JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
MINISTRY OF PUBLIC WORKS
THE REPUBLIC OF INDONESIA

THE STUDY ON KAMPAR-INDRAGIRI RIVER BASIN DEVELOPMENT PROJECT

VOLUME 4

SUPPORTING REPORT (2)

(FINAL REPORT)

DECEMBER 1995

CTI ENGINEERING CO., LTD.
IN ASSOCIATION WITH
NIPPON KOEI CO., LTD.

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CHAPTER 1 STUDY AREA FOR WATER RESOURCES DEVELOPMENT PLAN

1.1 Study Area

The study area consists of two river basins, the Kampar river basin with a catchment area of 24,548 km^2 and the Indragiri river basin with 16,268 km^2, as shown in Fig. VIII.1.1. In addition, a deltaic zone extending between the Kampar and Indragiri river basins with a catchment area of 10,580 km^2 will be included in the study area if the study is related to the zone. The study area belongs to the Riau and West Sumatra provinces and is divided by province as follows:

Unit: km^2

River Basin	West Sumatra Province	Riau Province	Total
Kampar	3,462	21,086	24,548
Indragiri	7,459	8,809	16,268
In-between Area	0	10,580	10,580
Total	10,921	40,475	51,396

Pekanbaru City, the capital of Riau Province, is included in the study area for water supply though it is located outside the both river basins, because Pekanbaru City has a plan to take water for domestic and urban flashing uses from the Kampar River in the near future.

1.2 Administrative Division

The study area administratively belongs to the two provinces of Riau and West Sumatra, or the following nine regencies (Kabupaten) and six municipalities (Kotamadya) of which locations are shown in Fig. VIII.1.1.

River Basin	Province	Regency (Kabupaten)	Municipality (Kotamadya)
Kampar	Riau	Kampar Indragiri Hulu (*)	Pekanbaru
	West Sumatra	Pasaman Limapuluh Kota (*)	
Indragiri	Riau	Indragiri Hulu (*) Indragiri Hilir	
	West Sumatra	Limapuluh Kota (*) Agam Tanahdatar Solok Sawahlunto/Sijunjung	Payakumbuh Bukittinggi Padang Panjang Solok Sawahlunto

* Regency belonging to both river basins

1.3 Area and Population Shares

All statistical data are compiled by administrative division such as province, regency and municipality. The administrative boundaries do not always coincide with those of the river basins and sub-basins, as shown in Figs. VIII.1.1 and VIII.4.1. To estimate the water demand of the river basins and sub-basins based on such administrative statistical data, an area share and a population share are introduced, as presented in Table VIII.1.1.

The population share indicates a ratio of population of the area belonging to the subject river basin to that of the whole regency or municipality in which the area is included. It is estimated in district (Kecamatan) level based on the 1990 population census. The area share is a ratio of the area belonging to the subject river basin to the area of the whole regency or municipality in which the area is included.

1.4 Population

The historical populations of regencies and municipalities in the Riau and West Sumatra provinces related to the study from 1982 to 1992 are given in Table VIII.1.2. The future populations are forecasted based on the growth in the past 10 years, also referring to REPELITA VI. The forecasted populations are presented in the same table.

The population of the Riau and West Sumatra provinces will increase as follows:

Province	1994	2019	Growth Rate
Riau	3,833,000	8,747,000	3.36 %/year
West Sumatra	4,404,000	6,279,000	1.43 %/year

The annual growth rate of Riau Province is much higher than West Sumatra Province and the population of Riau Province will exceed that of West Sumatra Province after 2000.

The populations of the Kampar and Indragiri river basins are estimated based on the respective regencies and municipalities dividing them into rural and urban areas as given in Table VIII.1.3. The population of the study area forecasted is summarized by area, river basin and province as below:

Unit: 1,000 persons

River Basin	Area	1994	1999	2004	2009	2014	2019
Kampar	Rural	493.1	551.5	609.5	672.7	733.7	792.8
	Urban	29.0	45.0	64.1	87.3	114.2	145.1
	Total	522.1	596.5	673.6	760.0	847.9	937.9
Indragiri	Rural	1,888.6	2,040.0	2,186.6	2,356.3	2,515.0	2,677.5
	Urban	322.5	382.4	448.4	528.6	614.4	710.3
	Total	2,211.1	2,422.4	2,635.0	2,884.9	3,129.4	3,387.8
Pekanbaru City	Rural	64.0	70.7	76.4	78.2	71.7	54.1
	Urban	432.8	578.6	782.4	1,057.5	1,395.1	1,818.0
	Total	496.8	649.3	858.8	1,135.7	1,466.8	1,872.1
Study Area	Total	3,230.0	3,668.2	4,167.4	4,780.6	5,444.1	6,197.8

Unit: 1,000 persons

Province	River Basin	1994	1999	2004	2009	2014	2019
Riau	Kampar	924.7	1,145.6	1,426.8	1,782.3	2,194.3	2,682.6
	Indragiri	711.3	813.2	921.4	1,037.7	1,156.3	1,282.4
	Total	1,635.0	1,958.8	2,348.2	2,820.0	3,350.6	3,965.0
West Sumatra	Kampar	94.3	100.2	105.5	113.4	120.4	127.4
	Indragiri	1,499.9	1,609.2	1,713.6	1,847.2	1,973.1	2,105.4
	Total	1,594.2	1,709.4	1,819.1	1,960.6	2,093.5	2,232.8
Study Area	Total	3,230.0	3,668.2	4,167.4	4,780.6	5,444.1	6,197.8

The average annual growth rate of the Kampar river basin is 2.4%, while that of the Indragiri river basin is 1.7%. Pekanbaru City has a higher growth rate of 5.4%. These are graphically shown in Fig. VIII.1.2.

CHAPTER 2 WATER RESOURCES POTENTIAL

2.1 Surface Water

Water resources are generally represented by surface water and groundwater. The study area is blessed with abundant rainfall and has a high potential of water resources development. The annual rainfall in the study area ranges from 4,500 mm in the mountain area to 2,000 mm in the lowland. The average annual rainfall of the Kampar river basin is 2,513 mm and that of the Indragiri river basin is 2,338 mm. Surface water potential in the study area is estimated, as mentioned hereinafter.

The surface water can be represented by river water. According to the hydrological analysis, the average discharges from 1981 to 1992 at major points of the Kampar and Indragiri rivers are as follows:

River Basin	Point	Catchment Area (km^2)	Ave. Discharge (m^3/sec)
Kampar	Kotapanjang Damsite	3,337	186.6
	Langgam	7,053	352.1
	River Mouth	24,548	1,010.4
Indragiri	Lubukjambi	7,453	260.9
	Air Morek	12,320	462.2
	River Mouth	16,268	590.5

The average monthly discharges of the Kampar and Indragiri river basins are presented in SECTOR I. The annual surface water potential volume and available water volume of both river basins are calculated from the above table as presented in Table VIII.2.1 and summarized below.

River Basin	Surface Water Potential (10^9 m^3/year)	Available Water (10^9 m^3/year)	Specific Discharge (m^3/sec/100 km^2)
Kampar	31.9	22.3	4.12
Indragiri	18.6	13.0	3.63

Note: Available water is assumed to be 70% of the surface water potential.

2.2 Groundwater

Groundwater use in the study area is not high because of abundant surface water, so that its potential has not yet been investigated in detail.

According to the study on "Water Resources and Potentially Irrigable Land of Riau" (Binnie & Partners Ltd. with Hunting Technical Service Ltd., July 1981), the groundwater potential areas (aquifer) in Riau Province are distributed as shown in Fig. VIII.2.1. The area of the Kampar river basin with high potential comes to 1,470 km^2 and that of the Indragiri river basin, 740 km^2.

On the other hand, the groundwater potential areas in West Sumatra Province was investigated by the Regional Office of the Ministry of Mines and Energy and a hydrogeological map is available. According to the map, the aquifers with medium-high potential of groundwater in the Kampar and Indragiri river basins are distributed as shown in Fig. VIII.2.1. The area with high potential is zero in the Kampar river basin and 1,800 km^2 in the Indragiri river basin.

Assuming that a recharge rate through potential area is 30% of effective rainfall in the area concerned, the groundwater potential is estimated as presented in Table VIII.2.2 and summarized below. The potential volume of groundwater is only 2 to 5% of the surface water potential.

River Basin	Groundwater Potential (billion m^3/Year)	Available Water (billion m^3/Year)	Specific Discharge (m^3/sec/100 km^2)
Kampar	0.6	0.4	0.07
Indragiri	0.9	0.6	0.17

Note: Available water is assumed to be 70% of the surface water potential.

CHAPTER 3 PRESENT AND FUTURE WATER DEMAND

3.1 Water Demands Subject to Study

The present and future water demands in the study area are studied for the following ten sectors.

- Irrigation
- Domestic Water
- Industry
- Inland Fishery
- Livestock
- Tourism
- Urban Area Flushing
- Hydropower Generation
- River Navigation
- River Maintenance Flow

The target year for water demand forecast is 2019. The analysis of historical data, estimation of present water demand and forecast of future water demand of the respective sectors are described hereinafter.

3.2 Irrigation Use

Present Water Demand

(1) Irrigation Area

The present irrigation condition, irrigable area and possibility of development of new irrigation area in the Kampar and Indragiri river basins are given in detail in SECTOR VII, IRRIGATION DEVELOPMENT PLAN. According to the study results, the existing irrigation area and future development area of both river basins as of 1993 are identified as presented in Tables VIII.3.1 and VIII.3.2. They are summarized by river basin as follows:

Unit: ha

River Basin	Existing Area	Extendible Area	Proposed Project Area	Total
Kampar	7,557	19,970	10,794	38,321
Indragiri	84,313	13,392	23,777	121,482

The proposed project area indicates the Rantauberangin Irrigation Development Project in the Kampar river basin and the Lubukjambi Irrigation

Development Project in the Indragiri river basin. In the Kampar river basin, the existing irrigation area corresponds to 20% of the irrigable area. In the Indragiri river basin, its ratio comes to 69% due to high development in West Sumatra Province.

The above irrigation areas include village irrigation areas managed by each village. The area of village irrigation is 560 ha (23 projects) in Riau Province and 28,716 ha (1,391 projects) in West Sumatra Province. However, no extension of the village irrigation is expected. The rest is under the control of the Ministry of Public Works.

(2) Water Demand

Presently, double-cropping is applied in the Kampar river basin and single cropping in Riau Province and double cropping in West Sumatra Province in the Indragiri river basin. The unit water requirement of the present cropping pattern is studied in SECTOR VII. In Tables VIII.3.4 and VIII.3.5 the unit water requirements of base years 1988 for Kampar river basin and 1986 for Indragiri river basin are presented.

The water demand is obtained by multiplying irrigation area by unit water requirement. The present irrigation water demands of both river basins in 1993 are estimated as presented in Tables VIII.3.4 and VIII.3.5 and summarized below.

River Basin	Existing Irrigation Area (ha)	Water Demand (m^3/sec)	
		Peak	Average
Kampar	7,557	12.09	3.26
Indragiri	84,313	147.77	38.84

Future Water Demand

(1) Irrigation Area

For forecast of the future irrigation water demand, extension of existing irrigation area and development of proposed project area are projected as presented in Table VIII.3.3 on condition that all the irrigable areas are to be constantly developed till 2019.

(2) Water Demand

The unit water requirement for future condition is studied in SECTOR VII and presented in Tables VIII.3.4 and VIII.3.5 by river basin. Double-cropping is applied to both the Kampar and Indragiri river basins.

Tables VIII.3.4 and VIII.3.5 give the future water demand of the Kampar and Indragiri river basins by extension of the existing irrigation area and Table VIII.3.6 by development of the proposed Rantaberangin Project and Lubukjambi Project. The peak and annual average demands are presented below. The average annual growth rate of water demand is 6.5% in the

Kampar river basin and 2.9% in the Indragiri river basin in peak and 7.1 % and 2.3% in annual average, respectively.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar Peak	22.57	31.68	40.79	49.90	59.01
Average	6.97	9.78	12.59	15.41	18.22
Indragiri Peak	122.73	131.80	140.87	149.94	159.01
Average	54.80	58.08	61.36	64.63	67.91

Note: Kampar river basin - Base year 1988
Indragiri river basin - Base year 1986

3.3 Domestic Water Use

Present Water Demand

(1) Water Supply Company

In the study area, the piped water for domestic use is supplied by 14 water supply companies called PDAM (Perusahaan Daerah Air Minum) listed in Table VIII.3.7. Four PDAMs belong to Riau Province and 10 to West Sumatra Province.

The Kampar river basin including Pekanbaru City is covered by four PDAMs, while the Indragiri river basin is covered by 12 PDAMs. Two PDAMs are related to both river basins.

The water supply level of each PDAM in Riau Province at the end of PELITA V (1988/89-1993/94) and that in West Sumatra Province are given in Table VIII.3.8. Historical water sales record by PDAM in both provinces are presented in Table VIII.3.9.

According to the water sales record in Riau Province, annual growth rate of PDAM Kab. Kampar is very high, while PDAM Kodya. Pekanbaru shows no increase for the recent 5 years. On the other hand, in West Sumatra Province, PDAMs of the regencies show the growth rate of more than 10%, while PDAMs of the municipalities are less than 10%.

The present water supply by PDAMs in 1994 on production basis is summarized as follows:

River Basin	Service Population (person)	Water Supply (m^3/sec)
Kampar	137,100	0.25
Indragiri	264,800	0.49

The source of the domestic water in Riau Province is mostly river water and partly groundwater, while those in West Sumatra Province are mostly spring

water and partly river water. West Sumatra has a plan to use only spring water in the future (refer to Fig. VIII.3.1).

Due to the difference of water sources, water price in Riau Province is much higher than that of West Sumatra Province because of high water treatment cost. The average water price of each PDAM is presented in Table VIII.3.8. The price of water in Riau Province ranges from Rp. 300/m^3 to Rp. 805/m^3, while that in West Sumatra is from Rp. 125/ m^3 to Rp. 165/m^3 in 1994.

(2) Area not Served by Water Supply Company

Aside from the area served by PDAM, rural areas not served by PDAM exist, but have domestic water demand. Since no data is available, population of these areas is taken as service population other than PDAM service population. The unit water consumption rate is assumed to be 30 ltr/capita/day. The present water demand in 1994 is obtained by multiplying the non-PDAM population by the unit water consumption as given below.

River Basin	Non-PDAM Population (person)	Water Demand (m^3/sec)
Kampar	881,800	0.31
Indragiri	1,946,400	0.68

Future Water Demand

The future domestic water demand is forecasted dividing areas into PDAM service areas and other rural areas not served by PDAM as mentioned before.

(1) PDAM Demand Forecast

The future water demand of PDAM is forecasted based on the future population, the guideline of water supply planning of PU given in Table VIII.3.10 and the REPELITA VI Program (1994/95-1999/2000) of the respective PDAMs given in Table VIII.3.11. The criteria applied for the forecast of future water demand of PDAM are as follows:

- Service population is to be constantly increased at the same rate as stipulated in REPELITA VI.
- Operation hour is to be 24 hours.
- Loss rate is to be reduced up to 20% of production volume by 2019.
- Unit consumption per capita is to reach the government guideline by 2019 (refer to Table VIII.3.10).

Table VIII.3.12 presents the water supply target of each PDAM in Riau and West Sumatra provinces set forth based on the above criteria.

(2) Non-PDAM Demand Forecast

The future water demand of the rural area not served by PDAM is forecasted assuming that unit water consumption per capita increases from

30 ltr/capita/day in 1994 to 40 ltr/capita/day in 2019 as presented in Table VIII.3.13.

(3) Water Demand Forecast

The future domestic water demand of the Kampar and Indragiri river basins is estimated based on the forecasted water demand of each PDAM and regency by the population share mentioned before.

Table VIII.3.12 presents the future water demand of each PDAM in the Riau and West Sumatra provinces and Table VIII.3.13 gives the future water demand of the rural area not served by PDAM by river basin. Based on these tables, the future domestic water demand of each river basin is forecasted as presented in Table VIII.3.14 and summarized below. The average annual growth rate of domestic water demand is 8.8% in the Kampar river basin and 5.0% in the Indragiri river basin.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	1.00	1.50	2.15	3.18	4.55
Indragiri	1.66	2.22	2.67	3.30	3.85

3.4 Industrial Use

Present Water Demand

According to the information from Dinas Perindustrian (Provincial Office of Industry) of the Riau and West Sumatra provinces, almost all the existing industries are medium and small scale ones. Also, no large scale industrial development plan exists so far in the study area.

Table VIII.3.15 gives historical productions of major industries such as crumb rubber, plywood, textile, etc., from 1987 to 1992 in the regencies subject to the study in the Riau and West Sumatra provinces. The unit water requirement per unit production is also presented in the same table.

Based on those data, the present industrial water demand in 1994 is estimated as presented in Table VIII.3.16 by river basin and summarized below.

River Basin	Water Demand (m^3/sec)
Kampar	0.23
Indragiri	0.74

Future Water Demand

Since the future industrial development program in the study area has not been fixed yet in the Riau and West Sumatra provinces, the future water demand for industrial use is forecasted by future production of the existing major industries forecasted by

regency based on the historical trend as presented in Table VIII.3.15. The same unit water requirement rate as the present ones are applied.

Besides the above, water demand of the Ombilin Coal-Fired Steam Power Station (200 MW) which is scheduled to be commissioned in 1997 is taken into account. The water demand is 0.3 m^3/sec.

The future industrial water demands of the Kampar and Indragiri river basins are presented in Table VIII.3.16 and summarized below. The average annual growth rate of industrial water demand is 5.2% in the Kampar river basin and 4.7% in the Indragiri river basin.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	0.34	0.46	0.58	0.68	0.81
Indragiri	0.78	1.22	1.62	2.03	2.35

3.5 Inland Fishery Use

Present Water Demand

The historical fishpond areas from 1987 to 1992 in Riau and West Sumatra provinces are presented in Table VIII.3.17 by regency. Based on those data, fishpond areas in the Kampar and Indragiri river basins in 1994 are estimated at 1,000 ha and 1,490 ha, respectively, by the area share mentioned before. Fishpond area has increased at 3 to 4% per annum in both basins in the past 5 years from 1987 to 1992.

The unit water consumption of fishpond is assumed to be 7 mm/day/ha or 0.81 ltr/sec/ha with reference to the Study on Planning of Integrated Water Resources Development (DGWRD, Ministry of Public Works, 1991). The water demand of inland fishery is obtained by multiplying fishpond area by unit water consumption. The water demands of inland fishery of both river basins are estimated as below.

River Basin	Fishpond Area (ha)	Water Demand (m^3/sec)
Kampar	1,000	0.81
Indragiri	1,490	1.21

Future Water Demand

The future growth of fishpond area is forecasted based on the past trend given in Table VIII.3.17. The unit water consumption is taken as 0.81 ltr/sec/ha as mentioned above. The future water demands of inland fishery in both river basins are given in Table VIII.3.18 and summarized below. The average annual growth rate of water demand is 2.4% in the Kampar river basin and 1.9% in the Indragiri river basin.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	0.99	1.11	1.23	1.35	1.47
Indragiri	1.37	1.51	1.65	1.80	1.94

3.6 Livestock Use

Present Water Demand

Six typical kinds of livestock are selected for the study: the cattle, the buffalo, the pig, the chicken, the duck and the goat/sheep. The historical livestock population in Riau Province from 1988 to 1993 is given in Table VIII.3.19 by regency and that of West Sumatra Province is in the same table.

The livestock populations of the Kampar and Indragiri river basins in 1994 are estimated by the area share, as shown in Table VIII.3.19 and summarized below.

Unit: head

River Basin	Cow	Buffalo	Pig	Chicken	Duck	Goat/Sheep
Kampar	46,600	28,300	280	1,673,500	60,600	39,600
Indragiri	102,700	63,100	340	2,457,200	364,600	96,500

The past annual growth rate in the Kampar river basin is low. The 3.8% population growth rate of the cattle is the highest and those of the chicken and goat/sheep are less than 3%. The others have a decreasing trend.

In the Indragiri river basin, chicken has the highest population growth rate of 6% and the others, 2% to 4%.

The unit water consumption rate by each animal is given below.

Kind	Cow	Buffalo	Pig	Chicken	Duck	Goat/Sheep
U.W.C	40	40	6	0.3	0.3	5

Note: U.W.C. = Unit water consumption rate in ltr/head/day.

Applying the above figures, the present livestock water demand of each river basin in 1994 is estimated as below.

River Basin	Water Demand (m^3/sec)
Kampar	0.05
Indragiri	0.11

Future Water Demand

For water demand forecast, the livestock population in the Riau and West Sumatra provinces is forecasted by kind and regency based on the past trend of population growth. The unit water consumption rates are the same as the present ones.

The future livestock populations forecasted for each province are given in Table VIII.3.19. The past annual growth rate is very different among kinds and regencies. The average annual growth rate from 1994 to 2019 is assumed to be generally 2% to 5%.

The future water demands of livestock of the Kampar and Indragiri river basins are forecasted as presented in Table VIII.3.20 and summarized below. The average annual growth rate of water demand is 3.6% in the Kampar river basin and 2.4% in the Indragiri river basin.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	0.06	0.08	0.09	0.11	0.12
Indragiri	0.12	0.14	0.16	0.18	0.20

3.7 Tourism Use

Present Water Demand

The water use for tourism is water consumption at tourism spots and recreation sites. Tourists are basically divided into domestic and foreign tourists.

Table VIII.3.21 presents the historical number of foreign tourists in major cities and the whole of Riau Province from 1987 to 1993. No data on domestic tourist number is available. The number of tourists by regency also is not available. Therefore, the number of domestic tourists is assumed to be two times the foreign tourists in Pekanbaru City and 30% in regencies according to the information from Dinas Pariwisata (Provincial Office of Tourism).

Table VIII.3.21 presents the historical number of domestic and foreign tourists of West Sumatra Province from 1987 to 1993 dividing them into Padang City, Bukittinggi City and other areas. The number of tourists by regency is not available.

Since no data by regency is available in both provinces, the number of tourists of the regencies related to the Kampar and Indragiri river basins are proportionally estimated by the number of tourism sites. The estimated number of tourists in the Kampar river basin in 1994 is 129,800 persons and in Indragiri river basin, 304,700 persons, as shown in Table VIII.3.21.

The unit water consumption per capita is assumed to be 10 ltr/capita/day and the average touring days 30 days/capita/year. Based on the above figures, the present water demand of tourism is estimated by river basin as below. The water demand of tourism is much smaller than other water demands.

River Basin	Number of Tourists (person)	Water Demand (m^3/sec)
Kampar	129,800	0.001
Indragiri	304,700	0.002

Future Water Demand

The future number of tourists by classification is given in Table VIII.3.21 based on the past trend of growth. The number of tourists by regency is estimated in the same manner mentioned before and given in Table VIII.3.22.

The future water demand of tourism of each river basin is given in Table VIII.3.23 and summarized below. The average annual growth rate of water demand is 10.1% in the Kampar river basin and 9.4% in the Indragiri river basin, but the water demand is still small.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	0.002	0.005	0.006	0.008	0.011
Indragiri	0.005	0.007	0.011	0.015	0.019

3.8 Urban Area Flushing Use

Present Water Demand

For the purpose of urban area sanitation, flushing water is required. However, no specific criteria or standards have been established in Indonesia.

No flushing is being carried out in the study area. Therefore, the present water use for urban area flushing in the study area is nil.

Future Water Demand

As mentioned above, no criteria and standards for flushing are available. Also, no concrete flushing plan or program has been prepared yet in the study area. Therefore, the future water demand of urban area flushing is estimated by urban area population and per capita flushing water requirement, referring to the Study on Planning of Integrated Water Resources Development (DGWRD, Ministry of Public Works, 1991) in which the following figures are presented. The less requirement in 2016 to 2020 is due to the expected provision of sewerage system.

Year	Per Capita Water Requirement
1990 - 2000	330 ltr/capita/day
2001 - 2015	360 ltr/capita/day
2016 - 2020	300 ltr/capita/day

The future urban area population is given in Table VIII.1.3. The urban area populations of the Kampar and the Indragiri river basins are estimated by the population share.

The future water demands of urban area flushing of both river basins are forecasted as given in Table VIII.3.24 and summarized below. The average annual growth rate from 1999 to 2019 is 5.4% in the Kampar river basin and 2.7% in the Indragiri river basin.

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	2.38	3.52	4.76	6.28	6.80
Indragiri	1.46	1.87	2.20	2.56	2.47

3.9 Hydropower Use

Present Water Demand

The existing hydropower stations located in the study area are Agam Station with installed capacity of 10,500 kW on the Agam River in Limapuluh Kota regency and a mini-hydropower station with 3 kW on the Sumani River in Solok regency. Both stations belong to Sumatra Province. Since they do not consume any water, no water demand for hydropower use exists at present.

Future Water Demand

In the study area, two big hydropower projects related to the study are under construction in the Riau and West Sumatra provinces. They are:

- Kotapanjang Hydropower Project (Installed Capacity: 114 MW)
- Singkarak Hydropower Project (Installed Capacity: 175 MW)

The Kotapanjang Hydropower Project will be completed in 1997 and the Singkarak Hydropower Project in 1998. They will affect the water balance in the study area.

The Kotapanjang Project is located upstream of Bangkinang on the Kampar Kanan River. The inflow to the reservoir is regulated by effective storage capacity of $1,040 \times 10^6 m^3$. Peak discharge of 348 m^3/sec for power generation is released to the downstream for 12 hours through the power station. The firm discharge is 174 m^3/sec. Since the annual inflow to the reservoir is 188.5 m^3/sec, the inflow is almost regulated.

The Singkarak Hydropower Project utilizes the Singkarak Lake as reservoir with effective storage capacity of 390 x 106 m^3. The water for hydropower generation is diverted to the Anai River situated outside the Indragiri river basin. The diversion discharge is 43.7 m^3/sec on average and 73.6 m^3/sec for a 3-hour peak, while the annual average inflow to the Singkarak Lake is 47.6 m^3/sec.

On the other hand, outflow from the outlet of the lake, the Ombilin River, is limited to 2 m^3/sec in a normal dry year and 6 m^3/sec in a severe dry year as sanitary flow

except in flooding time. Consequently, 92% of the annual inflow is diverted outside the Indragiri river basin. This is considered as water demand in the Indragiri river basin.

Therefore, the future water demand of hydropower use is summarized as follows:

Unit: m^3/sec

River Basin	1999	2004	2009	2014	2019
Kampar	0	0	0	0	0
Indragiri	43.7	43.7	43.7	43.7	43.7

3.10 River Navigation Use

Present Water Demand

In the lower reaches of the Kampar and Indragiri rivers, river navigation is an important means of transportation at present because of the poor road network in the lower areas. However, this role will be reduced with the improvement and extension of road networks.

The navigation reaches of the Kampar and Indragiri rivers are shown in Fig. VIII.3.2. The navigation reaches in the Indragiri River extends from the river mouth to Peranap, about 350 km long. On the other hand, the navigation reaches of the Kampar River extends from Penyalai to Pangkalan Baru, about 300 km long.

Table VIII.3.25 presents the historical river navigation records of the Kampar and Indragiri rivers. They are summarized at daily rate as below:

River Basin	Kind	1988	1992	Growth Rate (%)
Kampar	Ship (no./day)	1.6	2.7	13.2
	Passenger (prn/day)	4.8	10.1	25.2
	Cargo (ton/day)	4.0	13.0	31.9
Indragiri	Ship (no./day)	10.9	10.1	-1.8
	Passenger (prn/day)	44.5	200.0	53.0
	Cargo (ton/day)	17.3	41.0	21.8

As seen in the table, the navigation frequency on each rivers is not so high. The lesser frequency of the Kampar River is due to a tidal phenomena called "bore." Also, the navigation frequency of the Indragiri River has a tendency of slight decrease although the passenger number and cargo volume are increasing. The water demand of river navigation is the present river discharge.

Future Water Demand

Considering the present use of both rivers and the information from the Regional Office of the Ministry of Transportation, no significant increase of river navigation in both rivers is expected in the future. Therefore, it can be said that the water demand of river navigation is preferably to keep or improve the present river condition in the

dry season. In this study, the average annual minimum monthly mean discharge is taken as the future water demand as far as no obstacle appears in the study, and it coincides with the river maintenance flow mentioned in the next subsection.

3.11 River Maintenance Flow

Present Water Demand

Neither the Kampar River nor the Indragiri River has river structures to control river flow. Both rivers have been utilized under natural conditions so far. The river maintenance flow is important for water use in the downstream reaches such as river navigation, hindrance of sea water intrusion, irrigation, etc.

The river maintenance flow is usually set at an average annual minimum flow and represented by a specific discharge. Table VIII.3.26 presents the annual minimum monthly mean discharge from 1981 to 1992 of both rivers. The average annual minimum monthly mean discharges at major points are as follows:

River Basin	Point	Catchment Area (km^2)	Min. Discharge (m^3/sec)
Kampar	Kotapanjang Damsite	3,337	48.9
	Langgam	7,053	95.5
	River Mouth	24,548	275.6
Indragiri	Lubuk Jambi	7,453	65.1
	Air Morek	12,320	126.8
	River Mouth	16,268	165.4

The specific discharges of each river are summarized as follows:

Unit: m^3/sec/100 km^2

River Basin	Max.	Min.	Average
Kampar	1.46	0.62	1.20
Indragiri (*)	1.03	0.70	0.92

* Excluding Sinkarak lake basin.

Future Water Demand

To maintain the present conditions of the Kampar and Indragiri rivers as much as possible in the future, the river maintenance flow in the future for the present water resources development study is set at almost average of the annual minimum monthly mean discharge from 1981 to 1992, that is, 1.2 m^3/sec/100 km^2 in specific discharge for the Kampar river basin and 0.9 m^3/sec/100 km^2 for the Indragiri river basin.

The future water demands of river maintenance flow of both rivers are given in specific discharge as below. The river maintenance flow at river mouth is

294.6 m^3/sec on the Kampar River and 146.4 m^3/sec on the Indragiri River, excluding the Singkarak lake basin.

Unit: m^3/sec/100 km^2

River Basin	1999	2004	2009	2014	2019
Kampar	1.2	1.2	1.2	1.2	1.2
Indragiri	0.9	0.9	0.9	0.9	0.9

3.12 Summary of Future Water Demand

The future peak water demands forecasted by sector are summarized in Table VIII.3.27 and given below. They are graphically shown in Fig. VIII.3.3. The average annual growth rate of total water demand excluding the river maintenance flow is 6.9% in the Kampar river basin and 1.4% in the Indragiri river basin.

Unit: m^3/sec

River Basin	1994	1999	2004	2009	2014	2019
Kampar	308.32 (13.74)	321.92 (27.34)	332.94 (38.36)	344.19 (49.61)	356.10 (61.52)	367.35 (72.77)
Indragiri	297.34 (150.93)	318.24 (171.83)	328.88 (182.47)	339.29 (192.88)	349.94 (203.53)	359.95 (213.54)

Note: Figures in parentheses indicate water demand excluding river maintenance flow.

CHAPTER 4 WATER BALANCE ANALYSIS

4.1 Basin Division

For the water balance analysis, the Kampar and Indragiri river basins are divided into 11 sub-basins referring to the basin division for hydrological analysis shown in Fig. VIII.4.1. The river systems of both river basins are schematically shown in Figs. VIII.4.2 and VIII.4.3 based on this basin division. Both river basins have 11 reference points.

4.2 Basin Runoff

The runoff of each sub-basin to be used for water balance analysis is given by hydrological analysis in SECTOR I, METEOROLOGY AND HYDROLOGY. The period of runoff data is 12 years from 1981 to 1992.

The runoff data of both the Kampar and Indragiri river basins are prepared for two cases each to cope with implementation of the ongoing hydropower projects, as follows:

(1) Kampar River Basin

- Runoff without Kotapanjang Dam (Applicable until 1996)
- Runoff with Kotapanjang Dam (Applicable from 1997)

(2) Indragiri River Basin

- Runoff without Singkarak Hydropower Station (Applicable until 1997)
- Runoff with Singkarak Hydropower Station (Applicable from 1998)

The runoff at selected reference points for the above four cases is given in Figs. VIII.4.4 and VIII.4.5.

4.3. Water Demand of Each Sub-basin

The water demand obtained in the previous CHAPTER 3 by administrative division are distributed to each sub-basin by area ratio or the population ratio given in Table VIII.4.1. The water demand of each basin is presented in Tables VIII.4.2 to VIII.4.13 by kind of water demand. Fig. VIII.4.6 shows the future water demand in 2019 by sub- basin.

4.4 Criteria for Water Balance Calculation

The water balance calculation is made based on the following criteria.

(1) Simulation Period

- 12 years from 1981 to 1992

(2) Calculation Interval

- 5 days interval, in principle

(3) Water Demand Case

- Demand in 2019 is to be used for determination of project scale.

(4) Return Flow

- Return flow is to be taken into account at the following rates:

Irrigation Water	30%
Domestic Water	40%
Industrial Water	40%
Urban Area Flushing Water	40%

(5) Effect of Ongoing Hydropower Projects

As mentioned before, the Kotapanjang Hydropower Project in the Kampar river basin and Singkarak Hydropower Project in the Indragiri river basin are under construction. They will be completed in 1997 and 1998, respectively. The effect of these projects to the study is to be taken into account in the form of change of basin runoff as mentioned in the previous Section 4.2.

4.5 Water Balance in Sub-basin and at Reference Point

Water balance calculation is performed for the Kampar and Indragiri river basins following the criteria mentioned above. The calculation manner is schematically shown in Fig. VIII.4.7.

4.5.1 Water Balance in Sub-basin

The water deficit of each sub-basin is obtained by the independent water balance calculation in the subject sub-basin. Table VIII.4.14 presents the annual deficits in 2019 by sub-basin in the Kampar and Indragiri river basins excluding river maintenance flow which is subject to further study. The maximum annual deficits in the simulation period from 1981 to 1992 are summarized below. The sub-basins not given in the table have no water deficit.

Unit: $10^6 m^3$

Kampar River Basin		Indragiri River Basin	
Sub-basin	Max. Annual Deficit Volume	Sub-basin	Max. Annual Deficit Volume
K-2	89.1	I-1	57.2
		I-2	13.1
		I-3	13.3
		I-5	11.0
		I-6	272.8

The deficit in the sub-basin K-2 of the Kampar river basin is because of the proposed Rantauberangin Irrigation Project. On the other hand, deficits in the sub-basins of the Indragiri river basin is caused by existence of large irrigable area in the West Sumatra Province. The deficit in the sub-basin I-6 of the Indragiri river basin is because of the proposed Lubukjambi Irrigation Project.

4.5.2 Water Balance at Reference Point

The deficit at reference point is obtained by summing up the deficit of each sub-basin from the uppermost reference point to the downmost reference point based on the river systems given in Figs VIII.4.2 and VIII.4.3. The annual deficit at each reference point is given in Table VIII.4.15. The maximum annual deficits are summarized below.

Unit: $10^6 m^3$

Kampar River Basin		Indragiri River Basin	
Reference Point	Max. Annual Deficit Volume	Reference Point	Max. Annual Deficit Volume
KRP-1	0.0	IRP-1	57.2
KRP-2	89.1	IRP-2	13.1
KRP-3	0.0	IRP-3	57.2
KRP-4	0.0	IRP-4	0.0
KRP-5	0.0	IRP-5	68.1
KRP-6	0.0	IRP-6	282.8
KRP-7	89.1	IRP-7	0.0
KRP-8	0.0	IRP-8	282.8
KRP-9	89.1	IRP-9	282.8
KRP-10	0.0	IRP-10	0.0
KRP-11	89.1	IRP-11	282.8

CHAPTER 5 POSSIBLE WATER SUPPLY SOURCES

Four water supply sources of river water, groundwater, spring water and lake water are considered in the study area and they are evaluated as follows:

(1) River Water

River water is a main water source and has the greatest potential of development among the water sources. It is usable for almost all purposes in most of the study area.

(2) Groundwater

Groundwater has been used a little in the study area so far because of small potential compared with the river water. The groundwater is utilized for domestic water in the lower basins of the Kampar and Indragiri rivers in Riau Province where piped water supply is difficult. However, water quality is not good for domestic use. No room exists in substantial and economical development of the groundwater.

(3) Spring Water

On the other hand, spring water is abundant in West Sumatra Province and fully used for domestic water because water quality is good for domestic use and treatment cost is low. However, no room exists in substantial development of the spring water for the other purposes.

(4) Lake Water

There are two natural lakes in the Indragiri river basin. One is the Singkarak Lake with a surface area of 130.11 km^2. It has a great storage capacity, but will be almost fully utilized for the Singkarak Hydropower Project after completion. No more room for further development may exist unless the present hydropower generation plan is altered. The other is Dibaruh Lake with surface area of 14.00 km^2. It is located upstream from Singkarak Lake and at the uppermost reach of the Indragiri River. No room for substantial development exists due to the small catchment area.

After completion of the Kotapanjang Dam for hydropower on the Kampar River, a huge reservoir is created and flow of the Kampar River will be almost completely regulated. The water regulated is suitable for water supply for irrigation, domestic water of Pekanbaru City, etc. Accordingly, the river water should be considered as water source to be developed in this study.

CHAPTER 6 OVERALL PLAN OF WATER RESOURCES DEVELOPMENT

6.1 Water Resources Development Plan in Kampar River Basin

6.1.1 Major Water Demand Area

According to the results of water balance analysis, water deficit in the Kampar river basin occurs in Sub-basin K-2 in Fig. VIII.4.1. This is because of water demands of the proposed Rantauberangin Irrigation Project (maximum water requirement: 16.62 m^3/s in 2019) and Pekanbaru City (water requirement: 10.90 m^3/s). No water deficit appears in the other sub-basins. The major water demand area in the Kampar river basin is the Rantauberangin Irrigation Project and Pekanbaru City in the Sub-basin K-2. They are shown in Fig. VIII.6.1.

6.1.2 Possible Damsites

It is common to develop river water resources by constructing dams. In SECTOR XII, DAM ENGINEERING, the following three possible damsites are identified in the Kampar river basin aside from the Kotapanjang Dam which is under construction.

Damsite	Catchment Area (km^2)	Max. Effective Storage (10^6m^3)
Kampar Kiri No. 1	1,187	2,289 (El. 130 m)
Kampar Kiri No. 2	552	3,189 (El. 150 m)
Kapoernan	650	107 (El. 125 m)

Note: Figures in parentheses indicate possible maximum water levels.

The locations of these damsites are shown in Fig. VIII.6.1. Among them, the Kapoernan damsite is located just upstream from the reservoir of the Kotapanjang Dam which has a huge effective storage capacity of 1,040 x 10^6m^3 and no water demand will depend on this Kapoernan Dam. Also, its dam height will be less than 30 m. It is not suitable for hydropower development. Accordingly, the Kapoernan Dam is excluded from the present water resources development for water supply, but it will be studied for flood control. In this chapter, the Kampar Kiri No. 1 and Kampar Kiri No. 2 damsites are studied as possible damsites for water resources development.

6.1.3 Formulation of Water Resources Development Plan

As mentioned before, the major water demand areas for the present study in the Kampar river basin are the Rantauberangin Irrigation Project and Pekanbaru City. Since they are situated downstream from the Kotapanjang Dam, it may be appropriate

to take the water released from the Kotapanjang Hydropower Station (348 m^3/s for 12 hours) by constructing a weir on the Kampar River.

On the other hand, it is difficult to use the Kampar Kiri No. 1 and No. 2 dams for water supply to the above water demand areas due to their far location. Therefore, they should be independently developed. The expected benefits by these dams are of flood control and hydropower generation since the water demands downstream from these dams are as small as below 1 m^3/s.

Consequently, the water resources development plans in the Kampar river basin are formulated as follows:

(1) Kampar Kanan Water Supply Project

Purpose: Irrigation water supply to Rantauberangin Irrigation Project and supply of domestic water, etc., to Pekanbaru City.

(2) Kampar Kiri No. 1 Dam Multipurpose Dam Plan

Purpose: Flood control and hydropower generation.

(3) Kampar Kiri No. 2 Dam Multipurpose Dam Plan

Purpose: Flood control and hydropower generation.

The location of each plan is as shown in Fig. VIII.6.1.

6.1.4 Optimization of Plans Formulated

The water resources development plans formulated in the previous subsection are optimized as mentioned hereinafter.

Kampar Kanan Water Supply Project

In this plan, a weir is proposed on the Kampar Kanan River to re-regulate the water released from the Kotapanjang Hydropower Station and divert the water to Rantauberangin Irrigation Project area and Pekanbaru City. The diversion requirement is 36.39 m^3/sec at peak time as given below.

Rantauberangin Project	25.49 m^3/s (*)
Pekanbaru City	10.90 m^3/s
Total	36.39 m^3/s

* for 5-year probable drought

The diversion requirement of 8.87 m^3/s for the shortage of existing irrigation areas appears once a 5-year.

Since power generation by the Kotapanjang Power Station lasts for 12 hours, the required afterbay capacity is calculated at 1.6 x $10^6 m^3$. No optimization on the afterbay capacity is made since the full development of the proposed Rantauberangin Project is intended.

Kampar Kiri No. 1 Multipurpose Dam Plan

The water demand in the downstream area along the Kampar Kiri River is less than 1 m^3/sec and the effective reservoir capacity of the Kampar Kiri No. 1 Dam is large enough to accommodate the capacity for hydropower generation and flood control use. Therefore, the proposed dam scale is determined by adding the required capacity for flood control to the capacity for hydropower generation.

The optimum scales of reservoir capacity and installed capacity for hydropower generation are determined through comparative study in SECTOR IX, HYDROPOWER GENERATION PLAN. The capacity determined are as follows:

Necessary Storage Capacity for Hydropower	$646 \times 10^6 m^3$
Installed Capacity	131 MW

The reservoir operation result of the above optimum case is shown in Fig. VIII.6.2. The storage required for flood control is added to the above storage and then the proposed dam scale is determined in SECTOR XI, MULTIPURPOSE DEVELOPMENT PLAN.

Kampar Kiri No. 2 Multipurpose Dam Plan

This dam is also in a similar situation as the Kampar Kiri No. 1 Dam. The water demand in the downstream area is small ,while the effective reservoir capacity is as huge as 3,161 x 10^6 m^3. Therefore, the same idea as the Kampar Kiri No. 1 dam is applied. The optimum scales of the reservoir and installed capacity for hydropower generation are studied in SECTOR IX, HYDROPOWER GENERATION PLAN. The results are as follows:

Necessary Storage Capacity for Hydropower	$438 \times 10^6 m^3$
Installed Capacity	40 MW

The reservoir operation result of the above optimum case is shown in Fig. VIII.6.2. The storage required for flood control is added to the above storage capacity and the proposed dam scale is as determined in SECTOR XI.

6.2 Water Resources Development Plan in Indragiri River Basin

6.2.1 Major Water Demand Area

According to the water balance analysis, water deficit occurs in Sub-basins I-1, I-2, I-3 and I-5 located in the upstream of the Indragiri river basin in West Sumatra Province and I-6 in Riau Province as shown in Fig. VIII.4.1. The deficit of Sub-basins I-1, I-2, I-3 and I-5 are because of change of cropping pattern of the existing irrigation area, which has rather large extension, from the present single cropping to the proposed double cropping as well as further extension of the existing irrigation areas. While, the deficit of Sub-basin I-6 is caused by the proposed Lubukjambi Irrigation Project.

Furthermore, the irrigation area of one system is as small as several hundred hectares and widely distributed. Also, the ground slope of the irrigation area is rather steep and no wide and flat irrigable area exists. It is, therefore, difficult to irrigate the remaining irrigable area by dam on the Indragiri River main stream efficiently and economically.

Taking a feasibility of the proposed plan into account, the Lubukjambi Irrigation Project is selected as the main water demand area subject to the present water resources development study.

From these conditions, the future irrigation water demand to be incorporated in the Project is the amount for the proposed project area (maximum water requirement: 48.03 m^3/s in 2019), as presented in Table VIII.3.6.

6.2.2 Possible Damsites

The possible damsites in the Indragiri river basin selected in SECTOR XII, DAM ENGINEERING, are the following three:

Damsite	Catchment Area (km^2)	Max. Effective Storage (10^6 m^3)
Kuantan	7,453	1,765 (El. 125 m)
Upper Sinamar	1,580	104 (El. 485 m)
Sukam	360	674 (El. 240 m)

Note: Figures in parentheses indicate possible maximum water levels.

The locations of these damsites are shown in Fig. VIII.6.1. The Kuantan Dam is the nearest to the Lubukjambi Irrigation Project Area.

6.2.3 Formulation of Water Resources Development Plan

The expected annual mean discharges at the respective possible damsites in 2019 and river maintenance flow from each dam are as follows:

Unit: m^3/s

Damsite	Annual Mean Discharge	River Maintenance Flow
Kuantan	194.5	57.39
Upper Sinamar	46.7	14.22
Sukam	13.0	3.24

On the other hand, maximum peak water demand of the Lubukjambi Irrigation Project is 48.03 m^3/s in peak and 15.7 m^3/s in annual average. Taking into account the required additional river maintenance flow to maintain the present flow conditions in the downstream reaches of the Indragiri River for repulsion for saline water intrusion and river navigation, only the Kuantan Dam has a capacity to meet such demands among the above possible dams. Accordingly, the water resources development plan is formulated considering the Kuantan Dam as the main facilities.

The Kuantan Dam is also important for flood control purpose due to its locational advantage. The optimum allocation of storage capacity between flood control purpose and water supply purpose is required. If the required storage for flood control cannot be secured in the Kuantan Dam, the Upper Sinamar or Sukam Dam may share a part of the required storage. Accordingly, the water resources development plans to be studied are formulated as follows:

(1) Single Development Plan of Kuantan Dam

Purpose: Flood control, irrigation water supply to Lubukjambi Irrigation Project, supply of other water demand except irrigation water and hydropower generation

(2) Combined Development Plan of Kuantan and Upper Sinamar Dams

Purpose: Same as Plan (1)

(3) Combined Development Plan of Kuantan and Sukam Dams

Purpose: Same as Plan (1)

The location of each plan is shown in Fig. VIII.6.1. The optimum scales of the above proposed plans are determined in SECTOR XI in combination with flood control plans.

6.2.4 Optimization of Plans Formulated

The alternative development plans formulated in the previous Subsection 6.2.3 are to be studied from viewpoint of water resources development as mentioned hereinafter, but the optimum overall development plans to be proposed are studied by combining with flood control plans as described in SECTOR XI.

Criteria for Reservoir Operation

To determine the scale of a dam, a study on reservoir operation is required and it is conducted under the following criteria.

(1) Water Demand

The water demands to be met by the Kuantan Dam are as follows:

- Irrigation water for the Lubukjambi Project.
- River maintenance flow from the dams.
- River maintenance flow shortage in the downstream reaches.

The Upper Sinamar and Sukam dams are used to bear a part of the water supply capacity of the Kuantan Dam and no water demand for the areas between those dams and the Kuantan Dam is considered because of topographic conditions as mentioned before.

(2) Evaporation from Reservoir

Evaporation from the reservoir is taken at 2.9 mm/day which is 70% of the annual mean daily evaporation observed at Sukarami by a Class A pan, 4.1 mm/day.

(3) Water for Hydropower Use

As mentioned before, priority of water use is given to flood control and water supply. The hydropower generation is, in principle, made by using the water released to meet other water demands. If the reservoir capacity of Kuantan Dam can have a room for hydropower use, increase of discharge for hydropower generation is to be considered.

(4) River Maintenance Flow (Constant Release)

The specific discharge of river maintenance flow is taken at 0.9 $m^3/s/100\ km^2$. The river maintenance flow at the proposed damsites is tabulated as follows:

Damsite	Catchment Area (km^2)	Maintenance Flow (m^3/s)
Lower Kuantan	6,377(*)	57.39
Upper Sinamar	1,580	14.22
Sukam	360	3.24

* Excluding Singkarak lake basin

The Singkarak Lake basin with a catchment area of 1,076 km^2 is not taken into account as the basin responsible in river maintenance flow by the Kuantan Dam because only the river maintenance flow of 2 m^3/s is released from the lake after completion of the Singkarak Hydropower Station.

(5) River Maintenance Flow (Supplementation of Deficit in Downstream Area)

The river maintenance flow of 57.39 m^3/s at Kuantan damsite as calculated in item (4) above will be constantly released. This value can be considered as the responsible release at the damsite.

The other river maintenance flow is to supplement deficit which might occur in the residual catchment of the Kuantan-Indragiri River. With this release, a specific discharge of 0.9 $m^3/s/100\ km^2$ is realized at the river mouth. This deficit is calculated as the balance of available water resources and the future water demand in the subject basin. As a result of the simulation, a peak release of 24.64 m^3/s for this purpose has been calculated.

(6) Sediment Deposit

As mentioned in SECTOR I, the sediment deposit volume of each dam is tabulated as follows:

Damsite	Catchment Area (km^2)	Specific Sediment Volume ($m^3/km^2/yr$)	Sediment Deposit ($10^6 m^3$)
Kuantan	6,377	525	335
Upper Sinamar	1,580	585	93
Sukam	360	525	19

Note : Deposit volume is for 100 years.

Single Development Plan of Kuantan Dam

The cases studied are as follows:

Unit: m^3/s

Case	Irrigation Water (*)	River Maintenance Flow (Constant Release) **	River Maintenance Flow (Supplementation of Deficit in Downstream Area)
a.1	0	57.39	Full supply (24.64 m^3/s in peak)
a.2	Full Supply (48.03 m^3/s in peak)	"	"
a.3	"	80	"
a.4	"	100	"
a.5	"	120	"
a.6	"	140	"
a.7	"	160	"
a.8	"	180	"

* Peak demand of Lubukjambi Irrigation Project.

** Including water for power generation.

Case a.1 is set to obtain the storage volume required to maintain the present flow conditions in dry season. Case a.2 is set to indicate the minimum required storage for full water supply, while Cases a.3 to a.8 are set to get more hydropower generation benefit by increasing minimum flow. The required effective storages are calculated by the reservoir operation as tabulated below.

Unit : $10^6 m^3$

Case	Required Effective Storage	Remarks
a.1	213 (El.106.5 m)	For river maintenance only
a.2	330 (El.108.8 m)	Required volume for water supply
a.3	384 (El.110.0 m)	
a.4	517 (El.111.0 m)	
a.5	694 (El.114.5 m)	
a.6	902 (El.117.0 m)	
a.7	1,143 (El.120.0 m)	
a.8	1,472 (El.123.5 m)	

Note: Figures in parentheses indicate normal high water levels. Dead storage is $425 \times 10^6 m^3$.

From the above results, the required effective storage for the proposed water supply is $330 \times 10^6 m^3$, of which $213 \times 10^6 m^3$ is shared for river flow maintenance and the remaining storage of $117 \times 10^6 m^3$ is for the Lubukjambi Irrigation Project.

The results of the study on reservoir operation for Cases a.2 and a.7 are presented in Fig. VIII.6.2. The storage required for flood control is added to the above storage and then the proposed dam scale is determined in SECTOR XI.

Combined Development Plan of Kuantan and Upper Sinamar Dams

Since the Lower Kuantan Dam is to be used for both purposes of flood control and water supply, the combined development of the Upper Sinamar and Kuantan dams is considered to give more capacity for flood control in the Kuantan dam reservoir by transferring a part of storage of the Kuantan Dam to the Upper Sinamar Dam.

The cases studied are as follows:

Unit : m^3/s

Case	Upper Sinamar Dam		Kuantan Dam
	Irrigation Water	River Maintenance Flow (**)	
b.1	0	14.22	Case a.2
b.2	"	20.00	"
b.3	"	23.00	"
b.4	25.46 (53%*)	14.22	"
b.5	19.21 (40%*)	14.22	"

* Peak demand of Lubukjambi Irrigation Project.

** Including water for power generation.

The required effective storage of both dams were calculated as tabulated below.

Unit: $10^6 m^3$

Case	Upper Sinamar Dam	Kuantan Dam	Efficiency (%)
b.1	68 (El.481.8 m)	262 (El.107.8 m)	100
b.2	115 (El.487.2 m)	234 (El.107.0 m)	83
b.3	147 (El.490.2 m)	219 (El.106.5 m)	76
b.4	148 (El.490.4 m)	203 (El.106.2 m)	86
b.5	124 (El.488.3 m)	217 (El.106.4 m)	91

Note: Figures in parentheses indicate normal high water levels. Dead storage of Upper Sinamar Dam is $97 \times 10^6 m^3$.

The efficiency in the above table indicates ratio of decreased volume of the effective storage in the Kuantan Reservoir against Case a.2 (330×10^6 m^3) to the effective storage in the Upper Sinamar Reservoir. As seen in the table, the storage in the Upper Sinamar Reservoir is not fully effective to decrease the storage for water supply use in the Kuantan Reservoir.

The possible maximum high water level of the Upper Sinamar Dam is about EL 485 m because of topographic conditions around the damsite, which correspond to the elevation of suddle part adjacent to the damsite. The water level higher than EL 485 m requires a saddle dam.

Taking the surcharge storage for flood routing into account, only Case b.1 may be acceptable. The dam height for the Case b.1 is estimated as high as 132.5 m. The Upper Sinamar Dam may not be preferable for increasing the flood control capacity in the Kuantan Reservoir.

The result of the study on reservoir operation for Case b.1 is presented in Fig. VIII.6.2. The proposed dam scale has been studied in SECTOR XI taking the storage for flood control into account.

Combined Development Plan of Kuantan and Sukam Dams

Under the same idea as the Upper Sinamar Dam, the combination of Kuantan and Sukam dams is considered. The cases studied are as follows:

Unit: m^3/s

Case	Sukam Dam		Kuantan Dam
	Irrigation Water	River Maintenance Flow (**)	
c.1	0	3.24	Case a.2
c.2	"	5.00	"
c.3	"	7.00	"
c.4	"	11.00	"
c.5	24.26 (67%*)	3.24	"
c.6	18.67 (50%*)	"	"

* Peak demand of Lubukjambi Irrigation Project.

** Including water for power generation.

Cases c.5 and c.6 are set under the condition that the reservoir shall recover to full storage within five years. The maximum possible supply rate is 67%. The required effective storage of each dam was calculated as tabulated below.

Unit: $10^6 m^3$

Case	Sukam Dam	Kuantan Dam	Efficiency (%)
c.1	9 (El.195.2 m)	327 (El.108.5 m)	33
c.2	29 (El.199.6 m)	318 (El.108.3 m)	41
c.3	58 (El.203.0 m)	304 (El.108.2 m)	45
c.4	232 (El.218.1 m)	275 (El.108.0 m)	24
c.5	203 (El.216.0 m)	249 (El.107.5 m)	40
c.6	136 (El.211.1 m)	271 (El.107.9 m)	43

Note: Figures in parentheses indicate normal high water levels. Dead storage of Sukam Dam is $27 \times 10^6 m^3$.

The efficiency indicates ratio of decreased volume of the effective storage in the Kuantan reservoir against the Case a.2 (330×10^6 m^3) to the effective storage in the Sukam reservoir. As seen in the table, the storage in the Upper Sinamar reservoir is not fully effective to decrease the storage for water supply use in the Kuantan reservoir. The efficiency ranges from 24% to 45% and it is much lower than that of the Upper Sinamar Dam. This may be because of smaller catchment area (360 km^2).

Paddy fields are distributed in the reservoir area of the Sukam Dam, but no special constraints to limit the maximum reservoir water level exists. Consequently, the Case c.5 is preferable because it gives the Kuantan Dam a larger capacity for flood control use though the efficiency is low. The dam height for the Case c.5 is estimated at 66.5 m.

The result of reservoir operation for Case c.5 is presented in Fig. VIII.6.2. The proposed dam scale is studied in SECTOR XI taking the storage for flood control use into account.

Lubukjambi Intake Weir

In the development plan of the Kuantan Dam, a weir is proposed to be constructed on the Indragiri River about 7 km downstream from the dam to divert the water to Lubukjambi Irrigation Project area. The diversion requirement is 35.67 m^3/sec in total at peak time as given below.

Lubukjambi Project	35.67 m^3/s(*)
Existing Irrigation Area (shortage)	1.26 m^3/s (*)
Total	36.93 m^3/s

* For 5-year probable drought.

The diversion of 1.26 m^3/s for the shortage of existing irrigation areas is required once a 5 year, so that it is not taken into account in the reservoir operation. However, the proposed canal will have the capacity to meet this requirement.

Since the power generation of the Kuantan Power Station will last for 8 hours, the required afterbay capacity is calculated at $2.2 \times 10^6 m^3$. Since the full development of the proposed Lubukjambi Irrigation Project is intended, no optimization on the weir scale is made.

6.3 Possible Maximum Development Amount of Water Resources

Both governments of Indonesia and Singapore executed a Memorandum of Understanding in August 1990 on the export of water from Indonesia to Singapore. The export amount agreed so far is as follows:

- 31.25 m^3/s from Riau Province by 2010
- 52.6 m^3/s from Sumatra by 2090

Riau Province is expected to bear a large share and the Kampar and Indragiri rivers under the present study are a promising source of the exportable water in the province from the viewpoints of potential and locational advantage.

According to the proposed overall development plan in this study, the following three dams are finally proposed. With these dams, the minimum discharges of both rivers are increased in the downstream reaches.

- Kampar Kiri No. 1 dam (Kampar river basin)
- Kampar Kiri No. 2 dam (Kampar river basin)
- Kuantan dam (Indragiri river basin)

The possible maximum development amount of water resources in the Kampar and Indragiri river basins is defined as the increment of minimum monthly mean discharge at the river mouth in 2019 to the present river flow condition in 1994 after subtracting all the future demand.

According to the reservoir operation study results of each dam, the annual minimum monthly mean discharge at the river mouth is changed case to case as presented in Table VIII.6.1. In the reservoir operation for the future condition, the Kotapanjang Dam and the Singkarak Power Station are taken into account since they will be completed in 1997 and 1998, respectively.

The increment of minimum monthly mean discharge is evaluated by setting five cases for the Kampar River and three cases for the Indragiri River as listed below.

(1) Kampar River

Case 1	Present condition in 1994
Case 2	With Kotapanjang Dam in 2019
Case 3	Case 2 + Kampar Kiri No. 1 Dam in 2019
Case 4	Case 2 + Kampar Kiri No. 2 Dam in 2019
Case 5	Case 2 + Kampar Kiri No. 1 Dam + Kampar Kiri No. 2 Dam in 2019

(2) Indragiri River

Case 1	Present condition in 1994
Case 2	With Singkarak Power Station in 2019
Case 3	Case 2 + Kuantan Dam in 2019

The increment of minimum monthly mean discharge at the river mouth of the Kampar River is summarized below.

Unit: m^3/s

Case	Condition	Minimum Discharge	Incremental Discharge
1	Present (1994)	276	-
2	With Kotapanjang Dam	297	21
3	Case 2 + Kampar Kiri No. 1 Dam	343	67
4	Case 2 + Kampar Kiri No. 2 Dam	311	35
5	Case 2 + Kampar Kiri No. 1 and No. 2 Dams	357	81

On the other hand, the increment at the river mouth of the Indragiri River is as given below.

Unit: m^3/s

Case	Condition	Minimum Discharge	Incremental Discharge
1	Present	170	-
2	With Singkarak Power Station	87	(-) 83
3	Case 2 + Kuantan Dam	192	22

Based on the above two tables, the possible maximum development amount comes to 103 m^3/s by a combination of Case 5 of Kampar River and Case 3 for Indragiri River.

As mentioned before, six possible damsites are identified in this study and the three dams mentioned above are taken up for the overall development plan of the study area from the economical viewpoint. However, if the economical, environmental and social matters are put aside, the total effective storage of the remaining three possible dams comes to 443×10^6 m^3 against the total effective storage of $1,829 \times 10^6$ m^3 of the proposed three dams. Assuming that the development amount is proportionally increased against increase of the effective storage, about 25 m^3/s is additionally obtained although the development cost may be high.

CHAPTER 7 WATER RESOURCES DEVELOPMENT PLAN IN FEASIBILITY STUDY

7.1 Priority Projects

Based on the study on Overall Development Plan including the Flood Control Plan, the priority projects for feasibility study were selected as follows:

(1) Kampar River System

(a) Kampar Kanan Water Supply Project

(b) Kampar Kanan River Improvement Project (Bangkinang Area)

(2) Indragiri River System

(a) Kuantan River Multipurpose Development Project

(b) Rengat Area Flood Control Project

Among them, the Kampar Kanan Water Supply Project and the Kuantan River Multipurpose Development Project are related to the water resources development plan. They were studied as described below.

7.2 Kampar Kanan Water Supply Project

7.2.1 Water Demand

Objective Area

The Overall Development Plan of this Project is as described in Subsection 6.1.4. The Project aims at supplying 25.49 m^3/s of irrigation water for a total of 20,303 ha at peak time, and 10.90 m^3/s for domestic water, urban area flushing water, etc., to Pekanbaru City.

After reviewing the overall plan from the viewpoint of economic feasibility, the objective water supply areas for the priority project were selected as described below.

In accordance with the results of review of the Overall Development Plan, the objective area for irrigation development in priority projects is defined as the area on the right and left banks from Kuok Intake Weir to Danau Bingkuang Bridge as mentioned in SECTOR VII. The areas are as tabulated below.

Unit: ha

Area	Left Bank Area	Right Bank Area
New Irrigation Area (Rantauberangin Project)	4,429	277
Existing Irrigation Area	5,171	4,338
Total	9,600	4,615

On the other hand, no charge is made for the water supply to Pekanbaru City.

Water Demand

Based on the above, the peak water demand in the Feasibility Study was estimated as follows:

Area	Water Demand (m^3/s)
Rantauberangin Project	
New Irrigation Area	7.24 *
Existing Irrigation Area (shortage)	8.87 *
Pekanbaru City	10.90
Total	27.01 *

* For 5-year probable drought.

The diversion requirement of 8.87 m^3/s for the shortage of existing irrigation areas appears once a 5-year.

The water demand of Pekanbaru City consists of 3.80 m^3/s for domestic use, 0.78 m^3/s for industry use, 0.01 m^3/s for tourism use, and 6.31 m^3/s for urban area flushing use.

7.2.2 Storage Capacity of Kuok Intake Weir

The required capacity of Kuok Intake Weir to regulate hydropower generation release to constant release is calculated at $1.2 \times 10^6 m^3$ based on the water requirement for priority projects at Kuok Intake Weir. This is estimated for 12-hour power generation of the Katapanjang Power Station. On the other hand, the capacity for the Overall Development Plan has been estimated at $1.6 \times 10^6 m^3$ from the irrigation peak diversion water requirement of 25.49 m^3/s and water demand of Pekanbaru City of 10.90 m3/s.

The weir crest elevation proposed in the Overall Development Plan shall be maintained in the initial phase because elevations determined by the alignment of irrigation canals could not be changed. Accordingly, the storage capacity of $1.6 \times 10^6 m^3$ required for the Overall Development Plan has been applied to avoid reconstruction of intake and distribution facilities.

7.2.3 Diversion for Pekanbaru City

In the present study, the water demand of Pekanbaru City was estimated for the water balance study. However, optimum intake and transmission facilities were not studied and they should be selected through an independent study for this purpose. These would include the option of taking water at Kuok Intake Weir and transmitting water partly using the irrigation canal, or taking water by pumping up in the downstream area for the shortest transmission length.

The volume of water to be supplied to Pekanbaru City may not be considered in the left bank irrigation canal.

7.3 Kuantan River Multipurpose Development Project

7.3.1 Water Demand

Objective Area for Feasibility Study

This project has multipurpose of flood control, maintenance of normal function of river flow, irrigation water supply and power generation. Major facilities are Lower Kuantan Dam and Lubukjambi Intake Weir.

Among the water demands for the above purposes, the irrigation water demand was reviewed for the feasibility study as discussed in SUPPORTING REPORT VII.

The overall development plan covers the irrigation area of 30,149 ha in total on the left and right bank areas of the Indragiri River, however in accordance with result of review of the overall development plan, the objective area for irrigation development in the feasibility study is defined as the area on the left bank of the Kuantan River from Lubukjambi intake weir to Kampung Baru. The area is as follows:

Unit: ha

Area	Left Bank Upstream Area
Objective Irrigation Area (Lubukjambi Project)	5,234
Existing Irrigation Area	4,142
Total	9,376

Water Demand

For the above development area, the irrigation water demand in the feasibility study is calculated. The Kuantan Dam has storage for irrigation water supply only for the new irrigation area of 5,234 ha, while the diversion requirement from the Lubukjambi Intake Weir covers the whole area of 9,376 ha.

The peak water demand in the feasibility study is summarized as follows:

Unit: m^3/s

Area	Diversion Requirement
Objective Irrigation Area (Lubukjambi Project)	7.85 *
Existing Irrigation Area (Shortage)	0.00 *
River Maintenance Flow (Constant Release)	57.39
River Maintenance Flow (Supplementation of Deficit in Downstream Area)	24.64 **
Total	89.88

* For 5-year probable drought.
** For 10-year probable drought.

7.3.2 Required Storage in Kuantan Dam for Irrigation Use

The storage capacity of the Kuantan Dam is allocated for the respective water uses except flood control in the Overall Development Plan.

Unit: 10^6m^3

Purpose	Allocated Capacity
River Maintenance	213
Irrigation	117
Hydropower	415
Total	745

In the Feasibility Study, the objective irrigation area has been decreased from 23,777 ha to 5,234 ha. By this decrease, the required storage for irrigation use has been calculated in the Feasibility Study as $4 \times 10^6m^3$ by the reservoir operation. Since the capacity for flood control ($400 \times 10^6m^3$) has not been changed, the storage allocation is revised as follows:

Unit: 10^6m^3

Purpose	Allocated Capacity
River Maintenance	213
Irrigation	4
Hydropower	528
Total	745

Considering total net benefit of the Project, the residual capacity of irrigation use is allocated to the hydropower use.

7.3.3 Storage Capacity of Lubukjambi Intake Weir

The required capacity of Kuok Intake Weir to regulate hydropower generation release to constant release is calculated at $0.45 \times 10^6m^3$ based on the water requirement for

priority projects at Lubukjambi Intake Weir. This is estimated for 8-hour power generation of the Kuantan Power Station. On the other hand, the capacity for the Overall Development Plan has been estimated at $2.2 \times 10^6 m^3$ from the peak diversion water requirement of 36.93 m^3/s.

The weir crest elevation proposed in the Overall Development Plan shall be maintained in the initial phase because elevations determined by the alignment of main irrigation canals could not be changed. Accordingly, the storage capacity of $2.2 \times 10^6 m^3$ required for the Overall Development Plan has been applied to avoid reconstruction of intake and distribution facilities.

TABLES

VIII WATER RESOURCES DEVELOPMENT PLAN

Table VIII.1.1 AREA AND POPULATION SHARES BY REGENCY AND MUNICIPALITY

(1) Kampar River Basin

Regency/Municipality	Area (km^2)		Ratio (%)		Population (person)		Ratio (%)	
	Whole Regency (A)	Within Basin (B)	B/A	B/E	Whole Regency (C)	Within Basin (D)	D/C	D/E
Kab.Pasaman	7,835	530	7	2	451,551	21,900	5	3
Kab. Limapuluh Kota	3,354	2,000	60	8	297,009	65,400	22	8
Kab. Indragiri Hulu	15,854	2,210	14	9	368,374	53,800	15	6
Kab. Kampar	27,908	19,808	71	81	569,911	314,300	55	38
Kodya. Pekanbaru	447	0	0	0	375,521	375,500	100	45
Kampar River Basin (E)	-	24,548	-	100	-	830,900	-	100

Note : Population share is calculated based on 1990 Census.

(2) Indragiri River Basin

Regency/Municipality	Area (km^2)		Ratio (%)		Population (person)		Ratio (%)	
	Whole Regency (A)	Within Basin (B)	B/A	B/E	Whole Regency (C)	Within Basin (D)	D/C	D/E
Kab. Limapuluh Kota	3,354	1,354	40	8	297,009	231,800	78	11
Kab. Agam	2,232	330	15	2	407,767	181,500	45	9
Kab. Tanah Datar	1,336	1,336	100	8	342,139	342,100	100	17
Kab. Solok	7,084	1,650	23	10	427,476	207,900	49	10
Kab. Sawahlunto/Sijunjung	6,092	2,310	38	14	297,129	159,300	54	8
Kodya. Payakumbuh	80	80	100	0	90,872	90,900	100	5
Kodya. Bukittinggi	25	25	100	0	83,811	83,800	100	4
Kodya. Padang Panjang	27	27	100	0	38,557	38,600	100	2
Kodya. Solok	25	25	100	0	42,730	42,700	100	2
Kodya.Sawahlunto	321	320	100	2	15,279	15,300	100	1
Kab. Indragiri Hulu	15,854	7,643	48	47	368,374	294,700	80	15
Kab. Indragiri Hilir	11,606	1,168	10	7	478,066	329,900	69	16
Indragiri River Basin (E)	-	16,268	-	100	-	2,018,500	-	100

Note : Population share is calculated based on 1990 Census.

Table VIII.1.2 (1/2) HISTORICAL AND FUTURE POPULATION BY REGENCY

(1) Riau Province

Unit : person

Year	Riau Province	Kodya. Pekanbaru	Kab. Indragiri Hulu	Kab. Indragiri Hilir	Kab. Kampar	Total of Regencies
1982	2,333,156	192,196	259,032	414,309	422,360	1,287,897
1983	2,427,908	195,068	272,827	417,375	456,061	1,341,331
1984	2,490,176	198,212	277,334	424,640	484,784	1,384,970
1985	2,644,181	207,358	299,253	426,896	529,117	1,462,624
1986	2,735,918	211,563	321,512	435,147	561,226	1,529,448
1987	2,778,803	212,704	330,452	437,777	573,416	1,554,349
1988	2,842,955	309,614	336,169	448,673	482,705	1,577,161
1989	2,908,347	311,165	346,104	455,946	506,889	1,620,104
1990	3,306,215	375,521	368,374	478,066	569,911	1,791,872
1991	3,345,467	394,133	379,859	486,037	587,164	1,847,193
1992	3,500,697	425,742	397,750	498,723	610,181	1,911,291
1993	3,663,129	459,887	416,484	511,739	634,100	1,977,612
1994	3,833,098	496,770	436,101	525,096	658,957	2,046,236
1999	4,539,900	649,300	516,700	579,400	761,400	2,506,800
2004	5,377,600	858,800	610,700	627,200	866,300	2,963,000
2009	6,342,600	1,135,700	714,700	675,300	980,600	3,506,300
2014	7,448,500	1,466,800	822,300	722,500	1,098,400	4,110,000
2019	8,747,200	1,872,100	939,000	769,800	1,220,400	4,801,300
Average Annual Growth Rate (%)						
1982-1987	3.56	2.05	4.99	1.11	6.31	3.83
1987-1991	4.75	16.67	3.54	2.65	0.59	4.41
1991-1994	4.64	8.02	4.71	2.61	3.92	3.47
1994-1999	3.44	5.50	3.45	1.99	2.93	4.32
1999-2004	3.44	5.75	3.40	1.60	2.62	3.40
2004-2009	3.36	5.75	3.19	1.49	2.51	3.42
2009-2014	3.27	5.25	2.84	1.36	2.29	3.23
2014-2019	3.27	5.00	2.69	1.28	2.13	3.16

Source : Riau Dalam Angka (Histrical data up to 1992)

Note : Populations in 1993 and 1994 are estimated.

Table VIII.1.2 (2/2) HISTORICAL AND FUTURE POPULATION BY REGENCY

(2) West Sumatra Province

Unit : person

Year	West Sumatra Province	Kab. Solok	Kab. Sawahlunto /Sijunjung	Kab. Tanah Datar	Kab. Agam	Kab. Limapuluh Kota	Kab. Pasaman	Kodya Solok	Kodya. Sawahlunto	Kodya. Padang Panjang	Kodya. Bukittinggi	Kodya. Payakumbuh	Total of Regency
1982	3,524,198	364,720	242,114	324,488	396,119	281,553	371,352	32,900	14,185	34,216	71,999	81,971	2,215,617
1983	3,639,663	372,351	259,388	338,476	401,302	288,926	391,620	33,274	14,533	34,660	71,947	83,577	2,290,054
1984	3,696,004	379,810	259,838	338,481	406,849	292,442	405,550	33,604	14,736	34,754	73,476	84,488	2,324,028
1985	3,735,787	389,435	268,576	347,126	415,245	296,408	409,189	33,584	14,886	34,933	74,286	84,907	2,368,575
1986	3,818,264	405,256	274,851	347,234	408,093	298,044	416,906	37,210	15,168	34,870	75,450	85,403	2,398,485
1987	3,871,962	414,145	277,175	351,970	414,624	300,134	426,260	37,217	15,349	34,876	76,220	86,094	2,434,064
1988	3,943,363	420,464	286,176	355,737	425,003	304,356	443,221	37,355	15,338	35,337	76,727	86,603	2,486,317
1989	3,991,092	433,509	291,063	360,565	426,902	307,229	447,665	37,378	15,383	35,282	77,197	87,980	2,520,153
1990	3,999,120	427,476	297,129	342,139	407,767	297,009	451,551	42,730	15,279	38,557	83,811	90,872	2,494,320
1991	4,141,444	431,389	311,630	350,296	416,465	305,070	470,456	42,675	15,740	39,698	86,771	93,812	2,564,002
1992	4,206,879	439,370	320,792	352,433	419,005	307,541	483,535	44,352	15,957	40,472	89,044	96,298	2,609,128
1993	4,273,348	447,498	330,223	354,583	421,561	310,032	496,977	46,095	16,177	41,261	91,377	98,850	2,655,049
1994	4,403,900	455,700	339,900	356,800	424,100	312,500	510,900	47,900	16,400	42,100	93,800	101,500	2,701,600
1999	4,755,200	498,100	391,300	367,300	435,200	327,000	564,900	55,900	17,200	45,500	104,300	112,800	2,919,500
2004	5,122,000	537,500	447,100	376,100	444,900	339,800	615,100	63,600	17,800	48,500	114,100	123,400	3,127,900
2009	5,517,100	575,100	512,000	389,100	460,200	360,500	682,300	75,200	18,600	52,800	127,300	137,700	3,390,800
2014	5,928,100	608,000	584,600	400,100	473,300	378,500	743,300	86,400	19,300	56,600	139,300	149,700	3,639,100
2019	6,279,000	642,800	666,800	411,400	486,700	397,400	798,300	97,100	19,800	60,300	151,400	161,500	3,893,500
Average Annual Growth Rate (%)													
1982-1987	1.90	2.57	2.74	1.64	0.92	1.29	2.80	2.50	1.59	0.38	1.15	0.99	1.90
1987-1991	1.70	1.03	2.97	-0.12	0.11	0.41	2.50	3.48	0.63	3.29	3.29	2.17	1.31
1991-1994	1.58	1.85	2.94	0.61	0.61	0.81	2.78	3.93	1.38	1.95	2.62	2.65	1.76
1994-1999	1.55	1.82	2.86	0.58	0.52	0.91	2.03	3.12	0.91	1.56	2.15	2.15	1.55
1999-2004	1.50	1.51	2.70	0.47	0.44	0.77	1.72	2.64	0.77	1.32	1.81	1.81	1.38
2004-2009	1.50	1.36	2.75	0.68	0.68	1.19	2.10	3.40	0.85	1.70	2.21	2.21	1.63
2009-2014	1.45	1.12	2.69	0.56	0.56	0.98	1.73	2.80	0.70	1.40	1.82	1.68	1.43
2014-2019	1.45	1.12	2.66	0.56	0.56	0.98	1.44	2.38	0.56	1.26	1.68	1.54	1.36

Source Sumatera Barat Dalam Angka (Histrical data up to 1992)
Note : Populations in 1993 and 1994 are estimated.

Table VIII.1.3 (1/2) FUTURE POPULATION BY RIVER BASIN

(1) Kampar River Basin

Unit : 1,000 persons

Regency Related	Category	1994	1999	2004	2009	2014	2019
1) Kab. Pasaman	Kabupaten	510.9	564.9	615.1	682.3	743.3	798.3
	Basin (5%)	25.5	28.2	30.8	34.1	37.2	39.9
	Rural Area	24.8	27.0	29.0	31.6	34.0	35.8
	Urban Area	0.7	1.2	1.8	2.5	3.2	4.1
	Urban Ratio (%)	2.7	4.2	5.9	7.3	8.6	10.3
2) Kab. Limapuluh Kota	Kabupaten	312.5	327.0	339.8	360.5	378.5	397.4
	Basin (22%)	68.7	71.9	74.7	79.3	83.3	87.4
	Rural Area	67.0	69.0	70.6	73.8	76.2	78.7
	Urban Area	1.7	2.9	4.1	5.5	7.1	8.7
	Urban Ratio (%)	2.5	4.0	5.5	6.9	8.5	10.0
3) Kab. Indragiri Hulu	Kabupaten	436.1	516.7	610.7	714.7	822.3	929.0
	Basin (15%)	65.4	77.5	91.6	107.2	123.3	139.3
	Rural Area	60.1	69.6	80.5	92.0	103.3	113.7
	Urban Area	5.3	7.9	11.1	15.2	20.0	25.6
	Urban Ratio (%)	8.1	10.2	12.1	14.2	16.2	18.4
4) Kab. Kampar	Kabupaten	658.9	761.4	866.3	980.6	1,098.4	1,220.4
	Basin (55%)	362.4	418.8	476.5	539.4	604.1	671.2
	Rural Area	341.1	385.8	429.4	475.3	520.2	564.5
	Urban Area	21.3	33.0	47.1	64.1	83.9	106.7
	Urban Ratio (%)	5.9	7.9	9.9	11.9	13.9	15.9
Kampar River Basin	Basin	522.1	596.5	673.6	760.0	847.9	937.9
	Rural Area	493.1	551.5	609.5	672.7	733.7	792.8
	Urban Area	29.0	45.0	64.1	87.3	114.2	145.1
	Urban Ratio (%)	5.6	7.5	9.5	11.5	13.5	15.5
5) Kodya Pekanbaru	Kodya	496.8	649.3	858.8	1,135.7	1,466.8	1,872.1
	Basin (100%)	496.8	649.3	858.8	1,135.7	1,466.8	1,872.1
	Rural Area	64.0	70.7	76.4	78.2	71.7	54.1
	Urban Area	432.8	578.6	782.4	1,057.5	1,395.1	1,818.0
	Urban Ratio (%)	87.1	89.1	91.1	93.1	95.1	97.1
Kampar River Basin with Pekanbaru	Basin	1,018.9	1,245.8	1,532.3	1,895.7	2,314.7	2,810.0
	Rural Area	557.1	622.2	685.8	750.9	805.4	846.9
	Urban Area	461.8	623.6	846.5	1,144.8	1,509.3	1,963.1
	Urban Ratio (%)	45.3	50.1	55.2	60.4	65.2	69.9

Note : (1) Percentages in parentheses indicate population share given in Table VIII.1.1.
(2) Kotamadya Pekanbaru is outside the basin, but most of water demand will be met by the Kampar River in the future.

Table VIII.1.3 (2/2) FUTURE POPULATION BY RIVER BASIN

(2) Indragiri River Basin

Unit : 1,000 persons

Regency Related	Category	1994	1999	2004	2009	2014	2019
1) Kab. Limapuluh Kota	Kabupaten	312.5	327.0	339.8	360.5	378.5	397.4
	Basin (78%)	243.7	255.0	265.0	281.2	295.2	310.0
	Rural Area	237.6	244.8	250.4	261.5	270.1	277.8
	Urban Area	6.1	10.2	14.6	19.7	25.1	32.2
	Urban Ratio (%)	2.5	4.0	5.5	7.0	8.5	10.4
2) Kab. Agam	Kabupaten	424.1	435.2	444.9	460.2	473.3	486.7
	Basin (45%)	190.8	195.9	200.2	207.1	213.0	219.0
	Rural Area	174.3	176.0	176.8	179.8	181.8	183.6
	Urban Area	16.5	19.9	23.4	27.3	31.2	35.4
	Urban Ratio (%)	8.6	10.2	11.7	13.2	14.7	16.2
3) Kab. Tanah Datar	Kabupaten	356.8	367.3	376.1	389.1	400.1	411.4
	Basin (100%)	356.8	367.3	376.1	389.1	400.1	411.4
	Rural Area	335.4	339.8	342.3	348.3	352.1	355.9
	Urban Area	21.4	27.5	33.8	40.8	48.0	55.5
	Urban Ratio (%)	6.0	7.5	9.0	10.5	12.0	13.5
4) Kab. Solok	Kabupaten	455.8	498.1	537.5	575.1	608.0	642.8
	Basin (49%)	223.3	244.1	263.4	281.8	297.9	315.0
	Rural Area	217.2	233.8	248.4	261.5	271.9	282.9
	Urban Area	6.1	10.3	15.0	20.3	26.0	32.1
	Urban Ratio (%)	2.7	4.2	5.7	7.2	8.7	10.2
5) Kab. Sawahlunto/ Sijunjung	Kabupaten	339.9	391.3	447.1	512.0	584.6	666.8
	Basin (54%)	183.6	211.3	241.4	276.5	315.7	360.1
	Rural Area	166.3	188.3	211.5	238.1	267.1	299.2
	Urban Area	17.3	23.0	29.9	38.4	48.6	60.9
	Urban Ratio (%)	9.4	10.9	12.4	13.9	15.4	16.9
6) Kodya Payakumbuh	Kodya	101.5	112.8	123.4	137.7	149.7	161.5
	Basin (100%)	101.5	112.8	123.4	137.7	149.7	161.5
	Rural Area	44.1	47.3	49.8	53.6	56.0	58.0
	Urban Area	57.4	65.5	73.6	84.1	93.7	103.5
	Urban Ratio (%)	56.6	58.1	59.6	61.1	62.6	64.1
7) Kodya Bukittinggi	Kodya	93.8	104.3	114.1	127.3	139.3	151.4
	Basin (100%)	93.8	104.3	114.1	127.3	139.3	151.4
	Rural Area	12.1	21.2	29.6	41.4	52.0	62.7
	Urban Area	81.7	83.1	84.5	85.9	87.3	88.7
	Urban Ratio (%)	87.1	79.7	74.1	67.5	62.7	58.6
8) Kodya Padang Panjang	Kodya	42.1	45.5	48.5	52.8	56.6	60.3
	Basin (100%)	42.1	45.5	48.5	52.8	56.6	60.3
	Rural Area	6.7	6.5	6.2	5.9	5.5	5.0
	Urban Area	35.4	39.0	42.3	46.9	51.1	55.3
	Urban Ratio (%)	84.1	85.8	87.2	88.8	90.3	91.8
9) Kodya Solok	Kodya	47.9	55.9	63.6	75.2	86.4	97.0
	Basin (100%)	47.9	55.9	63.6	75.2	86.4	97.0
	Rural Area	27.5	31.3	34.6	39.9	44.5	48.5
	Urban Area	20.4	24.6	29.0	35.3	41.9	48.5
	Urban Ratio (%)	42.6	44.0	45.6	46.9	48.5	50.0
10) Kodya Sawahlunto	Kodya	16.4	17.2	17.8	18.6	19.3	19.8
	Basin (100%)	16.4	17.2	17.8	18.6	19.3	19.8
	Rural Area	1.0	0.9	0.7	0.6	0.5	0.2
	Urban Area	15.4	16.3	17.1	18.0	18.8	19.6
	Urban Ratio (%)	93.9	95.0	95.9	96.8	97.6	99.0
11) Kab. Indragiri Hulu	Kabupaten	436.1	516.7	610.7	714.7	822.3	939.0
	Basin (80%)	348.9	413.4	488.6	571.8	657.8	751.2
	Rural Area	321.9	373.5	432.2	494.9	556.9	621.7
	Urban Area	27.0	39.9	56.4	76.9	100.9	129.5
	Urban Ratio (%)	7.7	9.7	11.5	13.4	15.3	17.2
12) Kab. Indragiri Hilir	Kabupaten	525.2	579.4	627.2	675.3	722.5	769.8
	Basin (69%)	362.4	399.8	432.8	466.0	498.5	531.2
	Rural Area	344.6	376.7	404.0	431.0	456.7	482.1
	Urban Area	17.8	23.1	28.8	35.0	41.8	49.1
	Urban Ratio (%)	4.9	5.8	6.7	7.5	8.4	9.2
Indragiri River Basin	Basin	2,211.1	2,422.4	2,635.0	2,884.9	3,129.4	3,387.8
	Rural Area	1,888.6	2,040.0	2,186.6	2,356.3	2,515.0	2,677.5
	Urban Area	322.5	382.4	448.4	528.6	614.4	710.3
	Urban Ratio (%)	14.6	15.8	17.0	18.3	19.6	21.0

Note : Percentages in parentheses indicate population share given in Table VIII.1.1.

Table VIII.2.1 SURFACE WATER RESOURCES POTENTIAL

Item	Kampar River Basin	Indragiri River Basin
1. Catchment Area (km^2)	24,548	16,268
2. Annual Basin Average Rainfall (mm/year)	2,513	2,338
3. Annual Evapotranspiration (mm/year)	1,215	1,193
4. Annual Runoff Height (mm/year)	1,298	1,145
5. Potential Water (billion m^3/year)	31.9	18.6
6. Available Water (billion m^3/year)	22.3	13.0
7. Specific Runoff (m^3/sec/100 km^2)	4.12	3.63

Note : Available water is assumed to be 70% of potential annual runoff.

Table VIII.2.2 GROUNDWATER RESOURCES POTENTIAL

Item	Kampar River Basin	Indragiri River Basin
1. Catchment Area (km^2)	24,548	16,268
2. Groundwater Potential Area (km^2)	1,470	2,540
- Riau Province	1,470	740
- West Sumatra Province	0	1,800
3. Annual Basin Average Rainfall (mm/year)	2,513	2,338
4. Annual Evapotranspiration (mm/year)	1,215	1,193
5. Effective Rainfall (mm/year)	1,298	1,145
6. Potential Groundwater (billion m^3/year)	0.6	0.9
7. Available Water (billion m^3/year)	0.4	0.6
8. Specific Discharge (m^3/sec/100km^2)	0.07	0.17

Source: Water Resources and Potentially Irrigable Land of Riau,
July 1981, Binnie & Partners Ltd. with Hunting Technical Services Ltd.
Provincial of Office of Ministry of Mines and Energy, West Sumatra Province

Note : Recharge through potential area is estimated at 30 % of the effective rainfall.
Available water is assumed to be 70 % of potential groundwater.

Table VIII.3.1 EXISTING AND POTENTIAL IRRIGATION AREAS

Unit : ha

River Basin	Regency Related	Existing Irrigation Area	Irrigable Area	Extendable Area
Kampar	1) Kab. Limapuluh Kota	3,204	3,780	576
	2) Kab. Indragiri Hulu	44	12,403	12,359
	3) Kab. Kampar	4,309	11,344	7,035
	Total	7,557	27,527	19,970
Indragiri	1) Kab. Limapuluh Kota	23,081	23,518	437
	2) Kab. Agam	4,780	4,780	0
	3) Kab. Tanah Datar	20,495	21,315	820
	4) Kab. Solok	22,345	23,264	919
	5) Kab. Sawahlunto/Sijunjung	9,954	16,566	6,612
	6) Kab. Indragiri Hulu	3,658	8,262	4,604
	Total	84,313	97,705	13,392

Note : Existing irrigation areas including village irrigation are those as of 1992/93.

Table VIII.3.2 PROPOSED IRRIGATION PROJECTS

Unit : ha

River Basin	Proposed Project Name	Proposed Area
Kampar	Rantauberangin Project (Kab. Kampar)	
	1) Left Bank of Kampar River	10,517
	2) Right Bank of Kampar River	277
	Total	10,794
Indragiri	Lubukjambi Project (Kab. Indragiri Hulu)	
	1) Left Bank of Indragiri River	12,875
	2) Right Bank of Indragiri River	10,902
	Total	23,777

Table VIII.3.3 PROJECTION OF IRRIGATION DEVELOPMENT

(1) Extension of Existing Irrigation Area

Unit : ha

River Basin	Regency	Item	1994	1999	2004	2009	2014	2019
Kampar	1) Kab. Limapuluh Kota	Irrigation Area	3,204	3,337	3,448	3,558	3,669	3,780
		Increment		133	111	111	111	111
	2) Kab. Indragiri Hulu	Irrigation Area	44	2,896	5,273	7,650	10,026	12,403
		Increment		2,852	2,377	2,377	2,377	2,377
	3) Kab. Kampar	Irrigation Area	4,309	5,932	7,285	8,638	9,991	11,344
		Increment		1,623	1,353	1,353	1,353	1,353
	Total	Irrigation Area	7,557	12,165	16,006	19,846	23,687	27,527
		Increment		4,608	3,840	3,840	3,840	3,840
Indragiri	1) Kab. Limapuluh Kota	Irrigation Area	23,081	23,182	23,266	23,350	23,434	23,518
		Increment		101	84	84	84	84
	2) Kab. Agam	Irrigation Area	4,780	4,780	4,780	4,780	4,780	4,780
		Increment		0	0	0	0	0
	3) Kab. Tanah Datar	Irrigation Area	20,495	20,684	20,842	21,000	21,157	21,315
		Increment		189	158	158	158	158
	4) Kab. Solok	Irrigation Area	22,345	22,557	22,734	22,911	23,087	23,264
		Increment		212	177	177	177	177
	5) Kab. Sawahlunto/ Sijunjung	Irrigation Area	9,954	11,480	12,751	14,023	15,294	16,566
		Increment		1,526	1,272	1,272	1,272	1,272
	6) Kab. Indragiri Hulu	Irrigation Area	3,658	4,720	5,606	6,491	7,377	8,262
		Increment		1,062	885	885	885	885
	Total	Irrigation Area	84,313	87,403	89,979	92,554	95,130	97,705
		Increment		3,090	2,575	2,575	2,575	2,575

(2) Proposed Irrigation Projects

Unit : ha

River Basin	Project	Item	1994	1999	2004	2009	2014	2019
Kampar	Rantauberangin	Irrigation Area	0	2,491	4,567	6,642	8,718	10,794
	(Kab. Kampar)	Increment		2,491	2,076	2,076	2,076	2,076
Indragiri	Lubukjambi	Irrigation Area	0	5,487	10,060	14,632	19,205	23,777
	(Kab. Indragiri Hulu)	Increment		5,487	4,573	4,573	4,573	4,573

Table VIII.3.4 (1/2) FUTURE IRRIGATION WATER DEMAND BY EXTENSION OF EXISTING IRRIGATION AREAS IN KAMPAR RIVER BASIN

(Base Year: 1988)

Unit : m^3/sec

(1) Year : 1994

Regency Related	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	3,204	0.10	0.00	0.00	4.10	1.67	1.47	0.74	3.75	1.60	0.80	0.74	0.13	0.00	0.00	0.00	0.00	5.13	1.35	3.78	2.60	0.74	2.98	0.74	0.74
2) Kab. Ind. Hulu	44	0.00	0.00	0.00	0.06	0.02	0.02	0.01	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.07	0.02	0.05	0.04	0.01	0.04	0.01	0.01
3) Kab. Kampar	4,309	0.13	0.00	0.00	5.52	2.24	1.98	0.99	5.04	2.15	1.08	0.99	0.17	0.00	0.00	0.00	0.00	6.89	1.81	5.08	3.49	0.99	4.01	0.99	0.99
Total	7,557	0.23	0.00	0.00	9.67	3.93	3.48	1.74	8.84	3.78	1.89	1.74	0.30	0.00	0.00	0.00	0.00	12.09	3.17	8.92	6.12	1.74	7.03	1.74	1.74
Unit Water Requirement (l/sec/ha)		0.03	0.00	0.00	1.28	0.52	0.46	0.23	1.17	0.50	0.25	0.23	0.04	0.00	0.00	0.00	0.00	1.60	0.42	1.18	0.81	0.23	0.93	0.23	0.23

Unit : m^3/sec

(2) Year : 1999

Regency Related	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	3,337	2.70	0.77	0.77	0.83	0.00	0.00	2.10	5.14	1.67	1.80	1.33	2.87	3.60	2.67	0.83	0.00	0.00	0.00	0.00	4.64	1.67	3.14	0.77	0.77
2) Kab. Ind. Hulu	2,896	2.35	0.67	0.67	0.72	0.00	0.00	1.82	4.46	1.45	1.56	1.16	2.49	3.13	2.32	0.72	0.00	0.00	0.00	0.00	4.03	1.45	2.72	0.67	0.67
3) Kab. Kampar	5,932	4.81	1.36	1.36	1.48	0.00	0.00	3.74	9.14	2.97	3.20	2.37	5.10	6.41	4.75	1.48	0.00	0.00	0.00	0.00	8.25	2.97	5.58	1.36	1.36
Total	12,165	9.85	2.80	2.80	3.04	0.00	0.00	7.66	18.73	6.08	6.57	4.87	10.46	13.14	9.73	3.04	0.00	0.00	0.00	0.00	16.91	6.08	11.44	2.80	2.80
Increment	4,608	9.63	2.80	2.80	-6.63	-3.93	-3.48	5.93	9.89	2.30	4.68	3.13	10.16	13.14	9.73	3.04	0.00	-12.09	-3.17	-8.92	10.79	4.34	4.41	1.06	1.06
Unit Water Requirement (l/sec/ha)		0.81	0.23	0.23	0.25	0.00	0.00	0.63	1.54	0.50	0.54	0.40	0.86	1.08	0.80	0.25	0.00	0.00	0.00	0.00	1.39	0.50	0.94	0.23	0.23

Unit : m^3/sec

(3) Year : 2004

Regency Related	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	3,448	2.79	0.79	0.79	0.86	0.00	0.00	2.17	5.31	1.72	1.86	1.38	2.97	3.72	2.76	0.86	0.00	0.00	0.00	0.00	4.79	1.72	3.24	0.79	0.79
2) Kab. Ind. Hulu	5,273	4.27	1.21	1.21	1.32	0.00	0.00	3.32	8.12	2.64	2.85	2.11	4.53	5.69	4.22	1.32	0.00	0.00	0.00	0.00	7.33	2.64	4.96	1.21	1.21
3) Kab. Kampar	7,285	5.90	1.68	1.68	1.82	0.00	0.00	4.59	11.22	3.64	3.93	2.91	6.27	7.87	5.83	1.82	0.00	0.00	0.00	0.00	10.13	3.64	6.85	1.68	1.68
Total	16,006	12.96	3.68	3.68	4.00	0.00	0.00	10.08	24.65	8.00	8.64	6.40	13.77	17.29	12.80	4.00	0.00	0.00	0.00	0.00	22.25	8.00	15.05	3.68	3.68
Increment	8,449	12.74	3.68	3.68	-5.67	-3.93	-3.48	8.35	15.81	4.22	6.75	4.66	13.46	17.29	12.80	4.00	0.00	-12.09	-3.17	-8.92	16.13	6.26	8.02	1.94	1.94
Unit Water Requirement (l/sec/ha)		0.81	0.23	0.23	0.25	0.00	0.00	0.63	1.54	0.50	0.54	0.40	0.86	1.08	0.80	0.25	0.00	0.00	0.00	0.00	1.39	0.50	0.94	0.23	0.23

Table VIII.3.4 (2/2) FUTURE IRRIGATION WATER DEMAND BY EXTENSION OF EXISTING IRRIGATION AREAS IN KAMPAR RIVER BASIN

(Base Year: 1988)

(4) Year : 2009

Unit : m^3/sec

Regency Related	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	3,558	2.88	0.82	0.82	0.89	0.00	0.00	2.24	5.48	1.78	1.92	1.42	3.06	3.84	2.85	0.89	0.00	0.00	0.00	0.00	4.95	1.78	3.34	0.82	0.82
2) Kab. Ind. Hulu	7,650	6.20	1.76	1.76	1.91	0.00	0.00	4.82	11.78	3.82	4.13	3.06	6.58	8.26	6.12	1.91	0.00	0.00	0.00	0.00	10.63	3.82	7.19	1.76	1.76
3) Kab. Kampar	8,638	7.00	1.99	1.99	2.16	0.00	0.00	5.44	13.30	4.32	4.66	3.46	7.43	9.33	6.91	2.16	0.00	0.00	0.00	0.00	12.01	4.32	8.12	1.99	1.99
Total	19,846	16.08	4.56	4.56	4.96	0.00	0.00	12.50	30.56	9.92	10.72	7.94	17.07	21.43	15.88	4.96	0.00	0.00	0.00	0.00	27.59	9.92	18.66	4.56	4.56
Increment	12,289	15.85	4.56	4.56	-4.71	-3.93	-3.48	10.77	21.72	6.14	8.83	6.20	16.77	21.43	15.88	4.96	0.00	-12.09	-3.17	-8.92	21.47	8.19	11.63	2.83	2.83
Unit Water Requirement (l/sec/ha)		0.81	0.23	0.23	0.25	0.00	0.00	0.63	1.54	0.50	0.54	0.40	0.86	1.08	0.80	0.25	0.00	0.00	0.00	0.00	1.39	0.50	0.94	0.23	0.23

(5) Year : 2014

Unit : m^3/sec

Regency Related	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	3,669	2.97	0.84	0.84	0.92	0.00	0.00	2.31	5.65	1.83	1.98	1.47	3.16	3.96	2.94	0.92	0.00	0.00	0.00	0.00	5.10	1.83	3.45	0.84	0.84
2) Kab. Ind. Hulu	10,026	8.12	2.31	2.31	2.51	0.00	0.00	6.32	15.44	5.01	5.41	4.01	8.62	10.83	8.02	2.51	0.00	0.00	0.00	0.00	13.94	5.01	9.42	2.31	2.31
3) Kab. Kampar	9,991	8.09	2.30	2.30	2.50	0.00	0.00	6.29	15.39	5.00	5.40	4.00	8.59	10.79	7.99	2.50	0.00	0.00	0.00	0.00	13.89	5.00	9.39	2.30	2.30
Total	23,687	19.19	5.45	5.45	5.92	0.00	0.00	14.92	36.48	11.84	12.79	9.47	20.37	25.58	18.95	5.92	0.00	0.00	0.00	0.00	32.92	11.84	22.27	5.45	5.45
Increment	16,130	18.96	5.45	5.45	-3.75	-3.93	-3.48	13.18	27.64	8.06	10.90	7.74	20.07	25.58	18.95	5.92	0.00	-12.09	-3.17	-8.92	26.80	10.11	15.24	3.71	3.71
Unit Water Requirement (l/sec/ha)		0.81	0.23	0.23	0.25	0.00	0.00	0.63	1.54	0.50	0.54	0.40	0.86	1.08	0.80	0.25	0.00	0.00	0.00	0.00	1.39	0.50	0.94	0.23	0.23

(6) Year : 2019

Unit : m^3/sec

Regency Related	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	3,780	3.06	0.87	0.87	0.95	0.00	0.00	2.38	5.82	1.89	2.04	1.51	3.25	4.08	3.02	0.95	0.00	0.00	0.00	0.00	5.25	1.89	3.55	0.87	0.87
2) Kab. Ind. Hulu	12,403	10.05	2.85	2.85	3.10	0.00	0.00	7.81	19.10	6.20	6.70	4.96	10.67	13.40	9.92	3.10	0.00	0.00	0.00	0.00	17.24	6.20	11.66	2.85	2.85
3) Kab. Kampar	11,344	9.19	2.61	2.61	2.84	0.00	0.00	7.15	17.47	5.67	6.13	4.54	9.76	12.25	9.08	2.84	0.00	0.00	0.00	0.00	15.77	5.67	10.66	2.61	2.61
Total	27,527	22.30	6.33	6.33	6.88	0.00	0.00	17.34	42.39	13.76	14.86	11.01	23.67	29.73	22.02	6.88	0.00	0.00	0.00	0.00	38.26	13.76	25.88	6.33	6.33
Increment	19,970	22.07	6.33	6.33	-2.79	-3.93	-3.48	15.60	33.55	9.99	12.98	9.27	23.37	29.73	22.02	6.88	0.00	-12.09	-3.17	-8.92	32.14	12.03	18.85	4.59	4.59
Unit Water Requirement (l/sec/ha)		0.81	0.23	0.23	0.25	0.00	0.00	0.63	1.54	0.50	0.54	0.40	0.86	1.08	0.80	0.25	0.00	0.00	0.00	0.00	1.39	0.50	0.94	0.23	0.23

Table VIII.3.5 (1/2) FUTURE IRRIGATION WATER DEMAND BY EXTENSION OF EXISTING IRRIGATION AREAS IN INDRAGIRI RIVER BASIN
(Base Year: 1986)

Unit : m^3/sec

(1) Year : 1994

Regency / Related	Irrigation Area (ha)	Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-30	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31
1) Kab. Limapuluh Kota	23,081	0.00	0.00	0.00	40.39	0.00	7.16	14.08	11.31	21.70	18.46	12.69	6.69	0.00	0.00	0.00	0.00	32.08	17.54	9.00	9.69	27.24	18.00	5.31	9.92
2) Kab. Agam	4,780	0.00	0.00	0.00	8.37	0.00	1.48	2.92	2.34	4.49	3.82	2.63	1.39	0.00	0.00	0.00	0.00	6.64	3.63	1.86	2.01	5.64	3.73	1.10	2.06
3) Kab. Tanah Datar	20,495	0.00	0.00	0.00	35.87	0.00	6.35	12.50	10.04	19.27	16.40	11.27	5.94	0.00	0.00	0.00	0.00	28.49	15.58	7.99	8.61	24.18	15.99	4.71	8.81
4) Kab. Solok	22,345	0.00	0.00	0.00	39.10	0.00	6.93	13.63	10.95	21.00	17.88	12.29	6.48	0.00	0.00	0.00	0.00	31.06	16.98	8.71	9.38	26.37	17.43	5.14	9.61
5) Kab. Swlnt/Sjnjng	9,954	0.00	0.00	0.00	17.42	0.00	3.09	6.07	4.88	9.36	7.96	5.47	2.89	0.00	0.00	0.00	0.00	13.84	7.57	3.88	4.18	11.75	7.76	2.29	4.28
6) Kab. Ind. Hulu	3,658	0.00	0.00	0.00	6.62	0.00	1.28	1.46	0.84	1.68	4.32	2.01	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	84,313	0.00	0.00	0.00	147.77	0.00	26.28	50.66	40.36	77.50	68.84	46.37	24.34	0.00	0.00	0.00	0.00	112.11	61.30	31.46	33.88	95.17	62.91	18.55	34.68
Unit Water Requirement (l/sec/ha)	1) ~ 5)	0.00	0.00	0.00	1.75	0.00	0.31	0.61	0.49	0.94	0.80	0.55	0.29	0.00	0.00	0.00	0.00	1.39	0.76	0.39	0.42	1.18	0.78	0.23	0.43
	6)	0.00	0.00	0.00	1.81	0.00	0.35	0.40	0.23	0.46	1.18	0.55	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note : 50 Kota = Limapuluh Kota, Swlnt/Sjnjng = Sawahlunto/Sijunjung, Ind. Hulu = Indragiri Hulu

Unit : m^3/sec

(2) Year : 1999

Regency / Related	Irrigation Area (ha)	Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-30	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31
1) Kab. Limapuluh Kota	23,182	5.33	19.01	6.26	0.00	0.00	19.94	22.49	15.76	22.49	25.96	27.82	30.83	18.55	5.56	0.00	0.00	0.00	0.00	22.49	18.55	31.76	18.78	5.33	23.65
2) Kab. Agam	4,780	1.10	3.92	1.29	0.00	0.00	4.11	4.64	3.25	4.64	5.35	5.74	6.36	3.82	1.15	0.00	0.00	0.00	0.00	4.64	3.82	6.55	3.87	1.10	4.88
3) Kab. Tanah Datar	20,684	4.76	16.96	5.58	0.00	0.00	17.79	20.06	14.07	20.06	23.17	24.82	27.51	16.55	4.96	0.00	0.00	0.00	0.00	20.06	16.55	28.34	16.75	4.76	21.10
4) Kab. Solok	22,557	5.19	18.50	6.09	0.00	0.00	19.40	21.88	15.34	21.88	25.26	27.07	30.00	18.05	5.41	0.00	0.00	0.00	0.00	21.88	18.05	30.90	18.27	5.19	23.01
5) Kab. Swlnt/Sjnjng	11,480	2.64	9.41	3.10	0.00	0.00	9.87	11.14	7.81	11.14	12.86	13.78	15.27	9.18	2.76	0.00	0.00	0.00	0.00	11.14	9.18	15.73	9.30	2.64	11.71
6) Kab. Ind. Hulu	4,720	1.09	1.65	1.04	0.00	0.00	4.25	3.59	0.00	1.09	7.08	5.66	5.90	2.83	1.04	0.00	0.00	0.00	0.00	1.60	0.05	3.82	1.09	1.09	3.68
Total	87,403	20.10	69.45	23.36	0.00	0.00	75.36	83.79	56.22	81.29	99.69	104.88	115.87	68.98	20.88	0.00	0.00	0.00	0.00	81.81	66.19	117.10	68.06	20.10	88.02
Increment	3,090	20.10	69.45	23.36	-147.77	0.00	49.07	33.13	15.86	3.79	30.85	58.51	91.53	68.98	20.88	0.00	0.00	-112.11	-61.30	50.35	32.32	21.93	5.15	1.55	53.34
Unit Water Requirement (l/sec/ha)	1) ~ 5)	0.23	0.82	0.27	0.00	0.00	0.86	0.97	0.68	0.97	1.12	1.20	1.33	0.80	0.24	0.00	0.00	0.00	0.00	0.97	0.80	1.37	0.81	0.23	1.02
	6)	0.23	0.35	0.22	0.00	0.00	0.90	0.76	0.00	0.23	1.50	1.20	1.25	0.60	0.22	0.00	0.00	0.00	0.00	0.34	0.01	0.81	0.23	0.23	0.78

Note : 50 Kota = Limapuluh Kota, Swlnt/Sjnjng = Sawahlunto/Sijunjung, Ind. Hulu = Indragiri Hulu

Unit : m^3/sec

(3) Year : 2004

Regency / Related	Irrigation Area (ha)	Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-30	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31
1) Kab. Limapuluh Kota	23,266	5.35	19.08	6.28	0.00	0.00	20.01	22.57	15.82	22.57	26.06	27.92	30.94	18.61	5.58	0.00	0.00	0.00	0.00	22.57	18.61	31.87	18.85	5.35	23.73
2) Kab. Agam	4,780	1.10	3.92	1.29	0.00	0.00	4.11	4.64	3.25	4.64	5.35	5.74	6.36	3.82	1.15	0.00	0.00	0.00	0.00	4.64	3.82	6.55	3.87	1.10	4.88
3) Kab. Tanah Datar	20,842	4.79	17.09	5.63	0.00	0.00	17.92	20.22	14.17	20.22	23.34	25.01	27.72	16.67	5.00	0.00	0.00	0.00	0.00	20.22	16.67	28.55	16.88	4.79	21.26
4) Kab. Solok	22,734	5.23	18.64	6.14	0.00	0.00	19.55	22.05	15.46	22.05	25.46	27.28	30.24	18.19	5.46	0.00	0.00	0.00	0.00	22.05	18.19	31.15	18.41	5.23	23.19
5) Kab. Swlnt/Sjnjng	12,751	2.93	10.46	3.44	0.00	0.00	10.97	12.37	8.67	12.37	14.28	15.30	16.96	10.20	3.06	0.00	0.00	0.00	0.00	12.37	10.20	17.47	10.33	2.93	13.01
6) Kab. Ind. Hulu	5,606	1.29	1.96	1.23	0.00	0.00	5.05	4.26	0.00	1.29	8.41	6.73	7.01	3.36	1.23	0.00	0.00	0.00	0.00	1.91	0.06	4.54	1.29	1.29	4.37
Total	89,979	20.70	71.15	24.01	0.00	0.00	77.61	86.10	57.37	83.13	102.91	107.97	119.22	70.86	21.48	0.00	0.00	0.00	0.00	83.75	67.55	120.13	69.63	20.70	90.43
Increment	5,666	20.70	71.15	24.01	-147.77	0.00	51.32	35.44	17.01	5.63	34.07	61.60	94.88	70.86	21.48	0.00	0.00	-112.11	-61.30	52.29	33.68	24.96	6.72	2.14	55.75
Unit Water Requirement (l/sec/ha)	1) ~ 5)	0.23	0.82	0.27	0.00	0.00	0.86	0.97	0.68	0.97	1.12	1.20	1.33	0.80	0.24	0.00	0.00	0.00	0.00	0.97	0.80	1.37	0.81	0.23	1.02
	6)	0.23	0.35	0.22	0.00	0.00	0.90	0.76	0.00	0.23	1.50	1.20	1.25	0.60	0.22	0.00	0.00	0.00	0.00	0.34	0.01	0.81	0.23	0.23	0.78

Note : 50 Kota = Limapuluh Kota, Swlnt/Sjnjng = Sawahlunto/Sijunjung, Ind. Hulu = Indragiri Hulu

Table VIII.3.5 (2/2) FUTURE IRRIGATION WATER DEMAND BY EXTENSION OF EXISTING IRRIGATION AREAS IN INDRAGIRI RIVER BASIN

(Base Year: 1986)

Unit : m^3/sec

(4) Year : 2009

Regency	Irrigation	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
Related	Area (ha)	1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	23,350	5.37	19.15	6.30	0.00	0.00	20.08	22.65	15.88	22.65	26.15	28.02	31.06	18.68	5.60	0.00	0.00	0.00	0.00	22.65	18.68	31.99	18.91	5.37	23.82
2) Kab. Agam	4,780	1.10	3.92	1.29	0.00	0.00	4.11	4.64	3.25	4.64	5.35	5.74	6.36	3.82	1.15	0.00	0.00	0.00	0.00	4.64	3.82	6.55	3.87	1.10	4.88
3) Kab. Tanah Datar	21,000	4.83	17.22	5.67	0.00	0.00	18.06	20.37	14.28	20.37	23.52	25.20	27.93	16.80	5.04	0.00	0.00	0.00	0.00	20.37	16.80	28.77	17.01	4.83	21.42
4) Kab. Solok	22,911	5.27	18.79	6.19	0.00	0.00	19.70	22.22	15.58	22.22	25.66	27.49	30.47	18.33	5.50	0.00	0.00	0.00	0.00	22.22	18.33	31.39	18.56	5.27	23.37
5) Kab. Swlnt/Sjnjng	14,023	3.23	11.50	3.79	0.00	0.00	12.06	13.60	9.54	13.60	15.71	16.83	18.65	11.22	3.37	0.00	0.00	0.00	0.00	13.60	11.22	19.21	11.36	3.23	14.30
6) Kab. Ind. Hulu	6,491	1.49	2.27	1.43	0.00	0.00	5.84	4.93	0.00	1.49	9.74	7.79	8.11	3.89	1.43	0.00	0.00	0.00	0.00	2.21	0.06	5.26	1.49	1.49	5.06
Total	92,554	21.29	72.84	24.67	0.00	0.00	79.86	88.41	58.52	84.97	106.13	111.07	122.58	72.75	22.08	0.00	0.00	0.00	0.00	85.69	68.92	123.16	71.20	21.29	92.85
Increment	8,241	21.29	72.84	24.67	-147.77	0.00	53.57	37.75	18.16	7.48	37.29	64.69	98.24	72.75	22.08	0.00	0.00	-112.11	-61.30	54.23	35.04	27.99	8.29	2.74	58.17
Unit Water	1) ~ 5)	0.23	0.82	0.27	0.00	0.00	0.86	0.97	0.68	0.97	1.12	1.20	1.33	0.80	0.24	0.00	0.00	0.00	0.00	0.97	0.80	1.37	0.81	0.23	1.02
Requirement (l/sec/ha)	6)	0.23	0.35	0.22	0.00	0.00	0.90	0.76	0.00	0.23	1.50	1.20	1.25	0.60	0.22	0.00	0.00	0.00	0.00	0.34	0.01	0.81	0.23	0.23	0.78

Note : 50 Kota = Limapuluh Kota, Swlnt/Sjnjng = Sawahlunto/Sijunjung, Ind. Hulu = Indragiri Hulu

Unit : m^3/sec

(5) Year : 2014

Regency	Irrigation	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
Related	Area (ha)	1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	23,434	5.39	19.22	6.33	0.00	0.00	20.15	22.73	15.94	22.73	26.25	28.12	31.17	18.75	5.62	0.00	0.00	0.00	0.00	22.73	18.75	32.10	18.98	5.39	23.90
2) Kab. Agam	4,780	1.10	3.92	1.29	0.00	0.00	4.11	4.64	3.25	4.64	5.35	5.74	6.36	3.82	1.15	0.00	0.00	0.00	0.00	4.64	3.82	6.55	3.87	1.10	4.88
3) Kab. Tanah Datar	21,157	4.87	17.35	5.71	0.00	0.00	18.20	20.52	14.39	20.52	23.70	25.39	28.14	16.93	5.08	0.00	0.00	0.00	0.00	20.52	16.93	28.99	17.14	4.87	21.58
4) Kab. Solok	23,087	5.31	18.93	6.23	0.00	0.00	19.86	22.39	15.70	22.39	25.86	27.70	30.71	18.47	5.54	0.00	0.00	0.00	0.00	22.39	18.47	31.63	18.70	5.31	23.55
5) Kab. Swlnt/Sjnjng	15,294	3.52	12.54	4.13	0.00	0.00	13.15	14.84	10.40	14.84	17.13	18.35	20.34	12.24	3.67	0.00	0.00	0.00	0.00	14.84	12.24	20.95	12.39	3.52	15.60
6) Kab. Ind. Hulu	7,377	1.70	2.58	1.62	0.00	0.00	6.64	5.61	0.00	1.70	11.06	8.85	9.22	4.43	1.62	0.00	0.00	0.00	0.00	2.51	0.07	5.98	1.70	1.70	5.75
Total	95,130	21.88	74.54	25.32	0.00	0.00	82.11	90.73	59.67	86.82	109.35	114.16	125.93	74.63	22.68	0.00	0.00	0.00	0.00	87.63	70.28	126.20	72.78	21.88	95.26
Increment	10,817	21.88	74.54	25.32	-147.77	0.00	55.82	40.06	19.31	9.32	40.51	67.78	101.59	74.63	22.68	0.00	0.00	-112.11	-61.30	56.17	36.40	31.02	9.87	3.33	60.58
Unit Water	1) ~ 5)	0.23	0.82	0.27	0.00	0.00	0.86	0.97	0.68	0.97	1.12	1.20	1.33	0.80	0.24	0.00	0.00	0.00	0.00	0.97	0.80	1.37	0.81	0.23	1.02
Requirement (l/sec/ha)	6)	0.23	0.35	0.22	0.00	0.00	0.90	0.76	0.00	0.23	1.50	1.20	1.25	0.60	0.22	0.00	0.00	0.00	0.00	0.34	0.01	0.81	0.23	0.23	0.78

Note : 50 Kota = Limapuluh Kota, Swlnt/Sjnjng = Sawahlunto/Sijunjung, Ind. Hulu = Indragiri Hulu

Unit : m^3/sec

(6) Year : 2019

Regency	Irrigation	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
Related	Area (ha)	1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1) Kab. Limapuluh Kota	23,518	5.41	19.28	6.35	0.00	0.00	20.23	22.81	15.99	22.81	26.34	28.22	31.28	18.81	5.64	0.00	0.00	0.00	0.00	22.81	18.81	32.22	19.05	5.41	23.99
2) Kab. Agam	4,780	1.10	3.92	1.29	0.00	0.00	4.11	4.64	3.25	4.64	5.35	5.74	6.36	3.82	1.15	0.00	0.00	0.00	0.00	4.64	3.82	6.55	3.87	1.10	4.88
3) Kab. Tanah Datar	21,315	4.90	17.48	5.76	0.00	0.00	18.33	20.68	14.49	20.68	23.87	25.58	28.35	17.05	5.12	0.00	0.00	0.00	0.00	20.68	17.05	29.20	17.27	4.90	21.74
4) Kab. Solok	23,264	5.35	19.08	6.28	0.00	0.00	20.01	22.57	15.82	22.57	26.06	27.92	30.94	18.61	5.58	0.00	0.00	0.00	0.00	22.57	18.61	31.87	18.84	5.35	23.73
5) Kab. Swlnt/Sjnjng	16,566	3.81	13.58	4.47	0.00	0.00	14.25	16.07	11.26	16.07	18.55	19.88	22.03	13.25	3.98	0.00	0.00	0.00	0.00	16.07	13.25	22.70	13.42	3.81	16.90
6) Kab. Ind. Hulu	8,262	1.90	2.89	1.82	0.00	0.00	7.44	6.28	0.00	1.90	12.39	9.91	10.33	4.96	1.82	0.00	0.00	0.00	0.00	2.81	0.08	6.69	1.90	1.90	6.44
Total	97,705	22.47	76.23	25.97	0.00	0.00	84.36	93.04	60.82	88.66	112.57	117.25	129.29	76.51	23.28	0.00	0.00	0.00	0.00	89.57	71.64	129.23	74.35	22.47	97.68
Increment	13,392	22.47	76.23	25.97	-147.77	0.00	58.07	42.38	20.46	11.16	43.73	70.87	104.95	76.51	23.28	0.00	0.00	-112.11	-61.30	58.11	37.76	34.06	11.44	3.92	62.99
Unit Water	1) ~ 5)	0.23	0.82	0.27	0.00	0.00	0.86	0.97	0.68	0.97	1.12	1.20	1.33	0.80	0.24	0.00	0.00	0.00	0.00	0.97	0.80	1.37	0.81	0.23	1.02
Requirement (l/sec/ha)	6)	0.23	0.35	0.22	0.00	0.00	0.90	0.76	0.00	0.23	1.50	1.20	1.25	0.60	0.22	0.00	0.00	0.00	0.00	0.34	0.01	0.81	0.23	0.23	0.78

Note : 50 Kota = Limapuluh Kota, Swlnt/Sjnjng = Sawahlunto/Sijunjung, Ind. Hulu = Indragiri Hulu

Table VIII.3.6 FUTURE WATER DEMAND OF PROPOSED IRRIGATION PROJECTS

(1) Rantauberangin Irrigation Project in Kampar River Basin

Unit : m^3/sec

Fiscal Year	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1999	2,491	2.02	0.57	0.57	0.62	0.00	0.00	1.57	3.84	1.25	1.35	1.00	2.14	2.69	1.99	0.62	0.00	0.00	0.00	0.00	3.46	1.25	2.34	0.57	0.57
2004	4,567	3.70	1.05	1.05	1.14	0.00	0.00	2.88	7.03	2.28	2.47	1.83	3.93	4.93	3.65	1.14	0.00	0.00	0.00	0.00	6.35	2.28	4.29	1.05	1.05
2009	6,642	5.38	1.53	1.53	1.66	0.00	0.00	4.18	10.23	3.32	3.59	2.66	5.71	7.17	5.31	1.66	0.00	0.00	0.00	0.00	9.23	3.32	6.24	1.53	1.53
2014	8,718	7.06	2.01	2.01	2.18	0.00	0.00	5.49	13.43	4.36	4.71	3.49	7.50	9.42	6.97	2.18	0.00	0.00	0.00	0.00	12.12	4.36	8.20	2.01	2.01
2019	10,794	8.74	2.48	2.48	2.70	0.00	0.00	6.80	16.62	5.40	5.83	4.32	9.28	11.66	8.64	2.70	0.00	0.00	0.00	0.00	15.00	5.40	10.15	2.48	2.48
U.W.R. (l/sec/ha)		0.81	0.23	0.23	0.25	0.00	0.00	0.63	1.54	0.50	0.54	0.40	0.86	1.08	0.80	0.25	0.00	0.00	0.00	0.00	1.39	0.50	0.94	0.23	0.23

Note : U.W.R. = Unit water requirement

(2) Lubukjambi Irrigation Project in Indragiri River Basin

Unit : m^3/sec

Fiscal Year	Irrigation Area (ha)	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
1999	5,487	1.26	1.92	1.21	0.00	0.00	4.94	4.17	0.00	1.26	8.23	6.58	6.86	3.29	1.21	0.00	0.00	0.00	0.00	1.87	0.05	4.44	1.26	1.26	4.28
2004	10,060	2.31	3.52	2.21	0.00	0.00	9.05	7.65	0.00	2.31	15.09	12.07	12.57	6.04	2.21	0.00	0.00	0.00	0.00	3.42	0.10	8.15	2.31	2.31	7.85
2009	14,632	3.37	5.12	3.22	0.00	0.00	13.17	11.12	0.00	3.37	21.95	17.56	18.29	8.78	3.22	0.00	0.00	0.00	0.00	4.97	0.15	11.85	3.37	3.37	11.41
2014	19,205	4.42	6.72	4.22	0.00	0.00	17.28	14.60	0.00	4.42	28.81	23.05	24.01	11.52	4.22	0.00	0.00	0.00	0.00	6.53	0.19	15.56	4.42	4.42	14.98
2019	23,777	5.47	8.32	5.23	0.00	0.00	21.40	18.07	0.00	5.47	35.67	28.53	29.72	14.27	5.23	0.00	0.00	0.00	0.00	8.08	0.24	19.26	5.47	5.47	18.55
U.W.R. (l/sec/ha)		0.23	0.35	0.22	0.00	0.00	0.90	0.76	0.00	0.23	1.50	1.20	1.25	0.60	0.22	0.00	0.00	0.00	0.00	0.34	0.01	0.81	0.23	0.23	0.78

Note : U.W.R. = Unit water requirement

Table VIII.3.7 WATER SUPPLY COMPANIES SUBJECT TO STUDY

Water Supply Company	Province	River Basin
1. PDAM Kab. Indragiri Hulu	Riau	Kampar and Indragiri
2. PDAM Ka.Indragir Hilir	Riau	Indragiri
3. PDAM Kab. Kampar	Riau	Kampar
4. PDAM Kodya. Pekanbaru	Riau	Kampar
5. PDAM Kab. Solok	West Sumatra	Indragiri
6. PDAM Kab. Sawahlunto/Sijunjung	West Sumatra	Indragiri
7. PDAM Kab. Tanah Datar	West Sumatra	Indragiri
8. PDAM Kab. Agam	West Sumatra	Indragiri
9. PDAM Kab. Limapuluh Kota	West Sumatra	Kampar and Indragiri
10. PDAM Kodya. Solok	West Sumatra	Indragiri
11. PDAM Kodya. Sawahlunto	West Sumatra	Indragiri
12. PDAM Kodya. Padang Panjang	West Sumatra	Indragiri
13. PDAM Kodya. Bukittinggi	West Sumatra	Indragiri
14. PDAM Kodya. Payakumbuh	West Sumatra	Indragiri

Note : PDAM = Persahaan Daerah Air Minum