11.9	19.8	16.0

Eleven AWLR stations out of 25 total stations do not have neither water level records nor rating curve or table, then the runoff at gauging station is estimated above 14 stations.

3.1.2 Rainfall

As mentioned Section 1.1, monthly rainfall records are available at 72 stations for a period of 2 to 62 years.

3.2 Methodology

The Tank Model simulation is applied to convert rainfall data to runoff discharge. The procedure is 1) to determine Model coefficients at the selected gauging station by trial and error, and 2) to simulate long-term monthly runoff in the each basin by applying long-term monthly rainfall.

As shown in Figure 1.1, the Negara river system is divided into seven sub-systems. The Models are constructed at gauging stations selected from sub-systems if they have sufficient period of both runoff and rainfall data to determine the Model coefficients.

The long-term runoff is estimated in each basin by applying constructed Model and long-term monthly rainfall.

3.3 Tank Model

The Tank Model assumes that a sub-system is analogous to vertical stacks of horizontal soil layers, usually having four layers (tanks) as shown in Figure 3.1.

Top tank represents the ground surface and the outflow from the top tank gives the surface runoff. The second tank outflow shows intermediate runoff. The third and fourth tanks show the ground water layer and give baseflow discharge.

Runoff of Q is calculated by following formula:

$$Q = \sum_{i=1}^{4} qi = \sum_{i=1}^{4} \{(Ri+Hi-hi).fi - (Ri+Hi).bi - Ei\}$$

where, Q : total runoff
    qi : outflow from a tank
    Ri : rainfall or inflow from upper tank
    Hi : water depth in a tank
    hi : height of orifice
    fi : coefficient of outflow (qi) calculation
    bi : coefficient of infiltration (Ri) calculation
    Ei : evaporation
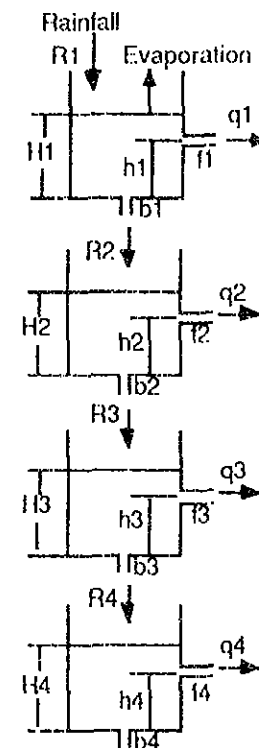
Fig. 3.1 Tank Model

The parameters of each tank are determined by trial and error method.

3.4 Simulation

3.4.1 Construction of Tank Model

As mentioned in Section 3.2, seven Tank Models are constructed in order to simulate long-term runoffs in each seven sub-systems.

<u>Selection of gauging station</u>

Runoff gauging stations and long-term rainfall stations are located in seven basins as below and shown in Figures 1.7 and 1.9.

Sub-system	Runoff Gauging Station in AWLR No.	Rainfall Station in No.
Tabalong Kiri	-	-
Tabalong Kanan	16	299, 300
Tabalong	12, 15, 17	301, 306
Balangan	13, 14, 26	302a, 303a
Batang Alal	9, 10, 11	305, 305a
Tapin	5, 6, 7, 8	306
Negara	-	303, 306a, 305b

From the above 14 runoff gauging stations, four stations are selected for the reason of 1) long observation period with less missing, 2) enough drainage area (200-1,000 km^2), 3) located on the upstream of diversion point and 4) reliable records. Selected stations are Nos. 5, 7, 9 and 26. Stations of Nos. 5 and 7 are located in Tapin sub-system. Then only three sub-systems i.e. Tapin, Balangan and Batang Alai can develop the Tank Model. These three Models will be applied to other sub-systems.

Six rainfall stations are selected by considering observation period and location. Selected stations are Nos. 299, 301, 303a, 305, 305b and 306.

<u>Determination of Parameters</u>

Parameters of each Tank Model are determined by trial and error calculations using selected runoff and rainfall data. In this calculation following assumption is applied.

Aerial rainfall	=	f_R x point rainfall
Aerial evaporation	=	f_E x pan evaporation

f_R is the ratio of aerial rainfall to the selected point rainfall station. An aerial rainfall is derived from arithmetic average of rainfall stations in the Study Area. Each f_R is estimated in each sub-systems as shown below:

Rainfall Station	299	301	303a	305	303	306
f_R	0.90	1.00	0.84	0.93	0.99	1.09

The pan evaporation record of Tatakan station is adopted and f_E is assumed to be 0.7. Aerial evaporation is then calculated as given below in monthly base.

(Unit: mm)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
85	80	100	97	89	88	100	59	53	115	100	89

Trial and error calculations are carried out to minimize the average error of low flows (dry season's runoff). After some calculations, the parameters of each Model are determined as follows:
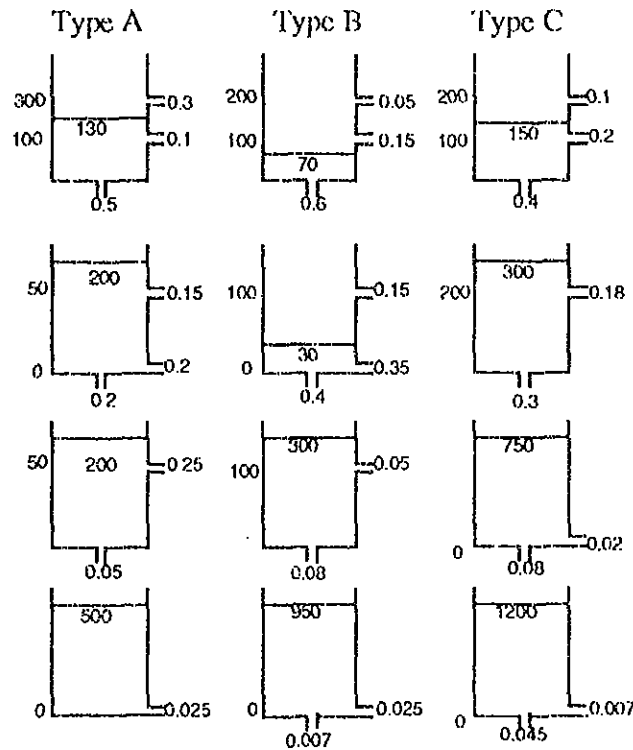
Figure 3.2   Results of Tank Model Parameters

Above three Tank Models are applied to other four sub-systems to simulate long-term runoff in each sub-system. Adopted Model to each sub-system is given below:

Sub-system	Tabalong Kiri	Tabalong Kanan	Tabalong	Balangan	Batang Alai	Tapin	Negara
Model	A	A	C	B	A	C	C

3.4.2 Simulation of basin runoff

Long-term monthly runoff for a period of 62 years are simulated by applying the afore-mentioned Tank Model for each sub-system. In this simulation, long-term monthly rainfalls are synthesized from observed rainfall records.

Synthetic monthly rainfall

As seen in Figure 1.6, all rainfall stations have fragmentary records. To compensate for missing data, neighboring station's data are borrowed and synthesized 62 years monthly rainfall at six selected stations as shown in Tables 3.2 to 3.7. The reliability of these monthly data can be examined by the double mass curve method as shown in Figure 3.3. From Figure 3.3, these synthetic monthly rainfall data are good for runoff analysis.

Simulation results

Simulated monthly runoff for each sub-system is shown in Tables 3.8 to 3.14 and following table shows monthly mean runoffs for seven sub-system.

(Unit m³/sec)

Sub-system	Monthly Mean Runoff												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tabalong Kiwa	74	70	71	61	50	37	32	28	26	28	41	68	586
Tabalong Kanan	60	57	57	49	40	30	26	23	21	23	33	54	473
Tabalong	54	54	56	49	36	26	20	17	17	19	30	52	433
Balangan	94	92	78	61	58	54	44	36	35	36	57	85	732
Batang Alai	86	90	90	84	72	57	47	37	30	30	44	72	740
Tapin	84	80	90	71	54	37	25	19	18	22	34	62	596
Negara	64	66	70	59	46	31	22	18	17	17	26	47	484

Low monthly flows occurring once in five years are also estimated from simulation results applying the Type III extremal distribution (Gumbel) as shown below:

(Unit m³/sec)

Sub-system	80% Probable Monthly Mean Runoff												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tabalaong Kiwa	58	56	56	48	39	29	25	22	20	22	33	53	462
Tabalong Kanan	47	45	45	39	32	24	20	18	16	18	26	43	373
Tabalong	41	40	42	37	27	20	15	13	13	14	22	39	324
Balangan	76	75	63	49	47	43	36	29	29	29	46	69	591
Batang Alai	66	69	69	64	55	44	36	28	23	23	34	55	565
Tapin	57	54	61	48	36	25	17	13	12	15	23	42	403
Negara	43	44	47	40	31	21	15	12	11	11	17	32	324

4. WATER BALANCE IN 2018

Water demand and supply balance projection is carried out to find areas which will be in short supply of water and those which will be in surplus with water in the future. Results of water balance study are presented in this chapter.

4.1 Water Demand Projection

Water demands are projected for population, livestock, industry and irrigation for each tertio-system.

4.1.1 Domestic water demand

Water demand for domestic use for each tertio-system in 2018 is estimated by multiplying projected population by per capita water consumption rate.

Population of tertio-system

Population of each tertio-system is estimated from projected population of Kecamatan (See Annex A Socio Economy) according to area percent of tertio-system in each Kecamatan as shown in Table 4.1.

Demand projection

According to the Guidelines for Integrated Urban Infrastructure Development Program, the water supply target for the future is set up for different size of city as follows:

City Size Category			Water Supply Targets (lit/capita/day)
	>	1,000,000	120
500,000	-	1,000,000	100
100,000	-	500,000	90
20,000	-	100,000	60
3,000	-	20,000 (IKK level)	45
	<	3,000 (IKK level)	30

In this Study, water supply facilities should be IKK (Ibu Kota Kecamatan) level in 2018 for the whole area and then water consumption rate of 45 liters per capita per day is applied for projection of domestic water demand. The projected domestic water demand by each tertio-system is shown in Table 4.2. Public water demands such as schools, hospitals, etc. are assumed to be included in this domestic water demand.

4.1.2 Livestock water demand

A livestock population in 2018 is estimated from human population in 2018. Namely per capita live stock population in 1985 assumed to be same value in 2018. Table 4.3 shows livestock population and average livestock water consumption in each Kabupaten. A water consumption rate of livestock unit per day is assumed as follows by refering to Ref. B-27:

Livestock	Water Consumption (liters/day)
Cattle/Buffalo	40
Sheep/Goat	5
Pig	6
Poultry	0.3

The projected livestock water demand by tertio-system is estimated by multiplying a water consumption rate by livestock population per person and human population in each tertio-system. The projected livestock water demand is shown in Table 4.2.

4.1.3 Industrial water demand

In this Study Area, rubber factory is biggest water consumer among other factories. Then the industrial water demands are assumed to be the water consumption by rubber factories with some allowance. Since the no rubber processing projects are planned, present total processing capacity is applied to 2018's total capacity.

A water consumption rate is assumed to be 18 m^3/ton[1] per one ton of processed rubber. Table 4.4 shows present processing factory in the Study Area and Table 4.2 shows estimated water demand by tertio-system with 20% allowance for other factories.

4.1.4 Irrigation water demand

Water demands for irrigation in 2018 are estimated based on the results of irrigation study in Annex F. Development areas for irrigation are identified in that study as follows:

1/   Ref. B-28

		(ha)
Tertio-system No.	Wet Season	Dry Season
5	1,169	484
6	836	773
7	643	643
9	1,004	1,004
10	2,172	2,172
11	188	188
12	4,757	5,388
14	677	647
16	7,229	8,042
17	6,632	5,817
18	2,059	691
21	7,221	5,449
22	6,610	3,977
23	1,227	454
24	1,874	714
Total	44,296	36,443

Water requirements are adopted from that study as follows:

					(lit./sec/ha)	(m³/ha)
	May	Jun	Jul	Aug	Sep	Total
Dry Season	0.28	0.63	0.83	0.86	0.35	7,805
	Nov	Dec	Jan	Feb	Mar	Total
Wet Season	0.20	0.38	0.41	0.17	0.22	3,606

Applying these water requirements to each tertio-system, estimated irrigation water demands in each tertio-system are shown in Table 4.5.

4.2 Water Balance

Water balance is computed from an upstream tertio-system to a downstream by following a river configuration as shown in Figure 1.2 with following formula:

$$Q_{out} = Q_{in} + Q_{run} - Q_d$$

where,
Q_{out} : outflow to a downstream tertio-system
Q_{in} : inflow from an upstream tertio-system
Q_{run} : runoff within the tertio-system
Q_d : water demand in the tertio-system

As Q_{run}, annual runoff volumes which may occur once in 5 years (80% dependability) are used, as estimated in Section 3.4.2. Computed results are shown in Table 4.6.

4.2.1 Water utilization ratio

To evaluate water balance calculation, the terms of water utilization ratio is introduced. This ratio is calculated by following formula:

$$f_R = \frac{Q_t}{Q_{in} + Q_{run}} \quad (\%)$$

From Table 4.6, f_R is calculated and shown in Table 4.7 and graphed in Figure 4.1. As seen in Figure 4.1, tertio-system No. 21 has about 96% utilization ratio, followed by 91% of No. 16, 81% of No. 22, 67% of No. 12 and so on.

This figure imply, those high utilization ratio area have less potential for water resources development in 2018 and other tertio-system still have enough potential in 2018 even after developing all proposed water resource development project in the Study Area.

5. FLOOD FLOW ANALYSIS

Flood flow analysis is carried out to get the probable flood flow in a tertio-system for designing hydraulic structure such as diversion weir, spillway, protection bank, etc. and to grasp flood phenomenon in the Study Area.

5.1 Methodology

Flood flow analysis is made by applying mathematical flood runoff simulation model of storage function model. This simulation model requires some geophysical parameters and hyetograph. Geophysical parameters such as river length, catchment area and river course slope are obtained from 1/50,000 scale topo-map. Hyetograph is estimated through frequency analysis and depth-area-duration analysis. Probable rainfall is estimated from daily maximum rainfall by frequency analysis and this estimated probable daily rainfall is converted to hourly rainfall for synthesis the hyetograph by depth-area-duration analysis.

5.2 Rainfall Analysis

The purpose of this analysis is to estimate the probable areal rainfall and its hourly distribution for each basin. This probable areal rainfall is used to estimate the probable flood flow.

5.2.1 Frequency analysis

The probable rainfall is calculated by using daily maximum rainfall record in the basin as shown in Table 5.1. The frequency analysis is performed by the Gumbel method for the each rainfall station. The results of this analysis is shown below:

Return Period	Station											
	299	300	301	302	302a	303	303a	305	305a	305b	306	306a
1000	236	321	301	250	190	302	533	230	625	380	381	276
500	221	298	280	234	180	280	489	217	571	350	353	257
200	201	269	253	213	167	252	432	199	500	310	316	232
100	187	246	232	198	158	231	388	186	446	280	288	213
50	172	224	211	182	148	209	344	172	392	249	260	194
10	136	170	161	144	125	159	240	140	263	177	193	148

5.2.2 Depth-Area analysis

The probable basin rainfall is estimated from point rainfall and ratio of point rainfall to basin rainfall. The basin rainfall is derived from arithmetic average of above 12 stations while the maximum rainfall among these stations is taken as a point rainfall. Figure 5.1 shows the relation between point rainfall and the basin rainfall. From this Figure 5.1, the ratio of 0.7 is obtained as a conversion factor from point rainfall to basin rainfall.
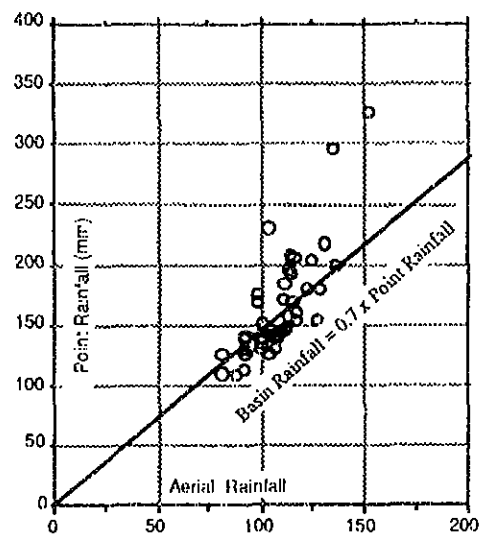
Figure 5.1 Point Rainfall and Aerial Rainfall

5.2.3 Probable aerial rainfall

The probable rainfall for seven sub-systems are estimated by average of probable point rainfall in the each sub-system. Then the probable aerial rainfall in the each system is estimated at follows:

(Unit: mm)

Return Period	Tabalong Kiwa	Tabalong Kanan	Tabalong	Balangan	Batang Alai	Tapin	Negara
1000	165	165	203	253	299	267	242
500	155	155	189	234	276	247	224
200	141	141	171	210	245	221	200
100	131	131	158	191	221	201	182
50	120	120	144	172	197	182	164
10	95	95	111	128	141	136	121

5.2.4 Depth-duration analysis

Depth-duration analysis is made to determine the hourly distribution pattern of storm rainfall. Storm rainfalls of which daily total is more than 100 mm are selected for this analysis from 18 automatic rain gauge stations.

Table 5.2 shows selected rainfall data and Figure 5.2 shows those recorded rainfall pattern. Relation between rainfall depth and time of selected rainfall is shown in Figure 5.3. As seen in Figure 5.2, all the storm rain in this Study Area has a duration of less than 24 hours. Then, the duration of probable rainfall is assumed to be 24 hours considering magnitude of probable rainfall.

The depth duration relation can be expressed by following empirical formula so called Monomobe's formula.

$$Rt = R_{24}/24 \times (24/t)^n$$

where, Rt : rainfall intention during
t hours (mm/h)

R_{24} : 24-hour rainfall (mm)

t : time (hours)

n : constant
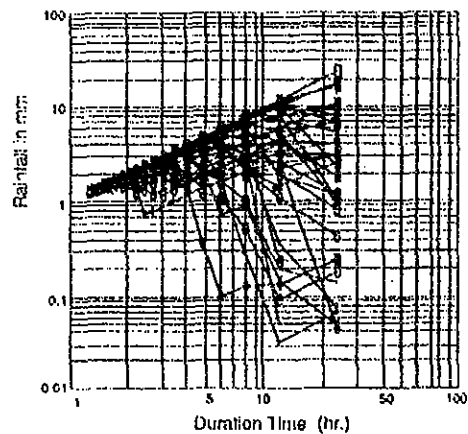
Figure 5.3   Rainfall Depth-duration

Constant of n is determined from observed hourly record by employing the least square method and 0.4 is obtained for the constant of n. Then the applied depth duration curve is:

$$Rt = R_{24}/24 \times (24/t)^{0.4}$$

The hourly rainfall distribution is estimated from above depth duration curve and assumed to be center-concentrated pattern as shown in Figure 5.4. The hyetograph for the estimation of probable flood is then derived by multiplying the above distribution pattern to the probable areal rainfall estimated in Section 5.2.3.
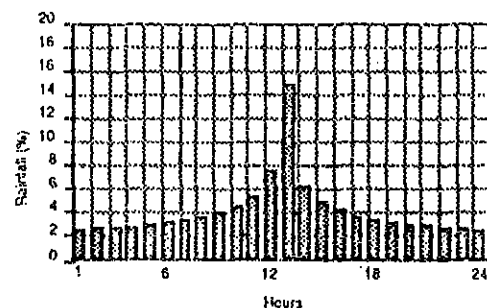
Figure 5.4   Hourly Distribution

5.3   Flood Analysis

Flood analysis is made by flood simulation model of storage function model to estimate the flood runoff from the rainfall by using storage function. The flood runoff in the basin is estimated in the each tertio-system and flood flow along the Negara river.

5.3.1 Storage function model

Flood runoffs are determined from the rainfall by solving the following two basic equations simultaneously.

Storage equation : $S = K \cdot Q^P$ .... (5.1)

Continuity equation : $\dfrac{dS}{dt} = \dfrac{1}{3.6} \cdot f \cdot r \cdot A - Q$

(for the drainage area) .... (5.2.1)

$\dfrac{dS}{dt} = \Sigma \cdot f \cdot I - Q$ (for the channel) .... (5.2.2)

where,
- S : storage in a basin or a channel
- $Q(t) = Q(t+T)$: runoff from a basin or a channel with lag time T
- f : runoff coefficient
- r : aerial rainfall
- A : aerial area
- I : inflow to this channel

5.3.2 Flood from tertio-system

The basic equation of the storage function method can be rewritten as follows considering that 1) the runoff consists of flood and base flows, that 2) the drainage area is divided into the infiltration and primary areas, that 3) in the infiltration area, the rainfall is infiltrated up to saturation point (R_{SA}) after that all rainfall becomes runoff. The rainfall volume from the beginning to saturation point is called the saturation rainfall (Rsa), and that 4), in the primary area, all rainfall changes to runoff, and a ratio of primary and drainage areas is called the primary runoff coefficient (f_1).

$$Ss = Kq_s^P$$

$$\frac{Ss}{dt} = r - qs$$

$$Q = \frac{1}{3.6} f_1 \cdot A \cdot qs + \frac{1}{3.6}(1 - f_1) A \cdot q_{sac} + Q_i$$

where,
- S : storage (mm)
- qe : runoff (mm/hr)
- r : rainfall (mm/hr)
- Q : runoff (m³/sec)
- f_1 : primary runoff coefficient
- A : basin area (km²)
- q_{sac} : runoff after saturation of rainfall (Rsa)
- Q_i : base flow
- K, P : coefficient

f₁ & Rsa :

Primary runoff coefficient (f_1) and saturated rainfall (Rsa) are estimated based on the observed discharge and corresponding rainfall records. Figure 5.5 shows the relationship between runoff and rainfall. From this Figure 5.5 f_1 = 0.4 and Rsa = 110 mm are obtained. These two figures are applied to all sub-systems.
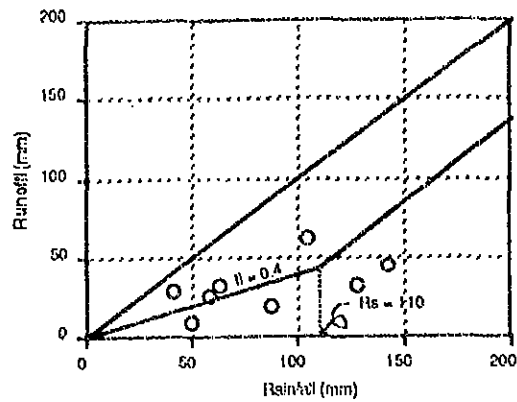
Figure 5.5 Primary Runoff Coefficient and Saturated Rainfall

Qi :

The baseflow (Q_i) is estimated lowest mean monthly runoff in the dry season, which represents the baseflow during the wet season. The Q_i is estimated from estimated long-term lowflow and basin area as the specific discharge of 0.02 m³/sec/km² as shown in Figure 5.6.
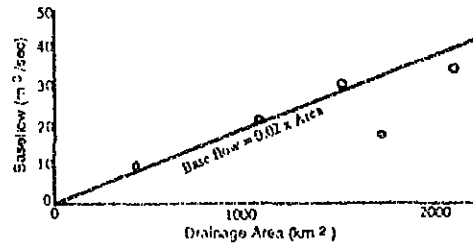
Figure 5.6 Base Flow and Drainage Area

K, P & T :

The coefficient of K, P and lag time T are estimated by the following formulas:

$$K = a \cdot 119 \times i^{0.3}$$
$$P = b \cdot 0.175 \times i^{(-0.235)}$$
$$T = c \cdot 0.047 \times L - 0.56$$

where,   i :   riverbed slope
          L :   river length (km)
     a, b, c : constant
        K, P : coefficient for a function
          T :   lag time (hr)

Those constants of a, b and c can be determined through trial and error by comparison of observed storage function and estimated storage function. However, empirical values of a=1, b=1 and c=1 are applied without trial and error calibration since no reliable data for verification this model are available. Table 5.3 shows the estimated K, P, T and Qi for each tertio-system.

<u>Calculation results</u> :

The estimated probable flood runoff in the each tertio-system are calculated by using above storage function model and probable areal rainfall as shown in Table 5.4.

5.3.3 Flood along the Negara river

The basic equations of 5.1 and 5.2.2 may be written.

$$S_C = KQ^P - T \cdot Q$$

$$\frac{dSc}{dt} = I - Q$$

$$Q(t) = Q(t + T)$$

where, S_C : channel storage (m^3)
$\quad\quad$ Q : outflow from the channel (m^3/sec)
$\quad\quad$ T : lag time (hr)
$\quad\quad$ I : inflow to the channel (m^3/sec)
$\quad$ K, P : coefficients

The values of K, P and lag time are estimated by following empirical formulas:

$$K = 0.309 \cdot L \cdot B^{0.4} \cdot i^{0.3} \cdot n$$
$$P = 0.6$$
$$T = 0.000736 \cdot L \cdot i^{(-0.5)}$$

where, $\quad$ L : river length (km)
$\quad\quad$ B : river width (m)
$\quad\quad$ i : river bed slope
$\quad\quad$ n : Manning's roughness coefficient

<u>River system model</u>

To estimate the flood runoff at the end point of the Negara (Marabahan), a river system model is prepared as shown in Figure 5.7 taking the following condition into account.

1) A probable storm falls in upper basin of Tabalong Kiri and Tabalong Kanan which has bigger basin area and longer river length.

2) Runoff from other basins are neglect, since the storm infrequently falls in whole basin.

3) Flood runoff at Tanjung, Amuntai, Negara and Margasari are also calculated.

K and T

The coefficients of K and lag time (T) are calculated based on the aforementioned formula and topographic information obtained from topographic maps and surveyed cross sections along the Negara river. Following table shows calculated K and T.

River Channel Number	Length (km)	Slope (1/n)	width (m)	n	K	TL
1	48	1600	60	0.025	76.28	1.413
2	35	1400	60	0.025	53.43	0.964
3	14	2700	60	0.025	26.03	0.535
4	29	2900	60	0.025	55.08	1.149
5	41	8200	60	0.025	106.38	2.733
6	38	12600	100	0.025	137.58	3.139
7	54	18000	120	0.025	234.05	5.332
8	32	32000	160	0.025	184.92	4.213

Calculation results

The estimated probable flood runoffs along the Negara river are calculated as shown in Table 5.5 and summarized below:

Calculation Point	Probable Flood Peak Discharge Return Period (years)				
	500	200	100	50	10
Amuntai	2,620	2,210	1,890	1,520	1,160
Negara	2,610	2,200	1,870	1,470	1,100
Margasari	2,580	2,110	1,750	1,310	900
Marabahan	2,490	1,980	1,600	1,190	800

Figure 5.8 shows the probable flood hydrograph of 100 year at each calculation point.

6. INUNDATION ANALYSIS

About one third of the Study Area is swampy area which lies lower Negara river sub-basin and along the Barito river . In wet season, this swampy area is flooded with the river water of the Barito and the Negara. This analysis is performed to seek a countermeasure for inundation by applying mathematical simulation model.

6.1 Methodology

The stagnant water in the swamp area (inside water) can be drained by gravity, if a river water (outside water) level is lower than an inside water level. However, river water stages fluctuate hour by hour due to tidal effects of the Barito and the Negara rivers. Taking this condition into account, the inundation condition in the Study Area is estimated by mathematical simulation model. In this Study, the simulation is performed for a month in the wet season of the year which represents hydrological phenomena with 80% probability. Using this model, proposed countermeasure against inundation water are verified by comparing the present condition.

6.2 Simulation Model

In this simulation, the area is converted into the model consisting of basin, field and river tanks as shown in Figure 6.1. In this model, the Barito river basin is divided into 16 river/basin tanks and six field/swamp tanks and the Negara river into 11 river/basin tanks and three field/swamp tanks.

The hydraulic calculation is performed to determine the water level and discharge applying flow formula of varied (non uniform) flow and overflow formula of submerged or free overflow. Detailed explanation of this simulation model is presented in Appendix.

6.3 Condition of Simulation

Considering the balance of inflow water and outflow water in the basin, following expression may be written.

$$S = R - E \pm Q$$

where, S : storage volume in the field/swamp
R : rainfall
E : evaporation
-Q : outflow from the field/swamp to the river
+Q : inflow from the river to the field/swamp

Rainfall

From frequency analysis of annual mean rainfall of 11 stations in the Study Area, 80% dependable annual rainfall of 2,900 mm is obtained (Figure 6.2). As seen in Figure 6.2, year of 1934 has almost 80% probable annual rainfall. Accordingly, year of 1934 is selected as model analysis year. Rainfall of each basin/field to be 1934's record of each corresponding rainfall station.

Evaporation

Daily evaporation record of Tatakan station is applied to this simulation.

Inflow and outflow

Inflow and outflow discharge is calculated by flow formula for over a broad-crested weir. Detailed explanation of overflow formula is shown in Appendix, Chapter 2.

Topographic information

Topographic information such as river length, basin area and basin elevation is obtained from topographic maps of 1/50,000 and 1/750,000 scale map. Information of the Negara river dimensions is obtained from river cross section survey results carried out by P3SA. A contour map of swamp area is developed from a topographic map of a scale of 1/50,000.

6.4 Case of Simulation

To mitigate flooding condition in the swamp area, two counter measures are considered i.e. 1) to provide a drain connecting the upstream of the Negara river and the Barito river and 2) to provide a drain along the right banks of the Negara river. Then the following three cases are examined by this simulation model.

Case-1   Without any preventive measures for inundation (present condition),

Case-2   Construct a short cut bypass channel between Amuntai and Paminggil, and

Case-3   Construct a bypass channel along the Negara river between Amuntai and Marabahan.

Case-1

Present facilities and natural conditions are kept intact. This Case-1 is the base of inundation condition in the Study Area.

Case-2

As shown in Figure 6.3, a short cut bypass is provided connecting upper Negara river and the Barito river. This bypass channel has trapezoidal cross section with 100 m bed width and 1:1.5 inside slope. The channel length is about 50 km.

Case-3

Same size of bypass channel of Case-1 is provided along the Negara river, as shown in Figure 6.4. The channel length is about 90 km.

6.5   Simulation Results

Simulation is carried out for a period of one month of March which represent typical wet season condition.

Results of simulation are shown in Figure 6.5. As seen in this Figure 6.5, Case-2 and Case-3 give the same result and these two preventive measures for inundation are effective measures to mitigate those stagnant water in the swampy areas.

7.   SEDIMENT ANALYSIS

This analysis is carried out to estimate the sediment yields from watersheds and total sediment load in the river for producing the reservoir sedimentation or headworks sedimentation.

7.1   Sediment Sampling

Sediment samplings are collected at 17 locations in the Study Area as shown in Figure 1.10. These samplings were carried out by P3SA and DPWA from 1979 to 1984. Sampling number of each station varied 5 to 342 as shown in following table.

Location (AWLR)	Sampling Number	Location (AWLR)	Sampling Number	Location (AWLR)	Sampling Number
5	151	11	98	17	51
6	60	12	103	22	332
7	134	13	342	23	25
8	58	14	290	28	5
9	126	15	5	30	8
10	162	16	119	-	-

From these samplings, 7 locations are selected for estimation of sediment yields, since other locations have less number of samplings and located lower part of the Study Area. Selected locations are Nos. 5, 7, 9, 10, 13, 16 and 22.

7.2   Sediment Yield

The sediment yield from watersheds is estimated by applying a sediment rating curve which is developed from sediment sampling records. Figure 7.1 shows the rating curve for selected seven locations. The annual sediment yield is calculated by this rating curve and daily runoff records at each location. Computed annual sediment yields are listed below:

Year	Location					
	5	7	9	10	13	16
1978	-	46.6	16.0	-	-	5.5
1979	-	45.2	-	-	-	6.6
1980	42.4	-	-	-	-	30.1
1981	31.4	-	18.5	-	87.1	-
1982	-	-	-	2.6	-	-
1983	13.4	-	6.4	2.2	41.5	-
1984	-	43.7	16.4	-	150.2	-
1985	-	40.2	9.6	-	-	-
Average	29.1	43.9	13.4	2.4	92.9	14.1

Since daily discharge record of AWLR No. 22 is not available, sediment yields are estimated at other six locations as shown in the above table.

7.3   Sediment Load

All sediment loads conveyed by the stream can be divided into two load conditions, i.e. wash load and bed-material load. The wash load is estimated as mentioned in Section 7.2. However, there are no bed-material loads measurements. The bed-material load is assumed to be 20% of the wash load. Thus, the the total sediment loads of six locations are estimated as shown below:

Location	River	Catchment Area (km^2)	Annual Runoff $(10^6 m^3)$	Wash Load $(1,000 t)$	Bed-material Load $(1,000 t)$	Total Annual Sediment (ton/km^2)
5	Tapin	382	305	29.1	5.8	91
7	Amandit	491	940	43.9	8.8	107
9	Batang Alai	318	490	13.4	2.7	51
10	Barabai	81	130	2.4	0.5	36
13	Balangan	1,201	1,304	92.9	18.6	93
16	Uya	77	290	14.1	2.8	219

8. WATER QUALITY

8.1 Tide

The Negara river is a tidal river. According to the information of P3SA, tidal effect on the Negara river can reach about 10 km upstream from Negara town. On the Barito river, tidal effect has faded around 150 km upstream from estuary. Tidal river section of the Barito river system is illustrated herein.

Daily water level is measured at Marabahan by P4S. Figure 8.1 shows daily maximum and minimum water levels in 1980. Figure 8.2 shows daily tidal range (tidal range - daily maximum - daily minimum). From this Figure 8.2, it can be read that the wet season river water level has a tidal range of 180 cm to 40 cm, and dry season tidal range is 180 cm to 10 cm.
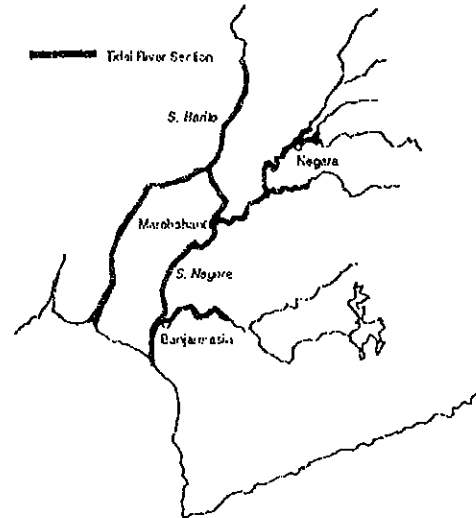
The tide causes the salinity intrusion along the river course. Investigation of salinity intrusion along the Barito river was carried out by DPMA in October 1978. According to this survey, saline intrusion penetrates up to the about 60 km upstream from the river mouth. This means, the Negara river is free from salinity at all. Figure 8.3 shows profile of saline intrusion along the Barito river.

8.2 Water Quality

Quality of river or swamp water in South Kalimantan have been checked by P3SA or DPMA. In 1986, P3SA carried out campaign for water quality checking in South Kalimantan by using water quality checker. Five items were checked, i.e. 1) Turbidity, 2) pH, 3) Dissolved Oxygen, 4) Temperature and 5) Electric Conductivity. Table 8.1 shows this campaign results and summarized below and Figure 1.11 shows location of sampling.

-	Turbidity	12	-	140	ppm
-	pH	5.8	-	8.4	
-	DO	0.9	-	11.1	ppm
-	Temperature	24	-	31	°C
-	Conductivity	25	-	250	µmho

Table 8.2 shows water quality standard in Indonesia. According to this standard, the water in the Study Area can be used for irrigation and domestic use.

In 1983, DPMA carried out the water quality investigation for the Balangan river. In this investigation, various items were checked as shown in Table 8.3 and the water in the Balangan river was assessed at group B, i.e. good for drinking and domestic use.

9. RECOMMENDATIONS

In this section some recommendations are given for aiming at improving data collection, processing and evaluation

9.1 Hydrometric Network

To ensure adequate sampling there must be adequate number and well distributed hydrometric stations. According to the WMO criteria the minimum density norms for hydrometric stations is shown in following table.

Type of Region	Range of Norms for Minimum Network Network Area (km^2) per station	
	Water Level	Rainfall
I. Flat regions of temperature, Mediterranean and tropical zones	1,000 - 2,500	600 - 900
II. Mountainous regions of temperature, Mediterranean and tropical zones Small mountainous is lands with very irregular precipitations, very dense stream network	300 - 1,000 140 - 300	100 - 250 25
III. Arid and polar zones	5,000 - 20,000	1,500 - 10,000

Present density of water level and rainfall stations are as follows:

Station	Area (km^2)	No. of Station	Density (km^2/station)
Water level	11,000	44	250
Rainfall	11,000	72	153

Comparing this present condition to the WMO criteria of upper figure of tropical zones (1,00 and 250), the Negara river basin has enough number of stations.

However, those all stations do not cover the whole the basin as shown in Figures 9.1 and 9.2. This figure shows the observation sphere of each station, i.e. one station covers 1,000 km^2 for one water level station (Figure 9.1) and 250 km^2 for one rainfall station (Figure 9.2).

As seen in these figures, mountainous area and swampy area are required another some stations of both rainfall and water level gauging stations.

9.2 Leveling Check

Almost staff gauging stations do not have their zero point elevation. It is necessary to have leveling survey works for all staff gauging station in order to perform further hydrological analysis.

9.3 Data Processing

At present all the collected raw data are processed by manual. Manual processing takes so much time and may results inaccurate data. To avoid these disadvantages, a hydrological data bank should be established in the computer. The data processing method for this data bank should follow DPMA's or DPP's[1] method as much as possible for exchanging valuable data with each other.

9.4 Operation & Maintenance

The most important things to observe the hydrometric station is continuous observation. The absence of raw hydrometric measurement data causes troublesome processing and analysis. P3SA should control and manage following O&M aspects with not only technical but also financial support.

- periodical calibration of equipment
- supply of recording chart
- repair of equipments
- data processing
- publication of periodical databooks
- training of the personnel in charge of data collection
- training of the personnel in charge of data processing

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[1] DPP : Directorate of Planning and Programming

TABLES

Table 1.1 List of Meteorological Station

No.	Code No.	Location Desa	Location Kecamatan	Kabupaten	Latitude	Longitude	Observation Item	Elevation	Operation Start Date
1	1	Sei Malang Amuntai	Amuntai	H.S.U	2 24 55	115 14 00	1,2,3,4,5,6,7,8,9	5m	Aug. 1975
2	2	Tabukan	Tambarangan	Tapin	3 9 34	115 07 50	1,2,3,4,5,6,7,8,-	15m	Apr. 1976
3	6	Juai	Juai	H.S.U	2 15 41	115 35 24	1,2,3,4,5,6,7,8,9	18m	May.1980
4	8	Mabulur	Tanta	Tabalong	2 10 32	115 25 35	1,2,3,4,5,6,7,8,-	24m	Apr. 1986
5	12	Batu Mandi	Batu Mandi	H.S.U.	2 24 52	115 24 52	1,2,3,4,5,6,7,8,9	24m	Mar. 1985
6	14	Kahakan	Banbonawa	H.S.T	2 36 13	115 27 10	1,2,5,4,5,6,7,8,-	22m	Sep. 1984
7	15	Ta'al	Sungai Raya	H.S.S	2 51 44	115 14 53	1,2,3,4,5,6,7,8,-	50m	Apr. 1986
8	16	Padai Humbawang	Labuan Amas Selatan	H.S.T.			-,2,3,-,5,-,7,8,-		

Observation Item

1: Rainfall by Automatic Rain Recorder
2: Rainfall by Standard Type Rain Recorde
3: Sun shine duration by Sun Shine Record
4: Wind speed by Anemometer
5: Solar radiation by Actinometer
6: Evaporation by Evaporpan
7: Relative Humidity by Psychrometer
8: Temperature by Thermohygrogrph
9: Water Temperature

Table 1.2 List of Rainfall Station

Serial No.	No.in Fig. 1.4	Register No.	Location Desa	Location Kechamatan	Kabupaten	Operation Start Date	Coordinate Latitude	Longitude	Elevation (m)	Remarks
Standard Recorder										
1	3	3-306j	Rantau	Tapin Utara	Tapin	Mar. 1975	2 55 47	115 8 39	10	
2	4	4-305f	Kandangan	Kandangan	H.S.S.	Apr. 1975	2 46 58	115 15 5	10	
3	5	5-306f	Barabai	Barabai	H.S.T.	May. 1975	2 34 57	115 22 20	10	
4	6	6-305c	Amuntai	Amuntai Tengah	H.S.U.	Dec. 1975	2 25 1	115 15 8	5	
5	7	7-306c	Tanjung	Murung Pudak	Tabalong	Aug. 1975	3 10 39	115 28 58	15	
6	10	10-301c	Jaro	Muara Uya	Tabalong	Apr. 1975	2 50 52	115 56 03	70	
7	11	11-305i	Negara	Daha Utara	H.S.S.	Sep. 1976	2 37 52	115 6 20	2	=ARR-32
8	12	12-306c	Margasari	Candi Laras	Tapin	Aug. 1976	2 52 50	115 55 52	3	
9	13	13-302d	Batu Mandi	Batu Mandi	H.S.U.	Dec. 1976	2 27 10	115 25 00	14	
10	14	14-303c	Babirik	Babirik	H.S.U.	Dec. 1976	2 32 13	115 8 00	2	
11	15	15-302d	Lampihong	Lampihong	H.S.U.	Dec. 1976	2 20 29	115 22 22	10	
12	16	16-302	Kelua	Kelua	Tabalong	Jun. 1976	2 16 31	115 17 50	10	
13	18	18	Telaga Langsat	Angkinang	H.S.S.	Apr. 1977	3 14 45	115 19 39	7	=ARR-31
14	19	19	Mu'ui	Haruyan	H.S.T.	May. 1977	2 13 19	115 21 21	23	
15	20	20	Sei Buluh	Labuhan Amas Utara	H.S.T.	Apr. 1977	2 33 29	115 14 29	2	
16	21	21	Intangan	Batang alai selatan	H.S.T.	Apr. 1977	2 34 36	115 27 15	7	
17	22	22	Mahe	Haruai	Tabalong	Apr. 1977	2 02 42	115 28 06	25	
18	25	25	Bungur	Tambarangan	Tapin	Feb. 1978	3 00 33	115 02 09	13	
19	26	26	Mangunang	Haruyan	H.S.T.	Feb. 1978	2 40 50	115 22 50	20	
20	27	27	Simpur	Simpur	H.S.S.	Feb. 1978	2 49 03	115 22 50	7	
21	28	28	Kambat	Batangalai	H.S.T.	Feb. 1978	2 31 38	115 19 52	5	
22	29	29	Hautakan	Batu Benawa	H.S.T.	Feb. 1978	2 38 05	115 26 21	53	
23	30	30	Kahakan	Batu Benawa	H.S.T.	Feb. 1978	2 36 37	115 27 27	31	
24	31	31	Haruai	Haruai	Tabalong	Feb. 1978	2 00 57	115 30 84	50	
Automatic Recorder (ARR)										
1	1	1-306k	Miyawa	Tambarangan	Tapin	Aug. 1976	2 59 18	115 16 15	162	
2	2	2-305g	Lumpangi kiri	Padang Batung	H S S	Aug. 1976	2 48 34	115 24 18	175	Stop
3	4	4	Muara Halong	Halong	H S U	Sep. 1977	2 15 36	115 38 2	25	
4	5	5	Batu Tangga	Batang Alai Selatan	H S T	Jun. 1977	2 32 23	115 30 21	33	
5	6	6	Bihara	Awayan	H S U	Jun. 1977	2 27 15	115 31 58	33	
6	7	7	Limau Manis	Tanta	Tabalong	Apr. 1979	2 12 0	115 24 49	62	Stop
7	8	8	Teratau	Muara Uya	Tabalong	Feb. 1978	1 52 43	115 38 47	91	
8	9	9	Binuang	Binuang	Tapin	Mar. 1978	3 0 34	115 5 35	30	
9	10	10	Salam baharis	Tambarangan	Tapin	Jun. 1979	3 2 47	115 10 48	55	
10	11	11	Kuripan	Kuripan	Barito Kuala	Aug. 1976	2 36 34	114 47 43	1	
11	13	13	Mantuyan	Halong	H S U	Oct. 1981	2 20 59	115 41 47	40	
12	14	14	Sei Batung	Juai	H S U	Oct. 1981	2 21 12	115 34 38	30	
13	19	19	Lampihong	Lampihong	H S U	Apr. 1986	2 20 47	115 22 16	19	
14	28	28	Hayup	Haruai	Tabalong	Nov. 1983	1 57 42	115 30 48	50	
15	29	29	Panaan	Muara Uya	Tabalong	Jan. 1982	1 50 19	115 24 7	180	
16	30	30	Paringin	Paringin	H S U	Aug. 1984	2 19 52	115 27 18	15	
17	31	31	Telaga Langsat	Angkinang	H S S	Aug. 1984	2 43 57	115 19 40	4	
18	32	32	Negara	Daha Selatan	H S S	Dec. 1984	2 37 54	115 6 19	4	
19	33	33	Marabahan	Marabahan	Batola	Jun. 1985	2 59 0	115 46 18	2	
BPTP VIII (Pertanian)										
1	101	200101	Muara Uya		Tabalong				-	
2	102	200102	Mabuai		Tabalong		2 10	115 25	36	
3	103	200103	Kelua		Tabalong		2 15	115 25	30	
4	201	200201	Sei Pandan Babirik		H S U				1.7	
5	203	200203	Kaludan		H S U		2 30	115 15	3.6	
6	204	200204	Paringin/Awayan		H S U				-	
7	301	200301	Labuan Amas Selatan		H S U				-	
8	302	200302	Barabai		H S T		2 35	115 20	15	
9	304	200304	Batang Alai Utara		H S T				-	
10	305	200305	Labuan Amas Utara		H S T				-	
11	401	200401	Padang Batung/Loksado		H S S				-	
12	402	200402	Angkinang		H S S		2 48	115 20	6.2	
13	403	200403	Sei Raya		H S S				5.8	
14	404	200404	Daha Utara/Selatan		H S S		2 20	115 20	1.02	
15	501	200501	Tapin Utara/Lok Paikat		Tapin		2 57	115 15	20	
16	503	200503	Tapin Tengah		Tapin				-	
17	504	200504	Candi Laras Utara		Tapin				-	

SOURCE : P3SA and BPTP VIII

Table 1.3 List of Water Level Gauging Station

No. in Figure 1.9	No.	Register No.	River	Desa	Location Kecamatan	Kabupaten	Latitude	Longitude	Operation by	Type	Elevation B.M	Elevation Gauge Zero Point	Elevation Top	Operation Start Date
Automatic Recorder														
1	5	03-026-00-19/5	S. Tapin	Karasi	Tapin Utara	Tapin	2 57 50	115 08	52 P3S A	A.OTT	10.898	6.987	9.987	Aug. 1976
2	6	03-026-00-17/6	S. Tapin	Linuh	Tapin Utara	Tapin	3 00 35	115 04	08 Puslitbang Air	A.OTT	24.657	21.059	25.059	Apr. 1976
3	7	03-026-00-03/7	S. Amandit	Jambu bubu	Padang Batung	H.S.S.	2 48 23	115 00	52 P3S S A	A.OTT	14.697	8.464	14.464	Jun. 1976
4	8	03-026-00-28/8	S. Amandit	Lungau	Kandangan	H.S.S.	2 44 55	115 12	54 P3S A	A.OTT	5.177	2.353	5.353	Jul. 1980
5	9	03-026-00-18/9	S. Batang Alai	Batu angga	Batang Alai Selatan	H.S.T.	2 32 23	115 16	47 P3S A	A.OTT	33.763	28.670	32.670	Des. 1976
6	10	03-026-00-27/10	S. Barabai	Banih Batang	Batu Benawa	H.S.T.	2 37 58	115 27	42 Puslitbang Air	A.OTT	53.102	49.961	53.961	Mar. 1979
7	11	03-026-00-20/11	S. Barabai	Kasarangan	Labuan Amas	H.S.T.	2 37 59	115 05	43 P3S A	A.OTT	5.572	0.442	4.442	Jul. 1979
8	12	03-026-00-01/12	S. Negara	Amuntai	Amuntai Tengah	H.S.U.	2 25 26	115 14	52 Puslitbang Air	A.OTT	4.495	-0.130	5.870	Feb. 1976
9	13	03-026-00-56/13	S. Balangan	Balang	Paringin	H.S.U.	2 19 24	115 30	10 P3S A	A.OTT	21.318	13.364	19.364	Jul. 1980
10	14	03-026-00-44/14	S. Balangan	Lamphtong	Lamphtong	Tabalong	2 20 19	115 22	26 Proyek Hydrologi	A.OTT/Baihe gauge	10.907	4.952	9.932	Aug. 1982
11	15	03-026-00-02/15	S. Tabalong	Tanjung	Tanjung	Tabalong	2 9 44	115 23	2 Proyek Hydrologi	A.OTT	15.960	7.816	15.816	May. 1977
12	16	03-026-00-02/6	S. Uya	Tantan	Muara Uya	Tabalong	2 11 28	115 35	34 Puslitbang Air	A.OTT Kampen	69.488	64.999	88.999	Mar. 1977
13	17	03-026-00-37/17	S. Haruyan	Sei. Anyar	Pasar Arba	H.S.U.	2 18 43	115 17	34 P3S A	A.OTT	7.894	2.001	8.001	Feb. 1983
14	22	22	S. Pitap	Bikra	Awan	H.S.T.	2 26 37	115 32	1 Puslitbang Air	A.OTT	33.515	23.948	26.948	Jan. 1983
15	23	03-026-00-40/23	S. Tabalong kiri	Mabe	Haruai	Tabalong	2 2 44	115 27	26 Proyek Hydrologi	A.OTT	23.044	13.332	21.332	Jan. 1982
16	26	03-026-00-42/26	S. Balangan	Kesayang	Halong	H.S.U.	2 15 54	115 39	35 P3S A	A.OTT	28.575	25.489	28.489	Jan. 1982
17	28	28	S. Tabalong Kiri	Pasaan	Haruai	Tabalong	1 51 50	115 21	58 Proyek Hydrologi	A.OTT	151.980	147.954	150.954	Dec. 1983
18	30	30	S. Tabalong Kanan	Batu Pulut	Haruai	Tabalong	2 00 41	115 32	03 Puslitbang Air	A.OTT	26.259	-	-	Jul. 1984
19	31	31	S. Ayu	Kampung Lima	Muara Uya	Tabalong	1 56 03	115 33	25 Puslitbang Air	A.OTT	38.105	32.007	35.007	Apr. 1983
20	009	009	S. Batang Alai	Sei. Buluh	Batang Alai Utara	H.S.T.	2 33 43	115 13	37 Proyek Hydrologi	A.OTT	2.956	-0.368	2.652	Jul. 1980
21	010	010	S. Barito	Negara	Daha Utara	H.S.U.	2 37 59	115 05	43 Proyek Hydrologi	A.OTT	2.291	-2.007	1.993	Oct. 1981
22	011	011	S. Tapin	Muara Muning	Candi-Laras Selatan	Tapin	2 52 22	114 58	28 Proyek Hydrologi	A.OTT	0.797	-2.059	1.941	May. 1982
23	012	012	S. Baimau	Baimau	Kelumpang	H.S.S.	2 48 05	115 10	03 JALDA, Japan	ISHIDASHIKI	7.178	3.656	7.656	Jan. 1984
24	013	013	S. Batang Alai	Mantaas	Batang Alai Utara	H.S.T.	2 36 58	115 09	31 JALDA, Japan	ISHIDASHIKI	-	-	-	Jan. 1984
25	014	014	S. Danu Panggang	Pandaman	Danu Panggang	H.S.U.	2 27 51	115 05	54 JALDA, Japan	ISHIDASHIKI	1.774	-2.51	0.849	Jan. 1984
Staff Gauge														
1	6	6	S. Tapin	Margasari	Candi Laras Selatan	Tapin	2 55 52	115 8	45 P3S A	Enamelt Steel Plate	-	-		Oct. 1976
2	7	7	S. Tapin	Rantau	Tapin Utara	Tapin	2 56 21	115 8	40 P3S S A	- do -	-	-		Jan. 1976
3	8	8	S. Binuang	Binuang	Binuang	Tapin	3 9 42	115 5	0 P3S S A	- do -	-	-		Jun. 1975
4	9	9	S. Batang Alai	Kembat	Pandawan	H.S.T.	2 3 50	115 32	13 P3S A	- do -	-	-		May. 1977
5	10	10	S. Barabai	Kasarangan	Labuan Amas Utara	H.S.T.	3 57 14	115 17	18 P3S A	- co -	-	-		May. 1977
6	11	11	S. Batang Alai	Sei Buluh	Labuan Amas Utara	H.S.T.	2 33 43	115 13	37 P3S A	- do -	-	-		Aug. 1980
7	12	12	S. Barabai	Pajukungan	Barabai	H.S.T.	2 35 55	115 20	44 P3S A	- do -	-	-		Jun. 1976
8	13	13	S. Barabai	Aluan Besar	Batu Benawa	H.S.T.	2 36 4	115 8	13 P3S A	- do -	-	-		Aug. 1976
9	14	14	S. Batang Alai	Ilung	Batang Alai Utara	H.S.T.	2 31 13	115 24	13 P3S A	- do -	-	-		Aug. 1975
10	15	15	S. Kasias	Amuntai	Amuntai Tengah	H.S.U.	2 25 18	115 15	50 P3S A	- do -	-	-		Aug. 1975
11	17	17	S. Tabalong	Kelua	Kelua	Tabalong	2 27 53	115 77	52 P3S A	- do -	-	-		Oct. 1976
12	19	19	S. Negara	Margasari	Candi Laras Selatan	Tapin	2 52 50	114 45	54 P3S A	- do -	-1.082	0.91	Mar. 1987
13	20	20	S. Rutas	Hiyung	Tapin Selatan	Tapin	2 54 3	115 3	10 P3S A	- do -	-3.756	0.244	Mar. 1987
14	21	21	S. Bangkau	Bangkau	Kandangan	H.S.S.	2 40 48	115 11	16 P3S A	- do -	+1.437	2.437	Mar. 1987
15	22	22	S. Tate	Tapus Halat	Amuntai Tengah	H.S.U.	2 31 56	115 13	24 P3S A	- do -	-.963	1.037	Mar. 1987
16	23	23	S. Danu Panggang	Seberang Masjid	Surga-Pancan	H.S.U.	2 26 8	115 10	53 P3S A	- do -	+1.112	3.112	Mar. 1987
17	24	24	S. Sidenia	Banjang	Amuntai Tengah	H.S.U.	2 24 11	115 13	2 P3S A	- do -	-0.802	4.082	Mar. 1987

Source : P3SA

Table 2.1 Monthly Mean Rainfall

Station	Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Year n
P3SA															
Rantau	3	282	209	225	182	170	103	70	54	86	134	219	289	2023	11
Kandangan	4	283	233	262	206	174	126	109	89	110	123	246	319	2280	11
Barabai	5	321	272	277	233	185	120	113	109	93	131	271	295	2420	13
Amuntai	6	274	276	212	180	145	132	132	76	105	145	240	286	2203	8
Tanjung	7	222	265	228	197	204	125	107	119	95	127	182	275	2146	11
Jaro	10	222	231	232	205	162	127	117	88	83	138	225	283	2113	10
Negara	11	169	145	216	223	172	99	79	57	78	104	178	286	1806	10
Margasari	12	203	251	221	219	148	97	66	40	61	107	164	291	1868	10
Batu Mandi	13	292	279	231	187	187	196	142	99	137	151	282	331	2515	26
Babirik	14	212	246	315	171	216	178	168	134	194	99	239	396	2568	7
Lampihong	15	298	253	254	179	179	144	188	101	85	149	235	351	2416	10
Kelua	16	325	276	240	285	192	192	142	120	92	133	293	283	2573	8
Telaga Langsat	18	250	205	272	244	150	113	71	56	84	99	199	257	2000	8
Mu'ui	19	249	231	246	238	168	105	117	60	75	107	242	259	2097	11
Sei Buluh	20	284	240	226	226	123	107	99	75	80	110	225	259	2054	9
Intangan	21	300	233	172	208	196	115	114	105	74	131	227	214	2089	10
Mahe	22	127	109	87	110	73	78	56	57	41	70	98	152	1058	9
Bungur	25	422	367	409	342	315	245	172	123	154	199	418	514	3680	8
Mangunang	26	280	233	190	219	179	97	99	73	79	113	170	286	2018	10
Simpur	27	210	190	233	220	212	97	119	56	116	120	219	266	2058	9
Kambat	28	280	228	218	247	146	136	99	82	93	81	241	248	2099	8
Hantakan	29	265	229	251	247	248	137	116	115	132	119	269	286	2414	8
Kahakan	30	332	277	293	324	269	186	148	137	128	170	299	323	2886	10
Haruai	31	242	201	255	193	160	135	90	129	101	118	212	292	2128	8
BPTP VIII															
Muara Uya	101	267	246	248	180	165	129	107	56	87	124	231	293	2133	8
Maburai	102	280	265	292	240	171	123	105	101	106	152	230	329	2396	59
Kelua	103	309	275	294	237	189	107	104	78	89	144	240	308	2374	45
Sei Pandan Bab	201	287	311	342	227	194	108	114	73	125	162	269	254	2466	16
Kaludan	203	285	258	284	230	179	120	96	70	93	108	219	284	2225	56
Paringin/Awaya	204	289	252	257	189	184	131	115	78	81	111	229	279	2195	25
Labuan Amas S	301	325	260	254	227	188	116	130	86	106	141	281	330	2444	23
Barabai	302	286	276	277	240	196	137	130	105	106	156	261	323	2492	56
Batang Alai Uta	304	254	280	228	179	165	100	153	112	92	149	272	296	2280	15
Labuan Amas Ut	305	283	133	172	179	106	67	84	61	69	104	199	246	1703	6
Padang Batung/	401	305	251	284	227	188	124	101	58	117	150	276	330	2411	13
Angkinang	402	320	252	319	255	190	121	116	94	100	146	243	315	2471	52
Sei Raya	403	338	265	297	212	260	143	112	70	131	158	297	389	2672	10
Daha Utara/Sela	404	310	258	269	219	177	114	85	69	87	121	200	303	2211	49
Tapin Utara/Lok	501	320	260	317	227	175	131	89	76	95	144	211	301	2346	53
Tapin Tengah	503	287	310	285	126	127	137	50	60	92	105	216	227	2022	4
Candi Laras Utai	504	225	279	238	202	153	89	61	64	81	74	144	348	1958	11
BMG															
Puruk Cau	296	334	279	344	353	318	206	158	179	212	264	346	341	3335	50
Muara Tewe	297	317	303	360	358	289	225	159	161	183	232	365	418	3370	51
Buntuk	298	307	246	300	299	224	157	106	93	126	153	287	320	2617	52
Ampoh	298a	320	247	341	320	255	176	120	116	141	174	305	356	2873	21
Tamiyang Layar	298b	311	267	297	262	225	164	106	90	138	143	241	336	2581	14
Hayap	299	321	288	316	266	207	141	124	122	106	176	255	339	2660	38
Mahe	300	294	249	298	249	190	149	91	124	114	150	245	318	2470	29
Tanjung	301	280	265	292	240	171	123	105	101	106	152	230	329	2396	59
Warukin	301a	279	240	262	229	277	136	190	120	119	180	197	253	2482	6
Murung Pudak	301b	222	227	224	195	161	110	113	105	111	131	199	270	2068	24
Kulua	302	309	275	294	237	189	107	104	78	89	144	240	308	2374	45
Paringin	302a	289	252	257	189	184	131	115	78	81	111	229	279	2195	25
Tabalong Kiwa	302b	353	254	280	299	198	197	115	140	152	99	311	415	2814	6
Amuntai	303	285	258	284	230	179	120	96	70	93	108	219	284	2225	56
Batu Mandi	303a	292	279	231	187	187	196	142	99	137	151	282	331	2515	26
Danau Panggan	303b	507	416	145	260	421	105	63	122	246	149	318	569	3319	4
Barabai	305	286	276	277	240	196	137	130	105	106	156	261	323	2492	56
Kandangan	305a	320	252	319	255	190	121	116	94	100	146	243	315	2471	52
Negara	305b	310	258	269	219	177	114	85	69	87	121	200	303	2211	49
Birajang	305c	254	228	257	255	214	149	139	94	90	150	195	288	2313	17
Rantau	306	320	260	317	227	175	131	89	76	95	144	211	301	2346	53
Marabahan	306a	305	254	286	211	162	126	70	75	94	103	197	259	2142	26

Source : P3SA,BPTP VIII

Table 2.2 Monthly Mean Temperature (°C)

Station : No. 1. Sei Malang

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1975								28.0	27.8	28.3	28.5	27.7	
1976	26.4	26.4	26.0	28.4	28.4	27.0	27.2	27.7	28.0	27.8	28.0	27.6	27.5
1977	26.6	26.1	26.7	27.1	27.3	26.6	26.5	26.2	27.0	27.3	27.1	26.8	26.7
1978	26.7	26.3	27.3	27.4	27.8	27.2	26.5	27.1	26.8	27.2	27.2	26.6	27.0
1979	27.1	26.9	27.5	27.2	27.8	27.2	27.4	27.1	27.7	28.2	28.2	26.8	27.4
1980	27.0		27.1				27.6	27.5	27.2	27.3	27.2	27.0	26.6
1981	26.9	26.7	27.7	27.8	27.7	27.6	26.6		27.6	26.0	27.5	26.7	
1982	26.9	29.2	27.2	27.6	27.2	27.6	24.8	26.0	25.1	27.6	26.0	25.7	26.7
1983	27.0	27.0	28.0	27.7	27.7	27.7	27.4	25.6	33.9	25.3	25.2	24.6	27.2
1984	24.2	23.1	24.2	27.7	27.7	27.5	27.3	27.2	27.5	26.2	25.0	24.7	26.2
1985	27.5	27.7	27.7	27.7	27.6	28.0	27.1	27.5	27.3	21.3	27.5	27.6	27.1
1986	27.6	34.1	26.6	27.7	27.7	28.3	26.8	24.3	27.3	27.4	30.6	27.4	28.0
1987	27.3	27.5	26.3	27.4	27.3	27.5	26.6	27.1	26.9				
Mean	26.8	27.4	27.0	27.6	27.7	27.5	26.8	26.7	27.7	26.8	27.3	26.6	27.1

Station : No. 12. Batu Mandi

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1984													
1985			20.2	20.5	20.7	20.7	20.1	20.0	19.7	20.7	20.7	20.1	
1986	20.7	19.7	20.8	20.8	20.9	20.6	20.2	20.1	19.6	22.6	20.2	19.1	20.4
1987	17.2	20.4	19.8	14.4	19.8	21.0	19.0	19.2	19.2				
1988													
Mean	18.9	20.1	20.3	18.6	20.4	20.8	20.1	19.8	19.5	21.7	20.4	19.6	20.0

Station : No. 16. Pantai Hambawang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1981	27.0	28.8		27.5		27.4	26.5	25.1	25.2	24.5	14.1	28.3	
1982						27.7		35.5	26.2	26.0	28.2	27.6	
1983	28.0	26.1	28.3	32.5	27.7	35.8	25.7	27.3	27.2	27.4	26.8	26.5	28.4
1984	25.7	28.1	26.0	34.8	28.3	25.5	19.2	26.3	26.4	26.7	26.3	26.5	26.5
1985	26.0	26.9	26.6	26.2	26.8	25.6	25.2	24.8	28.0	26.9	25.0	25.0	25.9
1986	26.2	25.3	24.4	25.5	25.4	20.9	26.2		28.9	25.2	25.8	25.0	
1987	25.0	25.2	25.4	26.4									
Mean	26.3	26.7	26.1	28.8	26.6	27.2	24.6	27.8	26.8	26.5	24.4	26.2	26.5

Station : No. 2. Tatakan

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1976				26.6	27.6	27.0	27.2	26.4	26.9	24.7	27.3	26.8	
1977	26.8	26.2	27.1	27.6	27.6	27.2	27.6	27.0	26.6	29.4	26.6		
1978	26.9	27.3	27.6	27.6	28.1	27.4	26.8	27.4	24.3	27.8	27.7	26.6	27.1
1979	26.3	26.1	27.4	27.0	32.5	27.1	27.5		26.0	26.8	26.0	27.1	
1980	27.2	26.5	27.5			27.6	28.0	27.9	26.9	26.5	28.3	27.3	
1981	27.4	27.1	26.0	28.0	29.6	28.3	27.4	26.5	27.8	28.5	27.6	26.9	27.9
1982		26.4	26.6	28.0	27.9	27.8	26.3	26.9	29.2	29.4	28.7	26.2	
1983	28.3	26.7	26.6	26.7	28.3	28.0	27.5	28.6	28.7	28.5		27.1	
1984	26.9	26.6	27.1	27.9	27.5	27.2	27.0	27.0	27.5	28.0		27.2	
1985		28.0	28.1	28.0	28.2	28.2	27.1	27.5	28.0	29.3	28.1	27.2	
1986	30.7	26.0	27.3	28.3	28.6	28.5	28.3	26.8	28.5	27.7	27.5	28.0	28.2
1987	27.3	27.3	28.0	28.7	28.2	28.8	28.0	29.0	29.3	29.6			
Mean	27.5	27.1	27.8	27.9	28.6	27.8	27.6	28.2	28.1	28.4	28.0	27.2	27.9

Station : No. 6. J u a i

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1980					27.9	28.0	27.6	26.1	27.9	27.0	27.3	25.9
1981	26.6	25.7	26.8	26.1	26.7	25.8	24.4		25.6	25.3	25.2	24.8
1982								27.1	27.8	27.5	26.5	
1983	27.6	27.7	26.5	27.1	27.3	26.3	26.0	26.4	26.8		25.9	24.8
1984	25.1	25.3	25.6	25.9	25.9	25.5	25.4	25.3	24.5	22.6	26.4	25.5	25.3
1985	24.1	25.1	25.4	25.7	25.3	24.4	24.5	24.2	24.1	23.4	22.3	20.0	24.0
1986	26.3	26.8	27.0			27.3	26.5	27.8	27.0	23.4		
Mean	25.9	26.1	26.7	26.2	26.6	26.2	25.7	25.9	26.2	24.9	25.8	24.6	25.9

Table 2.3 Monthly Mean Relative Humidity (%)

Station : No. 1. Sei Malang

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1975								76	82	83	85	87	
1976	87	84	86	84	79	82	83	79	81	86	87	89	84
1977	89	89	88	87	87	87	85	86	82	82	85	89	86
1978	88	88	87	86	66	87	08	85	86	88	86	89	87
1979	87	88	87	89	87	87	84	86	87	85	88	90	87
1980	92		92			91	88	86	82	86	92	93	
1981	95	96	96	97	96	97	95		87	87	98	94	
1982	95	95	85	97	84	93	93	95	95	94	94	95	93
1983	91	95	95	95	96	95	98	95	96	93	95	96	95
1984	96	92	96	95	96	95	90	95	96	94	96	98	95
1985	98	95	96	96	95	95	95	95	95	76	95	94	94
1986	94	95	92	94	94	88	91	85	95	94	94	94	93
1987	94	94	95	95	95	95	94	94	95				
Mean	92	92	91	92	91	92	91	88	90	87	91	92	90

Station : No. 12. Batu Mandi

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1984												48	
1985	84	79	80	83	81	75	80	76	76	76	80	78	79
1986	81	79	84	74	77	77	78	70	84	70	76	80	77
1987		81	79	61	79	77	74	77	69				
1988													
Mean	82	80	81	73	79	76	77	74	76	73	78	69	77

Station : No. 16. Pantai Hambawang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1981	83	84				84	80	98	81	73	71	110	
1982						78		72	71	72	78	81	
1983	81	83	82	88	86	85	73	83	87	84	85	83	83
1984	87	84	85	84	88	85	88	81	82	81	85	84	84
1985	86	83	84	81	87	82	87	83	85	82	85	88	84
1986	89	88	84	86	86	79	94	87	80	87	87	84	86
1987	85	83	86	89									
Mean	85	84	84	85	86	82	84	84	81	80	82	89	84

Station : No. 2 Tatakan

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1976						78	71	75	69	62	60	76	84	87
1977	86	88	88	89	87	83	73	73	66	67	76		
1978	87	85	66	85	85	84	85	81	77	82	82	88	82
1979	84	80	87	66	83	85	79		79	76	87	88	
1980	95	80	86			86	80	78	71	77	80	87	
1981	85	87	84	84	84	81	78	70	97	78	85	89	83
1982		87	85	82	81	78	69	64	63	65	76	63	
1983	82	80	80	81	85	83	75	67	73	77		65	
1984	88	88	86	86	87	84	84	77	81	77		84	
1985		81	81	81	80	77	79	76	76	76	81	79	
1986	82	79	82	79	75	78	77	69	59	51	84	81	78
1987	86	84	80	79	80	76	71	68	70	71			
Mean	86	85	82	83	82	81	77	71	74	75	82	85	80

Station : No. 6. J u a i

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980					82	81	76	75	71	79	87	88	
1981	87	90	86	87	86	85	89		90	90	92	91	
1982	89	90	89	88	86	88	82	80	80	89	92	97	88
1983	99		97	96	94	99	99	96	90		94	94	
1984	97	97	98	96	95	96	92	91	96	83	98	99	95
1985	99	99	99	98	80	87	98	99	98	99	99	98	96
1986	94	96				99	94	94	94	99			
Mean	94	94	93	93	87	91	90	89	89	90	94	94	92

Table 2.4 Monthly Mean Evaporation (m m)

Station : No. 1. Sei Malang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1975								4.1	3.3	3.6	4.2	.33	
1976	3.9	3.5	3.3	3.6	3.8	3.6	4.1	4.2	3.9	2.7	2.9	2.0	3.4
1977	2.9	1.9	2.3	2.9	3.8	3.5	4.0	3.8	3.4	3.2	3.1	2.9	3.1
1978	2.5	2.8	2.9	3.5	3.2	3.0	2.5	3.2	2.5	3.4	2.6	2.0	2.8
1979	2.6	3.3	2.7	2.8	3.7	2.1	5.7	3.5	2.6	2.4	2.4	2.0	2.8
1980	1.8	.	3.4				1.2	2.4	2.6	3.7	2.3	2.7	1.9
1981	1.9	1.2	2.6	2.5	2.6	2.5	1.9		2.5	2.0	2.0	2.4	
1982	1.9	2.4	2.3	2.5	2.3	3.0	4.3	3.2	1.3	2.3	2.6	2.1	2.5
1983	2.4	3.2	2.5	2.1	2.6	2.4	2.3	3.5	2.6	2.7	2.4	2.0	2.6
1984	1.6	1.0	1.7	2.1	2.0	1.4	1.0	2.6	2.0	2.1	2.0	1.5	1.9
1985	1.6	2.2	2.1	1.9	2.3	2.6	2.0	1.9	2.5	1.8	2.0	1.7	2.0
1986	1.3	1.3	1.2	2.0	2.9	1.4	1.7	3.0	1.8		1.2	2.0	
1987	1.2	1.5	2.5	2.8	2.6	2.1	3.4	2.5	1.9				
Mean	2.1	2.2	2.4	2.6	2.9	2.4	2.9	3.2	2.5	2.6	2.5	2.2	2.6

Station : No. 12. Batu Mandi

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1984													
1985													
1986													
1987			2.9	4.2	1.2	2.7							2.7
1988													
Mean			2.9	4.2	1.2	2.7							2.7

Station : No. 2. Talakan

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1976				4.2	4.4	4.4	5.1	6.3	6.7	4.8	4.2		4.4
1977	3.9	3.8	4.7	4.5	4.4	4.2	5.2	5.4	6.2	6.7	5.2		
1978	3.6	4.0	3.6	5.0	4.3	4.1	3.6	3.6	3.2	5.0	4.9	3.4	4.1
1979	3.6	4.4	4.2	4.7	4.3	3.7	5.1		4.9	6.2	4.5	4.0	
1980	3.6	4.2	5.0		3.9	4.6	4.7	6.4	5.3	4.7	4.1		
1981	4.2	4.0	5.4	4.4	4.1	4.1	4.0	5.8	4.9	5.4	3.8	3.6	4.5
1982		3.5	4.0	5.0	4.2	4.5	5.8	6.6	6.8	6.4	5.9	5.3	
1983	4.8	5.6	4.7	4.3	4.3	4.0	3.9	5.5	5.5	4.6		6.0	
1984	3.9	3.2	3.9	4.3	3.5	3.6	3.8	5.1	4.2	5.3	3.9		
1985		4.3	4.5	4.2	2.7	4.2	3.7	4.4	0.0	4.7	3.9	3.6	
1986	3.9	4.1	3.8	4.1	4.4	5.1	5.9	5.7	3.5	4.2	4.5	4.5	
1987	3.7	4.4	4.8	5.4	3.7	4.9	5.3	6.3	5.5	5.7			
Mean	3.9	4.1	4.6	4.6	4.1	4.2	4.6	5.4	5.0	5.3	4.6	4.1	4.6

Station : No. 6. Juai

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980					6.5	5.1	5.9	6.2	6.5	6.2	5.9	3.1	
1981	4.5	3.2	5.4	3.6	4.5	4.3	3.8	0.0	4.3	4.5	4.0	4.3	3.9
1982	4.3	4.1	7.1	6.3	4.6	4.5	5.4	5.5	5.3	6.1	5.3	5.8	5.4
1983	6.8	6.7	5.6	6.2	4.0	4.6	4.0	5.2	4.7	0.0	8.0	5.6	5.1
1984	8.2	4.6	5.3	4.7	5.2	3.1	4.3	7.5	5.0	5.2	4.4	4.2	5.1
1985	4.1	4.5	4.2	4.7	4.0	4.3	4.4	4.4	4.2	5.1	4.2	4.0	4.3
1986	3.9	4.7			4.0	4.3	5.3	6.2	5.1				
Mean	5.3	4.7	5.5	5.1	4.8	4.3	4.6	4.9	5.2	4.6	5.4	4.5	4.9

Table 2.5 Monthly Mean Wind Speed (km/day)

Station : No. 1. Sei Malang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1975								43	38	45	46	50	
1976	50	48	53	48	43	42	38	36	38	43	45	51	44
1977	48	44	47	49	45	41	37	40	42	33	44	44	43
1978	42	42	46	47	42	36	33	36	34	43	43	44	41
1979	45	51	46	50	41	37	34	33	8	11	41	48	37
1980	41		45		38	36	36	41	44	40	21		
1981	28	25	26	17	26	17	21		17	48	22	16	
1982	28	44	14	17	14	31	28	26	25	27	30	33	26
1983	32	33	20	4	4	2	1	1	19	39	47	41	20
1984	46	41	43	45	40	13	17	31	36	26	32	40	34
1985	35	39	39	38	33	32	32	35	31	31	33	36	35
1986	37	34	35	40	30	28	25	32	26	25	26	25	31
1987	28	26	40	33	29	26	25	29	28				
Mean	38	30	38	35	32	29	27	31	29	35	37	38	35

Station : No. 12. Batu Mandi

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1984												18	
1985	35		32	26	22	23	23	23	20	22	55	30	
1986	31	21	25	22	10	19	27	26	24	20	26	23	24
1987		19	27	13	17	18	26	25	34				
1988													
Mean	33	20	28	21	19	20	25	25	26	21	40	24	25

Station : No. 2. Talakan

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1976				76	88	94	118	140	135	96	74	78	
1977	75	73	79	73	70	8	11	110	120	136	98		
1978	74	71	75	73	69	68	66	78	58	73	89	61	69
1979	63	68	66	70	63	67	92		83	85	68	67	
1980	66	68	67		65	66	81	103	75	64	65		
1981	60	6	82	55	42	50	48	73	73	68	58	53	55
1982		50	46	65	62	63	113	126	138	111	74	73	
1983	68	74	65	60	57	63	73	105	85	75		69	
1984	68	64	56	64	68	64	80	65	61	60			
1985		54	56	47	49	48	46	66	60	56	51	34	
1986	49	45	44	46	37	26	40	92	82	56	50	4	48
1987	53	53	61	56	52	60	73	113	86	73			
Mean	65	57	63	67	58	57	67	97	91	81	67	56	68

Station : No. 6. Juai

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980					37	37	46	49	63	57	56	53	
1981	84	47	65	49	53	46	45		54	49	52	53	
1982	49	47	52	51	46	43	50	51	55	63	59	50	51
1983	51	61	60	56	50	41	42	46	43		51	42	
1984	46	39	40	39	34	25	30	36	37	36	34	33	36
1985													
1986	36	34	36			32	31	37	32				
Mean	53	46	51	49	44	37	41	44	47	52	50	46	47

Station : No. 16. Pantai Hambawang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1986						11	16		17	15	15	14	
1987	11	7	9	10									
Mean	11	7	9	10		11	16		17	15	15	14	

Table 2.6 Monthly Mean Sunshine Duration (%)

Station : No. 1. Sei Malang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1975								53	36	37	39	29	
1976	32	34	39	56	71	52	70	67	54	37	47	46	51
1977	35	21	28	48	63	41	64	60	54	45	39	39	45
1978	38	39	45	56	56	52	40	47	42	57	47	31	46
1979	38	43	41	46	60	31	61	57	45	41	39	36	45
1980	32		45			77	69	51	63	40	48	27	
1981	30	25	51	48	51	48	27		42	36	29	40	
1982	30	42	40	42	40	55	76	57	14	37	48	37	43
1983	41	54	38	32	43	40	37	52	44	48	44	36	42
1984	27	22	31	41	39	21	38	52	36	42	41	34	35
1985	34	45	47										
1986								62	40		31		
1987	29	33	55	58	53	46	64	50	40				
Mean	33	36	42	47	53	47	55	55	42	42	41	36	44

Station : No. 2. Talakan

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1975				56	65	55	61	65	57	36	37	34	
1977	29	18	46	55	59	51	61	56	55	40	36		
1978	30	38	39	54	58	65	37	46	29	52	46	25	44
1979	37	35	36	49	56	41	56		53	53	38	33	
1980	31	32	49		47	58	50	65	46	48	25		
1981	28	30	52	49	52	50	48	73	42	49	33	25	44
1982		28	29		49		59	65	15	44		42	
1983	39	53	40	37	44	48	41	64	58	45		35	
1984	28	22	30	40	37	40	40	58	36	52		23	
1985						54	41	45	48	46			
1986	32	35	32	45	55	52	57	68	57	28	31	39	44
1987		34					34						
Mean	32	32	40	43	54	46	49	58	50	47	40	30	43

Station : No. 6. Juai

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980					56	50	58	48	84	44	56		
1981	31	22	49	40	43	48	42		34	36	29	23	
1982	24	29	27	41	47	54	71	53	18	44	50	32	41
1983	44	52	36	29	40	43	35	47	35	42	42	28	40
1984	24	21	23	32	33	39	38	48	32	52	41	28	34
1985	29	33	36				26	65					
1986		9			45	48	48	32					
Mean	30	31	30	36	44	47	45	51	36	44	42	27	39

Station : No. 16. Pantai Hambawang

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1981	36	35											
1982													
Mean	36	35											

Table 3.1 Monthly Runoff

River Tapin
Location Kuranji
Code No. 5 CA = 382 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1976									1.5	5.6	11.2		
1977	62.4	61.0		62.4					2.0		2.7	16.2	
1978	17.2	15.7	23.6	24.6		11.0	9.8	6.2	7.4	7.7	11.5	15.3	
1979	19.2	22.4	16.2	22.7	13.1		5.2	2.2	2.2	1.6	10.0	19.6	
1980	24.6	11.8	13.9	22.0	15.8	12.2	6.6	3.4	1.6	1.6	6.4	16.4	11.4
1981	12.3	14.2	12.4	15.1	19.0	8.9	7.7		5.4	6.5	9.7	16.2	
1982	21.9	13.7	22.6	15.4	11.2	7.8		4.4	4.0	4.4	4.8	7.7	
1983	9.6	7.3		5.2	11.2	7.6		3.3	3.1	3.1	7.0	10.9	
Mean	23.9	21.2	17.7	23.9	14.1	9.5	7.3	3.9	3.4	4.4	7.9	14.6	12.6

River Tapin
Location Linuh
Code No. 6 CA = 340 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1977				19.9	13.2	8.1	3.4		1.3	1.1	2.6	10.7	
1978	10.8	14.0	15.9	17.4	13.1	10.1	9.1	5.5	5.1	5.6	5.9	10.2	10.7
1979	14.1	23.5	14.9	19.7	11.7	10.0	5.3	2.9	2.7	1.9	6.0	20.5	11.1
1980	19.4	9.2	11.3	18.1	10.5	9.0	4.9		1.9				
Mean	14.7	15.6	14.0	18.8	12.1	9.3	5.7	4.2	3.0	2.6	4.8	13.8	9.9

River Amandit
Location Jambubulu
Code No. 7 CA = 491 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1977						25.7	13.2	12.8			22.8	26.7	
1978	41.7	42.8	43.0	41.2	43.3	27.2	19.7	21.3	12.9	21.8	17.5	36.7	30.8
1979	36.0	38.5	37.3	60.4	30.9	35.2	15.4	8.7	7.7	4.9	17.9	45.5	29.9
1980	43.5	25.1	36.1	51.8		38.1	16.1	10.5	6.6	5.0	13.8	37.7	
1981				36.5	37.3	21.7	-21.7	13.4	11.5	15.1	27.4	41.3	
1982	44.2	33.3	38.6	36.6	35.8	28.8	17.5		5.5	5.7	6.4	18.3	
1983	26.0			13.1		23.9		9.2	6.9	6.4	21.3		
1984	41.1	39.8	38.0	40.8	39.7	31.9	22.4	15.6	19.0	16.1	27.3	36.7	30.7
1985	49.7	47.7	33.9	37.1	31.4	29.9	18.1	10.8	15.3	12.1	18.0	36.8	28.4
Mean	40.3	41.2	37.8	39.7	36.4	29.4	18.0	12.9	10.7	12.2	19.8	36.1	27.9

River Amandit
Location Turgau
Code No. 8 CA = km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980								8.3	7.6	15.6	35.5		
1981	26.8	26.7	31.7	35.3	39.4	17.6	19.2	11.8	10.3	11.9	26.1	44.1	25.1
1982	55.5	30.8	39.3	36.8	34.9	22.4	10.4	7.5	6.7	7.4	7.3	19.2	23.2
1983	19.8	19.5	15.2	11.8	33.1	27.5	13.3	8.7	6.0	8.5	23.0	35.7	18.7
1984	40.7	45.8	42.3	46.3	39.6	33.8	19.8	13.2	18.8	17.9	22.7	41.1	31.8
1985	61.1	34.2	35.6	40.4	23.8	21.2	15.5	10.5	10.1	9.1	18.9	34.0	26.2
1986	61.1	34.2	35.6	40.4	23.8	21.2	15.5	10.5	10.1	9.1	18.9	34.0	26.2
1987	61.7	65.9		42.4		23.3		8.9	7.3	7.1			
Mean	46.7	36.4	33.3	36.2	32.4	23.9	15.6	10.2	10.0	9.8	18.9	34.8	25.7

River Batang Alai
Location Batu Tanga
Code No. 9 CA = 318 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1977						20.5	10.5	8.6	5.7	4.4	6.8	15.9	
1978	16.1	29.5	21.8	23.0		12.5	13.9	9.1	9.1	10.3	18.6	25.6	
1979	21.6	36.9	23.5	38.9		21.0	11.4	10.2	8.6	6.1	17.6	33.7	
1980	26.9	20.9		28.1	21.7	16.8	11.7		5.8	5.9	13.4	19.6	
1981	15.0	19.5	21.7	37.8	28.7	18.3	18.9	8.9	9.1	10.0	11.4	25.5	19.2
1982	51.2	23.4	35.7	28.1	26.4		5.1	3.9	3.6	3.7	4.2	16.4	
1983	15.8	9.8	8.8	5.7	11.2	13.4	11.7	9.4	7.5	6.4	13.0	13.8	10.5
1984	21.9	31.2	24.3	29.8	24.7	18.7	13.1	11.4	13.0	5.8	9.6	15.6	18.5
1986	8.3	17.9											
Mean	22.1	23.6	22.8	27.4	22.5	17.2	11.7	9.3	7.8	6.9	12.6	21.3	17.1

River Batahai
Location Banih Batang
Code No. 10 CA = 81 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1979				6.3	4.6	4.8	3.1	2.6	2.5	2.0	4.5	9.4	
1980	7.1	5.9		6.0		4.5	5.0	2.6	2.0	2.2	5.2	8.8	
1981	5.8	5.2	4.2		5.4	4.5	3.1	1.1	1.4	2.3	9.3	9.8	
1982	10.3	4.9	5.0	5.3	3.7	3.7	2.5	2.1	1.7	2.0	2.1	8.7	4.3
1983	7.5	4.0	2.3	2.3	3.5	3.4	2.7	2.4	2.7	2.0	4.7	8.4	3.9
1984	8.4	7.0	4.0	4.0	3.9	3.8	3.0	2.9	3.9	3.0	4.9		
1985			5.2	4.9	4.6*	3.9	4.1	2.5	2.3	1.8	3.0	9.0	
1986		6.3											
Mean	7.8	5.6	4.1	4.8	4.3	4.1	3.1	2.3	2.3	2.2	4.8	9.0	4.6

River Barabai
Location Kasarangan
Code No. 11 CA = 474 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980								8.0	3.4	4.3	12.0	13.4	
1981	4.7	7.0				17.0	11.5	5.0	5.8	7.6	13.8	30.0	
1982	37.3	10.7	12.6	14.0	10.8	13.0	5.2		1.0	1.0		4.0	
1983	7.5		1.2	3.3	13.0	2.6	3.8	2.6	1.9	1.3	8.2		
1984	5.4	11.4	5.9	14.7	4.4	4.8	4.7	4.3	11.0	8.5	11.6	15.9	8.6
1985	33.5		19.1	19.7	7.3	8.2	7.8	2.6	2.2		1.5		
Mean	17.7	9.7	9.7	12.9	8.9	8.1	6.7	4.5	4.2	4.5	9.4	15.8	9.3

River Negara
Location Amuntai
Code No. 12 CA = 7183 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1977				178.5	182.6	67.0	46.6	13.3		9.8	170.6		
1978	193.1	193.9		196.0	161.4	146.2	174.5	115.2	92.1		202.2	254.3	
1979	246.1	270.9	209.8	240.9	204.7	117.9	67.5	32.8	15.0	10.0	87.5	245.2	145.7
1980	260.8	187.1	196.2	203.0	143.5	82.4	78.2	57.8	14.6	19.6			
1981				215.8				40.2	31.9	61.4		232.8	
1982	282.9	235.6	288.6	259.0	185.6			13.3	6.8	9.4	9.2	72.1	
1983		53.7	8.2	72.6	95.8	58.0	21.0	16.3	26.3	178.2	163.7		
1984	178.0	258.1	273.6	204.5	201.0	169.9	147.2	132.2	98.6	66.0	65.8	181.6	160.5
1985	240.2	164.1	190.8	206.5	119.1	126.7	114.9	53.4	49.1		89.9	158.5	
1986	172.6	216.8	233.2	282.9	196.8	96.4	82.2	25.9	10.4	66.3	155.8	200.9	145.0
1987	277.1	253.3	162.3	132.1	171.5	139.0	18.8				30.3		
Mean	231.3	222.5	194.8	194.9	163.5	128.5	89.8	53.8	34.8	37.0	92.1	186.6	135.8

River Balangan
Location Balang
Code No. 13 CA = 1201 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1980								16.5	5.4	5.7	39.9	62.2	
1981	48.8	46.3	40.7	64.7	46.3	32.6	49.1	12.6	11.7	23.2	41.3	80.7	41.5
1982	145.6	77.2	207.9	99.4	53.9	38.1	10.4	5.5	3.5	4.3	4.2	21.6	56.0
1983	61.6	31.9	8.0	1.6	15.7	28.7	16.9	7.3	5.2	9.2	42.4	41.7	22.5
1984	80.0	113.0	72.9	82.7	90.1	43.4	52.4	31.7	28.5	15.7	47.7	64.8	60.2
1985	88.0	53.1		79.6		42.6		9.5					
Mean	84.8	64.3	82.3	65.6	51.5	37.1	32.2	13.9	10.9	11.6	35.1	54.2	45.3

River Balangan
Location Lampihong
Code No. 14 CA = 1664 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1982									6.1	6.9	7.7		
1983			39.1	63.6	39.1	20.0	14.1	15.0	80.1	89.1			
1984	194.1	154.3	161.5	173.6	96.4	102.9	63.3	60.6	33.1	53.0	131.6		
Mean	194.1	154.3	161.5	106.4	80.0	71.0	41.6	27.0	18.3	46.9	110.3		

River Tabalong
Location Tanjung
Code No. 15 CA = 2847 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1977				199.6	126.8	145.1	28.7	24.3	16.1		25.5	171.8	
1982					100.0	19.3		7.1	9.7	11.4	58.5		
1983	135.5	74.7	33.1										
Mean	135.5	74.7	33.1	199.6	126.8	122.6	24.0	24.3	11.6	9.7	18.5	116.2	74.7

River Uya
Location Teratau
Code No. 16 CA = 77 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1977			7.9	6.2		2.2	1.7	1.3	0.7	0.9	4.2		
1978	5.0	5.0	5.2	7.0	5.9	7.9	7.9	1.8	5.0	2.3	6.0	5.9	5.4
1979	6.8	13.2	10.4	11.6	6.0	2.4	5.8	1.7	0.9	0.9	2.4	4.7	5.6
1980	7.3	5.4	4.2	4.3	4.3	5.6	3.4	2.5	1.6	1.1	2.3	9.9	4.3
1981	8.7	5.8	5.8	7.4	6.1	8.2		2.5	3.2	3.2	3.7	10.4	
1982	5.9	7.1	14.4		5.9	4.3	2.4	1.3	1.4		0.8	1.4	
Mean	6.7	7.3	8.0	7.7	5.7	5.7	4.3	1.9	2.2	1.6	2.7	6.1	5.0

River Hanyar
Location Sei Hayar
Code No. 17 CA = km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1981			47.4	55.3		37.2	41.8	17.6	17.3	25.9	47.7	109.0	
1982		89.3	131.1	107.4	71.9	46.5	12.8	8.7	5.6	7.9	8.9	34.7	
1983	73.9	46.9	22.2	7.9	30.9	40.7	21.1	11.8	9.5	17.1	65.0	68.4	34.6
1984	73.7	112.2	96.5	70.8	87.9	45.5	48.3	40.0	28.0	27.1	29.0	55.0	59.6
1985	102.5	55.5	80.5	71.7	39.9	34.9	23.2	21.1	13.6	14.2	35.2	64.3	46.4
1986	76.4	84.7	94.9	123.5	75.0	28.3	23.7	16.6	7.8	30.3	64.2	79.6	55.7
1987	114.7	98.1	53.6	49.2									
Mean	88.2	81.1	75.2	73.7	61.1	38.8	28.5	19.3	13.6	20.4	41.7	68.6	50.9

River Balangan
Location Halong
Code No. 26 CA = 468 km2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1982	34.5	27.8	42.2	29.4	23.6	16.1	8.9	5.1	2.7	2.3	2.8		
1983	15.6	9.2	3.4	0.6	10.2	13.5	9.8	6.9	4.9	5.1	17.0	19.7	9.7
1984	30.1	35.9	24.7	32.7	31.7	18.1	15.5		13.1	9.1	13.1	17.6	
1985	24.6	17.7	26.7	30.4	20.8	19.9	13.4	7.1	7.6	8.6	15.7	18.2	17.6
1986	17.0	24.1	26.7	27.7	19.4	9.8	7.4	2.9	2.2	3.3	11.0	23.8	14.6
1987	34.3	29.1	20.5	17.5	17.8	13.6	6.3	5.1					
Mean	26.0	24.0	24.0	23.1	20.6	15.2	10.2	5.4	6.1	5.7	11.9	19.8	16.0

Table 3.2 Monthly Rainfall

Station: Hayap
Code No. 299   Unit :mm

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1917	176	346	259	254	277	111	48	194	142	216	202	296	2521
1918	338	153	339	115	160	130	38	64	54	110	70	215	1786
1919	206	389	208	320	272	164	200	80	72	54	260	388	2613
1920	269	310	334	196	126	189	125	186	89	169	242	179	2414
1921	279	349	380	223	234	97	65	103	204	160	88	295	2477
1922	167	183	291	84	340	116	118	78	25	193	262	168	2025
1923	189	331	296	122	84	242	169	61	39	57	274	271	2135
1924	328	165	539	221	420	185	61	225	23	601	387	459	3614
1925	223	322	352	222	161	61	11	64	40	148	148	488	2240
1926	221	343	319	301	177	156	82	89	216	139	203	304	2550
1927	310	228	152	218	131	176	187	26	79	128	205	366	2206
1928	533	281	269	210	152	88	109	118	79	153	271	331	2594
1929	236	214	210	100	137	130	174	97	24	118	307	409	2156
1930	469	341	225	360	415	120	59	106	125	153	183	386	2942
1931	313	388	330	424	193	129	168	181	207	143	348	373	3197
1932	334	306	290	345	200	285	59	149	80	50	185	213	2496
1933	330	235	187	419	136	106	148	32	137	156	296	244	2426
1934	307	249	352	327	99	253	114	148	41	102	291	492	2775
1935	269	161	343	293	222	275	100	94	115	149	240	273	2534
1936	271	282	402	324	205	143	71	193	63	127	392	272	2745
1937	197	195	328	449	268	79	165	146	170	99	238	318	2652
1938	304	66	610	169	125	74	189	120	55	188	148	313	2361
1939	451	257	213	217	186	247	131	71	108	184	200	167	2432
1940	216	297	363	277	394	123	64	62	60	147	172	309	2484
1941	169	202	184	258	255	64	40	1	59	84	287	299	1902
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	276	350	230	213	147	171	158	137	98	135	262	435	2612
1952	230	530	352	144	228	83	118	144	80	500	392	307	3108
1953	553	159	297	364	121	48	161	163	75	164	248	292	2645
1954	351	324	447	364	250	215	229	109	198	134	242	348	3211
1955	678	451	328	253	74	250	136	370	78	394	395	302	3709
1956	377	334	375	314	241	162	147	143	124	206	299	397	3119
1957	428	409	408	349	254	161	339	39	59	115	210	502	3273
1958	438	410	243	148	196	112	79	128	58	179	231	279	2501
1959	181	199	347	278	264	114	83	76	35	148	324	406	2455
1960	334	173	245	190	238	137	86	187	194	44	437	603	2868
1961	257	226	304	178	126	106	99	14	83	109	131	338	1971
1962	314	279	313	262	201	135	123	120	104	172	250	331	2603
1963	239	212	238	199	153	103	94	91	79	131	190	252	1981
1964	278	247	277	232	178	120	109	106	92	152	221	293	2306
1965	375	224	192	192	74	22	34	59	82	217	75	579	2125
1966	294	261	292	245	188	126	115	112	97	161	233	309	2433
1967	242	215	241	202	155	104	95	92	80	132	192	255	2005
1968	361	321	359	301	231	155	141	137	119	197	287	380	2991
1969	274	243	272	228	175	118	107	104	90	150	217	288	2267
1970	349	310	348	291	224	150	137	133	115	191	277	368	2894
1971	395	312	247	280	24	42	45	113	143	158	291	165	2215
1972	194	172	193	161	124	83	76	74	64	106	154	204	1604
1973	316	281	315	263	203	136	124	120	104	173	251	333	2618
1974	274	243	273	228	176	118	107	104	90	150	218	289	2270
1975	369	372	439	375	367	164	450	268	286	383	473	502	4448
1976	342	370	486	337	101	89	260	185	184	165	409	319	3247
1977	304	368	178	210	252	239	71	94	112	134	195	259	2416
1978	330	293	328	275	211	142	129	125	109	180	262	347	2731
1979	275	244	273	229	176	118	108	104	91	150	218	289	2274
1980	249	221	248	207	159	107	97	95	82	136	198	262	2061
1981	252	224	251	210	161	108	99	96	83	138	200	265	2087
1982	277	246	276	231	177	119	108	105	91	151	220	292	2294
1983	329	292	327	274	211	141	129	125	108	180	261	347	2724
1984	302	268	301	251	194	130	118	115	100	165	240	318	2501
1985	223	198	222	186	143	96	87	85	74	122	177	235	1849
1986	288	256	287	240	185	124	113	110	95	158	229	304	2389
1987	277	246	276	231	177	119	108	105	91	151	220	292	2293
1988													
Mean	305	275	303	251	196	136	121	116	99	165	246	324	2538

Table 3.3 Monthly Rainfall

Station   Tanjung
Code No.   301   Unit : mm

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1917	244	228	309	197	140	201	116	157	76	166	188	200	2222
1918	286	168	293	298	142	66	63	35	87	84	163	289	1974
1919	204	155	374	268	331	190	57	14	52	66	150	188	2049
1920	383	224	186	295	113	193	88	295	168	199	198	292	2634
1921	382	254	228	168	145	85	50	46	352	161	355	231	2457
1922	156	262	499	176	95	134	108	71	67	182	121	274	2145
1923	311	199	279	86	146	51	169	43	55	38	292	385	2054
1924	329	253	493	482	354	107	118	308	248	367	527	448	4034
1925	313	415	211	260	105	85	31	29	16	56	123	463	2107
1926	261	264	280	43	222	82	53	31	120	343	256	338	2293
1927	223	233	290	97	281	121	144	39	42	195	276	134	2075
1928	506	823	761	180	156	85	115	117	43	149	259	258	3452
1929	246	260	225	144	36	92	104	28	47	50	233	472	1937
1930	322	379	318	627	349	126	38	33	92	190	145	555	3174
1931	405	326	218	522	134	256	96	62	128	202	147	576	3072
1932	446	261	296	393	189	207	57	167	200	45	281	399	2941
1933	290	175	175	392	200	147	117	54	151	168	417	233	2519
1934	240	172	335	446	119	178	124	45	63	168	224	468	2582
1935	187	31	201	164	112	128	70	96	68	178	151	356	1742
1936	227	72	337	401	152	174	29	131	74	176	307	267	2347
1937	261	303	288	438	193	254	293	72	123	181	198	313	2917
1938	415	139	493	152	212	172	177	221	114	75	327	384	2881
1939	405	251	503	318	248	222	274	52	122	83	194	207	2879
1940	227	436	511	163	220	151	42	139	17	49	93	288	2336
1941	327	333	314	340	322	12	55	4	75	56	138	264	2240
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	431	196	178	137	78	78	123	229	77	97	167	653	2444
1952	259	285	288	196	186	49	96	139	68	140	157	320	2183
1953	213	187	123	132	100	32	108	83	44	56	109	159	1346
1954	293	175	325	251	109	157	263	137	183	178	199	325	2595
1955	403	230	278	207	266	107	75	182	276	269	429	162	2884
1956	361	435	177	260	374	155	95	155	95	199	47	394	2747
1957	321	283	254	262	138	129	108	115	91	43	347	386	2477
1958	182	437	503	279	108	145	73	210	59	170	273	401	2840
1959	151	108	269	304	245	221	36	62	79	53	198	373	2099
1960	278	243	236	253	202	124	106	110	276	79	457	475	2839
1961	269	155	387	249	253	68	28	34	26	31	192	381	2073
1962	371	365	316	223	60	61	191	111	146	131	249	433	2657
1963	148	374	312	134	138	92	109	49	58	112	58	244	1828
1964	324	325	245	307	228	90	162	26	131	376	253	229	2696
1965	413	420	179	218	268	69	50	50	13	49	103	256	2088
1966	310	265	355	145	183	122	86	156	31	283	305	282	2523
1967	216	235	87	114	172	156	39	137	98	123	78	408	1863
1968	456	256	210	223	132	127	140	111	126	87	213	241	2322
1969	76	177	161	100	148	24	38	42	44	112	241	292	1455
1970	261	147	204	381	136	266	195	149	227	153	252	280	2657
1971	337	305	427	195	125	204	217	146	152	149	179	332	2768
1972	281	122	173	156	209	62	80	28	29	180	122	353	1795
1973	267	220	445	347	292	169	89	227	178	161	208	337	2940
1974	227	167	166	267	146	28	172	39	93	289	354	276	2224
1975	207	232	282	118	243	51	223	175	153	329	316	183	2512
1976	186	327	430	156	60	67	160	177	48	277	395	349	2632
1977	190	258	325	173	126	190	58	106	52	112	100	316	2006
1978	166	394	117	281	189	142	218	177	91	467	273	412	2927
1979	413	293	139	83	109	156	70	70	3	51	114	326	1827
1980	215	383	188	198	26	60	111	61	62	160	290	182	1936
1981	156	195	195	80	67	122	59	77	142	38	188	499	1818
1982	303	78	530	485	112	180	16	63	46	40	115	209	2177
1983	179	263	55	177	79	219	60	72	436	180	695	835	3250
1984	142	497	306	253	124	54	145	159	96	64	138	96	2074
1985	193	113	172	119	163	78	125	28	93	0	142	192	1418
1986	171	317	461	375	137	140	45	15	110	211	226	246	2454
1987	343	146	161	121	192	61	29	89	88	180	197	371	1978
1988													
Mean	279	262	292	242	172	125	106	101	107	149	228	330	2394

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Table 3.4 Monthly Rainfall

Station: Batu Mandi
Code No.: 303a

Unit : mm

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1917	293	272	247	194	193	166	132	99	121	139	259	302	2416
1918	224	208	189	148	148	127	101	76	92	106	198	230	1846
1919	270	251	228	179	178	154	122	91	112	128	239	279	2232
1920	275	256	232	182	182	157	125	93	114	131	244	284	2274
1921	279	260	236	185	184	159	126	95	115	132	247	288	2306
1922	260	242	219	172	172	148	118	88	107	123	230	268	2147
1923	257	239	217	170	170	146	116	87	106	122	227	265	2120
1924	360	335	304	238	238	205	163	122	149	171	319	371	2975
1925	258	240	217	170	170	146	117	87	106	122	228	266	2128
1926	291	270	245	192	192	165	132	98	120	138	257	300	2400
1927	265	247	224	175	175	151	120	90	109	126	235	273	2188
1928	306	284	258	202	202	174	138	104	126	145	271	315	2526
1929	259	241	218	171	171	147	117	88	107	123	229	267	2139
1930	279	259	235	184	184	158	126	94	115	132	247	287	2301
1931	311	289	262	206	205	177	141	105	128	147	275	320	2567
1932	313	291	264	207	207	178	142	106	129	148	277	323	2587
1933	310	289	262	205	205	176	140	105	128	147	275	320	2562
1934	318	295	268	210	210	181	144	107	131	151	281	327	2623
1935	251	233	212	166	166	143	114	85	104	119	222	259	2072
1936	269	250	227	178	178	153	122	91	111	128	238	277	2222
1937	316	294	266	209	208	179	143	107	130	150	280	326	2607
1938	285	265	240	188	188	162	129	96	118	135	252	294	2352
1939	264	245	222	174	174	150	119	89	109	125	234	272	2178
1940	266	248	225	176	176	151	120	90	110	126	236	274	2199
1941	211	196	178	140	139	120	96	71	87	100	187	218	1744
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	248	230	209	164	163	141	112	84	102	117	219	255	2045
1952	314	292	265	208	207	178	142	106	130	149	278	324	2592
1953	380	271	274	317	314	71	153	143	43	109	404	313	2792
1954	265	264	233	233	238	255	173	122	192	192	240	372	2779
1955	402	289	254	177	172	121	180	303	130	167	328	160	2683
1956	249	354	131	236	262	161	38	142	155	189	213	259	2389
1957	159	326	195	104	165	160	118	37	9	57	263	202	1795
1958	154	281	314	212	50	52	50	128	123	142	167	263	1936
1959	200	189	240	243	233	196	65	62	59	26	112	426	2051
1960	257	348	155	155	285	129	348	50	213	145	346	413	2844
1961	407	489	327	193	205	221	35	44	239	226	224	289	2899
1962	452	274	253	203	64	81	135	88	69	117	340	355	2431
1963	148	364	331	158	216	22	65	81	99	88	67	286	1925
1964	415	157	223	201	160	44	157	87	132	205	207	153	2141
1965	269	233	231	164	151	94	75	50	43	63	75	103	1551
1966	214	336	355	140	242	56	84	228	20	177	188	311	2351
1967	384	308	13	42	180	107	78	121	68	55	173	287	1816
1968	386	194	251	134	374	388	151	201	146	96	277	321	2919
1969	275	255	232	182	181	156	124	93	113	130	243	283	2267
1970	176	123	250	144	195	506	268	25	412	244	112	314	2769
1971	448	340	192	183	74	146	144	88	124	146	189	264	2338
1972	246	141	195	85	306	18	35	0	79	122	184	323	1734
1973	346	211	146	285	292	133	179	238	279	146	367	484	3106
1974	142	215	219	222	198	81	88	114	85	176	357	297	2194
1975	321	220	257	179	147	111	154	107	266	298	91	256	2407
1976	334	178	198	176	44	123	123	39	62	203	466	462	2408
1977	170	227	301	198	74	203	134	65	15	84	180	340	1991
1978	379	465	227	222	197	179	373	115	228	127	438	288	3238
1979	316	255	155	162	236	132	80	36	53	52	239	464	2180
1980	323	176	182	139	133	239	82	71	51	161	285	183	2025
1981	130	238	243	182	133	68	115	32	102	127	276	287	1933
1982	350	236	408	302	154	320	16	6	87	90	182	193	2344
1983	316	136	49	49	269	452	458	244	107	430	1093	777	4380
1984	327	748	651	470	222	149	82	133	183	42	246	277	3530
1985	352	280	344	143	129	441	131	63	103	56	117	150	2309
1986	207	313	489	261	220	237	143	21	26	125	241	194	2476
1987	427	171	192	297	346	17	39	121	158	82	173	372	2394
1988													
Mean	288	268	243	190	191	164	130	98	119	137	255	298	2382

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Table 3.5 Monthly Rainfall

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1917	310	340	298	191	174	253	52	197	117	210	145	368	2655
1918	332	204	314	292	101	70	38	65	44	139	259	345	2203
1919	462	235	320	259	252	82	92	14	135	56	190	373	2470
1920	213	129	233	330	133	63	75	210	143	268	290	290	2377
1921	267	320	257	201	129	141	217	52	166	230	135	250	2365
1922	248	336	290	263	99	248	43	51	52	244	168	285	2327
1923	343	375	281	246	149	59	192	117	21	140	359	239	2521
1924	276	242	454	307	165	157	208	102	155	362	434	306	3168
1925	190	288	321	244	285	146	104	58	55	19	131	500	2341
1926	225	208	282	358	326	151	169	120	130	219	242	256	2686
1927	346	231	305	236	155	268	55	51	161	163	299	342	2612
1928	376	261	403	74	190	120	71	98	100	181	272	359	2505
1929	312	211	392	201	66	164	74	66	67	61	204	467	2285
1930	313	211	228	246	190	36	5	9	22	158	199	319	1936
1931	261	133	87	358	188	256	89	59	154	303	219	525	2632
1932	355	295	416	456	188	174	190	250	86	146	147	352	3055
1933	423	271	447	341	170	318	108	74	172	141	232	289	2986
1934	239	197	259	303	91	152	240	103	61	261	382	246	2534
1935	279	216	167	255	270	97	65	46	177	285	157	346	2360
1936	403	125	257	240	165	269	48	63	42	100	288	198	2198
1937	265	296	113	318	329	139	177	6	250	183	199	301	2576
1938	263	172	343	116	168	140	161	173	95	175	240	264	2310
1939	351	175	306	354	123	159	129	50	81	111	90	172	2101
1940	218	303	300	56	227	68	99	74	20	86	183	201	1835
1941	150	95	190	66	280	122	32	5	79	20	289	236	1564
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	340	271	69	80	100	52	134	106	111	80	152	284	1779
1952	331	230	493	315	354	49	134	114	68	306	323	687	3454
1953	265	398	497	458	502	331	227	145	42	310	322	811	4308
1954	625	376	406	488	194	385	485	234	299	124	281	237	4134
1955	303	488	255	271	127	117	249	202	192	64	352	163	2783
1956	271	134	248	236	364	163	79	203	125	165	183	251	2422
1957	200	353	213	154	185	190	159	79	53	38	323	315	2262
1958	184	448	297	80	161	66	79	230	82	193	233	357	2410
1959	151	239	264	165	175	279	101	15	88	130	234	282	2123
1960	410	384	239	199	247	40	238	88	99	39	378	188	2549
1961	356	375	156	233	292	83	36	42	88	61	288	272	2282
1962	322	263	204	223	150	115	126	94	93	127	190	158	2065
1963	115	451	237	130	101	8	81	143	31	57	124	226	1704
1964	269	345	260	238	186	78	103	95	97	141	316	228	2356
1965	223	214	216	188	147	103	99	79	81	117	197	250	1914
1966	441	350	274	169	76	68	170	129	21	214	259	116	2287
1967	234	224	226	197	154	108	104	83	85	123	207	262	2005
1968	259	223	111	221	149	155	189	182	68	77	442	400	2476
1969	231	208	345	154	259	65	26	49	85	89	233	295	2039
1970	338	323	327	284	222	156	211	92	168	121	63	399	2703
1971	281	219	147	315	19	128	175	120	278	147	248	365	2442
1972	123	148	173	225	220	55	63	59	30	109	165	479	1849
1973	167	111	191	236	225	145	324	207	234	124	296	376	2636
1974	92	284	153	125	409	86	132	188	271	296	519	526	3081
1975	28	301	261	96	129	113	186	145	179	256	426	357	2477
1976	164	150	295	185	166	108	179	11	92	145	530	357	2382
1977	268	418	453	235	161	129	99	65	18	41	215	344	2446
1978	173	360	412	159	198	87	126	267	115	365	276	247	2785
1979	458	525	254	327	115	197	60	133	54	10	320	292	2745
1980	185	233	261	263	267	95	10	113	20	45	133	251	1876
1981	237	374	314	183	142	60	129	23	132	287	225	403	2509
1982	570	282	378	299	177	160	33	72	55	28	222	367	2643
1983	435	317	39	293	350	71	135	113	59	210	186	247	2455
1984	124	313	327	391	135	55	190	121	116	72	278	278	2400
1985	281	175	324	203	107	23	120	110	78	102	192	345	2060
1986	385	415	460	494	124	136	183	17	103	229	295	219	3060
1987	536	306	222	226	27	153	17	29	29	28	247	390	2210
Mean	288	276	278	243	189	133	128	102	104	150	252	320	2463

Table 3.6 Monthly Rainfall

Station Code No. : Negara 305b
Unit : mm

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1917	339	282	294	240	193	125	93	75	95	132	219	331	2418
1918	259	216	224	183	147	95	71	58	72	101	167	253	1846
1919	313	261	271	221	178	115	86	70	87	122	202	306	2232
1920	319	266	276	226	182	118	87	71	89	124	206	311	2275
1921	369	292	282	202	234	123	65	23	148	138	178	224	2278
1922	407	347	383	285	83	246	66	61	34	59	179	245	2395
1923	284	428	281	188	237	61	137	96	3	184	206	330	2435
1924	272	163	543	179	103	166	151	97	42	182	372	312	2582
1925	225	344	264	226	279	57	36	19	49	20	81	246	1846
1926	337	280	292	238	192	124	92	75	94	131	217	328	2400
1927	341	262	315	269	169	92	37	28	112	72	304	333	2334
1928	354	295	307	251	202	131	97	79	99	138	228	346	2527
1929	357	274	207	238	106	197	108	55	46	59	183	399	2229
1930	294	193	271	159	182	247	45	60	18	114	155	348	2086
1931	472	227	80	381	198	103	31	29	52	273	149	348	2343
1932	376	214	338	368	76	88	37	92	130	7	171	250	2147
1933	578	154	154	274	162	248	20	155	213	293	486	417	3154
1934	368	306	319	260	209	136	100	82	103	143	237	359	2622
1935	403	276	252	402	45	28	32	10	100	146	134	222	2050
1936	425	110	242	255	114	157	64	56	24	123	274	258	2102
1937	196	187	190	288	212	121	92	77	122	231	198	320	2234
1938	258	240	193	148	239	180	98	53	158	139	135	337	2178
1939	259	124	328	404	89	98	35	27	175	46	44	217	1846
1940	150	211	294	57	319	114	106	32	86	55	105	247	1776
1941	182	132	287	63	201	90	67	54	131	23	16	189	1435
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	307	128	77	124	65	78	48	95	44	37	125	149	1277
1952	293	346	410	127	179	52	86	72	52	63	140	162	1982
1953	249	293	208	235	153	82	92	39	38	44	227	344	2004
1954	419	228	314	259	242	256	127	145	159	163	270	409	2991
1955	627	405	360	311	329	239	120	184	154	75	403	331	3538
1956	269	224	233	190	153	99	73	60	75	104	173	262	1915
1957	356	266	269	81	150	134	191	47	46	98	196	485	2319
1958	281	234	244	199	160	104	77	63	79	109	181	274	2005
1959	420	350	364	297	239	155	115	93	117	163	271	409	2993
1960	329	447	197	172	179	19	105	25	108	150	249	275	2255
1961	373	232	191	180	152	124	80	21	38	92	165	341	1989
1962	310	192	300	247	111	60	147	104	162	169	194	400	2396
1963	180	427	427	321	209	55	24	12	7	11	25	367	2065
1964	315	227	421	201	169	193	147	91	148	206	216	161	2495
1965	469	402	224	203	158	91	42	26	9	104	25	275	2028
1966	221	367	317	238	208	93	73	81	6	71	62	203	1940
1967	341	284	295	241	194	125	93	76	95	132	220	332	2428
1968	286	238	248	202	163	105	78	64	80	111	184	279	2038
1969	383	319	332	271	218	141	105	85	107	149	247	374	2731
1970	239	246	262	228	199	164	138	86	122	106	95	249	2134
1971	438	313	188	121	78	54	71	93	176	215	248	291	2286
1972	159	152	144	132	109	68	31	13	3	15	35	116	977
1973	159	175	213	227	184	146	101	122	236	57	297	356	2273
1974	259	311	259	231	172	98	155	69	24	49	130	237	1994
1975	395	219	359	121	272	155	176	115	197	240	254	267	2770
1976	206	223	358	143	64	55	34	123	177	317	323	436	2459
1977	146	347	412	285	190	96	64	3	1	60	124	425	2153
1978	447	127	420	432	287	130	115	115	106	87	200	339	2805
1979	377	415	232	222	158	123	115	122	4	13	305	609	2695
1980	255	115	134	296	273	170	40	178	36	141	176	218	2032
1981	102	196	196	276	224	69	113	15	118	189	164	379	2041
1982	241	224	376	138	286	18	164	170	164	150	289	344	2564
1983	232	202	46	143	294	83	109	85	107	148	232	283	1964
1984	249	265	286	225	161	89	143	52	138	116	340	563	2627
1985	188	162	373	127	74	168	46	58	110	203	458	315	2282
1986	523	352	173	237	191	124	75	75	6	302	413	112	2583
1987	404	514	102	96	97	119	35	64	32	106	197	296	2062
1988													
Mean	316	262	272	222	179	119	87	72	90	123	205	309	2256

Table 3.7 Monthly Rainfall

Station Rantau
Code No. 306

Unit : mm

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1917	231	340	335	221	350	184	87	106	132	307	210	203	2706
1918	269	177	133	249	172	97	8	18	32	45	144	323	1667
1919	318	221	452	263	196	63	37	0	99	34	184	489	2356
1920	310	112	370	248	57	70	97	188	210	204	32	229	2127
1921	340	218	374	204	91	105	142	102	150	213	171	209	2319
1922	316	256	259	200	191	99	33	35	37	95	264	169	1954
1923	381	312	253	142	112	161	165	17	0	102	242	108	1995
1924	412	263	386	337	135	65	93	84	69	116	247	326	2533
1925	199	254	420	164	152	218	61	8	42	31	117	237	1903
1926	359	249	355	222	327	150	32	126	121	73	256	314	2584
1927	348	222	324	255	77	167	105	93	272	33	317	184	2397
1928	317	289	404	275	72	252	40	133	23	105	289	272	2471
1929	211	181	449	103	49	49	78	65	59	78	105	88	1515
1930	183	43	68	72	186	76	46	0	0	0	207	295	1176
1931	382	198	183	133	119	232	36	33	100	92	136	548	2192
1932	358	335	219	316	226	89	130	84	157	104	151	224	2393
1933	398	212	542	128	197	155	92	83	88	146	173	210	2424
1934	478	146	351	356	71	360	249	113	120	227	261	302	3034
1935	175	116	294	291	136	202	35	41	76	143	70	209	1788
1936	331	245	153	223	148	96	29	19	44	225	101	244	1858
1937	78	170	152	243	162	134	105	57	158	110	148	356	1873
1938	372	126	306	94	155	88	98	151	25	219	103	206	1943
1939	243	205	53	160	44	73	33	0	51	115	98	354	1429
1940	356	425	578	152	220	120	65	36	22	40	111	390	2515
1941	393	164	280	100	341	27	74	59	107	73	108	312	2038
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	278	227	276	198	153	114	78	66	83	126	184	262	2044
1952	353	287	350	251	194	144	98	84	105	160	234	332	2592
1953	342	278	339	243	188	140	95	81	102	155	226	322	2511
1954	407	331	403	289	223	166	113	97	121	184	269	383	2986
1955	423	345	420	301	232	173	101	101	126	191	280	399	3109
1956	425	346	421	302	233	174	118	101	126	192	281	400	3120
1957	341	278	338	242	187	139	95	81	101	154	226	321	2504
1958	381	310	378	270	209	155	106	90	113	172	252	358	2794
1959	301	245	299	214	165	123	84	72	90	136	199	283	2211
1960	389	446	371	290	168	40	233	89	61	190	468	277	3022
1961	359	333	230	332	207	164	6	37	64	167	129	411	2439
1962	502	249	483	301	83	165	249	88	114	286	324	270	3114
1963	303	333	449	229	149	16	270	88	4	56	199	485	2581
1964	344	255	311	302	86	116	60	38	202	294	323	148	2479
1965	450	175	338	185	111	111	0	86	21	172	28	426	2103
1966	265	598	411	94	188	81	23	197	90	205	317	451	2920
1967	412	203	143	235	160	66	132	139	147	100	294	555	2586
1968	705	378	409	342	326	394	318	227	124	217	428	381	4249
1969	345	453	286	351	347	41	0	79	67	266	371	474	3080
1970	380	420	732	442	285	333	214	122	182	283	221	404	4018
1971	319	345	208	162	172	206	66	184	198	297	447	192	2796
1972	205	434	204	245	373	40	76	2	16	132	262	218	2207
1973	345	127	268	269	167	137	108	159	124	184	315	333	2536
1974	314	104	361	398	301	168	65	140	224	216	202	200	2693
1975	358	143	505	119	158	43	67	49	254	275	312	288	2571
1976	255	170	415	273	72	113	17	48	25	323	244	398	2353
1977	272	416	239	176	112	163	26	25	15	48	137	192	1821
1978	245	215	282	146	401	150	114	137	167	107	127	180	2271
1979	273	314	272	343	163	193	49	74	70	32	198	465	2446
1980	340	182	202	273	221	129	160	88	105	83	218	247	2248
1981	110	331	188	315	225	94	130	4	84	230	298	443	2452
1982	437	256	402	133	123	118	5	7	12	71	156	338	2058
1983	151	162	368	240	189	151	102	105	61	69	285	270	2153
1984	171	203	272	258	200	88	72	34	92	71	115	226	1802
1985	329	264	212	178	62	124	111	73	102	44	140	199	1838
1986	98	181	216	92	72	33	48	0	127	111	287	306	1571
1987	502	614	429	152	180	131	32	72	92	194	108	364	2870
1988													
Mean	326	265	325	231	179	133	91	78	97	147	215	306	2393

Table 3.8 Estimated Monthly Runoff

Tabalong Kiwa Sub-system
Catchment Area : 1333 km2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1917	42.85	76.06	61.79	57.73	64.13	34.16	25.44	27.27	25.35	29.82	34.90	59.19	538.70
1918	78.65	44.60	70.21	33.94	31.90	28.43	21.09	17.82	15.67	19.57	18.80	29.13	409.79
1919	36.99	82.65	50.52	67.27	64.13	40.81	38.46	28.44	23.49	18.56	33.79	79.69	564.80
1920	67.80	75.28	78.47	49.71	32.65	35.33	28.20	27.97	25.72	25.12	36.84	35.54	518.64
1921	56.25	81.12	90.31	58.26	54.52	36.26	28.45	26.44	30.65	27.97	25.58	50.26	566.06
1922	38.67	38.65	56.78	32.92	67.40	33.58	25.97	21.92	15.62	21.27	38.37	33.39	424.54
1923	35.60	69.01	66.65	32.13	27.45	40.83	32.92	24.13	16.86	14.46	33.44	52.28	445.76
1924	72.62	43.77	114.38	63.63	97.45	54.86	31.78	35.01	23.35	109.04	101.27	118.04	865.19
1925	70.54	81.86	87.46	60.50	42.67	32.95	21.23	19.88	18.24	19.19	21.29	90.91	566.71
1926	60.98	81.47	77.15	73.04	47.23	36.53	30.74	26.87	32.66	27.04	31.33	59.54	584.59
1927	72.83	58.85	35.82	41.56	31.78	32.64	33.89	21.98	20.03	17.62	25.30	68.70	461.00
1928	125.49	84.77	66.13	50.05	36.21	31.53	30.27	29.58	25.85	23.71	40.81	70.47	614.86
1929	58.15	51.82	44.64	33.18	29.33	26.47	27.83	25.70	16.89	20.79	46.69	89.59	471.10
1930	116.11	96.00	59.71	81.82	103.46	44.28	31.15	28.83	24.86	23.72	27.70	74.62	712.26
1931	78.14	97.23	84.74	104.22	59.74	37.25	34.68	32.89	36.57	29.81	62.78	88.69	746.73
1932	87.70	82.41	72.78	84.02	56.81	68.08	36.59	30.56	27.34	22.12	27.13	37.10	632.65
1933	70.27	60.73	43.34	89.90	43.41	30.72	28.06	19.33	19.82	20.90	43.79	52.10	522.37
1934	69.10	62.28	79.29	79.42	35.20	49.49	31.17	26.22	19.93	21.57	43.62	108.78	626.07
1935	76.77	46.08	72.37	70.52	56.23	64.32	39.02	32.15	31.19	27.43	38.14	56.75	610.97
1936	63.64	69.38	93.68	83.77	56.69	37.82	30.88	31.24	26.11	28.25	73.38	67.94	662.77
1937	50.62	46.72	69.66	105.70	76.47	39.51	35.53	29.71	29.62	28.27	38.91	67.48	618.22
1938	74.50	36.59	129.75	59.14	36.11	30.67	32.71	32.15	25.61	27.24	26.50	55.62	566.58
1939	104.48	74.54	52.29	47.91	42.17	53.15	33.61	26.72	26.82	28.15	32.80	32.52	555.17
1940	41.82	64.96	82.55	68.57	94.14	41.98	30.56	23.96	20.48	20.22	24.29	53.52	567.05
1941	40.12	43.13	36.25	49.53	55.71	31.76	22.71	15.35	14.52	15.98	37.23	60.45	422.75
1942													
1943													
1944													
1945													
1946													
1947													
1948													
1949													
1950													
1951	64.39	84.30	57.77	48.39	34.95	34.70	31.52	25.61	24.85	21.62	37.02	92.75	557.87
1952	63.07	125.08	97.34	45.05	49.93	35.16	28.15	24.46	23.02	87.80	96.66	81.83	757.54
1953	135.92	62.90	68.87	87.85	41.88	31.63	30.65	29.04	26.07	25.89	38.91	61.67	641.27
1954	83.49	84.83	108.54	97.67	70.97	57.03	53.31	38.21	38.99	30.89	41.02	76.30	781.25
1955	163.97	138.01	98.01	71.67	41.61	55.39	38.43	71.93	39.80	79.43	98.16	84.62	981.03
1956	99.21	95.32	98.87	87.00	69.18	48.43	39.34	33.19	28.69	32.81	56.85	94.47	783.36
1957	112.73	115.04	110.95	97.75	75.02	49.69	77.24	37.98	30.46	31.54	38.09	111.04	887.52
1958	120.33	117.78	74.44	44.40	46.40	36.25	31.87	33.21	27.98	29.11	39.33	59.67	660.76
1959	46.78	47.16	75.06	68.87	66.21	37.03	31.70	26.89	19.95	20.81	49.53	92.20	582.19
1960	88.19	52.62	53.61	43.66	52.04	35.93	31.04	30.70	32.94	24.75	77.32	145.20	668.01
1961	85.39	63.39	71.20	47.03	34.91	28.53	28.11	19.22	20.57	23.50	22.47	56.97	501.30
1962	73.03	70.20	72.59	62.80	49.46	34.45	27.99	28.14	27.82	27.28	40.41	70.45	584.62
1963	59.32	52.07	50.83	43.28	34.35	27.14	25.71	23.94	22.10	19.13	24.57	42.12	424.58
1964	58.73	57.84	59.62	51.56	40.00	29.51	28.24	26.61	24.81	22.69	31.02	56.14	486.76
1965	85.55	60.45	42.82	38.33	29.51	20.29	15.69	14.64	16.17	23.60	21.57	111.53	480.14
1966	81.56	66.74	65.59	56.02	43.72	31.04	24.43	24.55	24.22	23.35	33.77	61.24	536.24
1967	56.28	50.61	49.83	42.47	33.22	25.87	24.48	22.77	20.99	18.09	23.70	42.01	410.30
1968	77.09	79.35	83.94	73.42	57.15	37.96	30.58	24.54	20.35	24.47	46.21	83.11	638.17
1969	70.19	61.01	60.51	51.91	40.48	30.29	28.80	27.13	25.16	22.91	30.52	54.77	503.69
1970	79.39	78.62	82.38	71.78	56.36	37.72	30.79	24.71	26.23	28.33	47.55	81.25	645.12
1971	98.20	85.44	62.32	64.86	31.45	23.91	19.07	22.50	22.66	22.48	44.20	35.55	532.64
1972	38.45	36.23	35.45	30.84	26.27	24.23	21.72	18.93	16.74	19.07	20.74	29.04	317.72
1973	60.30	64.96	69.21	59.72	46.78	31.50	25.26	25.49	25.26	24.93	38.42	68.82	540.67
1974	65.50	58.95	59.37	50.79	39.41	29.28	27.85	26.23	24.32	22.11	29.95	54.42	488.18
1975	83.40	93.58	107.13	97.90	96.09	51.39	99.70	68.49	66.94	86.78	116.98	135.13	1103.51
1976	105.03	104.94	127.05	100.29	45.13	39.27	52.72	42.29	40.20	35.94	83.30	84.55	860.70
1977	82.22	97.66	54.81	50.34	59.77	60.30	37.88	33.02	32.67	28.01	32.27	50.71	619.66
1978	76.80	77.03	80.06	70.08	55.56	38.57	32.09	32.14	31.62	31.26	46.86	77.75	649.83
1979	71.43	63.94	63.75	55.10	43.38	33.02	31.54	29.74	27.77	25.37	33.06	57.39	535.48
1980	58.69	54.19	53.93	46.23	36.38	28.57	27.01	25.40	23.57	20.72	26.57	46.28	447.54
1981	54.75	52.43	52.78	45.35	35.27	27.27	25.89	24.22	22.47	19.81	25.82	46.30	432.37
1982	59.69	57.67	59.19	51.10	39.50	29.17	27.84	26.30	24.45	22.28	30.47	55.50	483.15
1983	74.53	72.75	75.49	65.59	51.48	34.61	28.33	28.57	28.10	27.91	43.42	74.62	605.41
1984	74.61	68.21	69.45	59.51	47.27	33.42	26.67	26.75	26.39	25.59	36.90	65.56	560.33
1985	54.24	47.11	45.48	38.21	31.69	29.21	26.30	23.28	20.87	23.74	26.35	39.86	406.34
1986	59.83	59.97	62.30	53.68	42.17	30.24	23.57	23.67	23.45	22.44	32.25	59.23	492.79
1987	63.44	58.82	59.71	51.44	39.78	29.39	28.03	26.45	24.57	22.38	30.55	55.55	490.09
Mean	73.81	70.44	70.92	61.30	49.64	36.95	31.98	28.27	25.75	28.49	41.25	67.55	586.35