16.6.3 Solid Waste

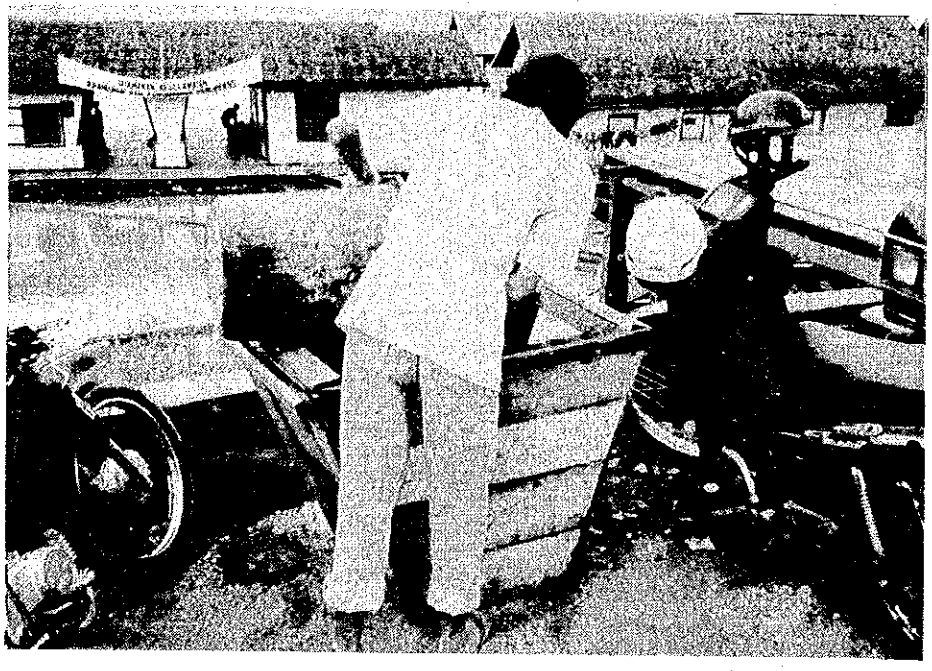
Indonesian government has a system to encourage activities in keeping each city clean by commending good achievement. In general, all cities, except for public market areas, are being kept clean through the regular collection of solid wastes and the sweeping of roads.

Collection points and containers for solid waste collection from households are set at the roadside in urban areas and regular collection and haulage are carried out. People discharge refuses to the designated places near their houses. However, discharged solid waste are not separated into combustible and noncombustible items.

Solid waste is collected and disposed of without any intermediate treatment by the public sector. Any final disposal site is not designated in the Study Area. Dumping solid waste to rivers and/or open fields in the fringe area of urban areas, therefor, is the usual disposal practice. Construction of a final disposal site is now being implemented at Pontianak and Palangkaraya cities as the KUDP aided by the World Bank.

There is no service of solid waste collection in the rural areas. Inhabitants dispose solid wastes by dumping and burying to rivers and open fields near their houses. Burning is also another common disposal practice.

Photo 16.6.4 Garbage Box on the street in Muarateweh



16.6.4 Electricity

Electric supply works in the Study Area are done by PLN using diesel generators. Capacity of generators installed is almost constant but electricity production and sold to customer are increasing about 10% year by year. Ratio of electricity sold to production in West Kalimantan is about 80% and 90% in the other three provinces. It is estimated that 10~20% lose occurs during the transmission of electricity (see Table 16.6.7).

Table 16.6.7 Capacity of Generator Installed and Electricity Production by PLN

Area	Type of Gene		1991	1992	1993	1994	1995
West Kalimantan	Diesel	Capa(kw)	122,857	126,757	143,207	144,297	142,097
		Prod(Mwh)	310,454	346,664	382,230	426,296	462,927
		Sold(Mwh)	248,189	281,344	314,412	352,943	384,734
		Sold/Prod	0.80	0.81	0.82	0.83	0.83
Cen, Eas, Sou Kalimantan	Total	Capa(kw)	313,121	352,270	389,556	406,651	417,033
		Prod(Mwh)	921,837	1,047,722	1,145,967	1,084,162	1,413,847
		Sold(Mwh)	802,629	916,027	1,003,663	1,115,307	1,249,462
		Sold/Prod	0.87	0.87	0.88	1.03	0.88
	Diesel	Capa(kw)	262,121	301,247	338,548	355,621	366,003
		Prod(Mwh)	698,707	826,131	947,080	944,458	1,257,429
	Hydro	Capa(kw)	30,000	30,023	30,008	30,030	30,030
		Prod(Mwh)	102,856	114,084	146,737	134,748	132,161
	Gas Turbine	Capa(kw)	21,000	21,000	21,000	21,000	21,000
		Prod(Mwh)	120,274	107,507	52,150	4,956	24,257

Source: PLN Electricity Statistics 1991-1995

The number of customers in West Kalimantan is increasing by more than 15% every year. The main customers are households which are increasing by 20% year by year. The commercial sector and industry are other major customers for PLN. The volume of electricity sold or consumed is 0.8Mwh per year to each household, 3.0Mwh to each commercial business and 300Mwh to each industry and is almost constant every year. The three other provinces in Kalimantan have the same trend as West (see Table 16.6.8).

Only half of the households in the Study Area use electricity according to the 1995 Census. More than 90% of urban households are use electricity while only 36% of rural households use electricity. All the regencies except Pontianak and Palangkaraya cities have the same tendency. The urban and rural areas at Pontianak and Palangkaraya cities show high ratio of electricity use. The ratio of electricity usage at the rural areas of Sanggau and Barito Utara is very low compared with other rural areas (see Table 16.6.9).

Table 16.6.8 Number of PLN Customer and Electricity Sold by Type

Area	Customer		1991	1992	1993	1994	1995
West Kalimantan	Household	1. Number	132,513	144,410	177,894	195,755	231,597
		2. Sold(Mwh)	107,067	123,838	139,725	166,687	192,281
		Sold/Number	0.81	0.86	0.79	0.85	0.83
	Commercial	1. Number	14,350	15,000	16,019	16,624	17,750
		2. Sold(Mwh)	36,174	41,420	45,205	48,400	53,356
		Sold/Number	2.52	2.76	2.82	2.91	3.01
	Industrial	1. Number	307	311	334	345	352
		2. Sold(Mwh)	79,084	88,276	97,580	104,417	103,598
		Sold/Number	257.60	283.85	292.16	302.66	294.31
	Others	1. Number	5,528	5,707	6,449	6,447	7,263
		2. Sold(Mwh)	25,864	27,810	31,902	33,439	35,499
		Sold/Number	4.68	4.87	4.95	5.19	4.89
	Total	1. Number	152,698	165,428	200,696	219,171	256,962
		2. Sold(Mwh)	248,189	281,344	314,412	352,943	384,734
		Sold/Number	1.63	1.70	1.57	1.61	1.50
Cen, Eas, Sou Kalimantan	Household	1. Number	376,805	414,678	467,867	542,304	624,275
		2. Sold(Mwh)	336,585	384,949	430,719	491,770	565,907
		Sold/Number	0.89	0.93	0.92	0.91	0.91
	Commercial	1. Number	19,044	21,384	23,789	26,547	31,428
		2. Sold(Mwh)	72,059	86,685	100,966	118,346	139,119
		Sold/Number	3.78	4.05	4.24	4.46	4.43
	Industrial	1. Number	709	724	743	790	847
		2. Sold(Mwh)	288,707	330,843	351,290	379,560	408,975
		Sold/Number	407.20	456.97	472.80	480.46	482.85
	Others	1. Number	14,526	16,325	18,207	20,058	21,970
		2. Sold(Mwh)	105,278	113,550	120,688	125,631	135,461
		Sold/Number	7.25	6.96	6.63	6.26	6.17
	Total	1. Number	411,084	453,111	510,606	589,699	678,520
		2. Sold(Mwh)	802,629	916,027	1,003,663	1,115,307	1,249,462
		Sold/Number	1.95	2.02	1.97	1.89	1.84

Source: PLN Electricity Statistics 1991-1995

In West Kalimantan, PLN supplied electricity to 231,597 households in 1995. However, 357,073 households used electricity in 1995. 139,734 households at urban and 217,339 at rural areas. This means that power plants are located only at urban areas so that the main areas of electric supply are urban areas while rural areas are under-supplied except where located near urban area by PLN. One of the reasons for this is the shortage of generator capacity and production by PLN. Another reason is the lack of transmission facilities due to the lack of connecting roads from tertiary urban centers to rural areas. Households not supplied electricity by PLN, especially at rural areas, use their own portable generators.

Table 16.6.9 Households by Type of Lighting in Living Quarter

West Kalimantan

Regency/Municipality	Area	Electricity		Gas		Pumped Lamp		Kerosene		Others		Total	
Smbas	Urban	24,035	99.0%	0	0	0	0	253	1.0%	0	0	24,288	100%
	Rural	74,045	49.0%	0	0	4,130	2.7%	72,865	48.2%	0	0	151,040	"
	Total	98,080	55.9%	0	0	4,130	2.4%	73,118	41.7%	0	0	175,328	"
Kabupaten Pontianak	Urban	23,922	84.4%	0	0	443	1.6%	3,987	14.1%	0	0	28,352	"
	Rural	47,502	33.5%	0	0	10,440	7.4%	84,042	59.2%	0	0	141,984	"
	Total	71,424	41.9%	0	0	10,883	6.4%	88,029	51.7%	0	0	170,336	"
Sanggau	Urban	5,670	93.8%	0	0	0	0	378	6.3%	0	0	6,048	"
	Rural	22,144	22.2%	0	0	5,536	5.6%	71,968	72.2%	0	0	99,648	"
	Total	27,814	26.3%	0	0	5,536	5.2%	72,346	68.4%	0	0	105,696	"
Ketapang	Urban	4,592	87.5%	0	0	0	0	656	12.5%	0	0	5,248	"
	Rural	29,700	38.3%	0	0	2,430	3.1%	45,495	58.6%	0	0	77,625	"
	Total	34,292	41.4%	0	0	2,430	2.9%	46,151	55.7%	0	0	82,873	"
Sintang	Urban	5,220	93.8%	0	0	0	0	348	6.3%	0	0	5,568	"
	Rural	23,556	26.2%	0	0	5,616	6.3%	60,684	67.5%	0	0	89,856	"
	Total	28,776	30.2%	0	0	5,616	5.9%	61,032	64.0%	0	0	95,424	"
Kapuas Hulu	Urban	2,175	90.6%	0	0	75	3.1%	150	6.3%	0	0	2,400	"
	Rural	13,392	37.5%	124	0.3%	4,092	11.5%	18,104	50.7%	0	0	35,712	"
	Total	15,567	40.8%	124	0.3%	4,167	10.9%	18,254	47.9%	0	0	38,112	"
Kotamadya Pontianak	Urban	74,120	94.6%	0	0	1,496	1.9%	2,720	3.5%	0	0	78,336	"
	Rural	7,000	87.5%	0	0	0	0	750	9.4%	250	3.1%	8,000	"
	Total	81,120	94.0%	0	0	1,496	1.7%	3,470	4.0%	250	0.3%	86,336	"
Total of West	Urban	139,734	93.0%	0	0	2,014	1.3%	8,492	5.7%	0	0.0%	150,240	"
	Rural	217,339	36.0%	124	0.0%	32,244	5.3%	353,908	58.6%	250	0.0%	603,865	"
	Total	357,073	47.4%	124	0.0%	34,258	4.5%	362,400	48.1%	250	0.0%	754,105	"

Central Kalimantan

Regency/Municipality	Area	Electricity		Gas		Pumped Lamp		Kerosene		Others		Total	
Kotawaringin Barat	Urban	11,152	85.4%	0	0	1,224	9.4%	680	5.2%	0	0	13,056	100%
	Rural	16,524	47.5%	0	0	1,292	3.7%	16,524	47.5%	476	1.4%	34,816	"
	Total	27,676	57.8%	0	0	2,516	5.3%	17,204	35.9%	476	1.0%	47,872	"
Kotawaringin Timur	Urban	16,320	85.7%	0	0	170	0.9%	2,550	13.4%	0	0	19,040	"
	Rural	28,620	36.3%	0	0	3,975	5.0%	46,269	58.7%	0	0	78,864	"
	Total	44,940	45.9%	0	0	4,145	4.2%	48,819	49.9%	0	0	97,904	"
Kapuas	Urban	6,475	78.1%	0	0	1,295	15.6%	518	6.3%	0	0	8,288	"
	Rural	43,188	40.1%	0	0	13,098	12.2%	48,852	45.4%	2,478	2.3%	107,616	"
	Total	49,663	42.8%	0	0	14,393	12.4%	49,370	42.6%	2,478	2.1%	115,904	"
Barito Selatan	Urban	5,751	84.4%	0	0	639	9.4%	426	6.3%	0	0	6,816	"
	Rural	11,592	35.9%	0	0	4,347	13.5%	16,317	50.6%	0	0	32,256	"
	Total	17,343	44.4%	0	0	4,986	12.8%	16,743	42.9%	0	0	39,072	"
Balito Utara	Urban	6,375	88.5%	0	0	225	3.1%	600	8.3%	0	0	7,200	"
	Rural	4,340	13.7%	0	0	3,906	12.3%	23,498	74.0%	0	0	31,744	"
	Total	10,715	27.5%	0	0	4,131	10.6%	24,098	61.9%	0	0	38,944	"
Palangkaraya	Urban	28,600	95.6%	0	0	495	1.7%	825	2.8%	0	0	29,920	"
	Rural	1,638	60.9%	0	0	0	0.0%	1,050	39.1%	0	0	2,688	"
	Total	30,238	92.7%	0	0	495	1.5%	1,875	5.8%	0	0	32,608	"
Total of Central	Urban	74,673	88.6%	0	0	4,048	4.8%	5,599	6.6%	0	0	84,320	"
	Rural	105,902	36.8%	0	0	26,618	9.2%	152,510	53.0%	2,954	1.0%	287,984	"
	Total	180,575	48.5%	0	0	30,666	8.2%	158,109	42.5%	2,954	0.8%	372,304	"

Source: Census 1995

Photo 16.6.3 Diesel Generator at Power Plant in Muarateweh

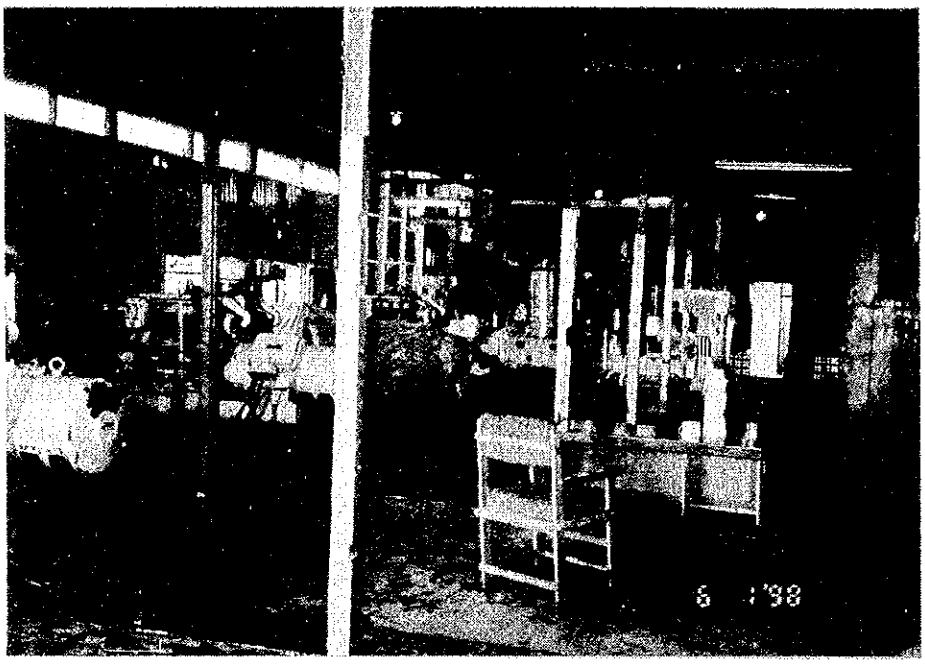
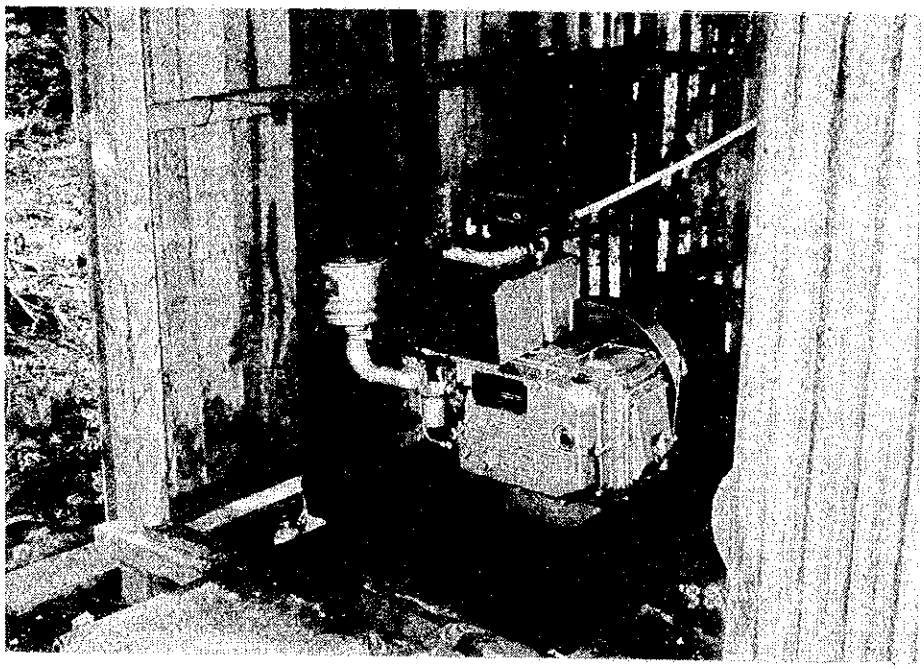


Photo 16.6.4 Portable Generator at Rural Area in Central Kalimantan



16.6.5 Telephone and Mail Services

Telephone services are done by PT. Telkom using a terrestrial microwave system and a domestic satellite system (PALAPA) in the Study Area.

Capacity of the central exchange has rapidly increased 2.8 times from 22,814 to 63,668 in West Kalimantan, and 3.5 times from 7,040 to 24,888 in Central Kalimantan during the four years from 1993 to 1996. Telephone subscribers also have increased 2.4 times from 17,598 to 41,804 and 2.9 times from 6,473 to 18, 718 at each province in the same period. The number of subscribers per 100 population has increased from 0.50 to 1.12 and from 0.42 to 1.11 in West and in Central Kalimantan respectively. However, the figures of 1996 reflect only half of the national average which is at 2.07. Telephone service is still limited to the urban areas while rural areas are greatly lacking (see Table 16.6.10).

Table 16.6.10 Number of Telephone Capacity, Customer, Circuit, Public Telephone, Wartel and Population

Province		1993	1994	1995	1996
West Kalimantan	1	22,814	23,192	52,690	63,668
	2	17,598	21,235	27,700	41,804
	3				43,344
	4	336	461	547	611
	5	15	25	29	56
	6	34,908	35,713	36,518	37,323
	2/6	0.50	0.59	0.76	1.12
Cent. Kalimantan	1	7,040	9,747	20,026	24,888
	2	6,473	8,567	13,118	18,718
	3	6,592	8,742	13,492	19,165
	4	119	175	235	278
	5			139	169
	6	15,423	15,895	16,373	16,859
	2/6	0.42	0.54	0.80	1.11
All Kalimantan	1				241,452
	2	72,235	86,070	123,817	170,412
	3				175,084
	4				2,980
	6	99,588	102,377	105,205	108,079
	2/6	0.73	0.84	1.18	1.58
Indonesia	1				6,309,865
	2	1,848,678	2,439,670	3,214,404	4,111,225
	3				4,245,465
	4				104,719
	6	1,891,356	1,922,165	1,952,832	1,983,429
	2/6	0.98	1.27	1.65	2.07

Note: **1**:Central Capacity, **2**:Telephone Customer, **3**:Telephone Circuit, **4**:Public Pay Telephone, **5**:Wartel, **6**:Population('000)

Source: Data from PT.Telkom of West Kalimantan and PT.Telkom of Central Kalimantan.
Statistik Telekomunikasi 1996
STATISTICAL YEAR BOOK INDONESIA 1996

Photo 16.6.6 PALAPA Parabolic Antenna at telephone office in Muarateweh

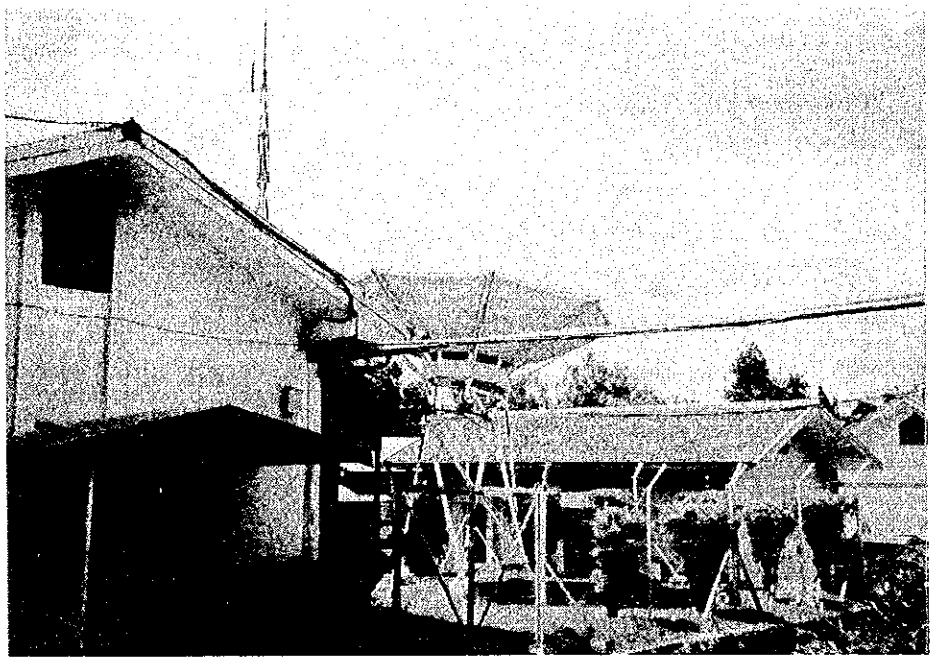


Photo 16.6.7 Antenna Terrestrial Microwave in Central Kalimantan

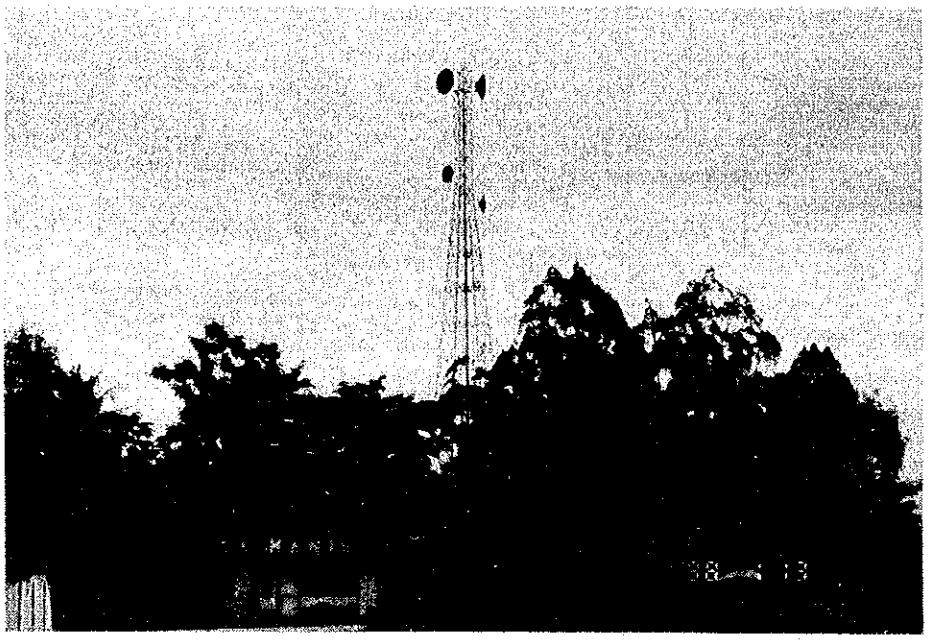


Table 16.6.11 shows existing potential for PT. Telkom in the Study Area in 1997.

In West Kalimantan, there are 22 telephone offices. One central office is in Pontianak city and 21 local offices in other cities. The exchange capacity is 82,840 with 52,783 subscribers at present. In Central, two central telephone offices cover service areas. One is the Palangkaraya office and the other office is in Banjarmasin in South Kalimantan. There are also 15 local offices in Central Kalimantan. The exchange capacity is 38,582 with 27,904 subscriber at present.

The number of subscribers per 100 population is 1.38 in West and 1.61 in Central Kalimantan respectively. Pontianak and Palangkaraya cities, however, show the high figure of 6.62 and 6.28 respectively compared with other regencies.

Table 16.6.11 Existing Potential of PT.Telkom in 1997

West Kalimantan

Regency	Connection to/from Central	Location of Local Office	Capacity of Local Office	Customer of Local Office 1	Population of Regency 2	1/2 *100
Sambas	PTK-SW	Singkawang	8,212	5,635		
	PTK-BEK	Bengkayang	532	376		
	PTK-PMK	Pemangkat	2,772	1,653		
	PTK-SBS	Sambas	3,582	1,113		
	PTK-TBS	Tebas	910	732		
	PTK-SDR	Sungaiduri	500	273		
Sub total	6		16,508	9,782	880,200	1.11
Kabupaten	PTK-MPW	Mempawah	904	836		
Pontianak	PTK-NBA	Ngabang	528	471		
	PTK-SNP	Sungai Pinyuh	1,016	939		
Sub total	3		2,448	2,246	908,200	0.25
Sanggau	PTK-SAG	Sanggau	2,184	1,866		
	PTK-BGN	Balai Karangan	482	373		
	PTK-SED	Sekadau	642	484		
Sub total	3		3,308	2,723	512,200	0.53
Ketapang	PTK-KTP	Ketapang	2,834	2,543		
	PTK-KDN	Kendawangan	532	434		
Sub total	2		3,366	2,977	383,100	0.78
Sintang	PTK-STG	Sintang	3,092	2,296		
	PTK-NGP	Nangah Pinoh	1,094	909		
Sub total	2		4,186	3,205	477,900	0.67
Kapuas Hulu	PTK-PTS	Putussibau	912	809		
Sub total	1		912	809	181,900	0.44
Kotamadya	PTK-Centrum	Pontianak	29,508	24,533		
Pontianak	PTK-Sei.Raya	Pontianak	3,522	2,853		
	PTK-Siantan	Pontianak	6,480	3,655		
	PTK-JAWI	Pontianak	12,602	0		
Sub total	4		52,112	31,041	469,000	6.62
Total	21		82,840	52,783	3,812,500	1.38

Source: from Pontianak PT.Telkom

Central Kalimantan

Regency	Connection to/from Central	Location of Local Office	Capacity of Local Office	Customer of Local Office 1	Population of Regency 2	1/2 *100
Kotawaringin	PLK-SPT	Sampit	6,592	4,323		
Timur	PLK-KPA	Kuala Pembuang	1,024	904		
	PLK-KSN	Kasongan	520	371		
	PLK-KKY	Kuala Kuayan	296	272		
Sub total	4		8,432	5,870	232,800	2.52
Kotawaringin	PLK-PBU	Pangkalanbun	4,534	3,834		
Barat	PLK-KMI	Kumai	776	740		
Sub total	2		5,310	4,574	479,600	0.95
Barito	PLK-MTW	Muarateweh	2,008	1,869		
Utara	PLK-PRC	Purukcahu	812	389		
Sub total	2		2,820	2,258	527,300	0.43
Barito	BJM-BNT	Buntok	1,432	1,374		
Selatan	BJM-TML	Tamiang Layang	448	282		
	BJM-AMP	Ampah	432	346		
Sub total	3		2,312	2,002	169,200	1.18
Kapuas	BJM-KKP	Kuala Kapuas	3,719	2,758		
	PLK-KKN	Kuala Kurun	400	302		
Sub total	2		4,119	3,060	164,800	1.86
Kotamadya	PLK-Centrum	Palangkaraya	15,081	9,733		
Palangkaraya	PLK-KM5	Palangkaraya	508	407		
Sub total	2		15,589	10,140	161,500	6.28
Total	15		38,582	27,904	1,735,200	1.61

Source: from Palangkaraya PT.Telkom

Photo 16.6.8 Public Pay Phone at Palangkaraya

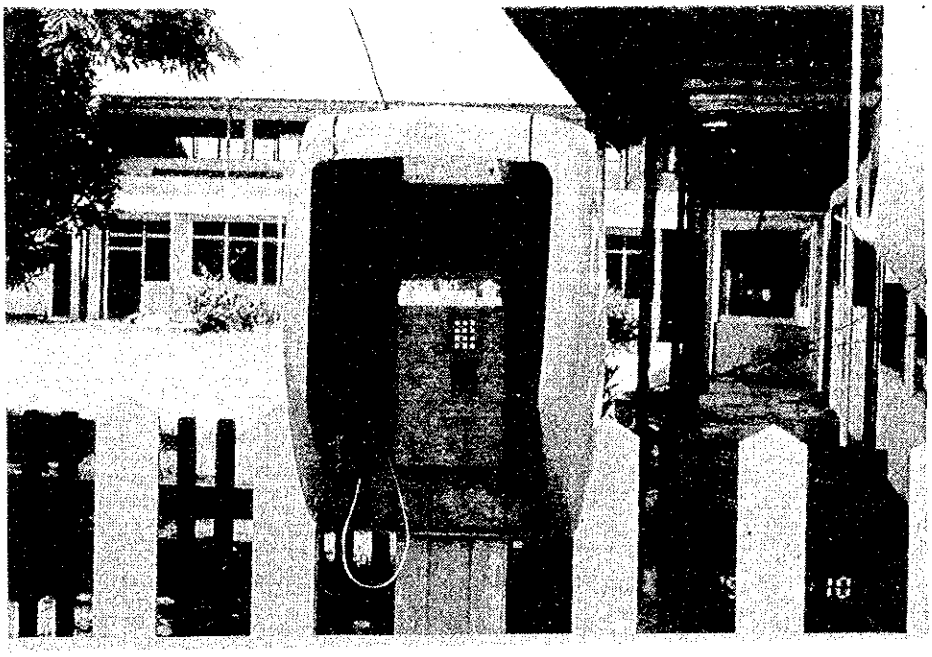


Photo 16.6.9 Wartel at Pangkalanbun

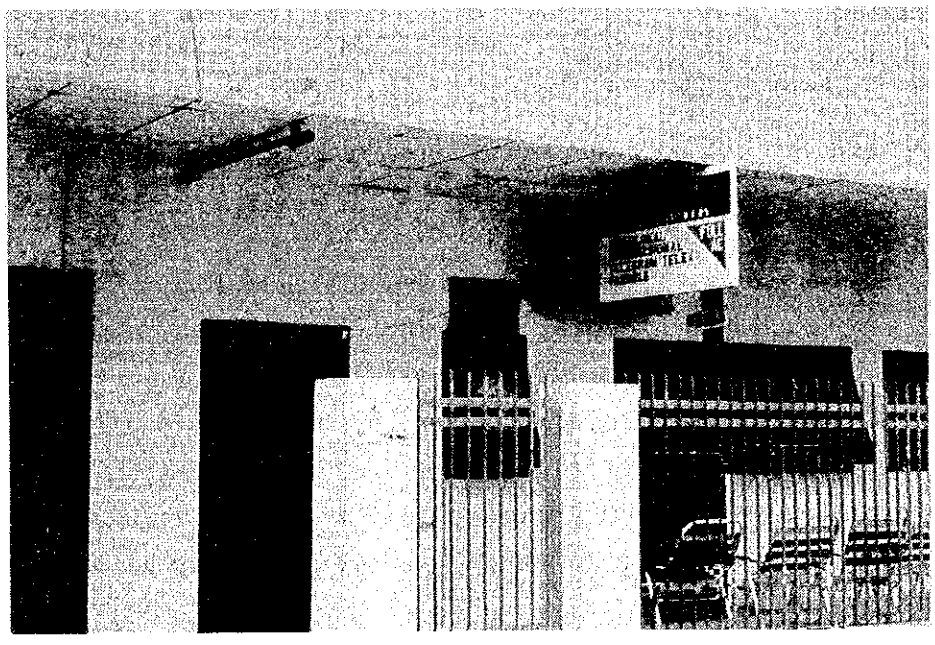


Table 16.6.12 shows the number of post offices by province in the Study Area.

Table 16.6.12 Number of Post Office by Province

West Kalimantan

Regency		Post Office			Total of	No.of
		Central	Supplement	Auxiliary	Post Office.	Subdistrict
Kab Sambas		1	17	0	18	19
Kab Pontianak		1	19	0	20	20
Kab Sanggau		1	14	0	15	22
Kab Ketapang		1	8	0	9	15
Kab Sintan		1	13	1	15	21
Kab Kapuas Hulu		1	12	0	13	23
Kodya Pontianak		1	0	10	11	4
Total	1995	7	83	11	101	124
	1994	7	82	11	100	124
	1993	7	82	10	99	124

Source: BPS West Kalimantan in Figures 1996

Central Kalimantan

Regency	No. of Post Office				No.of
	1993	1994	1995	1996	Subdistrict
Kotawaringin Barat	8	8	8	8	10
Kotawaringin Timur	13	13	13	13	24
Kapuas	16	16	16	16	23
Barito Selatan	8	8	8	8	12
Barito Utara	4	4	4	4	11
Palangkaraya	6	6	6	6	2
Total	55	55	55	55	82

Source: from Kalimantan Tengah Post Office

All the regencies have one central post office and many supplement and/or auxiliary offices for mail service.

In West Kalimantan, there are 101 post offices among 124 sub districts. Central Kalimantan has 55 post offices and 82 sub districts. Area coverage of post office is 81% and 67% respectively while 20~30% of the sub districts have extreme difficulty in receiving mail service. Number of post office is almost constant. The number of post office at the Kabupaten of Ketapang and Kapuas Hulu in West Kalimantan and Barito Utara and Kotawaringin Timur in Central Kalimantan are the least among the other regencies. Furthermore, there are many rural areas which have almost no access to post offices at tertiary urban centers due to lack of roads.

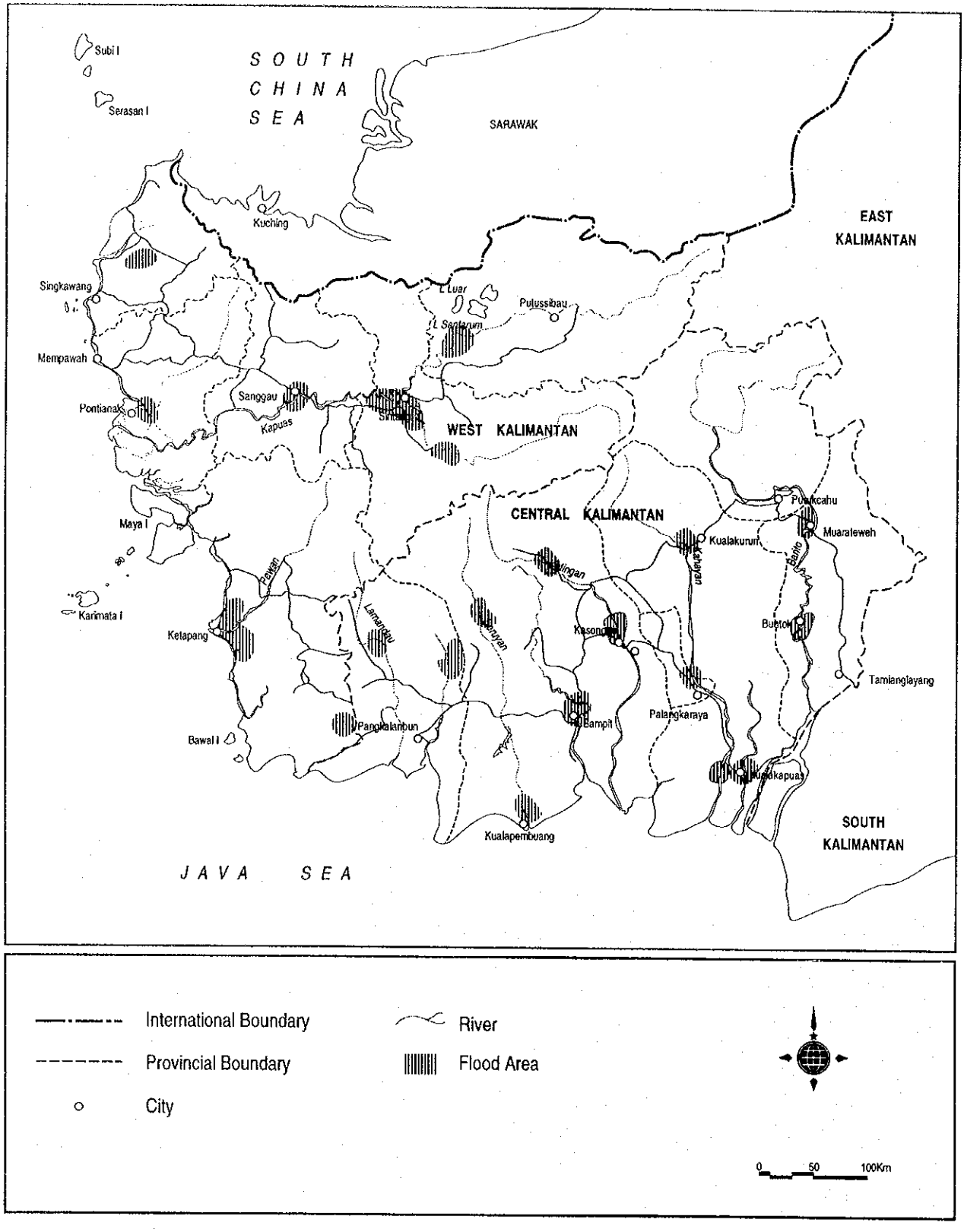
The number of post offices in Pontianak and Palangkaraya cities is about 3 times that of the sub-districts. People living in both cities can access easily post offices and receive good mail service.

16.6.6 Drainage and Flood Control

Most of the major cities in West and Central Kalimantan are located in lowland and swampy areas. It is common in these areas for flooding to frequently occur (see Figure 16.6.1). This threatens urban people's lives and health while disrupting urban activities. The main reasons for flooding are rapid urbanization, poor drainage facilities and the development of upstream areas. Therefor, the rehabilitation and improvement of drainage facilities in urban areas and the methodical development at upstream areas are necessary.

Rehabilitation and improvement of drains and channels in Pontianak and Palangkaraya cities are now being implemented as the KUDP aided by World Bank.

Figure 16.6.1 Location of Flooded Area



16.7 ON-GOING PROJECTS

16.7.1 Integrated Urban Infrastructure Development Program - Kalimantan Urban Development Project (KUDP)

The Kalimantan Urban Development Project (KUDP) is an integrated urban infrastructure development program scheme implemented in Pontianak, Palangkaraya, Banjarmasin, Balikpapan, and Samarinda in Kalimantan and is aided by the World Bank.

The objectives of the project are as follows:

- To increase the provision of urban infrastructure and services and the efficiency of urban investments
- To promote stronger, more autonomous, and financially more independent municipal governments, and
- To contribute toward urban poverty alleviation, mainly through better access to essential services and an improved urban environment.

KUDP covers nine sectors: a) urban roads b) water supply and distribution systems c) storm drainage and flood control d) solid waste collection and disposal e) human waste disposal (sewage and on-site sanitation facilities) f) multi-sectoral programs for Kampung (low income neighborhood) improvement, market improvement, and infrastructure for urban renewal pilot projects and for low cost housing developments g) programs for the development and strengthening of local institutions h) programs to increase local revenue generation and i) technical assistance for implementation.

The project period is 5 years from 1995/1996 to 2000/2001 and implementation agencies are Cipta Karya, Bina Marga, and PDAMs. The main components of KUDP at Pontianak and Palangkaraya cities are summarized in Table 16.7.1.

16.7.2 Village Infrastructure Development Projects

(1) Inpres Desa Tertinggal (IDT) Program

To assist the development of economic activities at all under-developed villages, the Inpres Desa Tertinggal (IDT) program was started in 1994/95 by the Government of Indonesia (GOI) and completed in 1996/97. The IDT program provided domestic funding of about $200 million per year for three years to approximately 21,000 "poor" villages (IDT village) identified based on a BPS survey of all villages in Indonesia (some 66,000). In West and Central Kalimantan, there are 525 and 696 poor villages among 21,000 villages respectively.

(2) The Infrastructure Development Project (P3DT)

To support the IDT program, the Infrastructure Development Project (P3DT) as a complementary program was initiated to provide needed basic infrastructures to poor villages. This project consisted of four (4) main projects. One was the Village Improvement Program (VIP). The second was the Rural Areas Infrastructure Development Project. Other two were Program Pembangunan Jalan Poros Desa (P2JPD) and Rupiah Murni Program.

1) The Village Improvement Project (VIP)

As a part of the P3DT program, The IBRD-funded Village Improvement Project (VIP) had been implemented at 1,200 of the poorest villages in Java and Bali from 1995/96 to 1996/97 for the first stage. In the second stage, this program was extended to Sumatra, and 2,600 villages were proposed for assistance in the period to project completion in FY 1998/99.

2) The OECF Loan Project

The Overseas Co-operation Fund (OECF) has been a major participant in the P3DT program. In 1994/95, OECF provided a loan (Loan No. IP- 437) to GOI in support of the overall IDT program for village infrastructure improvements under the P3DT program. The infrastructures improved in this program were access roads, bridges,

piers, water supply and sanitary facilities. In the two-year period 1995/96 – 1996/97 for phase I, a total of 3,449 villages received assistance in the 21 provinces outside Java and Bali. In phase II of this project (1997/98 – 1998/99), a further 3,400 villages are now being assisted and a similar number of villages will be expected to be included in the proposed phase III program.

In West and Central Kalimantan, a total number of 576 villages were received an assistance for this program in 1995/95 – 1997/98 among 2,751 villages of two provinces.

There is a different focus and emphasis from the VIP program. The VIP program addressed the poorest villages in Java, Bali and Sumatra, and emphasized the economic benefits derived by villagers from their employment in project implementation, and the benefits of community-led planning and implementation. By contrast, the OECF program was directed at "potentially productive" villages outside Java, Bali and Sumatra, and was intended to improve economic development by improving access to markets and other services and facilities, as well as providing other needed infrastructure.

3) The P2JPD Project

The P2JPD project which had been started with funds from APBN in 1996/97 was mainly directed towards the connection of isolated villages to the Kabupaten road system. It has been largely directed at supporting P3DT villages in outside Java and Bali. A total of Rp. 80 billion had been spent on improvements to 614 villages in 1996/97. 392 villages were planned to receive assistance to the same amount in 1997/98.

4) The Rupiah Murni Program

The Rupiah Murni Program which was directly funded by APBN, was started in 1997/98 as a continuation of the GOI IDT program which ended in 1996/97. This program was focused on infrastructure provision under the P3DT program. It was operated in close support of the VIP and the Rural Areas Infrastructure Development Project (OECF). The villages which had not received any assistance from either of these projects were selected for this project. 89 villages in West Kalimantan and 81 villages in Central Kalimantan were selected in 1997/98.

(3) Rural Water Supply and Sanitation Sector Project (RWSS)

RWSS is also one of the rural infrastructure development projects. This project was started in 1995/96 as the ADB loan project and will be continued to 1998/99. Ibu Kota Kecamatan (IKK : sub-district capital), Desa Pusat Pengembangan (DPP : center village of development) and Desa Tertinggal (DT : under developed village) in Kalimantan and Sumatera were the target towns/villages in this project. A total of 675 towns/villages were proposed to implement this project in the Study Area. 470 towns/villages were in West Kalimantan while 187 were in Central Kalimantan. Approximately 85% (573) of 675 were DT. 316 (222 in West and 94 in Central Kalimantan) towns/villages had been implemented in 1995/96 – 1996/97 (see Table 16.7.1).

The projects of village infrastructure development mentioned above were successful, and villagers were almost satisfied. There are, however, still lots of "poor" villages not only in

West and Central Kalimantan but also throughout Indonesia. These kinds of programs/projects should be continued from now on.

Table 16.7.1 No. of Town/Village of Rural Water Supply and Sanitation Sector Project (ADB Loan)

West kalimantan

Kabupaten		95/96		96/97		97/98	98/99	Total	
		Prop	Agre	Prop	Agre	Prop	Prop	Prop	Agre
Sambas	IKK	1	1					1	1
	DPP			3	3	3		6	3
	DT			28	28	28		56	28
Sub total		1	1	31	31	31		63	32
Pontianak	IKK	1	1					1	1
	DPP	1	1	1	1	3		5	2
	DT	24	24	28	28	28		80	52
Sub total		26	26	29	29	31		86	55
Sanggau	IKK			1	1			1	1
	DPP			1	1	2		3	1
	DT			29	29	29		58	29
Sub total				31	31	31		62	31
Sintang	IKK			2	2			2	2
	DPP	1	1	1	1	2		4	2
	DT			30	30	30		60	30
Sub total		1	1	33	33	32		66	34
Kapuas Hulu	IKK			5	5			5	5
	DPP			2	2	2		4	2
	DT			29	29	29		58	29
Sub total				36	36	31		67	36
Ketapang	IKK	1	1					1	1
	DPP	1	1	4	4	3		8	5
	DT			28	28	28		56	28
Sub total		2	2	32	32	31		65	34
Total	IKK	3	3	8	8	0	0	11	11
	DPP	3	3	12	12	15	0	30	15
	DT	24	24	172	172	172	61	429	196
Grand total		30	30	192	192	187	61	470	222

Central Kalimantan

Kabupaten		95/96		96/97		97/98	98/99	Total	
		Prop	Agre	Prop	Agre	Prop	Prop	Prop	Agre
Kotawa. Bar	IKK			2	2	1		3	2
	DPP			2	2	2		4	2
	DT			10	10	10		20	10
Sub total				14	14	13		27	14
Kotawa. Tim	IKK			1	1	1		2	1
	DPP			3	3	1		4	3
	DT			11	11	14		25	11
Sub total				15	15	16		31	15
Kapuas	IKK			3	3	2		5	3
	DPP			4	4	6		10	4
	DT			10	10	12		22	10
Sub total				17	17	20		37	17
Barito Selat.	IKK	1	1			1		2	1
	DPP			1	1	3		4	1
	DT			10	10	10		20	10
Sub total		1	1	11	11	14		26	12
Barito Utara	IKK	1	1	1	1			2	2
	DPP	1	1	2	2	1		4	3
	DT	17	17	14	14	9		40	31
Sub total		19	19	17	17	10		46	36
Total	IKK	2	2	7	7	5	0	14	9
	DPP	1	1	12	12	13	3	29	13
	DT	17	17	55	55	55	17	144	72
Grand total		20	20	74	74	73	20	187	94

Source : Rural Water Supply and Sanitation Sector Project (ADB Loan No.1352-INO)

CHAPTER 17

WATER RESOURCES

CHAPTER 17 WATER RESOURCES

17.1 WATER RESOURCES DEVELOPMENT PLAN

17.1.1 Issues and Goals of Water Resources Development

(1) Issues of Water Resources Development

At present, river water is used for drinking, agriculture and industry. However, many areas have been developed by deforestation and economic development. Therefore, a lack of water, water pollution, salinitation have increased by a lack of water flow in the dry season. Flooding has been promoted by an increase of water in the wet season.

In the study area, the increase of water demand is forecasted by proposed agricultural and industrial development and the promotion of urbanization. Water pollution will also increase.

Originally, the study area has the function of water keeping and purification. It is difficult to make these functions artificially, because these functions are very large and complicated.

(2) Goals of Water Resources Development

The following goal of water resources is decided in accordance with the issues of water resources mentioned above.

"To re-build the rich environment using the nature, which has the rich function of water keeping and purification, and to create a rich and safe environment for water resource utilization"

17.1.2 Objectives of Water Resources Development

The following objectives of water resources is decided to achieve the goal.

- To secure water flow in the dry season
- To protect flooding in the wet season
- To manage water quality

17.1.3 Strategies of Water Resources Development

The following seven policies are needed to implement the strategies of water.

- Conservation and management of the forest
- Conservation and management of the holding reservoir
- Conservation and management of the condition for groundwater and rainwater utilization
- Measurement of the flood control (regulating pond)
- Measurement of water pollution
- Security of drinking water

17.1.4 Priority Projects and Programs for Water Resources Development

(1) Required Projects and Programs of Water Resources Development

1) Sambas River System

This System is small compared with the other Systems in West Kalimantan. The System has a vast amount of land suitable for paddy, rubber, coconut and tree crops. Generally, low flow discharge in the dry season is a critical factor in the smaller basin. The following measurements will be required.

2) Kapuas River System in West Kalimantan

a. Upper Kapuas River System (Kapuas Hulu)

This System should be conserved in terms of maintaining floodwater storage function in the peat deposit areas and avoiding erosion in the northern part of this System.

b. Middle Kapuas River System (Tayan ~ Silat)

The steep slope area with mud-sandstone along the mountain ranges would be a major source of silt in river water if deforestation proceeds. The steep slope areas in the Melawi River basin and the area around Sanggau are suitable for tree crop agricultural development according to the land suitability map. These areas can be categorized as mud-silt stone areas so that erosion control should be conducted. In comparatively flat lands, soil erosion can be controlled easily. The peat deposit area is not distributed in this System except in the area around Sintang. In terms of keeping acidity in river water, the peat deposit area around Sintang should be reserved.

c. Lower Kapuas River System (Pontianak ~ Tayan)

The System is generally lowland with the vast peat deposit areas along the coast. The population in West Kalimantan is highly concentrated in these areas. The development of peat deposit areas would cause many kinds of environmental problems as described in the previous

sections. Especially high acid water and saline content would directly affect drinking water in Pontianak.

At present, the Landak River basin has already become a major source of silt in the Lower System. The steep slope area with mud-sandstone along the mountain ranges should be protected. Erosion must be controlled in areas suitable for tree crop development.

3) Pawan River System

The situation in this System is the same as that in the Lower Kapuas River System. In addition, most rivers in Pawan River System are small like the Sambas River System. The only difference is categorized as continental magmatite rock which does not hold water but drains rapidly. This is different from the Sambas River System. Generally low flow discharge in the dry season would be a critical factor in the smaller basin. Water quantity management is significant here.

4) Seruyan River System

The conditions in this System are almost the same as Eastern Part of Central Kalimantan except that the Western Part does not have a podsol soil area in the upper part. This condition results in a comparatively non-polluted river water in Western Kalimantan at present. There are also vast areas suitable for tree crops, food crops and large-scale plantation in the middle part. The upper part of the System is categorized geologically as continental magmatite rock. This is different from the podsol area in Eastern Part. The podsol area is based on sedimentary rocks such as mudstone and silt stone. In the development of the upper part, this geological difference should be considered.

As described in the above, swamp development itself in the peat deposit area in the middle part has a lot of complicated problems as described in the previous sections. Further studies on the peat deposit area are needed.

5) KAKAB River System

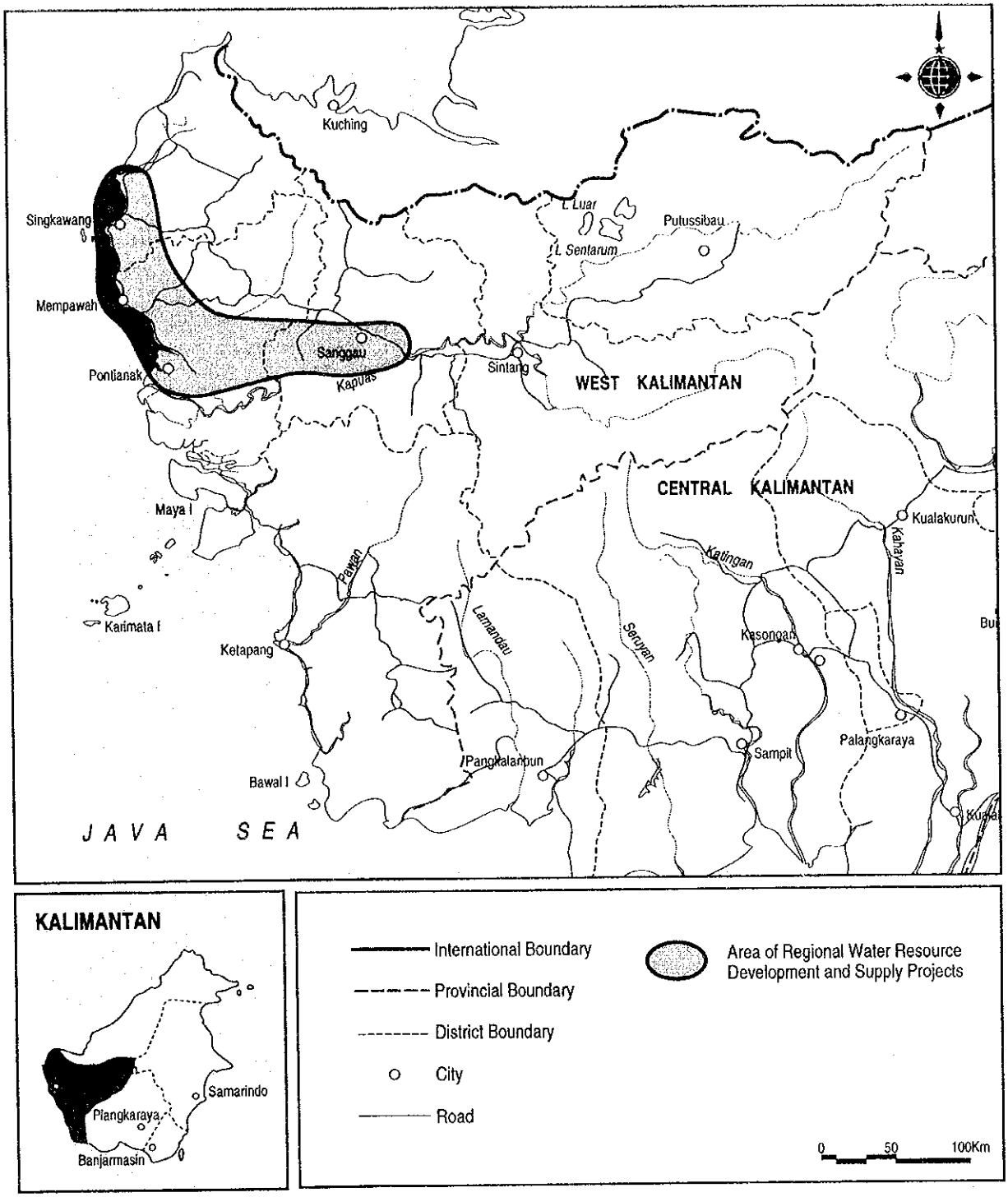
This System consists of Barito, Kapuas and Kahayan rivers. Rivers in Central Kalimantan are quite similar in their characteristics. This System has a vast podsol soil area in the upper part. The deforestation commenced in 1970's has provided high concentrations of silt in these rivers. The middle part of this System has a vast peat deposit area, which provides high acid water in the main rivers. The upstream area of the peat deposit area is suitable for tree crops and large scale plantations. The population is distributed mainly along the main rivers in the middle part of the System.

Regarding water supply in the populated areas in the middle part, protection in the podsol area and erosion control in which some large-scale land developments are expected, are necessary. Swamp development, in the peat deposit area in the middle part, has a lot of complicated problems as described in the previous sections. Further studies on the peat deposit area are needed.

(2) Priority Projects and Programs of Water Resources Development

Title:	• Regional Water Resources Development And Supply Program
Sector:	• Urban and Industry
Location:	• Pontianak, Sambas, Sanggau (West Kalimantan)
Time to be Implemented:	• Year 2009 ~ 2018 (10 years)
Institutions Responsible for Implementation:	• DINAS - PU (West Kalimantan)
Objectives:	• To secure volume of water supply for a future increasing domestic and industrial water demand • To improve a quality of clean water
Rationale:	• The river water of the middle stream of the Kapuas is of good quality unlike the upper stream and the down stream due to the presence of huge peat swamps. Pontianak is expected to be a large city with a population of one million, and other coastal towns between Pontianak and Pemangkat are also becoming larger. Their suburban and surrounding rural areas of these towns are to become agricultural production areas of high-value crops for urban centers. • Good quality water is a precious water source for future water supply to these growing urban and rural areas.
Beneficiaries:	• Urban and rural people, industrial sectors
Contents of the Project:	• Construction of a water intake and a raw water conveyance facility
Related Plans, Programs and Projects:	• Repelita IX and X • Regional development plan
Important Policy Conditions:	• DINAS PU of West Kalimantan should fill the role of a leader on this project
Contribution to Different Goals:	• This project contributes to an improvement of living conditions at rural area and to regional development

Figure 17.1.1 Area of Regional Water Resources Development and Supply Program



17.2 PRESENT CONDITIONS RELATED TO WATER RESOURCES

17.2.1 Geographical Features and Land Cover

Figure 17.2.1 shows the water system by watershed in Western Part of Kalimantan. The dominant geographical feature of these watershed areas is its flatness. The altitude of more than 75 % in this area is less than 100 m (Table 17.2.1 and Figure 17.2.2 ~ 17.2.3).

Table 17.2.1 Distribution of Elevation in Western Part of Kalimantan

Elevation (m)	West Kalimantan Province		Central Kalimantan Province	
	Area (km 2)	Ratio (%)	Area (km 2)	Ratio (%)
~ 100	113,194.22	76.77	118,637.26	77.20
~ 300	16,824.48	11.41	17,582.55	11.44
~ 500	9,079.63	6.16	8,668.71	5.64
~ 700	4,273.20	2.90	4,218.18	2.74
~ 900	2,315.71	1.57	2,575.88	1.68
~ 1250	1,418.85	0.96	1,863.61	1.21
~ 1750	253.24	0.17	107.00	0.07
~ 2250	84.22	0.06	15.57	0.01
	147,443.56	100.00	153,668.78	100.00

Source: RUPABUMI

Shifting cultivation, estate and paddy field are scattered throughout the mainly forested cover with mangrove forests located at some estuaries. Although dense tropical forests cover much of the Study Area, soil fertility is generally low and soil erosion becomes a problem where large scale plantations are found. Vulnerable ecosystems, such as mangrove, freshwater swamp forest, peat swamp forest, are shown in Figure 17.2.5.

Figure 17.2.1 Water System by Watershed in the Western Part of Kalimantan

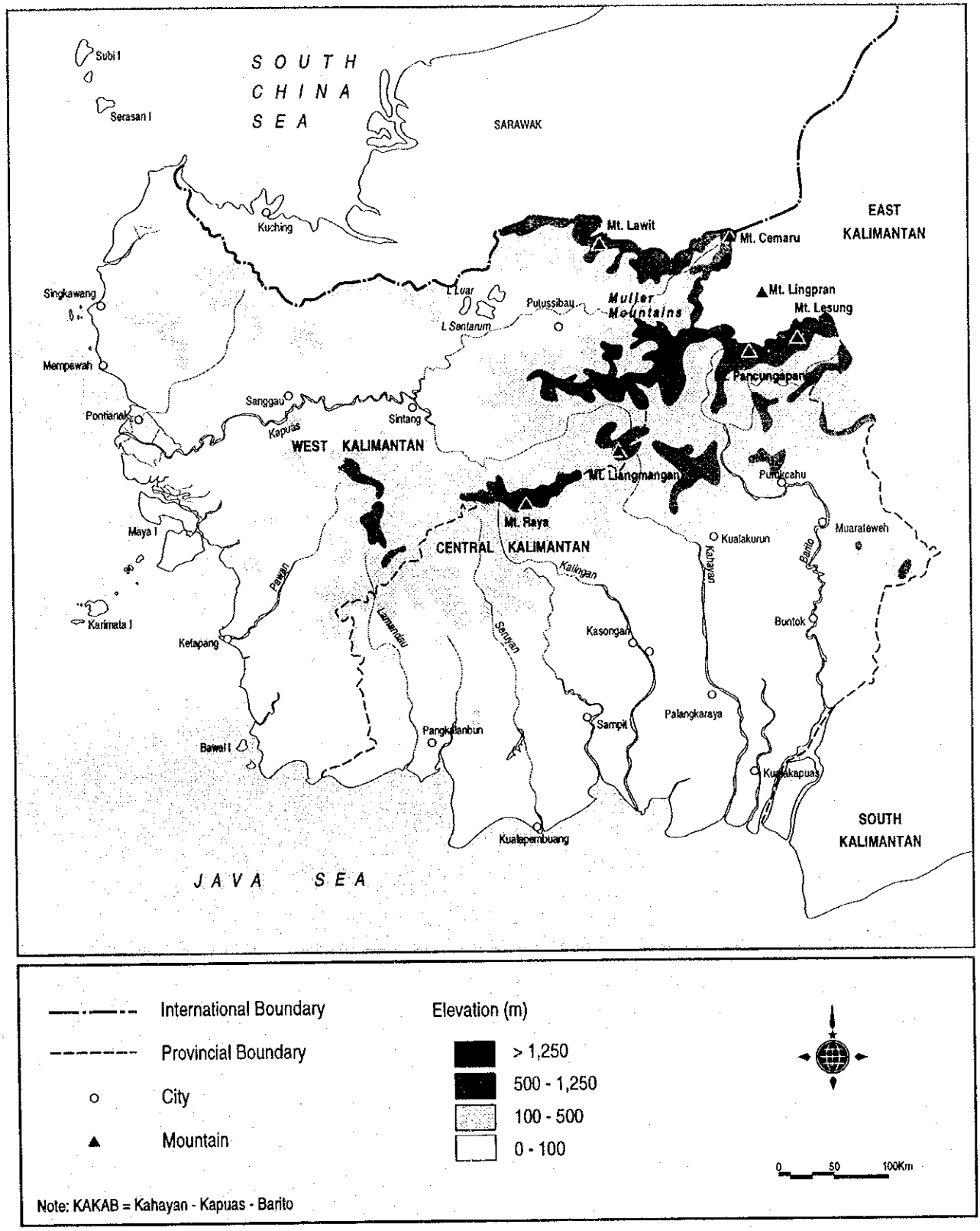


Figure 17.2.2 Longitudinal Profile of Rivers in West Kalimantan

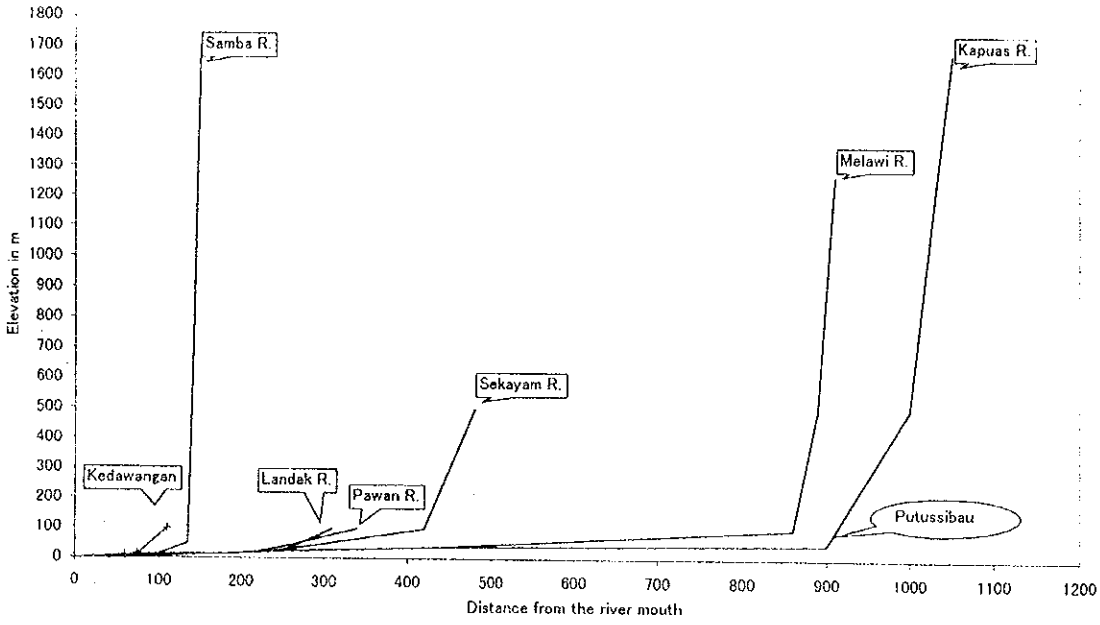


Figure 17.2.3 Longitudinal Profile of Rivers in Central Kalimantan

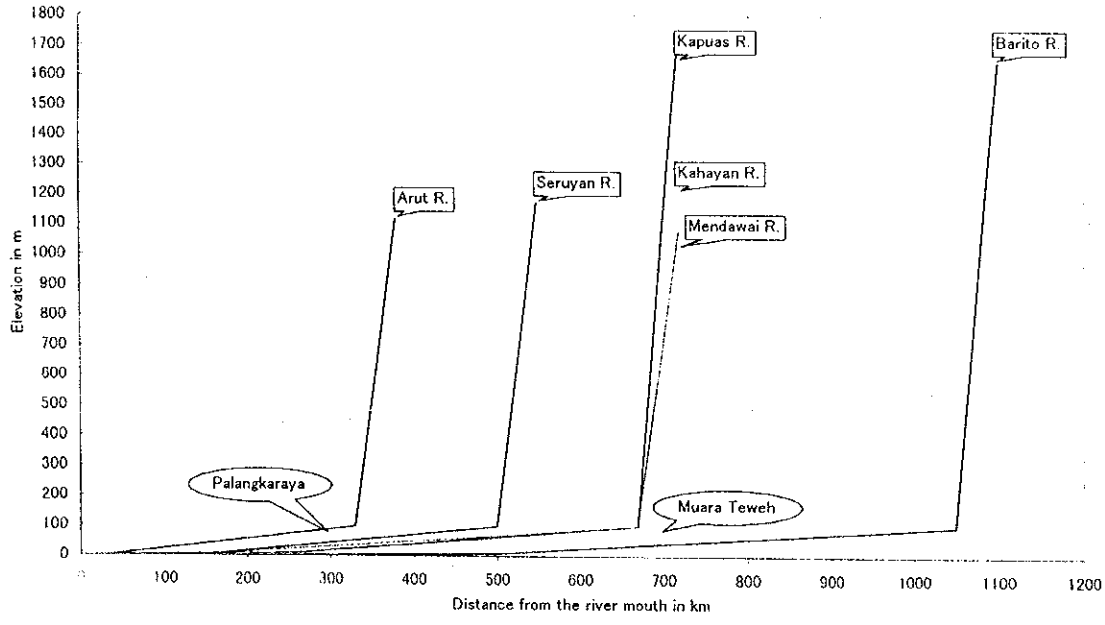


Figure 17.2.4 Land Cover in the Western Part of Kalimantan

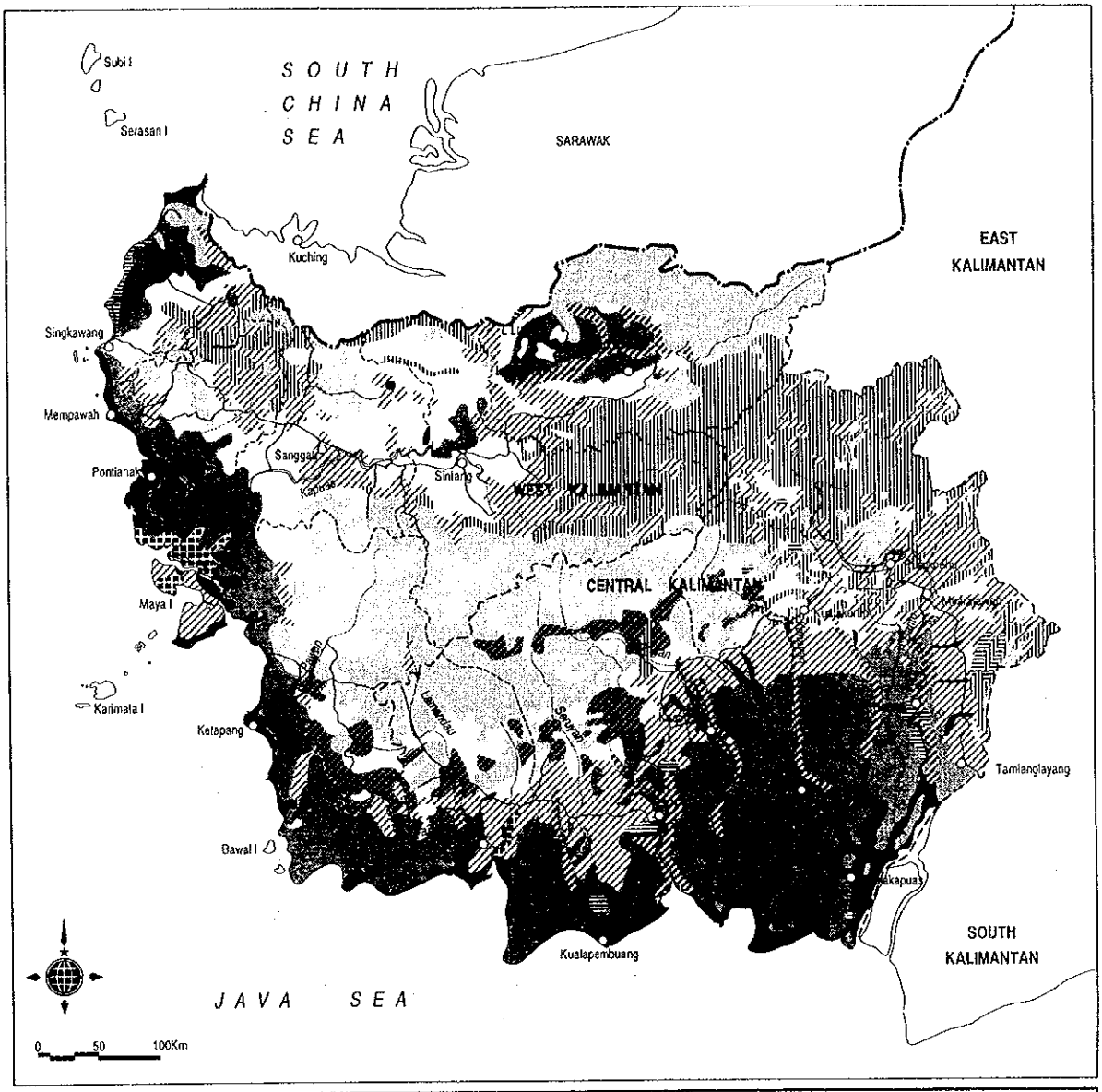
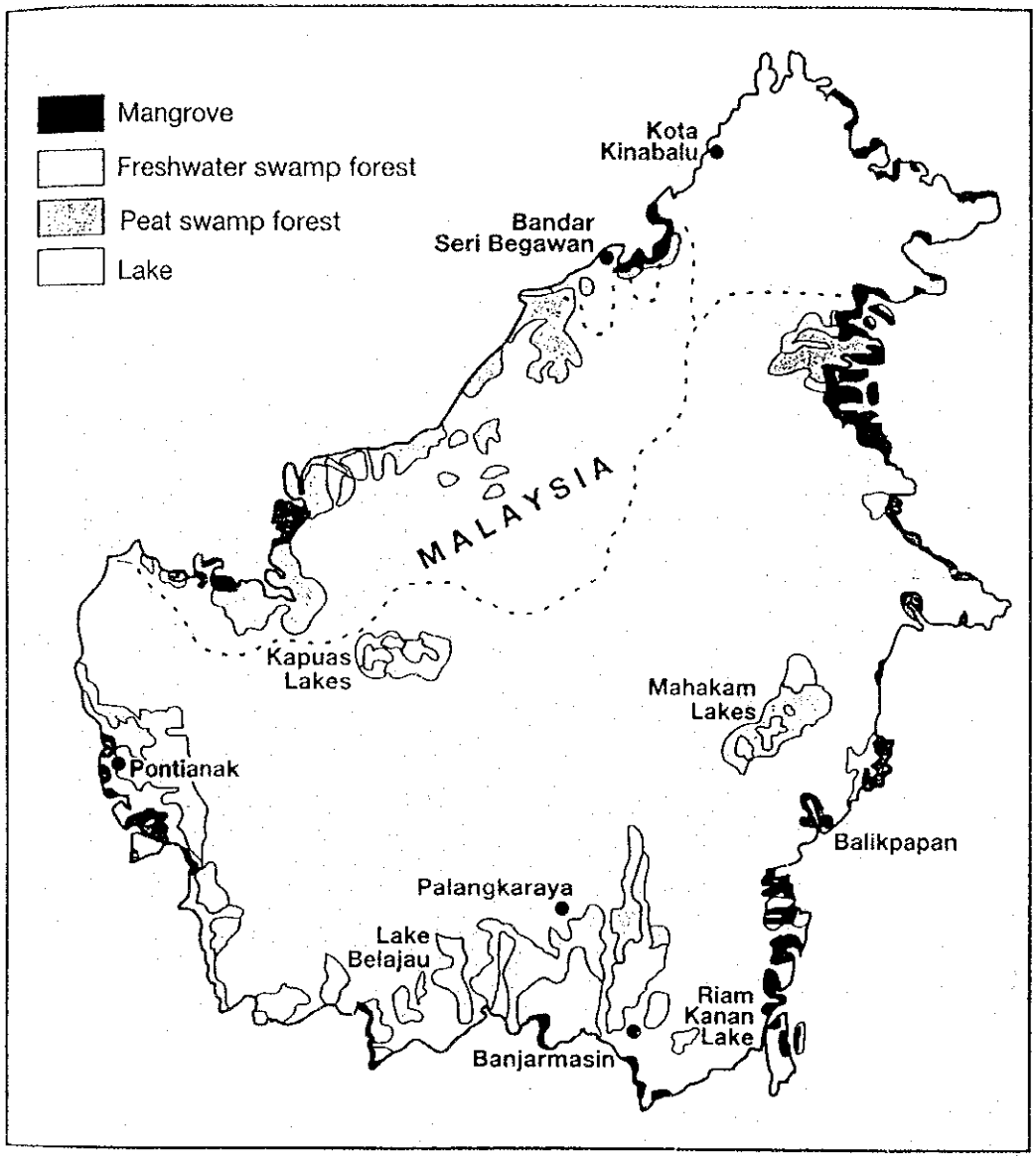


Figure 17.2.5 Wetland Habitats in Kalimantan



Source: The Ecology of Kalimantan

17.2.2 Monthly Rainfall

(1) Distribution in Area

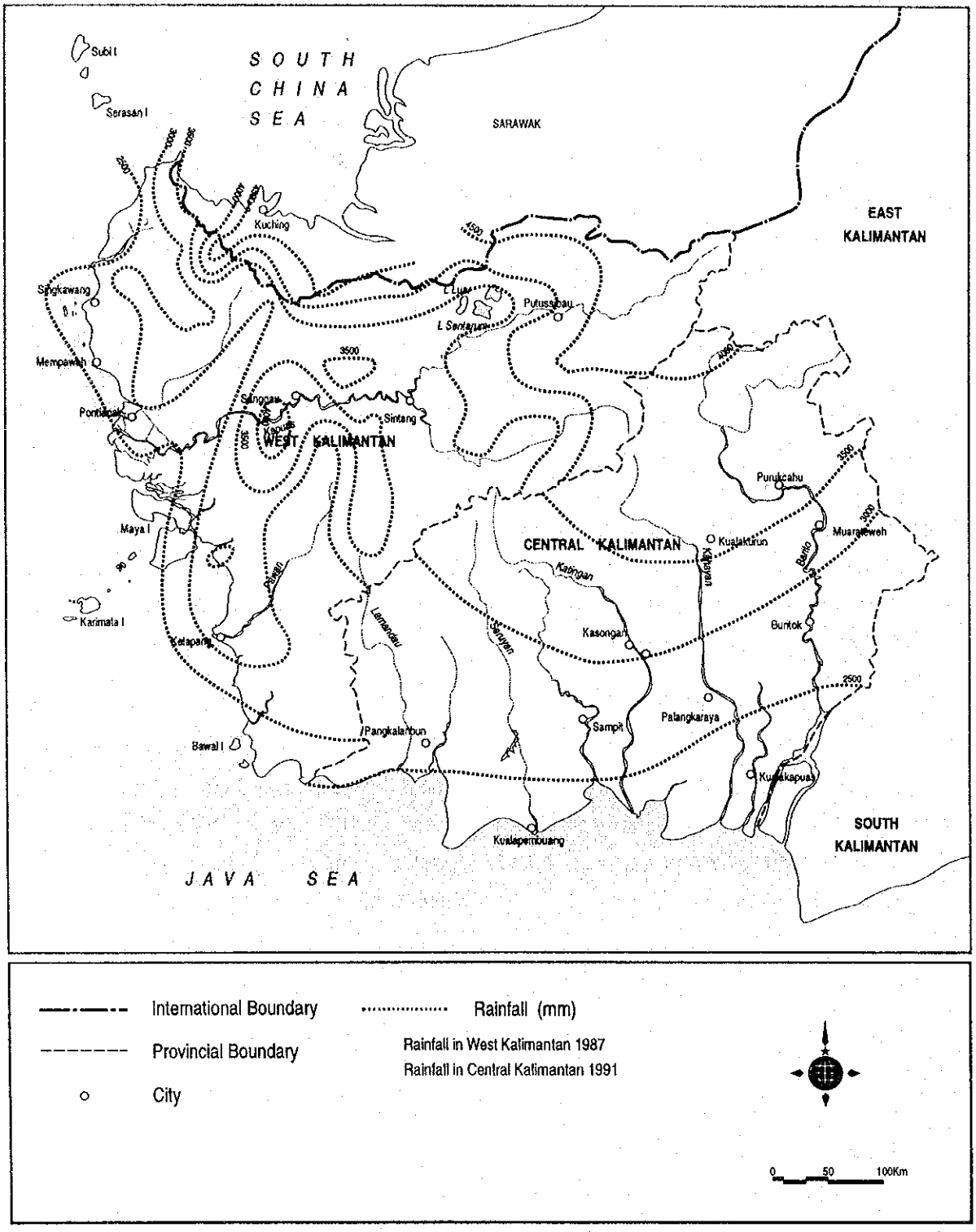
The characteristics of rainfall pattern in area and time in Western Kalimantan can be clearly categorized into 2 types, which are West Kalimantan type and Central Kalimantan type. On Borneo island, four provinces are divided by mountain ranges such as Kapuas Hulu Range, Schwaner-Muller Mountains and Meratus Mountains. The pattern of rainfall in Kalimantan is dominated by two main monsoons, a southeast or dry monsoon (May ~ October) and a northwest or wet monsoon (November ~ April).

Annual rainfall in West Kalimantan ranges from 2,500 to over 4,500 mm (Figure 17.2.6 ~ 17.2.7). Coastal areas having annual rainfall 3,000 mm, for example Ketapang, tend to have clarified wet and dry seasons. Putussibau in the upper part of Kapuas River has an annual rainfall between 3,250 mm and 4,250 mm, with rarely any month less than 150 mm. Annual rainfall in Central Kalimantan ranges from 2,000 mm to over 4,000 mm. Muara Teweh has an annual rainfall 2,100 mm, and Pangkalangbun 3,000 mm (Figure 17.2.6 ~ 17.2.8). The annual rainfall increases going from northeast to southwest. Seasonal variation of monthly rainfall is small compared with that in West Kalimantan. Annual rainfall in Pontianak ranges from 2,000 mm to 3,500 mm (Figure 17.2.9).

(2) Distribution in Time

In recent years, a comparatively long drought has taken place during June and September all over West and Central Kalimantan, resulting in a few months having less than 50 mm rainfall. This situation affected various aspects related to water resources. It has been very serious especially to the people relying upon rainwater storage for drinking water.

Figure 17.2.6 Rainfall in West Kalimantan Province (1987) and in Central Kalimantan Province (1991)



Source: Rencana Tata Ruang Kalimantan Barat Tahun 2008
Rencana Struktur Tata Ruang Propinsi Kalimantan Tengah

Figure 17.2.7 Monthly Rainfall in West Kalimantan (1980 ~ 1988)

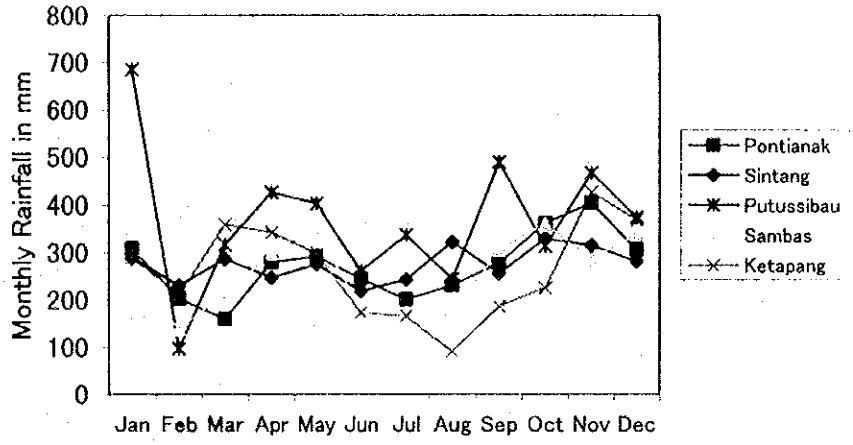


Figure 17.2.8 Monthly Rainfall in Central Kalimantan (1980 ~ 1995)

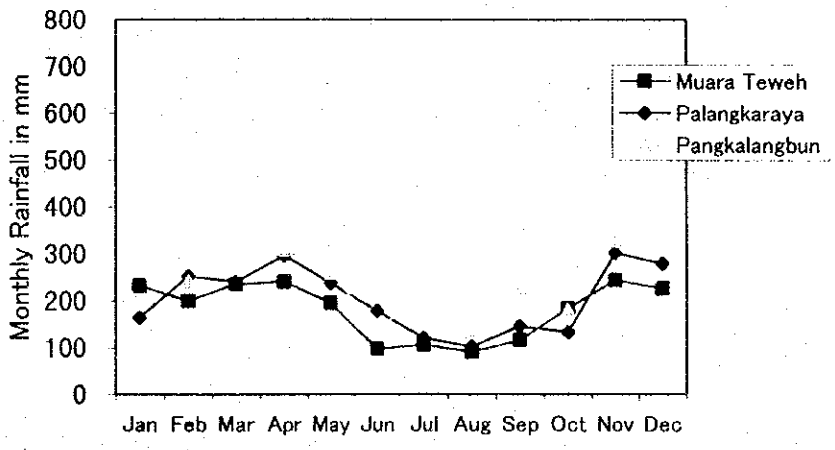
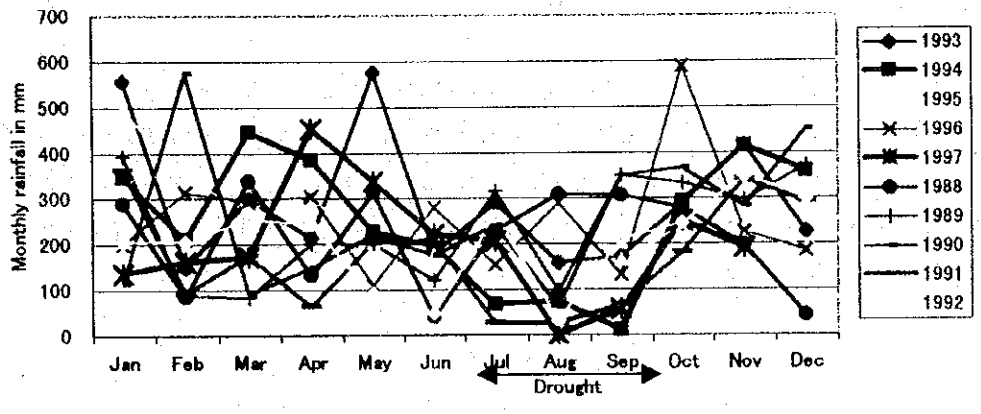


Figure 17.2.9 Monthly Rainfall in Pontianak (1988 ~ 1997)



17.2.3 Groundwater

In West and Central Kalimantan, generally the swamp and alluvial deposit areas coincide with the areas of moderate to high permeability from a hydro-geological viewpoint. Shallow groundwater can be expected in such areas so that it is affected by sea water and iron ions because the water infiltrates through the peat layer. Therefore the shallow groundwater is not suitable for drinking water. The area, except the swamp and alluvial deposit areas, can be characterized as having poor to low permeability hydro-geologically. In this kind of area, shallow groundwater can not be expected according to hydro-geological maps of West Kalimantan.

Ministry of Public Works has dug test wells in West and Central Kalimantan with the intention of developing a groundwater supply. The number of test wells is 40 with 12 in West and Central Kalimantan, respectively. In Central Kalimantan, 9 wells are located in the Barito River Basin and 3 wells are in the Kahayan River Basin especially in the Swamp Development Areas. These 52 wells are all deep, non-artesian wells so that the groundwater has to be pumped up. Average depths of the deep wells are 60 meters and 200 meter in West and Central Kalimantan, respectively. The viability of the wells is unknown due to lack of information.

17.2.4 River Flow

(1) Monthly Flow Regime

The affect of deforestation on the river flow regime is one of the most important concerns in watershed management in Western Kalimantan. Figures 17.2.10 and 17.2.11 are comparisons of monthly rainfall (point rainfall) and runoff depth in Central Kalimantan between 1985 and 1995. Generally deforestation results in an increased runoff rate, decreased low water flow in the dry season and changed hydro-graphic shape.

As far as seen in these figures, such kind of tendency can not be recognized. To conduct this kind of study in detail, the accurate evaluation of basin averaged rainfall is inevitable because the area in which homogeneous rainfall can take place is very small compared with the catchment size. The former 2 figures are based on only one rainfall station available in the upstream of each discharge station.

Figure 17.2.10 Monthly Rainfall and Runoff Depth at Muara Teweh

(A = 48,316 km2, 1985 ~ 1995)

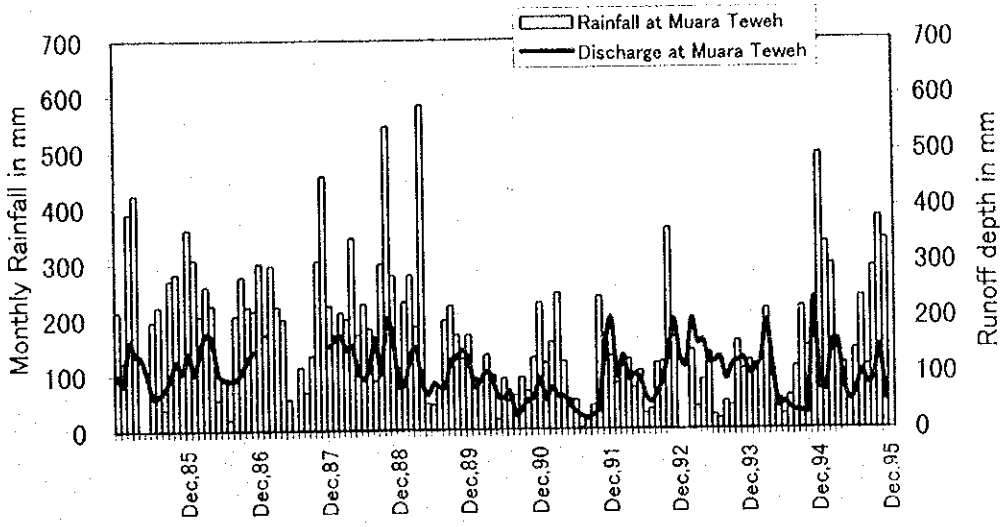
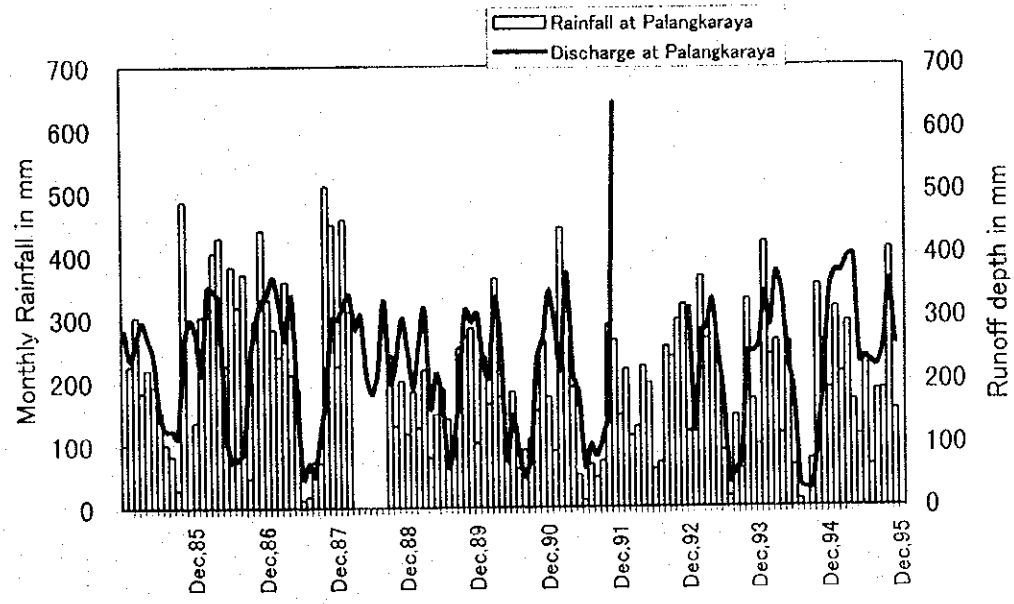


Figure 17.2.11 Monthly Rainfall and Runoff Depth at Palangkaraya

(A = 14,175 km2, 1985 ~ 1995)



(2) Flow Regime in Dry Season

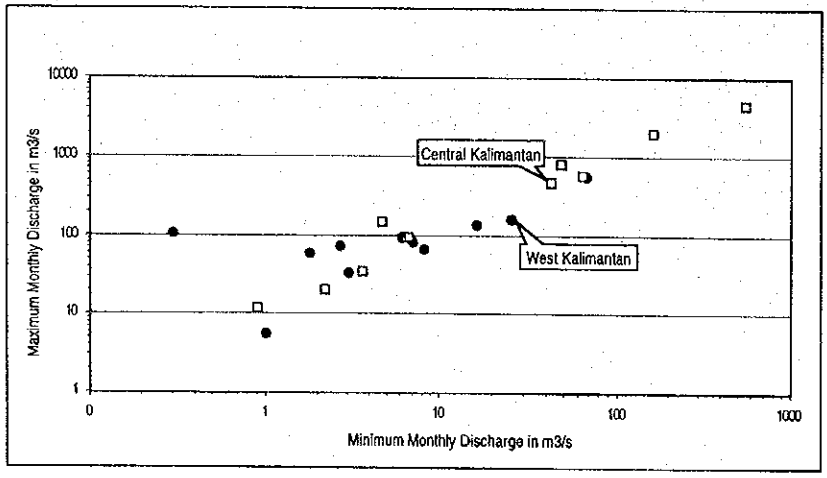
The Table 17.2.2 shows the minimum monthly discharge within the Study Area in recent years. One of the driest years in the last ten has been 1994. Here the flow regime in 1994 will be used as the representative dry year.

The Figure 17.2.12 shows the comparison of maximum and minimum monthly discharge in West and Central Kalimantan in 1994 *1. The ratios of minimum monthly discharge to maximum monthly discharge in the tributary basins are approximately 1:8 up to 1:9. The ratios reflect the minimum to maximum monthly rainfall in the basins.

Table 17.2.2 List of Minimum Monthly Discharge (m3/s)

River: Kahayan			River: Barito			River: Sekayam			River: Sekadau		
Station: Palangkaraya			Station: Muara Teweh			Station: Balai Karangan			Station: Nanga Taman		
Ranking	Year	Minimum Monthly Discharge	Ranking	Year	Minimum Monthly Discharge	Ranking	Year	Minimum Monthly Discharge	Ranking	Year	Minimum Monthly Discharge
1	**1994**	**164**	1	1991	366	1	1982	6.13	**1**	**1994**	**0.3**
2	1993	223	2	1990	467	**2**	**1994**	**8.1**	2	1993	6.0
3	1987	259	**3**	**1994**	**552**	3	1981	11.7	3	1996	12.9
4	1990	265	4	1992	879	4	1993	12.9	4	1995	19.6
5	1991	345	5	1995	938	5	1979	15.8	5	1992	38.7
6	1989	347	6	1985	1125	6	1996	16			
7	1986	391	7	1996	1183	7	1980	18.6			
8	1985	601	8	1989	1184	8	1984	18.7			
9	1992	879	9	1986	1633	9	1991	19			
10	1988	963	10	1988	1665	10	1985	20.1			
11	1996	1053	11	1993	1674	11	1995	38.4			
12	1995	1206									

Figure 17.2.12 Comparison of Minimum and Maximum Monthly Discharge in 1994



*1 This data based on Research Institute of Water Resources Development, Bandung

17.2.5 River Water Quality

(1) Apparent Color

In West and Central Kalimantan the color of river water and swamp is one of the most conspicuous features. There are 3 kinds of river water quality in terms of color:

- Type 1: Brown water leaching from laterite soil (Photo 17.2.1)
- Type 2: Black water (like coffee) coming from peat deposits (Photo 17.2.2)
- Type 3: Brown-yellow water with high concentration of silt (Photo 17.2.2)

Type 1 is quite common in rivers of West and Central Kalimantan as tropical lands are strongly weathered. Type 2 is quite distinctive in rivers and swamps that have peat deposits in their catchment. Type 3 can be recognized in some river reaches compared with other types. According to a field survey in the wet season in West Kalimantan, the Landak and Kapuas Rivers near Sintang can be categorized as Type 3. In Central Kalimantan, the Kapuas and Kahayan Rivers can also be categorized as this type. This high concentration of silt results from the erosion of steep slope areas in the uplands.

(2) Other Chemical Water Quality

The Table 17.2.3 shows the river water quality in West and Central Kalimantan measured by the Ministry of Public Works. Figures 17.2.13 and 17.2.14 show the locations of river water quality measurement stations. River water is the major water source for drinking, irrigation and industry both in West and Central Kalimantan.

1) Drinking water

The critical constituents for drinking water in West and Central Kalimantan are Turbidity, Color, Iron ion and pH. Other water quality indicators compared with Water Quality Standard of Clear Water in Indonesia (Table 17.2.4).

Turbidity is an indicator of brown clay concentration in water. The turbidity of KAKAB River is higher than the rivers in West Kalimantan. This is due to the deforestation of steep slope areas in the upper part of the Barito River Basin.

Color and Iron ion are indicators of peat deposits. The values of color and iron ion of Kahayan and Landak rivers are higher than those of other rivers because of the peat deposit area. The higher concentration of iron ion in the Barito River results from the existence of black clay in the downstream part of peat deposits.

Photo 17.2.1 Type 1, Kapuas River at Sanggau

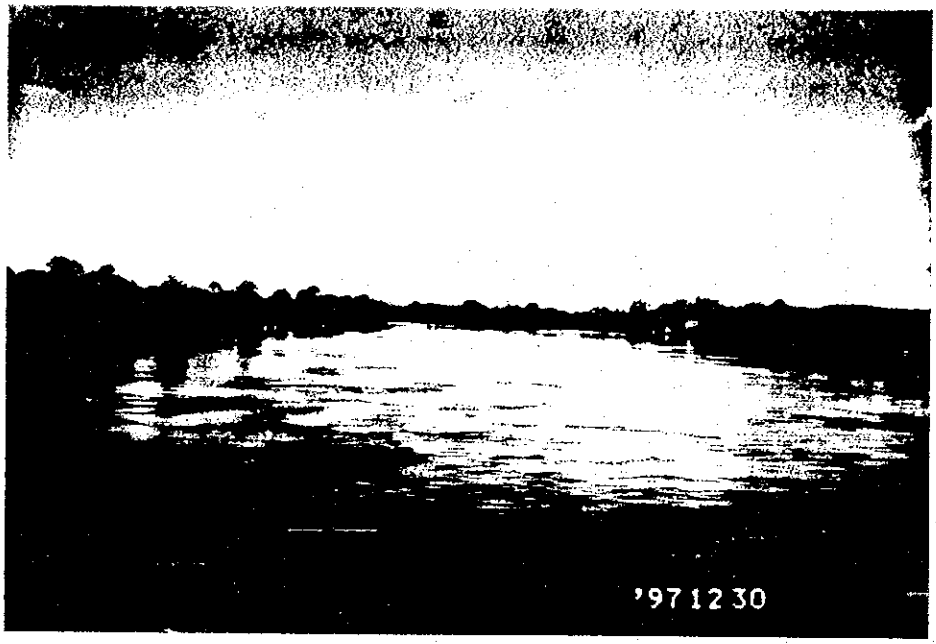


Photo 17.2.2 Type 2 (left), Type 3 (right), Kahayan River near Palangkaraya

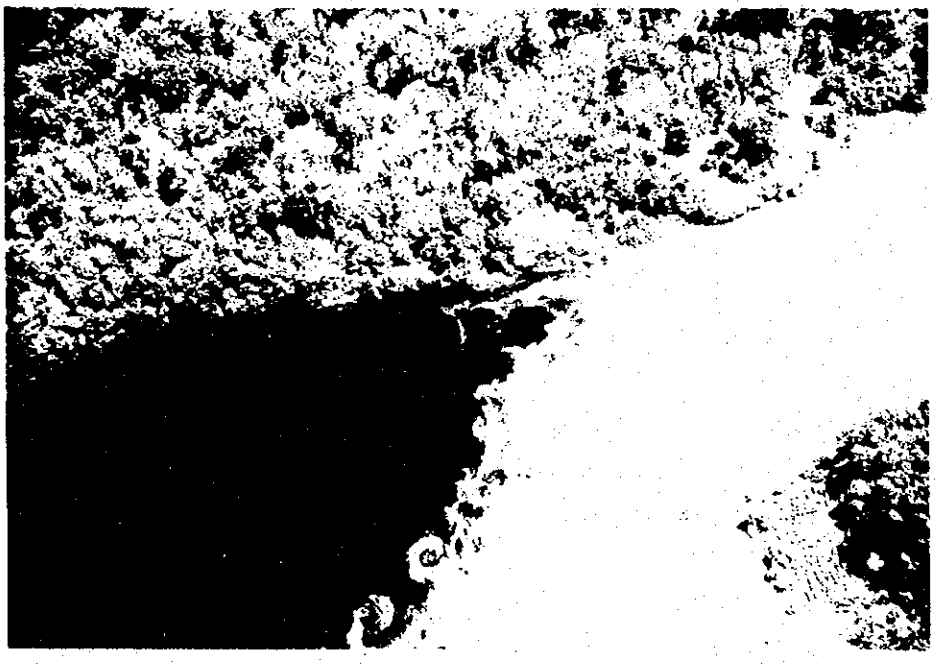


Table 17.2.3 Surface Water Quality in 1993

Parameter	Code	408.1.0.01	408.1.0.02	408.1.0.03	408.1.1.01	408.1.1.02	403.1.0.01	403.1.0.02	403.1.0.03	402.1.0.01	402.1.0.02	Indonesian Standard for Drinking Water	WHO Guideline for Drinking Water
	River Name	Kapuas	Kapuas	Kapuas	Landak	Landak	Kahayan	Kahayan	Kahayan	Barito	Barito		
	Station Name	Supadio	Pontianak	Jeruju	Penepat	Pontianak	Sebelum Pam	Intake Pam	Pelabuhan	Marabahan	Pelabuhan Trisakti		
	Unit												
DHL		33	29	40	54	72	45	50	60	44	56		
Turbidity	mg/L	33	19	22	21	20	25	20	18	27	35	25	
Temp.	C	28.4	27.5	28.3	27.1	27.8	-	-	-	-	-		
Color	PtCo	40	48	47	49	51	35	50	60	53	46	50	
Diss.	mg/L	23	20	28	34	48	36	45	50	32	40	1500	
SS	mg/L	59	36	39	38	46	-	-	-	74	70		
Alkali	mg/L	10	9.3	11	17	17	24	30	34	-	-		
NH3-N	mg/L	0.001	0.0015	t	t	t	-	-	-	-	-		
NH4-N	mg/L	0.649	0.760	0.626	1.010	0.156	0.200	0.120	0.170	0.561	0.643		
CO2	mg/L	8.5	8.1	8.2	14	14	4.5	5	6	-	-		
Fe	mg/L	0.66	0.52	0.65	0.77	0.74	1.00	1.00	0.80	1.79	1.15	1.00	
Total Fe	mg/L	1.23	0.94	0.92	2.06	1.13	1.20	1.30	1.40	2.90	1.83		
B	mg/L	0.05	0.06	0.09	0.09	0.11	t	t	t	0.04	0.03		0.30
Detergen	mg/L	0.007	0.010	0.001	t	0.005	0.010	0.011	0.020	0.021	0.005		
Fenol	mg/L	t	t	t	t	t	t	t	t	-	t		
F	mg/L	t	0.05	0.07	t	t	t	t	t	-	t	1.5	
PO4-P	mg/L	t	t	t	t	t	0.02	0.02	0.02	t	t		
Total PO4-P	mg/L	0.048	0.105	0.065	0.042	0.045	0.030	0.030	0.040	0.013	0.021		
Cd	mg/L	t	t	t	t	t	t	t	t	t	t	0.005	0.003
Total Cd	mg/L	t	t	t	t	t	t	t	t	t	t		
K	mg/L	0.40	0.35	1.00	1.80	2.00	0.80	1.00	2.10	0.33	0.62		
Ca	mg/L	2.8	2.2	3.1	4.3	4.5	4.0	5.0	6.0	5.7	7.9		
CaCO3	mg/L	11.0	10.0	10.2	17.0	17.0	22.0	29.0	31.0	24.0	34.0	500.0	
Cl	mg/L	2.7	2.6	3.7	4.6	7.3	4.0	5.0	5.0	5.5	7.6	600.0	
KOB	mg/L	6.1	6.8	-	6.6	7.6	-	-	-	-	-		
KOK	mg/L	12	13	13	12	14	19	30	25	40	29		
Cr	mg/L	t	t	t	t	t	t	t	t	t	t	0.05	0.05
Total Cr	mg/L	t	t	t	t	t	t	t	t	t	t		
Mg	mg/L	0.89	1.1	0.77	1.5	1.4	3	4	4	2.3	3.5		
Mn	mg/L	t	t	0.02	t	t	t	t	t	0.03	0.00	0.50	0.50
Total Mn	mg/L	t	0.03	0.03	0.04	0.04	t	t	t	0.11	0.03		
Minyak-lemak	mg/L	t	t	t	t	t	t	t	t	-	-		
Na	mg/L	1.9	1.6	2.4	2.9	4.9	3.4	5.0	6.0	0.6	1.7		
%Na	-	26	25	30	25	35	24	26	28	5	9		
Ni	mg/L	t	t	t	t	t	t	t	t	0.017	0.017		0.02
Total Ni	mg/L	t	t	t	t	t	t	t	t	0.04	0.04		
KMnO4	mg/L	31	34	32	37	38	23	30	40	28	19	10.0	
NO3-N	mg/L	0.058	0.042	0.13	0.118	0.046	t	t	t	0.37	0.432	10.0	
NO2-N	mg/L	t	t	t	t	t	t	t	t	0.006	0.007	1.0	
N-organic	mg/L	0.368	0.389	0.485	0.518	0.244	0.200	0.300	0.200	0.337	0.433		
DO	mg/L	3.4	3.8	4.1	3.5	3.4	-	-	-	-	-		
pH	-	6.3	6.4	6.2	5.3	5.0	6.8	7.1	7.2	6.8	6.5	6.5-9.0	
RSC	-	-0.01	-0.01	0	-0.008	-0.008	0.03	0.02	0.05	0	-1		
SAR	-	0.26	0.22	0.32	0.3	0.51	0.31	0.4	0.47	0	0		
Zn	mg/L	0.010	0.013	0.003	0.005	0.010	0.030	0.030	0.040	0.003	0.001	15.000	
Total Zn	mg/L	0.075	0.060	0.048	0.075	0.165	0.043	0.050	0.050	0.033	0.023		
SiO2	mg/L	22	21	22	22	22	40	30	30	14	15		
SO4	mg/L	0.7	0.4	1.6	2.0	4.1	3.0	3.6	5.0	9.2	9.8	400.0	
Cu	mg/L	t	t	t	t	t	t	t	t	0.03	0.02		1.5
Total Cu	mg/L	t	t	t	t	t	-	-	-	0.03	0.04		
Pb	mg/L	t	t	t	t	t	t	t	t	t	t	0.05	0.01
Total Pb	mg/L	t	t	t	t	t	-	-	-	t	t		

note: tt means not detected

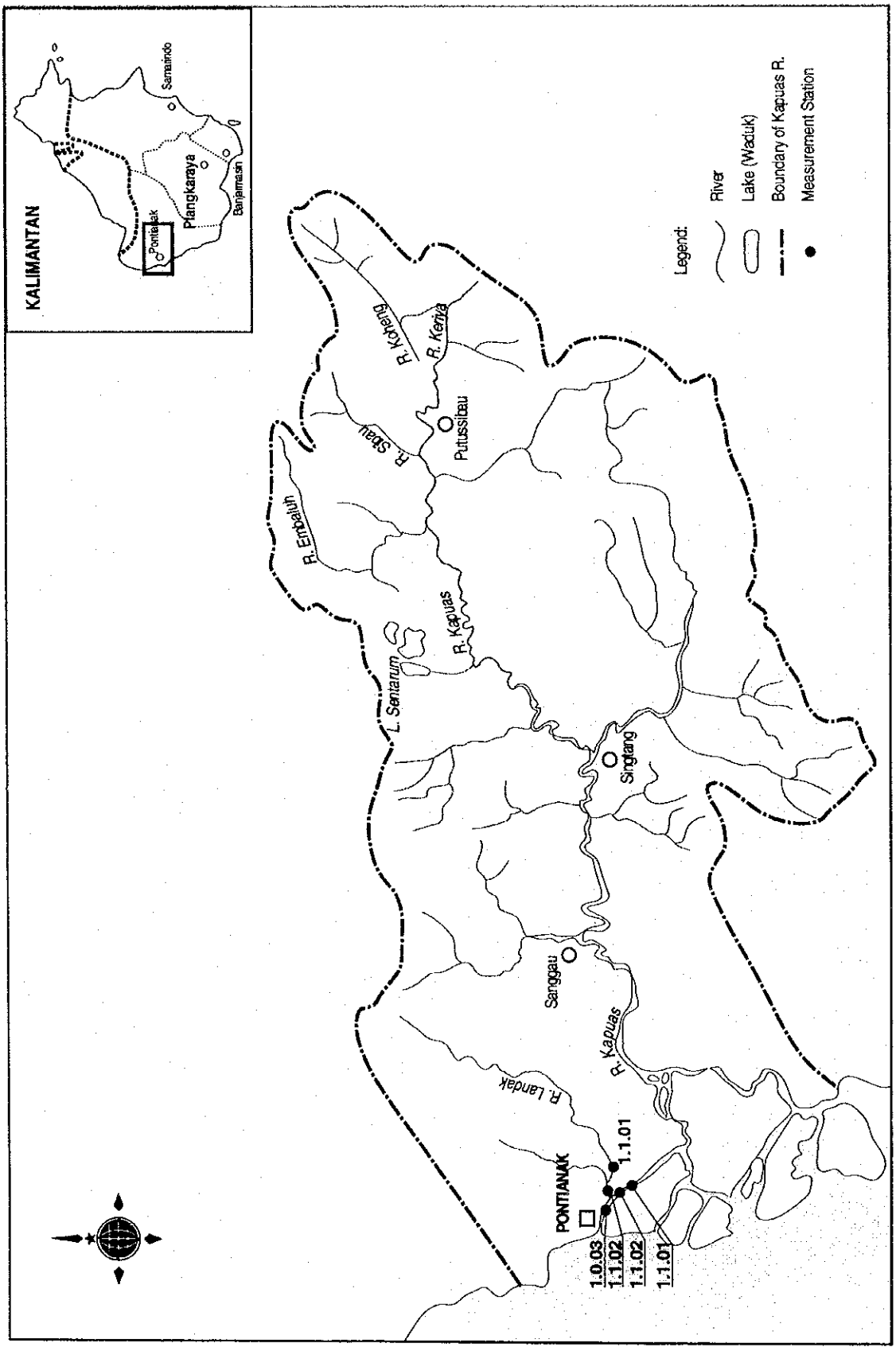


Figure 17.2.13 Location of River Water Quality Mesurement Station in Kpuas River Basin

Figure 17.2.14 Locations of River Water Quality Measurement Stations in Kahayan River Basin

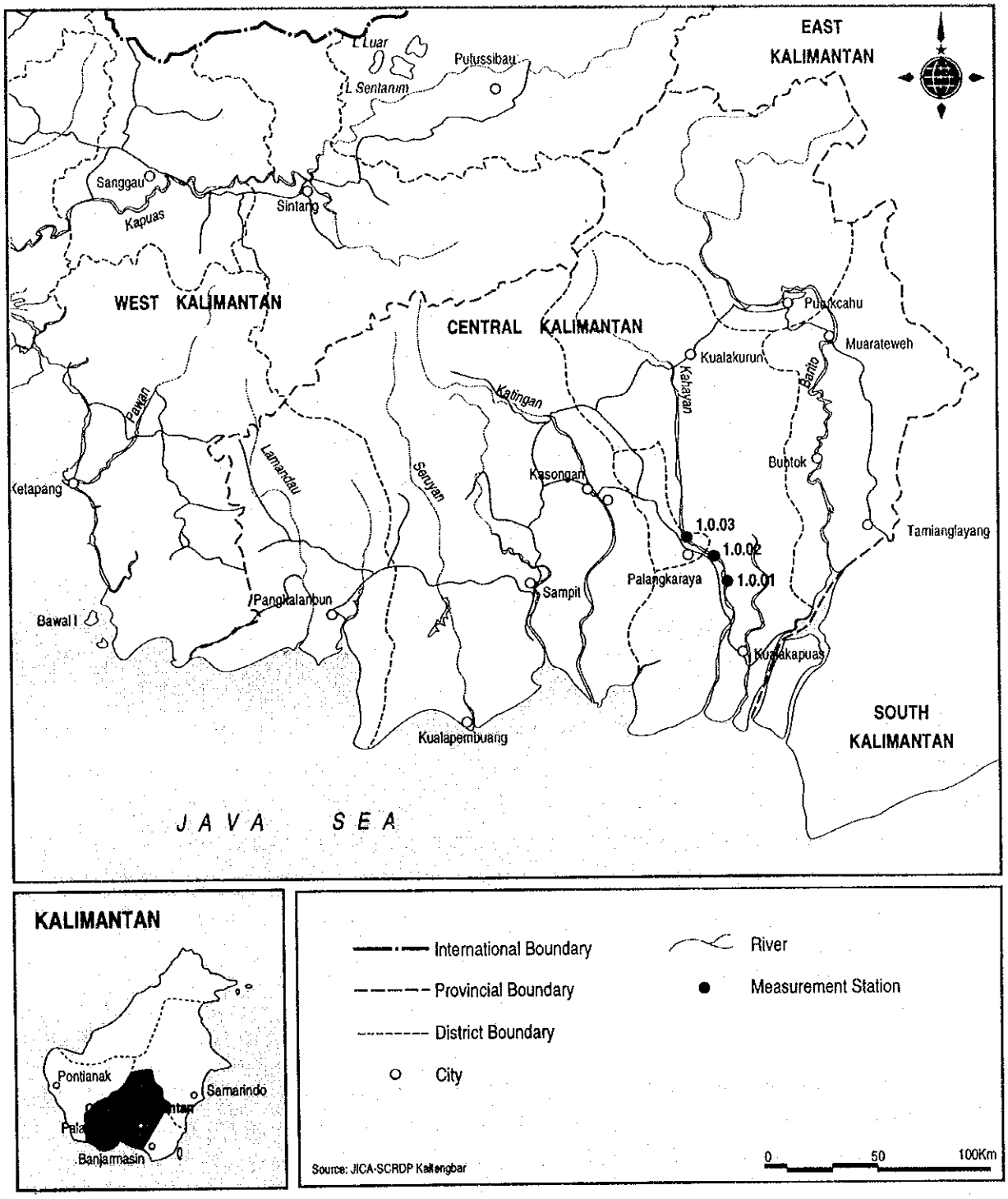


Table 17.2.4 Water Quality Standard of Clean Water in Indonesia

Item		Unit	Standard
Physical	Odor	-	not detective
	Total Dissolved Solids	mg/l	1500
	Turbidity	NTU	25
	Color	TCU	50
Inorganic Chemicals	Hg	mg/l	0.001
	As	mg/l	0.05
	Fe	mg/l	1.0
	F	mg/l	1.5
	Cd	mg/l	0.05
	Hardness as CaCO3	mg/l	500
	Cl	mg/l	600
	Cr	mg/l	0.05
	Mn	mg/l	0.5
	N-NO3	mg/l	10
	N-NO2	mg/l	1.0
	pH	ph	6.5-9.0
	Se	mg/l	0.01
	Zn	mg/l	15
	Si	mg/l	0.1
	SO4	mg/l	400
	Pb	mg/l	0.05
Organic Chemicals	--------		
Microbiological	Coliform	1 per 100 ml	50
Radionucleides	--------		

Source: Regulation of Ministry of Health, Indonesia, September 3, 1990

The level of pH is an indicator of acidity resulting also from the existence of peat deposit. The runoff from the peat deposit area generally has a low pH value such as 2 up to 5, however, the measured values in the stations are comparatively normal except in the Landak River. In the case of Kapuas River in West Kalimantan, the measurement station is located downstream of the big basin and peat deposit areas are not distributed in the vast Middle Basin. The Kahayan River basin has large peat deposit areas, however, the stations are located on the large upstream part of the peat deposit.

2) Irrigation

The river water quality in West and Central Kalimantan at present is not so critical for irrigation, especially paddy field irrigation. The productivity of paddy is comparatively low, 1 up to 2 ton/ha/year in the area affected by saline water intrusion in West Kalimantan. There are still a lot of unknown factors about deterioration of water quality when swamp area development proceeds to develop peat deposit area.

17.2.6 Classification of Watersheds in Western Part of Kalimantan

There are 30 watershed areas ranging from 280 km 2 to 85,200 km 2 in the Study Area (see Table 17.2.5 and Figure 17.2.15).

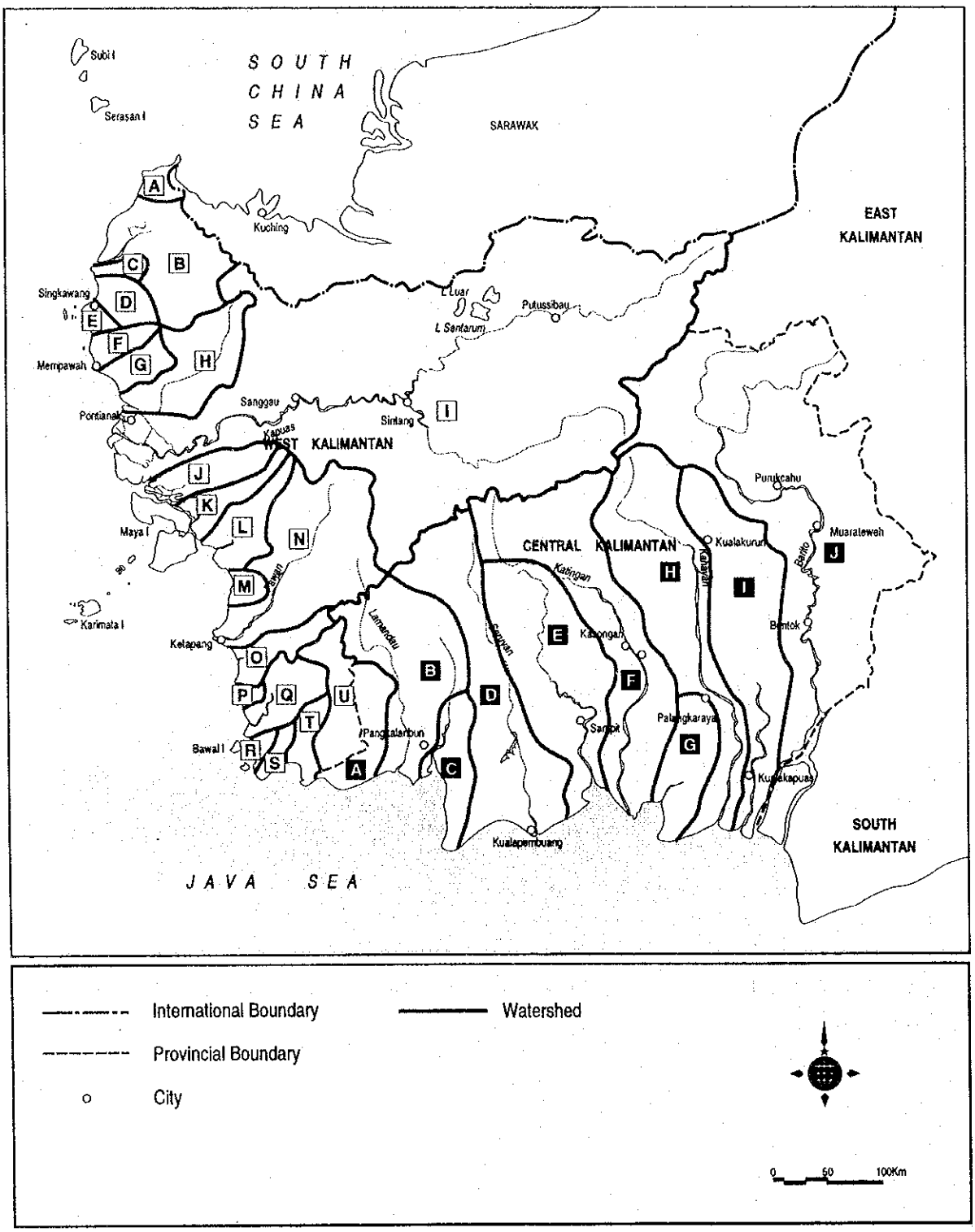
Table 17.2.5 Watershed Area in Western Part of Kalimantan

No.	Watershed	Area (km 2)	Province
A	Paloh	770	West Kalimantan
B	Sambas	7,740	
C	Sebangkau	420	
D	Selakau	1,400	
E	Raya	420	
F	Duri	700	
G	Mempawah	2,080	
H	Landak	8,650	
I	Kapuas	85,200	
J	Mendawak	2,950	
K	Lida	2,530	
L	Simpang	3,090	
M	Tullak	840	
N	Pawan	13,400	
O	Pesagian	2,880	
P	Tengar	280	
Q	Kendawangan	3,380	
R	Simbar	630	
S	Air Hitam Kecil	980	
T	Air Hitam Besar	1,900	
U	Jelai	5,840	
A	Jelai	3,210	Central Kalimantan
B	Lamandau	11,400	
C	Kumai	4,030	
D	Seruyan	17,940	
E	Mentaya	16,700	
F	Katingan	17,040	
G	Sebangau	5,970	
H	Kahayan	17,890	
I	Kapuas	16,820	
J	Barito	42,820	

Source: Rencana Tata Ruang Kalimantan Barat Tahun 2008
Rencana Struktur Tata Ruang Propinsi Kalimantan Tengah

There are several different types of watersheds where different approaches will be needed in the management of each type.

Figure 17.2.15 Watersheds in Western Part of Kalimantan



Source: Rencana Tata Ruang Kalimantan Barat Tahun 2008
Rencana Struktur Tata Ruang Propinsi Kalimantan Tengah

The Study Area's watersheds can be grouped into 5 major watersheds as follows (also see Figure 17.2.16).

- The Sambas River System
- The Kapuas River System
  - The Lower Kapuas River System
  - The Middle Kapuas River System
  - The Upper Kapuas River System
- The Pawan River System
- The Seruyan River System
- The KAKAB River System

For this classification, the following factors were considered,

- Topography
- Hydro-geology
- Catchment size
- Climate
- Soil
- Present Land Use.

The characteristics of each watershed are shown in Table 17.2.6.

Figure 17.2.16 Classification of Watersheds

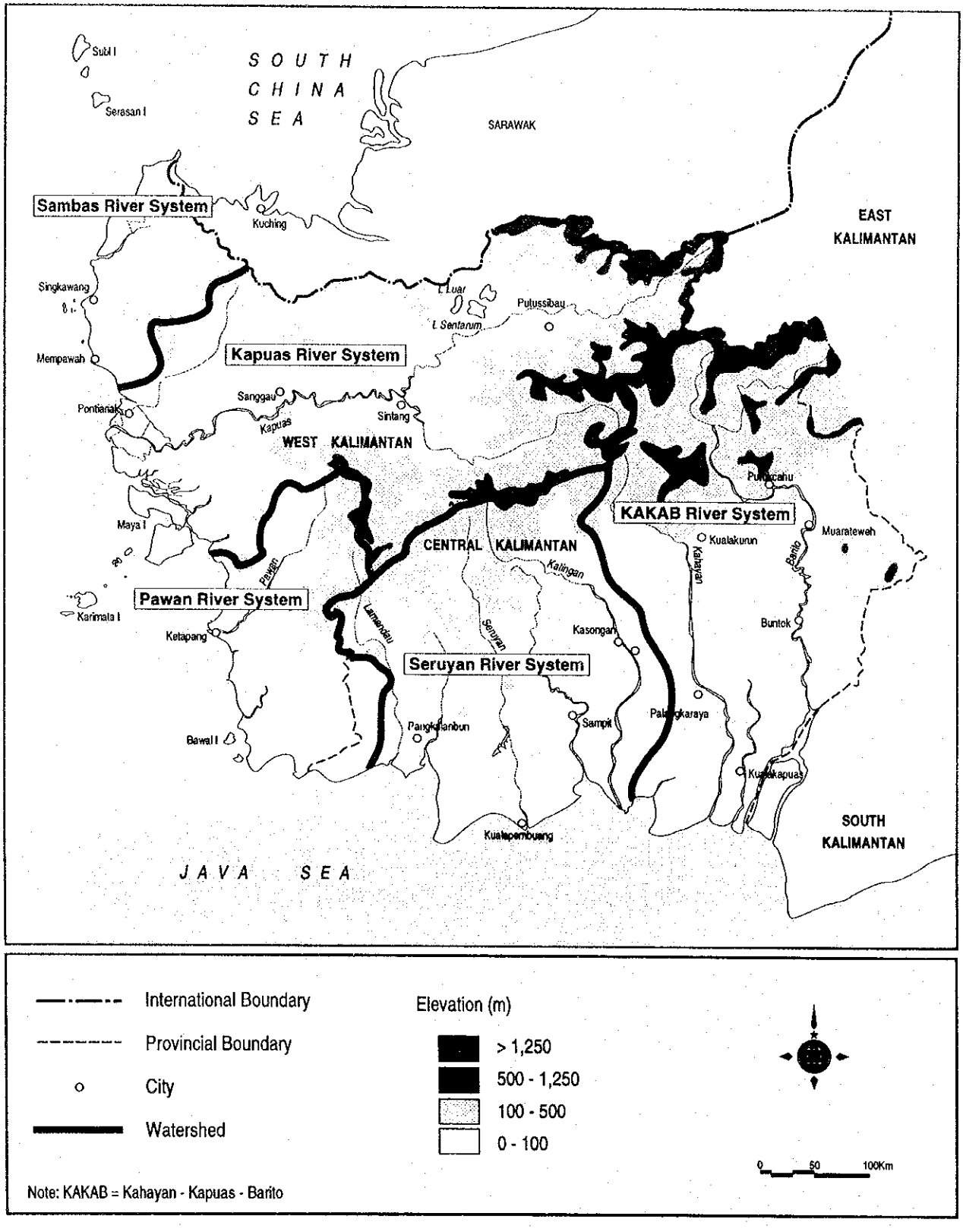


Table 17.2.6 Characteristics of Rivers by Major Watersheds

Province	Watershed Name		River Name	Area (km2)	Sub Total Area (km2)	Topography			Hydro-Geology		Climate (Annual Rainfall)	Specific Runoff (in m3/s/km2) (1994)	
						Elevation (m)	Length (km)	Slope				Annual	Minimum
West Kalimantan	Sambas		Paloh	770	13,530	0-50	135	1/2,700	Sedimentary rocks, sand in upland, Alluvium and peat deposits in lowland	Coastal swamp area with high permeability, brackish groundwater	3,100 mm at Sambas	0.05	0.01
			Sambas	7,740									
			Sebakau	420									
			Selakau	1,400									
			Raya	420									
			Duri	700									
			Mempawah	2,080									
	Kapuas	Lower Kapuas	Landak	8,650	22,240	0-10	120	1/12,000	Alluvium and peat deposits	Coastal swamp area with high permeability, brackish groundwater		0.04	0.01
			Lower Kapuas	5,020									
			Mendawak	2,950									
			Lida	2,530									
			Simpang	3,090									
		Middle Kapuas at Tayan	Middle Kapuas	50,900	50,900	10-40	320	1/11,000	Sedimentary rocks in upland	Low permeability	3,300mm at Sintang	0.08	0.01
		Upper Kapuas at Sisit	Upper Kapuas	29,280	29,280	40-50	460	1/46,000	Alluvium and peat deposits	High permeability, Groundwater Potential	4,400mm at Puttusibau	0.09	0.02
	Pawan		Tulak	840	33,340	0-100	340	1/3,400	Old volcanic rocks in upland, Alluvium and peat deposits in lowland	Coastal swamp area with high permeability, brackish groundwater	3,100 mm at Ketapang, Dry season with less than 100 mm/month	0.05	0.01
			Pawan	13,400									
			Pesagian	2,880									
			Tengar	280									
			Kendawangan	3,380									
			Simbar	630									
			Air Hitam Kecil	980									
			Air Hitam Besar	1,900									
			Jelai	5,840									
			Jelai	3,210									
Central Kalimantan	Seruyan		Lamandau	11,400	67,110	0-100	500	1/5,000	Sedimentary rocks,sand in upland, Alluvium and peat deposits in lowland	Coastal swamp area with high permeability, brackish groundwater	3,000 mm at Pangkalanbun	0.05	0.01
			Kumai	4,030									
			Seruyan	17,940									
			Mentaya	16,700									
			Katingan	17,040									
	KAKAB		Sebangau	5,970	83,500	0-100	1050	1/10,500	Sedimentary rocks,sand in upland, Alluvium and peat deposits in lowland	Swamp area from coast to middle reach with high permeability, groundwater potential	2,200 mm at Muara Teweh, 2,400 mm at Palangkaraya, Dry season with less than 100 mm/month	0.04	0.01
			Kahayan	17,890									
			Kapuas	16,820									
			Barito	42,820									
Total				299,900	299,900								

17.2.7 Water Supply

(1) Drinking Water in West Kalimantan

In West Kalimantan drinking water mainly depends on river water and rainwater. In urban areas intake is by gravity or pumping river water for storage in reservoirs. After treatment it is delivered to each area. Even in urban areas rainwater drums are prepared beside houses. In rural area, intake is by pumping or dipping river water for storage in reservoirs or drums beside houses.

It should be certain that in West Kalimantan the population is concentrated in western part of the province. This part is located on lower reaches of rivers and is exposed to saline intrusion in dry season. As described in the above, even in urban areas people prepare rainwater drums in case of salinization of water source. This situation is endemic to West Kalimantan.

The problems related with drinking water in West Kalimantan are as follows;

- Acidity in water source due to infiltration from both the peat layer in lower areas and strongly weathered soils. Major cities along the coast are located downstream of the peat layer.
- Saline water in lowland areas which are highly populated, within 50 ~ 60 km from the sea in the dry season.
- Deterioration in river water quality due to extremely low flow in dry season
- High concentrations of silt in river water, especially the Landak and Melawi rivers.

(2) Drinking Water in Central Kalimantan

In Central Kalimantan drinking water basically depends on river water. In urban areas, intake is by gravity or pumping river water for storage in reservoirs. After treatment, it is delivered to each area. In Muara Teweh of Barito River a weir to store river water has been constructed and used for the drinking water supply and irrigation. In rural areas, intake is by pumping or dipping river water for storage in reservoirs or drums beside houses. On some hilly areas, water is used from shallow wells and springs for drinking water. The lowland areas along the coast suffer from saline intrusion in river in the dry season. Rainwater drums have been prepared for this kind of situation, however, recent long droughts such as in 1994 and 1997 have caused a panic for drinking water.

The problems related to drinking water in Central Kalimantan are as follows;

- Acidity in water source due to infiltration from both peat layer in middle and lower areas and strongly weathered soils.

- Saline water in lowland areas within 50 ~ 60 km from the sea in dry season.
- Deterioration in river water quality due to extremely low flow in dry season
- High concentrations of silt in river water, especially the Barito, Kapuas and Kahayan rivers

(3) Irrigation

The irrigation areas in Western Kalimantan are shown in Table 17.2.7 ~ 17.2.8. In Central Kalimantan, swamps are being developed for food crop production, especially paddy and to improve drainage in order to implement the transmigration program. The minimum monthly specific discharge is approximately 0.01 $m^3/s/km^2$ in West and Central Kalimantan except in the Upper Kapuas Basin. This value is smaller than the water consumption for paddy irrigation, 0.013 $m^3/s/km^2$.

The amount of specific discharge itself can not lead to a shortage of irrigation water because the total irrigation area is small enough compared with the catchment size. However if an irrigation area is located in an upstream part of a river, especially a small tributary, the low flow discharge in the dry season becomes a serious factor for irrigation. This situation is more serious in smaller river basins such as the Sambas River Basin and the Pawan River Basin.

Table 17.2.7 West Kalimantan Irrigation Areas

Kabupaten	Irrigation (ha)	Swamp (ha)	Total (ha)
Kapuas Hulu	2,850	2,000	4,850
Ketapang	2,862	36,735	39,597
Pontianak	8,959	89,293	98,252
Sambas	6,423	24,925	31,348
Sanggau	5,152	0	5,152
Sintang	1,721	0	1,721
Total	27,967	152,953	180,920

Table 17.2.8 Central Kalimantan Irrigation Areas

Area	Irrigation(ha)
Kualakurun	1,550
Muara Teweh	1,687
Buntok	10,209
Total	13,446

17.2.8 Flooded Areas

(1) West Kalimantan

The flood condition in West Kalimantan is shown in Table 17.2.9 and Figure 17.2.17 ~ 17.2.18.

Table 17.2.9 Flood Condition in West Kalimantan

Area	Duration (day)	Depth (m)	Total Area (ha)
Kab. Sambas	1 to 3	0.25 to 1.5	3,300
Kab. Pontianak	2 to 4	0.1 to 1.5	4,500
Kab. Sanggau	5 to 10	0.5 to 2	4,800
Kab. Sintang	3 to 20	1 to 2	14,000
Kab. Kapuas Hulu	1 to 5	0.25 to 1	18,600
Kab. Ketapang	7	0.75 to 1.25	112,000
Kod. Pontianak	0.5 to 2	0.1 to 0.15	-

1) Pontianak, Sambas and Ketapang

Short duration and shallow depth inundation due to flat topography, high tide and high intensity of rainfall. Swamp area in Ketapang has a long duration.

2) Sanggau, Sintang, Kapuas Hulu

Long duration and deep depth inundation, especially in riverine areas, is due to the flooding of the main river like the Kapuas River.

(2) Central Kalimantan

There are 14 flooded areas in Central Kalimantan shown in Table 17.2.10 and Figure 17.2.19.

Table 17.2.10 Flood Condition in Central Kalimantan

Location	Flooded Area (ha)
Muara Teweh upstream, Buntok	12,800
Kuala Kapuas	6,128
Pangkuh upstream, Palangkaraya upstream, Kuala Kurun	11,200
Kasongan	10,700
Sampit	6,400
Telaga Pulang	5,746
Arut river upstream	2,685
Kotawaringin upstream	2,388
Jelai river	600
Total	58,647

Figure 17.2.17 Location of Flooded Areas in West Kalimantan

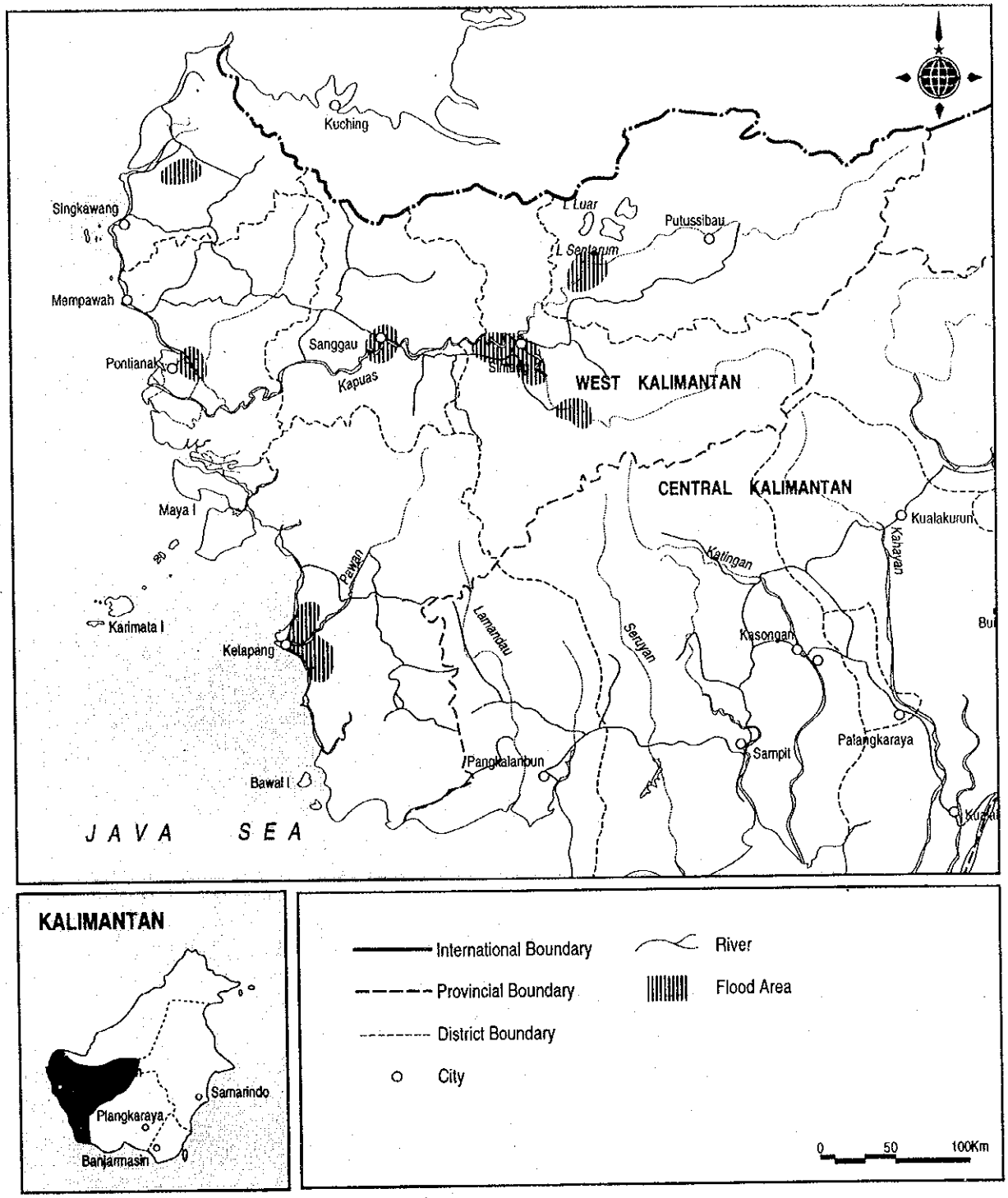


Figure 17.2.18 Location of Flooded Areas in Pontianak, West Kalimantan

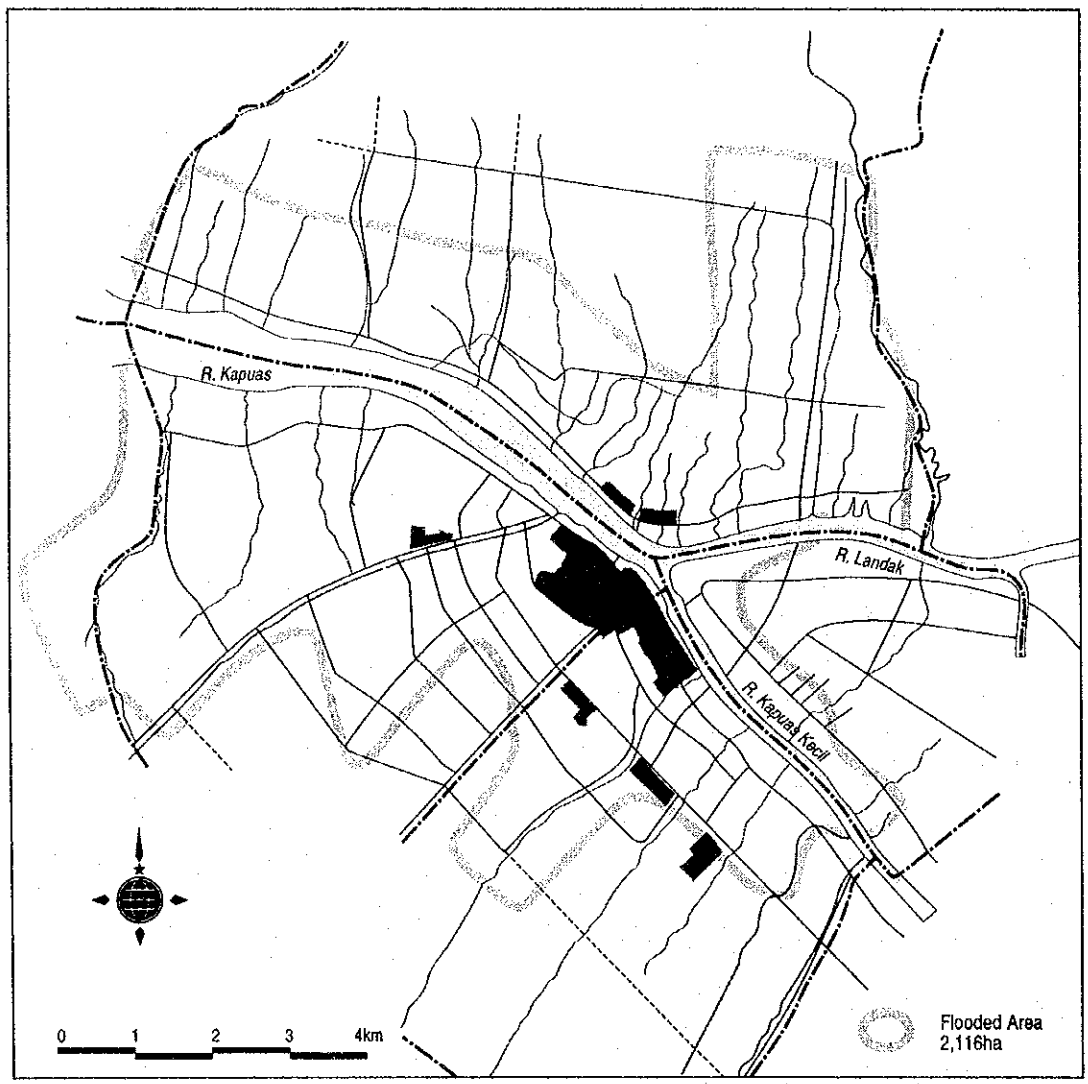
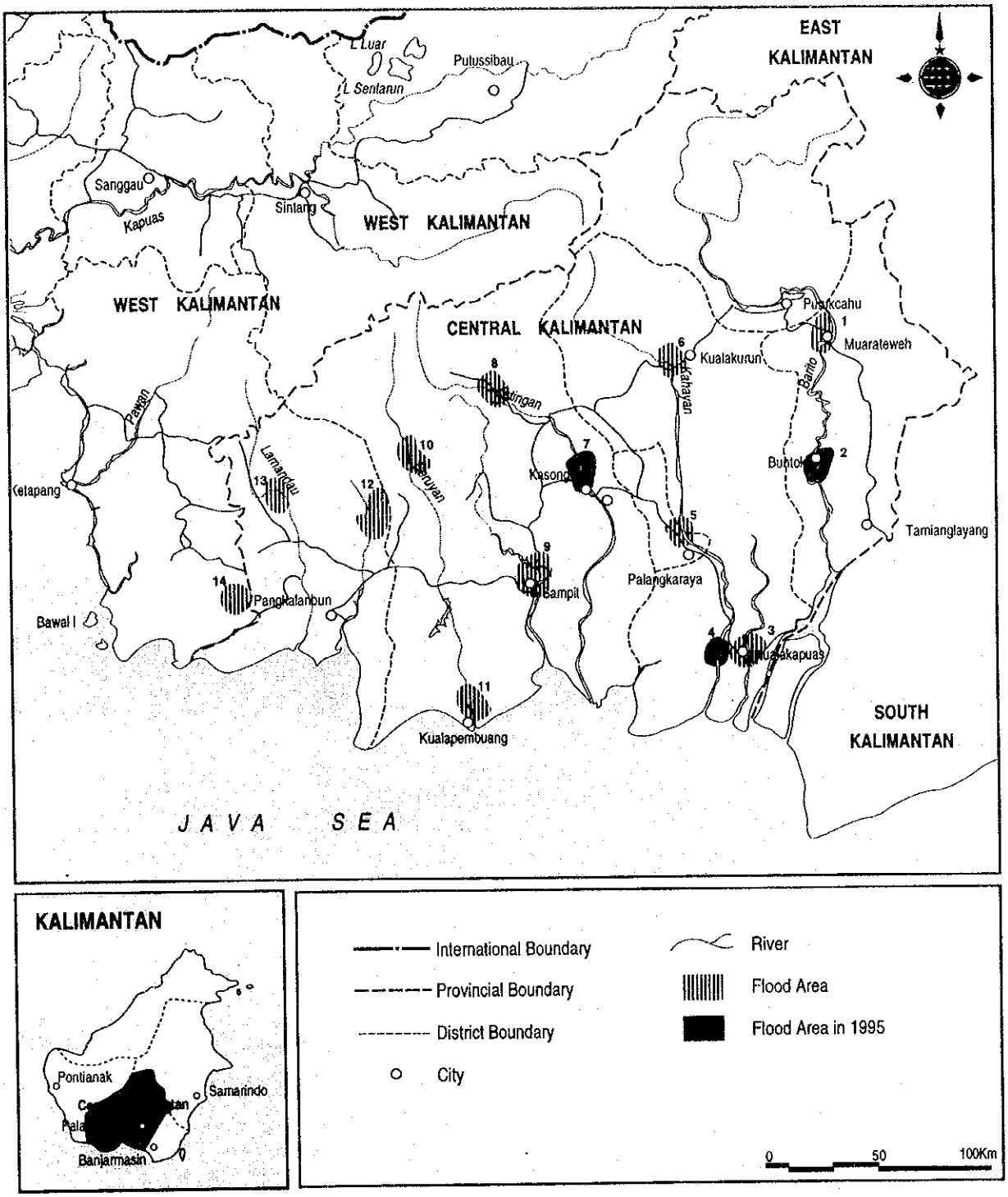


Figure 17.2.19 Location of Flooded Areas in Central Kalimantan



The areas located upstream suffer from the flooding of the river itself. The areas located in lowland areas are flooded due to the combination of high tide and river flood. At present, there are no flood projects. In 1995 Central Kalimantan had serious floods in some areas such as Buntok, northern part of Pangkuh and Kasongan.

As shown in the above, not only the coastal swamp area but also the riverine areas in the middle basin are annually exposed to flooding. The conservation of swampy and forested areas in the upper basin is significant in terms of avoiding flood runoff increase.

17.2.9 River Navigation

The navigable reaches of West and Central Kalimantan are as follows,

Table 17.2.11 Navigable Reaches in West and Central Kalimantan

Province	River Name	Wet Season	Dry Season
West Kalimantan	Kapuas	Puttusibau	Tyan
Central Kalimantan	Barito	most upstream areas	Muara Laung
	Kapuas	most upstream areas	Pujoh
	Kahayan	most upstream areas	Bawan
	Katingan	most upstream areas	Buntutbali
	Mentaya	most upstream areas	Kualakuayan
	Seruyan	most upstream areas	Rantaupulut
	Lamandau	most upstream areas	Tapinbin

In the dry season, because of the extremely low flow discharge, the navigable lengths decrease to less than 50 % of those in the wet season.