5.3.8 Economic Evaluation

1) Overview

This section evaluates the economic feasibility of GKS-ISP transportation project based on the project implementation plan. Economic evaluation examines the economic feasibility of a project through a cost-benefit analysis from a national economic perspective where quantified benefits of the project are compared with its economic costs.

The results of the evaluation showed that the Benefit-Cost ratio (B/C) and the Economic Internal Rate of Return (EIRR) of the project is economically justified from a national economic viewpoint.

2) Comparison of Benefits and Costs

(1) "With Project" and "Without Project" Assumptions

In the cost-benefit analysis, two scenarios were assumed in order to distinguish and compare the benefits and costs arising from project implementation. Two scenarios, i.e. "with project" and "without project," had the following assumptions.

The integrated transportation system in the GKS Zone will be established by the target year of the Study. In this economic evaluation, the transportation action plan is regarded as a "with project" scenario. On the other hand, a "without project" scenario was formulated under the assumption that the proposed projects were eliminated from the "With Project" scenario.

(2) Economic Costs of the Project

Total project cost of the proposed projects in the GKS-ISP transportation action plan was composed of construction work costs, costs for consulting services, land costs, physical contingencies, and operation and maintenance (OM) cost of the project, as described in previous subsections. They were estimated in constant February 2010 prices, identified by each category of foreign/local costs for economic evaluation and then converted into economic prices for economic evaluation under the assumptions described below.

(3) Economic Benefits of Project

There are a variety of direct and indirect benefits (quantitative and qualitative) derived from the proposed transportation project.

Among these are the benefits from savings in vehicle operating costs (VOC) and passenger travel time costs (TTC), and the benefits from the avoided costs, which were treated as quantitative benefits in conventional economic analysis of urban transportation. In this economic evaluation, the VOC and TTC cost-savings were estimated as quantitative benefits especially in comparing the "with project scenario" to the "without project" scenario.

3) Assumptions of Economic Evaluation

(1) General Assumptions of Economic Evaluation

The following were the assumptions of the general conditions in the economic evaluation:

- Base Year: Year 2010;
- Project Life: 30 years after the start of service, namely 2015 to 2044;
- Life Period : Life period of facility was estimated based on physical life period of the facility,
  Civil works, structure and building: 40 years;
- Discount Rate: discount rate of 10% was used;
- Inflation: Inflation was not taken into account, or was either considered in benefit or was cost estimated during the evaluation period;
- Foreign Exchange Rate: The foreign exchange rate was fixed at the following rate as of September 2010 and a shadow exchange rate was not considered,
  1 US$= Rp. 9000, 1JPY=Rp. 102; and,
- Financial and Economic Costs: Financial costs were converted into economic costs by using the following conversion factors.

Table 5.3.20 Factors for Converting Financial into Economic Price

Cost Item	Cost Component	Conversion Factor
Land acquisition	LC	0.843
Civil works	LC	0.843
	FC	0.795
Engineering services	LC	0.843
	FC	1.000
Equipment Cost	LC	0.843
	FC	0.795
Project overhead	LC	0.872
O&M	LC & FC	0.860
Physical contingency	LC	0.843
	FC	0.795

Source: JICA Study Team
Note: LC= Local cost, FC=Foreign cost

(2) Basic Calculation of Unit Value for Benefit Estimate

i) Vehicle Operation Cost (VOC)

Unit vehicle operating costs were estimated by the representative vehicles and operating speed in 2009 prices, as shown in Table 5.3.21.

Table 5.3.21 Vehicle Operating Cost

(Rp. Vehicle-Km)

Speed (km/Hour)	Private Passenger Car	Mini Bus	Large Bus	Truck	Motorcycle
0-10	7,328	3,688	11,747	9,077	837
10-20	3,486	1,775	6,828	3,309	493
20-30	2,524	1,354	5,753	2,454	392
30-40	2,039	1,175	5,326	2,077	339
40-50	1,759	0	0	1,885	309
50-60	1,600	0	0	1,796	291
60-70	1,535	0	0	1,778	313
70-80	1,546	0	0	1,815	288
80-90	1,625	0	0	1,900	300

Note: Economic costs in 2009 prices
Source: Estimated by the Study Team

ii) Travel Time Cost Estimate

Time value of each passenger car, motorcycle and bus were estimated through the income approach. The time value of each truck was estimated by the time value of its freight and crew.

Estimation of time value of each passenger car and motorcycle were made through the income approach and by estimating the time value of their owner. Estimation of monthly income of car owners was made through GDP per capita. Income approaches for those "not-owning" vehicles were adopted in estimating the time value for the bus. Estimation results of time values of each vehicle unit are shown in Table 5.3.22.

Table 5.3.22 Time Value of Each Vehicle Unit

(Rp. / Vehicle-hour)

	Economic Price
Passenger Car	13,399
Motorcycle	3,194
Mini Bus	9,294
Large Bus	46,413
Truck	3,064

Source: Estimated by the Study Team

4) Economic Evaluation

(1) Estimation of Benefits

The benefit from vehicle operating cost was estimated as the difference of vehicle operating costs between the "with project" and "without project" scenarios. The vehicle operating cost was derived from computing the daily mileage in each operating speed and the unit vehicle operating cost for each speed by vehicle type. The daily "vehicle-kilometer" for both the "with project" and "without project" scenarios were obtained as the traffic assignment results in the transport demand forecast.

The benefit of passenger travel time cost was estimated as the difference of passenger travel time cost between the "with project" and "without project" scenarios. The

passenger time cost is derived from the computed daily passenger-hour and the unit passenger time cost by vehicle type. The daily passenger-hour for both scenarios was obtained from traffic assignment results.

(2) Cost Benefit Analysis

Results of the Cost Benefit Analysis of the project proposed in the GKS-ISP transportation action plan is shown in Table 5.3.23.

Table 5.3.23 Economic Evaluation Results of GKS-ISP Transportation Projects

EIRR	B/C
32.74%	3.33

The EIRR value of the GKS-ISP transportation projects is approximately 33% of the discount rate, which was considered to fulfill the evaluation criteria of the EIRR for infrastructure projects in Indonesia.

(3) Sensitivity Analysis

The effect of the variations in the costs and the benefits of the EIRR were examined, when simultaneously the cost increased by 10%, the benefit decreased by 10%, and when the cost decreased by 10% and the benefit increased by 10%. Table 5.3.24 examines the sensitivity of the EIRR for the GKS-ISP transportation projects.

Table 5.3.24 Sensitivity of EIRR

Cost	Benefit	EIRR	B/C
Base Case		32.74%	3.33
10% Increase	-	30.65%	3.06
-	10% Decrease	30.28%	3.01
10% Increase	10% Decrease	28.26%	2.77

The EIRR in all the cases mentioned above were considered to fulfill the evaluation criteria for EIRR of infrastructure projects in Indonesia.

In addition to the quantified benefits due to the cost savings from the VOC and TTC, there were a variety of benefits which could be derived from the implementation of GKS-ISP transportation projects, although they were not included in the benefits for this economic evaluation.

Land values along railways and roads were also expected to increase in the “with project” case. However, it was difficult to distinguish and estimate the increased values solely due to GKS-ISP transportation project implementation since there will be a variety of factors that will determine land prices other than the GKS-ISP transportation projects.

Furthermore, benefits from increased comfort, convenience, and the reduction of accidents were not regarded as quantitative benefits in the economic evaluation as they were difficult to define in monetary terms. The value of EIRR was 32.74%, which is a highly appreciated level fulfilling the evaluation criteria for EIRR of infrastructure projects in Indonesia.

5.4 Plan for Regional Infrastructure Network

5.4.1 Water Supply

1) Water Resources

(1) Surface Water

East Java has four river basins: Solo River, Lower River, Pekalen River, and the Sampean and Madura River basins. The basins within the GKS Zone are the Brantas River basin, running through Sidoarjo, Mojokerto, and Surabaya; the Solo River basin, running through Lamongan and Gresik; and the Sampean-Madura River basin in Bangkalan.

The Brantas and Solo rivers are utilized for power generation, irrigation, and flood control which are done through dams.

The Madura River basin comprises seven rivers: Rangko, Balega, Sampang, Saropa, Larus, Pacung, and Rajak, and its water volume varies by season: water flow is abundant during the rainy season and minimal during the dry season.

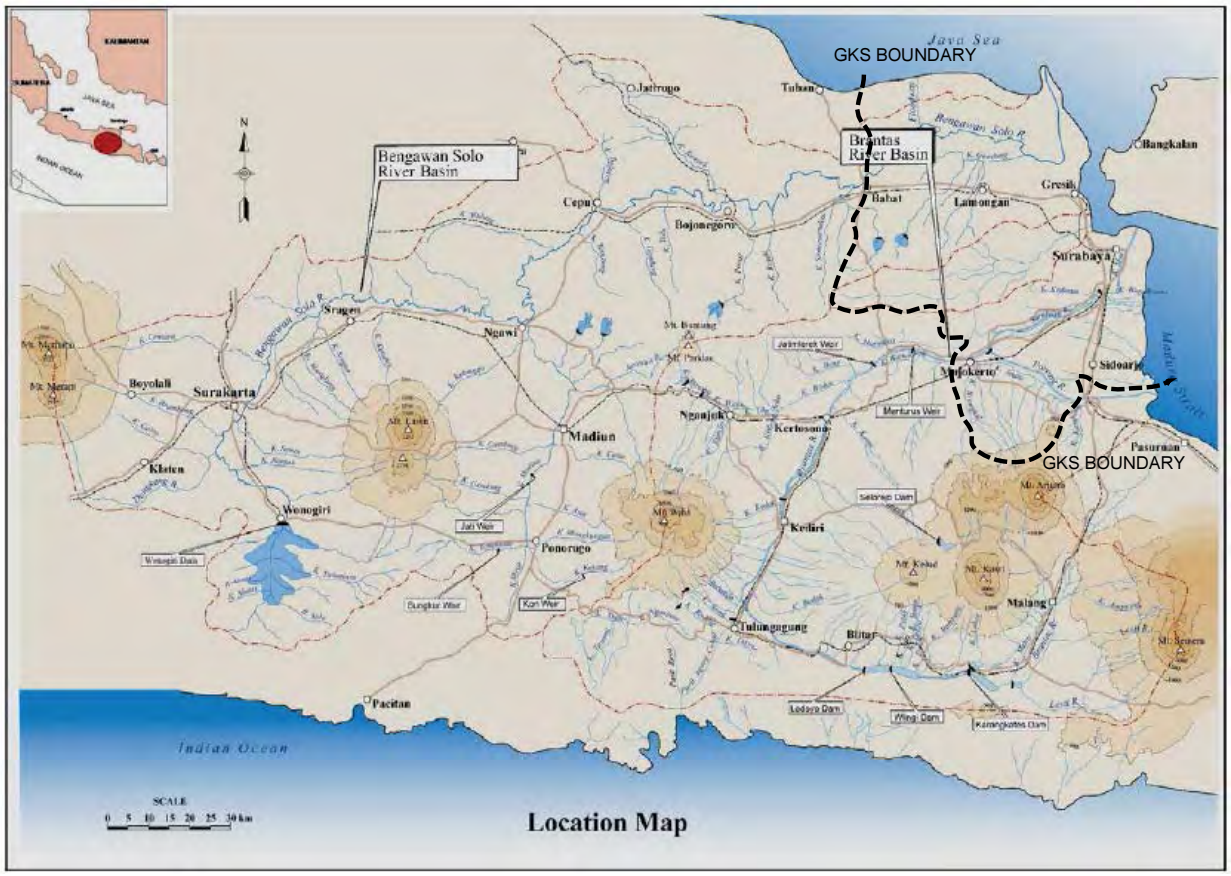
Dams control the availability of water in the basins used for power and irrigation. Volume is programmed by the River Basin Management Agency (**Balai Besar** Wilayah Sungai **Brantas, Balai Besar** Wilayah Bengawan **Solo) which manages river flow and water demand, both of which fluctuate seasonally**. The Brantas and Solo rivers have master plans: The Comprehensive Management Plan for the Water Resources of the Brantas River (1998) and the Comprehensive Development and Management Plan for the Bengawan Solo, revised in 2005. The contents of both plans include the following water management templates: (1) water resource development, (2) watershed management, (3) water quality management, (4) flood control management, and (5) institutional framework of water resources management.

Table 5.4.1 Surface Water Availability in GKS Zone

(Unit:m3/sec)

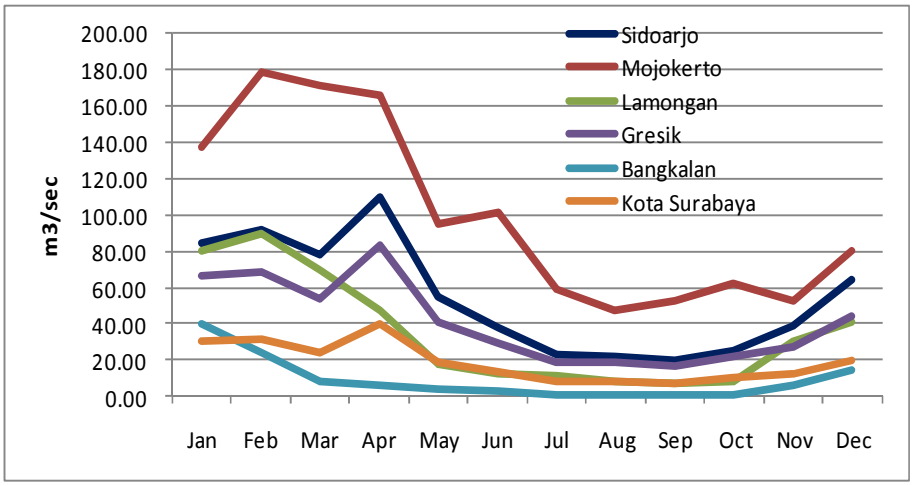
Month / Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sidoarjo	84.35	92.05	78.44	110.30	54.60	37.70	22.80	22.10	19.40	25.00	39.00	64.70
Mojokerto	136.86	178.70	171.15	165.70	94.71	101.44	59.40	47.04	52.99	62.14	52.90	79.87
Lamongan	80.03	89.78	69.40	47.51	17.91	12.88	11.01	8.55	6.75	8.11	30.10	40.92
Gresik	66.75	68.56	53.53	83.11	41.31	29.70	19.02	18.32	16.71	21.68	27.75	44.04
Bangkalan	39.75	23.93	8.56	6.56	3.83	3.01	0.54	0.33	0.33	0.28	5.74	14.79
Kota Surabaya	30.45	31.53	24.14	39.48	19.30	14.00	8.64	8.33	7.64	10.10	12.28	20.35

Source: SDA2006



Source: Brantas and Bengawan Solo River Basins Management Agency, Malang

Figure 5.4.1 Brantas and Solo River Basins



Source: SDA2006

Figure 5.4.2 Surface Water Availability in GKS Zone

(2) Groundwater

Groundwater resource is critical to development and in sustaining community life, especially as an alternative water source for domestic use, industry, and commerce. Proper management and maintenance of groundwater is crucial because groundwater demand is

rapidly rising and the resource is not limitless. Striking a balance between its recharge and yield is critical to ensure its availability for future generations. The mandate over groundwater management has been handed to regional governments by Law No. 22, 1999, and Government Regulation No. 25, 2000, along with ensuring their environmental sustainability. In Pasuruan and other areas, groundwater is a commodity sold to other regencies, thereby contributing to the local economy through local government revenues (PAD).

Table 5.4.2 Groundwater Potential in GKS Zone

(Unit: m3/sec)

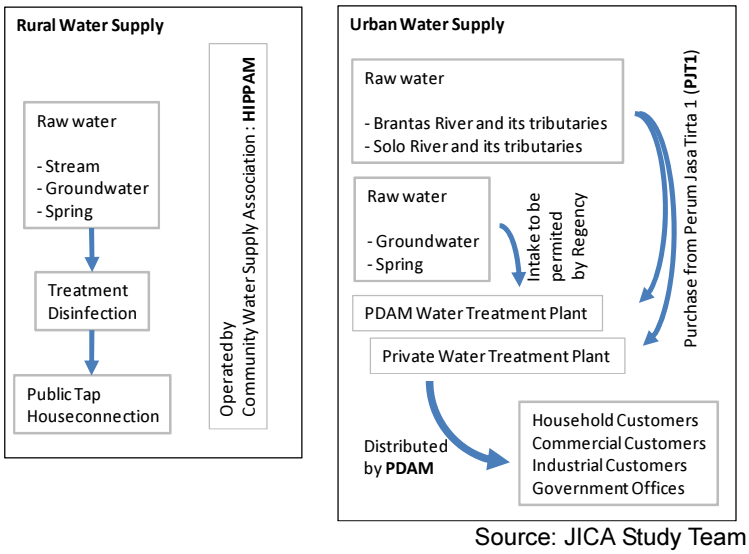
Area	Yield (m3/sec)
Sidoarjo	8.37
Mojokerto	11.65
Lamongan	10.12
Gresik	7.41
Bangkalan	6.06
Surabaya	3.63

Source: SDA2006

2) Water Supply Services

(1) Supply System

There are two water supply systems in East Java: potable water and industrial water supply systems. Potable water in urban areas is supplied by the PDAM, the municipal water supply company, which is owned by each regency and the private water treatment companies. Raw water is supplied from Brantas River and Solo River by the River Management Public Corporation (Perum Jasa Tirta 1, PJT1). In the rural areas, potable water is sourced from individual wells or from community water supply systems called HIPPAM or IKK system operated by the respective communities. The provincial government of East Java established the Provincial Water Supply Corporation for inter-regency water supply.



Source: JICA Study Team

Figure 5.4.3 Water Supply Framework in GKS Zone

(2) Service Coverage

PDAM Surabaya currently services 68% of its urban coverage area. In 2007, PDAM Sidiarjo serviced 29% of its consumers and it plans to raise this to 45% by 2022. PDAM Lamongan currently covers only 12% of its area although it targets to raise this to 44% by 2020.

The improvement of rural water supply is a priority government program. The Ministry of Public Works, in cooperation with USAID, currently has a water supply and sanitation program for the rural areas which it implements through the construction of rural water supply systems and public sanitation facilities for domestic water use. Once completed, these systems will be operated and maintained by the local HIPPAM. The Indonesian government has been using the program to help in the correction of regional disparities. In 2009, the HIPPAM program serviced 144,623 people in the GKS Zone, equivalent to 2% of its population, and plans are afoot to extend this further.

(3) Water Shortage

The effects of water shortage during the dry season impacts irrigation, domestic, and industrial uses. Water shortage mitigation programs of the PDAM have mainly been through the construction of reservoirs and new water treatment facilities. Corollary to this problem, the shares of non-revenue water (NRW) in each PDAM are significantly high at 35–40%, which shows high inefficiency. Increasing production and reducing NRW are two major challenges for local water resource management; and since the source for raw water is unlikely to increase, NRW measures will be top priority.

3) Current Water Demand

Household, commercial, industrial, livestock, fisheries, and irrigation comprise the water consumers in the GKS Zone. Irrigation demand dominates the other uses, and its volume is legally fixed in accordance with the land-use plan (RTRW). This preferential use has affected the flexibility in allocating water for other uses and is one of the major issues for the urban and industrial development program.

(1) Domestic Water Demand

Each water provider divides water demand into rural and urban demand. The disparity between both demand can be inferred from the population difference in both areas. In 2007, the urban population in the GKS was 6.3 million and its rural population was 3 million.

Tables 5.4.3 and 5.4.4 illustrate water consumption in urban and rural areas in the GKS, respectively. Potable water service ratios in the GKS urban area vary by regency, between 9% and 70%, or 47% on average. Potable water service ratios (or potable water accessible ratios) in the rural areas vary between 1 and 14%, or 4% on average. The service ratio in the entire GKS is 33%, lower than the Millennium Development Goals' (MDG) target service ratio of 60%.

Unit water consumption in urban areas differs among regencies, between 78 lpcd, in

Kota Mojokerto and 245 lpcd in Kota Surabaya. The average consumption in GKS urban areas is 199 lpcd. Unit water consumption in rural areas is 30 lpcd, which is the national design standard for rural water supply.

Table 5.4.3 Water Consumption in Urban Areas in GKS Zone (2007)

Area	Pop.	Service Ratio (%)	Unit Consumption (lpcd)	Sales (l/s)	Sales (m3/d)	UFW (%)	Product (l/s)	Product (m3/d)
Kota Surabaya	2,764,245	70	245	5,448	470,707	33	8,131	702,548
Kota Mojokerto	123,566	19	78	21	1,823	61	55	4,726
Sidoarjo	1,673,412	29	115	646	55,808	37	1,030	88,992
Kab.Mojokerto	500,379	9	114	58	4,994	32	85	7,358
Lamongan	286,611	30	120	119	1,296	6	200	1,382
Gresik	617,347	52	105	389	33,636	30	552	47,722
Bangkalan	284,905	24	122	96	8,264	43	167	14,451
GKS	6,250,465	47	199	6,777	585,549	34	10,221	883,077

Source: PDAM data

Table 5.4.4 Water Consumption in Rural Areas in GKS Zone (2007)

Area	Pop.	Service Ratio (%)	Unit Consumption (lpcd)	Sales (l/s)	Sales (m3/d)	UFW (%)	Product (l/s)	Product (m3/d)
Sidoarjo	246,900	2	29	2	146	5	2	154
Kab.Mojokerto	574,500	14	30	28	2,449	5	30	2,578
Lamongan	1,017,700	3	30	11	928	5	11	977
Gresik	552,000	2	30	4	320	5	4	336
Bangkalan	704,100	1	30	2	180	5	2	189
GKS	3,095,200	4	30	47	4,022	5	49	4,234

Source: PDAM data

(2) Non-domestic Water Demand

The rise in commercial water consumption changes in accordance with the domestic consumption. The ratio of consumption between domestic and commercial water has been 1:0.25–0.40.

After irrigation, fishery is the second largest water consumer in the GKS Zone. Fishery is a major industry in Sidoarjo and Gresik. Water consumed by the fishery sector depends on the cumulative size of the fishponds. And its volume has not changed significantly, with the standard demand still pegged at 7 mm /m3 water surface/day.

The livestock sector is a minor water consumer, accounting for less than 1% of the total water consumption in the GKS Zone.

In 2005, non-domestic water was consumed at around 51m3/sec, as shown in Table

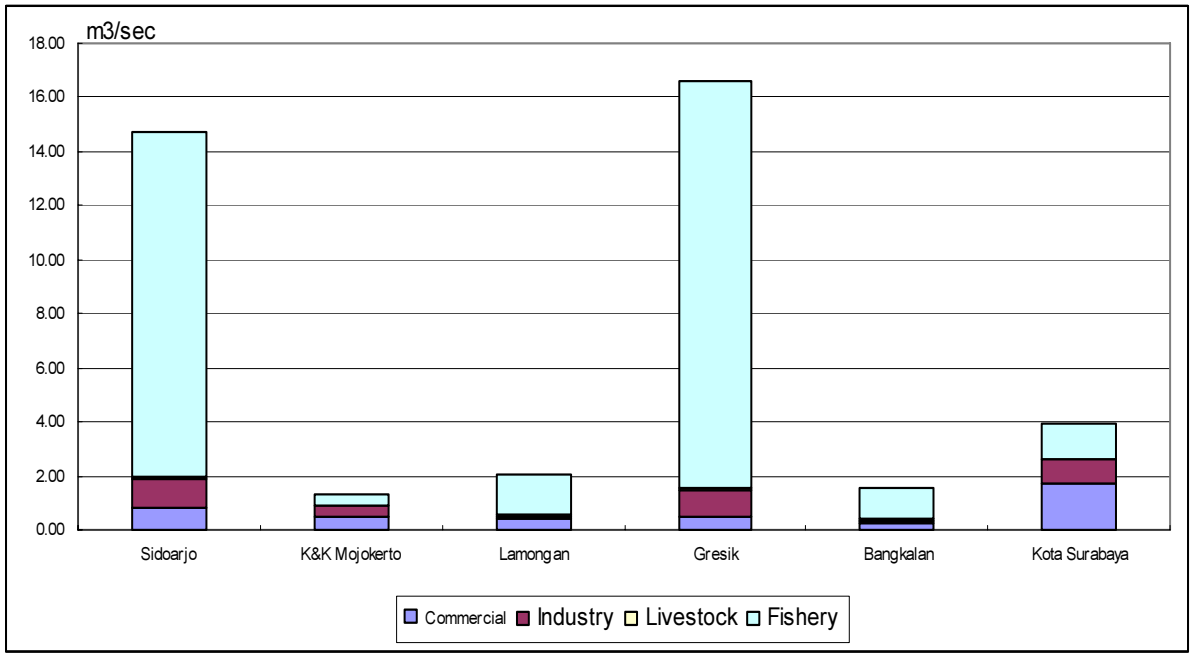
5.4.5 and Figure 5.4.4.

Table 5.4.5 Non-domestic Water Consumption in 2005 by Consumer

(m3/sec)

Consumer / Area	Commercial	Industry	Livestock	Fishery	Total
Sidoarjo	0.86	1.06	0.01	12.77	14.70
K&K Mojokerto	0.48	0.39	0.04	0.38	1.29
Lamongan	0.44	0.09	0.03	1.51	2.07
Gresik	0.48	1.02	0.04	15.04	16.58
Bangkalan	0.26	0.05	0.07	1.15	1.53
Kota Surabaya	1.71	0.93	0.00	1.30	3.94
GKS	**4.22**	**3.54**	**0.20**	**32.14**	**40.11**

Source: PDAM



Source: JICA Study Team

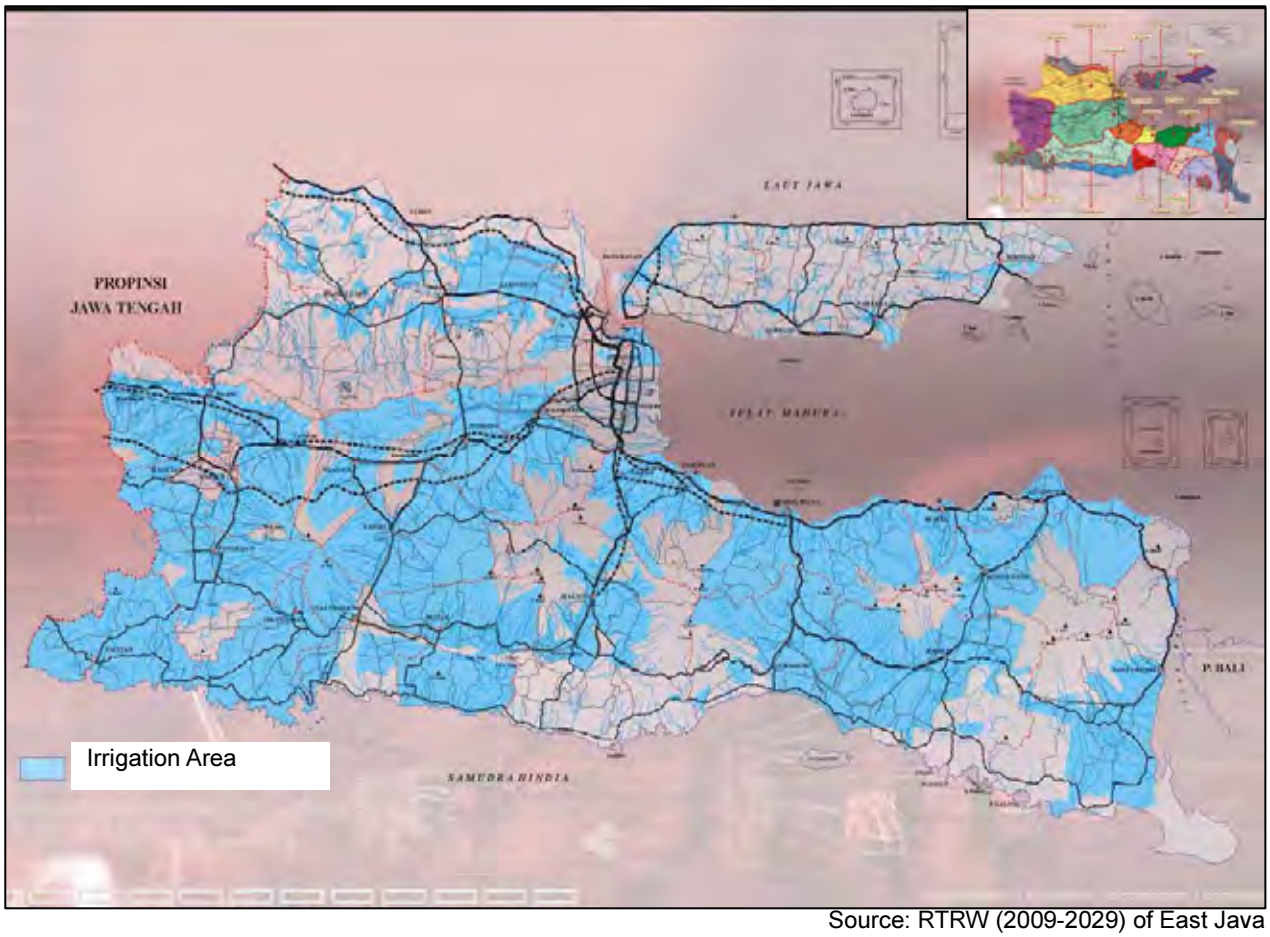
Figure 5.4.4 Non-domestic Water Consumption in 2005

(3) Irrigation Water Demand

Irrigation demand varies according to crop, climatic conditions (rainfall and evapotranspiration), soil (rate of percolation), and irrigation practices for rice planting (water requirement for land management and replacement of the water layer).

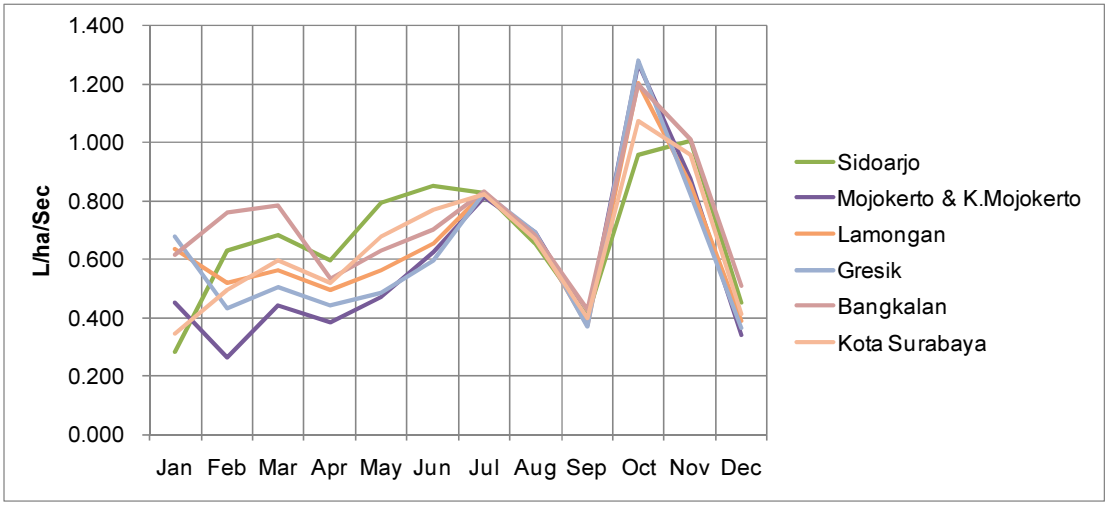
Rice is the major crop in East Java but it is only harvested once a year because available water only suffices for one time rice planting. To reduce peak water demand, water rationing has been pegged to a planting schedule submitted by farmer groups based on the size and location of the land area of each farmer.

In 2003, the irrigated area in the GKS Zone was 1263 km^2. The area is forecasted to slightly decrease by 3% per annum. The average irrigation rate at peak time (the month of planting) was 1.00–1.28 L/ha/sec in 2003. Peak irrigation rates for 2025 are shown in SDA2006 at 0.87–1.48 L/ha/sec, which include increasing the irrigation rates in Mojokerto by 112%, Gresik by 115%, and Bangkalan by 105%. Even a slight increase in the irrigation rate significantly impacts the total water volume. Such incremental increases could be averted through the institution of technical improvements that will lead to water efficiency in the irrigation sector.



Source: RTRW (2009-2029) of East Java

Figure 5.4.5 Irrigated Areas in East Java Province



Source: JICA Study Team analyzed based on SDA2006 data

Figure 5.4.6 Seasonal Changes in Irrigation Water Demand, 2003

4) Future Water Demand

(1) Non-irrigation Water Demand

The respective regencies and cities in the GKS Zone have their demand forecasts for non-irrigation water, based on which the GKS Zone spatial plan calculated the standards for water demand, as shown in Tables 5.4.6 to 5.4.8

i) Planning Criteria for Domestic Water Demand

The planning criteria for domestic water demand are shown in Table 5.4.6.

Table 5.4.6 GKS-ISP 2030 Planning Criteria for Domestic Water Demand

Category, Subcategory, and Description				Criteria
Domestic (Household) Unit Demand	Metro		Pop >1,000,000	200 Lpcd
	Big city		Pop >500,000	150 Lpcd
	Middle city		Pop >100,000	125 Lpcd
	Small city		Pop >20,000	110 Lpcd
	Village		Pop <20,000	60 Lpcd
Domestic (Household) Service Ratio	Metro		Pop >1,000,000	75%
	Big city		Pop >500,000	80%
	Middle city		Pop >100,000	80%
	Small city		Pop >20,000	90%
	Village		Pop <20,000	80%
Parameters	Capita per House connection			5 persons per tap
	Capita per Public hydrant			50 persons per tap
	Daily Maximum			1.15
	Hourly Maximum			1.60
	Non-revenue Water (NRW)	Metro	Pop >1,000,000	25%

Category, Subcategory, and Description				Criteria
		Big city	Pop >500,000	20%
		Mid-sized city	Pop >100,000	20%
		Small city	Pop >20,000	10%
		Village	Pop <20,000	5%
Public Hydrant	Unit Demand			60 lpcd
	Coverage	Metro	Pop >1,000,000	5%
		Big city	Pop >500,000	10%
		Middle city	Pop >100,000	20%
		Small city	Pop >20,000	30%
		Village	Pop <20,000	40%

Source: JICA Study Team based on PDMA standard

ii) Planning Criteria for Non-domestic Water Demand

Non-domestic water is used for fishery, industrial, commercial, and livestock purposes. Recently, the need for non-irrigation water has tended to increase with the growth of industrial and commercial activities in the GKS Zone.

(a) Industrial Water

In SDA 2006, the GKS Zone's industrial water demand was forecast to have a 5.7% annual growth rate, which is almost equal to the GRDP growth rate. The following are the expected annual increases in industrial water demand: Kota Mojokerto and Kabupaten Mojokerto at 10.5%, Lamongan at 8.5%, Sidoarjo at 7.7%, Surabaya and Gresik at 3.2%, and Bangkalan at 1.1%.

Industrial demand in Sidoarjo was calculated at 50 m/customer/month. Industrial water demand varies according to the type and size of the industry. The textile and heavy-metal industries require more water compared with the assembly industries. The use of more modern equipment and technology will lead to better water efficiency. Recently, large factories have been working to institute measures that would conserve water. In the future, medium to small industries should be required to implement water saving measures (refer to Table 5.4.7).

Table 5.4.7 GKS-ISP 2030 Planning Criteria for Industrial Water Demand

Category, Subcategory and Description		Criteria
Industries	Demand forecast	Increase 6% per year till year 2030
	Daily Maximum	1.00
	Hourly Maximum	1.00

Source: JICA Study Team

(b) Commercial Water

Commercial water is defined as water used by public facilities, commercial facilities, tourism facilities, health facilities, street cleaning, fire fighting, sanitation and greenery.

The amount of urban water demand was calculated based on the number of connections which is approximately 25–40% of the household demand.

(c) Livestock Water

Water demand for livestock raising was calculated by multiplying the number of livestock in the district with the average water consumption per type of livestock. Large livestock, i.e., cows, buffaloes, and horses require an average of 40 liters of water per head/day. Small livestock, i.e., goats or sheep, require five liters/head/day. Poultry requires an average of 0.6 liters/head/day. This demand is expected to be consistent.

(d) Fishery Water

Fishery water is used to maintain fishponds, either as make-up water or replacement pond water. Standard demand for fishery water was pegged at 7 mm/m^2 water surface/day.

Table 5.4.8 GKS-ISP 2030 Planning Criteria for Non-domestic Water Demand

Category, Subcategory, and Description		Criteria
Commercial	Unit demand	33% of household demand
	Day Max	1.15
	Hourly Max	1.60
Livestock	Big, four-legged	40 L/head/day
	Small four-legged	5 L/head/day
	Poultry	0.6 L/head/day
Fishery	Unit demand	7 mm /m^2 water surface / day

Source: JICA Study Team

iii) Calculations of Future Demand

Based on the planning criteria above, the forecasts for non-irrigation water are shown in Table 5.4.9.

Table 5.4.9 Demand Forecasts for Non-irrigation Water in GKS Zone

Year	2003	2005	2010	2015	2020	2025	2030
Population (000)							
Sidoarjo	1,682	1,823	2,229	2,726	2,893	3,070	3,257
K&K Mojokerto	1,081	1,115	1,206	1,304	1,411	1,526	1,844
Population (000)							
Lamongan	1,236	1,253	1,295	1,340	1,385	1,433	1,795
Gresik	1,060	1,102	1,213	1,336	1,471	1,620	1,910
Bangkalan	886	916	997	1,084	1,179	1,282	1,587
Kota Surabaya	2,660	2,742	2,959	3,192	3,444	3,715	3,724
Domestic (Household) m^3/sec							
Sidoarjo	1.032	1.032	1.032	3.231	5.429	6.052	6.675
K&K Mojokerto	1.563	1.613	1.745	1.887	2.041	2.208	2.056
Lamongan	0.211	0.337	0.463	0.787	1.111	1.264	1.417
Gresik	1.533	1.594	1.755	1.933	2.129	2.344	3.017
Bangkalan	0.820	0.848	0.923	1.004	1.091	1.187	1.531
Kota Surabaya	5.542	5.713	6.164	6.650	7.174	7.740	8.253
Commercial m^3/sec							
Sidoarjo	0.789	0.855	1.045	1.278	1.562	1.910	2.203
K&K Mojokerto	0.469	0.484	0.523	0.566	0.612	0.662	0.679
Lamongan	0.429	0.435	0.450	0.465	0.481	0.497	0.468
Gresik	0.460	0.478	0.527	0.580	0.639	0.703	0.996
Bangkalan	0.246	0.255	0.277	0.301	0.327	0.356	0.505
Kota Surabaya	1.663	1.714	1.849	1.995	2.152	2.322	2.724
Industry m^3/Sec							
Sidoarjo	0.917	1.064	1.541	2.231	3.232	4.681	6.264
K&K Mojokerto	0.318	0.388	0.639	1.054	1.737	2.862	3.830
Lamongan	0.075	0.089	0.133	0.199	0.298	0.447	0.598
Gresik	1.012	1.019	1.035	1.052	1.068	1.086	1.453
Bangkalan	0.051	0.052	0.055	0.058	0.062	0.065	0.087
Kota Surabaya	0.871	0.928	1.088	1.275	1.494	1.751	2.343
Livestock m^3/Sec							
Sidoarjo	0.013	0.013	0.013	0.013	0.014	0.014	0.014
K&K Mojokerto	0.043	0.043	0.044	0.044	0.046	0.048	0.048
Lamongan	0.034	0.032	0.028	0.025	0.023	0.022	0.022
Gresik	0.040	0.041	0.044	0.048	0.055	0.066	0.066
Bangkalan	0.075	0.074	0.071	0.070	0.071	0.074	0.074
Kota Surabaya	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Fishery m^3/Sec							
Sidoarjo	12.611	12.768	13.166	13.578	14.002	14.439	14.439
K&K Mojokerto	0.390	0.375	0.340	0.308	0.280	0.254	0.254
Lamongan	1.387	1.511	1.873	2.320	2.875	3.562	3.562
Gresik	14.815	15.037	15.607	16.199	16.813	17.451	17.451
Bangkalan	1.232	1.151	0.970	0.818	0.689	0.581	0.581
Kota Surabaya	1.538	1.300	0.853	0.560	0.368	0.241	0.241

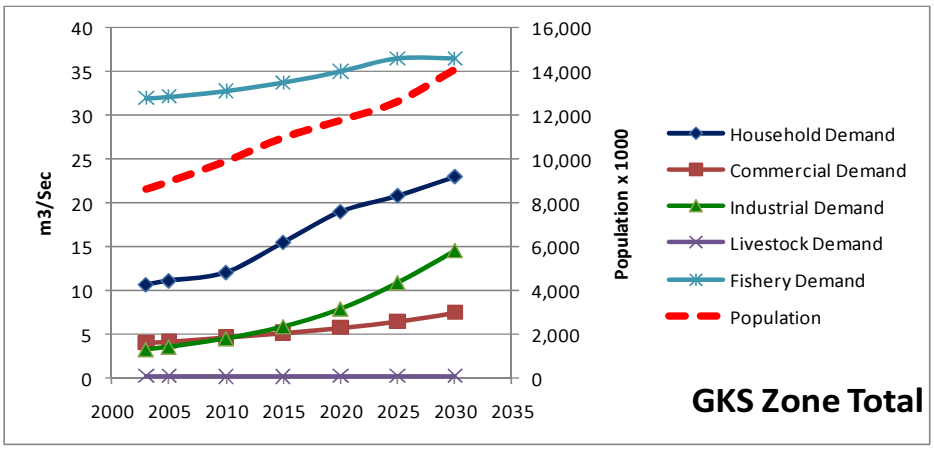
Source: JICA Study Team

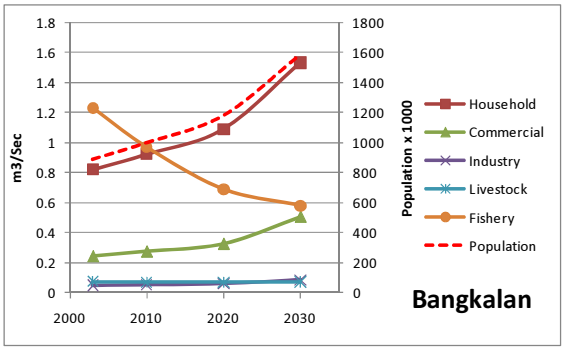
Table 5.4.10 Demand Forecasts for Non-irrigation Water in GKS Zone by User

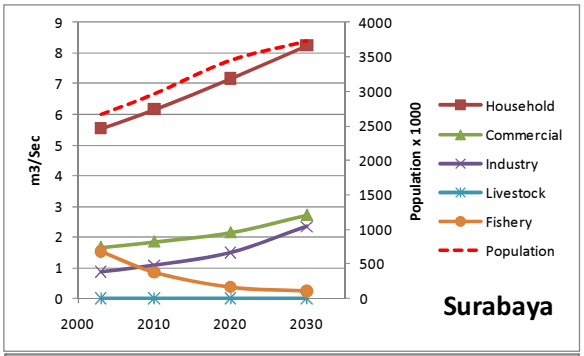
(Unit: m3/Sec)

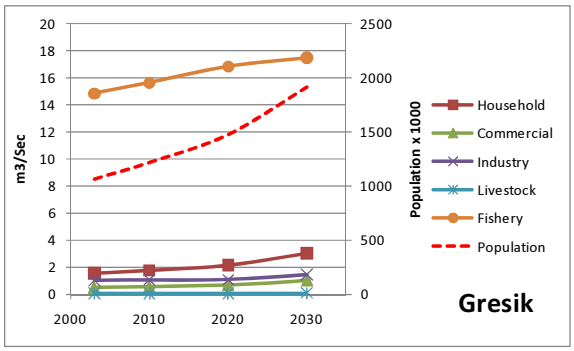
Year	2003	2005	2010	2015	2020	2025	2030
Household Demand	13.52	14.07	15.57	17.28	19.25	21.51	22.95
Commercial Demand	4.06	4.22	4.67	5.19	5.77	6.45	7.46
Industrial Demand	3.24	3.54	4.49	5.87	7.89	10.89	14.58
Livestock Demand	0.21	0.20	0.20	0.20	0.21	0.23	0.23
Fishery Demand	31.97	32.14	32.81	33.78	35.03	36.53	36.53
Total	53.00	54.17	57.74	62.32	68.15	75.61	81.75
Population (000)	8,605	8,951	9,899	10,981	12,223	13,652	14,118

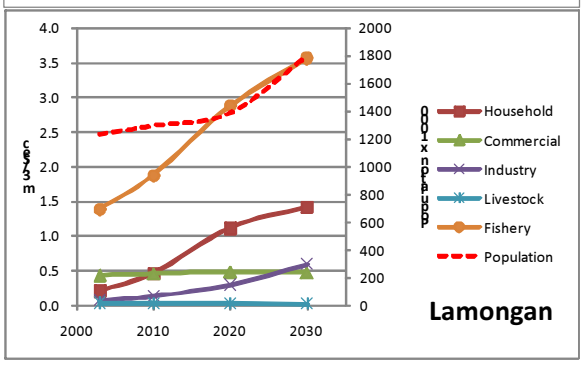
Source: JICA Study Team

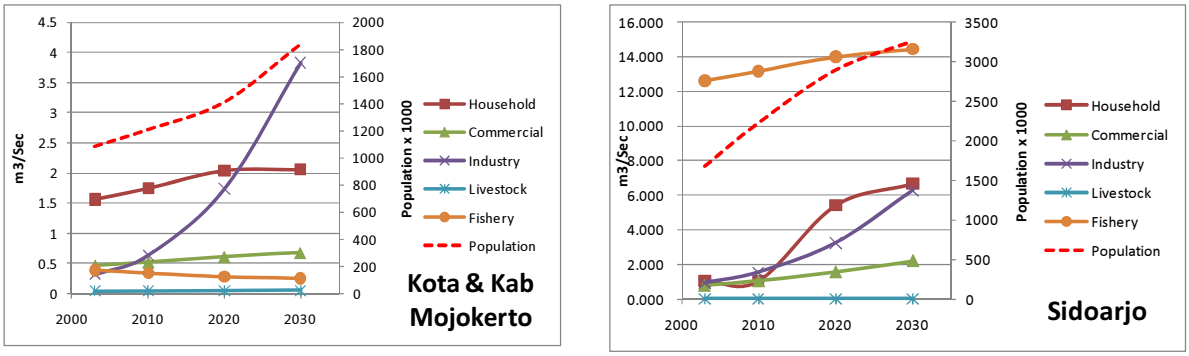












Source: JICA Study Team

Figure 5.4.7 Demand Forecasts for Non-Irrigation Water by Area

(2) Future Irrigation Water Demand

Demand for irrigation water varies according to crop type, climatic conditions (rainfall and evapotranspiration), soil (rate of percolation) and irrigation practices for rice planting (water requirement for land management and replacement of the water layer). Rice, the major crop in East Java, is harvested only once a year because the availability of water is only sufficient for one planting per year water is rationed through a planting schedule submitted by farmer groups based on the size and location of the land area of each farmer.

In 2003, the irrigation water feeding area in the GKS Zone was 1263 km2. The area is forecasted to slightly decrease by -3% per annum. The average water feeding rate in the peak time (the month of planting) was 1.00~1.28 L/ha/sec in 2003. Peak time feeding rates for 2025 are shown in SDA2006 at 0.87~1.48 L/ha/sec. This includes increasing feeding rates in Mojokerto by 112%, Gresik by 115% and Bangkalan by 105%. It should be noted that even a slight increase in the irrigation feeding rate significantly impacts the total water volume. Such increment increases may be avoided through the institution of with technical improvements that will lead to efficiency in water use in the irrigation sector.

Table 5.4.11 Irrigated Areas in GKS Zone

(Unit: ha)

Year / Area	2003	2005	2010	2015	2020	2025	2030
Sidoarjo	24,683	24,370	23,606	22,866	22,149	21,455	11,683
Mojokerto	32,617	32,952	33,808	34,694	35,612	36,563	30,065
Lamongan	50,731	50,089	48,518	46,997	45,523	44,096	50,563
Gresik	7,618	7,717	7,970	8,232	8,502	8,781	6,062
Bangkalan	8,294	8,359	8,522	8,689	8,860	9,033	3,690
Kota Surabaya	367	362	351	340	329	319	367
Total	126,313	125,854	124,785	123,833	122,995	122,272	102,430

Source: Data in 2003 – 2025 are referred to SDA2006, Data in 2030 is based on GKSISP forecast.

Table 5.4.12 Annual and Peak Feeding Rates in GKS Zone

(Unit: Liter / ha / sec)

Area \ Year	2003 Annual	2003 Peak	2025 Annual	2025 Peak	2030
Sidoarjo	0.677	1.004	0.588	0.873	2030 feeding rates were assumed to be the same as 2025 rates.
Mojokerto	0.588	1.272	0.657	1.422	
Lamongan	0.648	1.202	0.563	1.045	
Gresik	0.626	1.280	0.722	1.475	
Bangkalan	0.723	1.199	0.787	1.305	
Kota Surabaya	0.645	1.071	0.559	0.929	

Source: SDA2006 and JICA team

Table 5.4.13 Feeding Rate Forecasts in GKS Zone for 2030

(Unit: Liter / ha / sec)

Area \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sidoarjo	0.285	0.628	0.681	0.595	0.793	0.849	0.827	0.653	0.401	0.957	1.004	0.451
Mojokerto	0.449	0.266	0.442	0.385	0.470	0.625	0.814	0.694	0.392	1.272	0.873	0.340
Lamongan	0.637	0.520	0.562	0.492	0.563	0.653	0.829	0.683	0.372	1.202	0.855	0.390
Gresik	0.677	0.431	0.503	0.441	0.484	0.598	0.826	0.693	0.370	1.280	0.823	0.363
Bangkalan	0.614	0.759	0.784	0.532	0.629	0.700	0.830	0.681	0.427	1.199	1.008	0.511
Kota Surabaya	0.343	0.496	0.594	0.520	0.676	0.768	0.823	0.668	0.398	1.071	0.956	0.411

Source: SDA2006 and JICA Study Team

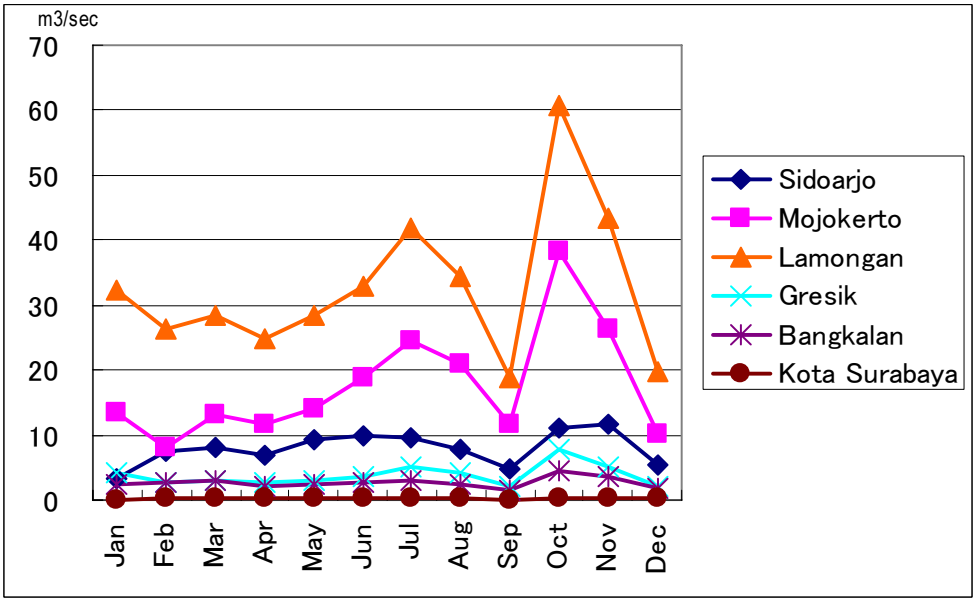
Based on the feeding rates, irrigation water demand was forecast as shown in Table 5.4.14, with a peak rate of 112.8 m^3/sec in October.

Table 5.4.14 Irrigation Water Demand by 2030

(Unit: m3/ sec)

Area \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sidoarjo	3.33	7.34	7.96	6.95	9.26	9.92	9.66	7.63	4.68	11.18	11.73	5.27
Mojokerto	13.50	8.00	13.29	11.58	14.13	18.79	24.47	20.87	11.79	38.24	26.25	10.22
Lamongan	32.21	26.29	28.42	24.88	28.47	33.02	41.92	34.53	18.81	60.78	43.23	19.72
Gresik	4.10	2.61	3.05	2.67	2.93	3.63	5.01	4.20	2.24	7.76	4.99	2.20
Bangkalan	2.27	2.80	2.89	1.96	2.32	2.58	3.06	2.51	1.58	4.42	3.72	1.89
Kota Surabaya	0.13	0.18	0.22	0.19	0.25	0.28	0.30	0.25	0.15	0.39	0.35	0.15
GKS	55.53	47.22	55.82	48.23	57.37	68.22	84.42	69.99	39.24	122.78	90.27	39.45

Source: JICA Study Team



Source: JICA Study Team

Figure 5.4.8 Irrigation Water Demand by 2030

5) Water Supply–Demand Balance

Summarizing all water demand and available volume of water, the water balance for each regency and the total in the GKS are shown in Table 5.4.15. The dry season usually causes a big water shortage amounting to 68 m3/sec, especially in October. Only Kota and Kabupaten Mojokerto do not experience water shortage year round, while Lamongan and Bangkalan commonly undergo a seven-month shortage each year.

Water saving measures, such as NRW reduction, especially for future consumption have been considered in the domestic water sector. However, other users were not considered in forecasting the demand. Irrigation and industrial demand were calculated based on land-use changes as analyzed under the GKS spatial plan by the JICA Team. Other types of demand were estimated based on extensions of present conditions.

Based on the water balance forecast by the JICA Team, water supply will remain short during the dry season, both in the present and in future. This forecast underscores the critical need for undertaking water-saving measures, the primary measures of which are the following:

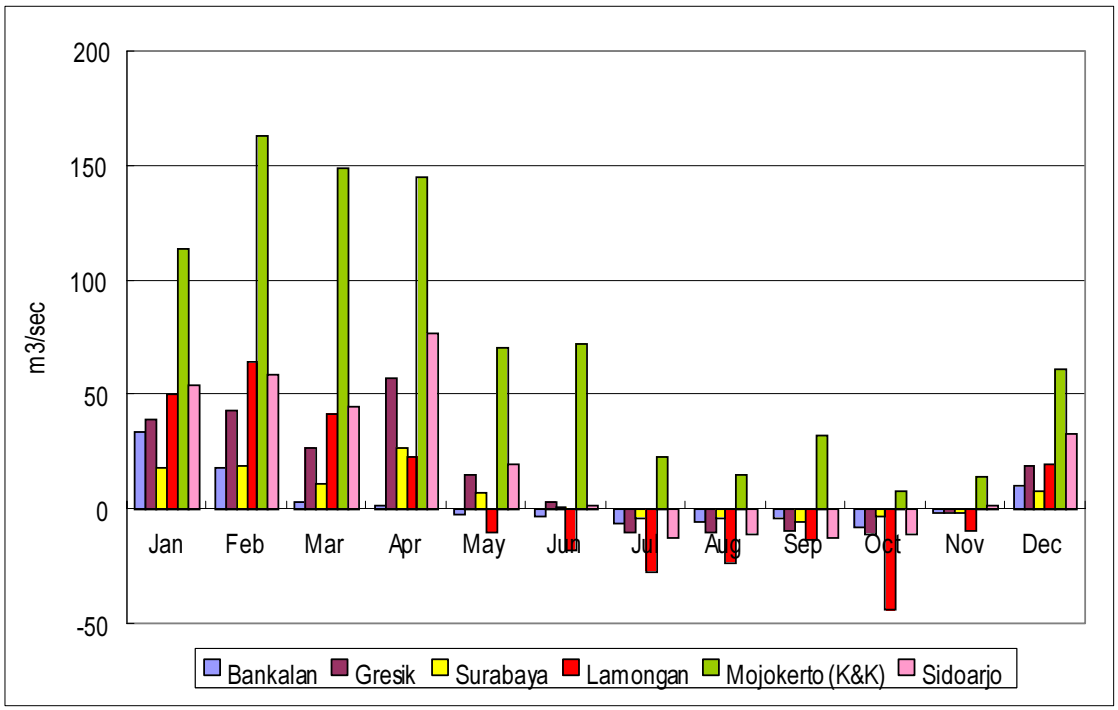
- Saving domestic water through NRW reduction;
- Saving industrial water by recycling at individual factories;
- Saving irrigation water by rehabilitating irrigation systems and improving their operation; and
- Saving fishery water by enhancing the efficiency of operations.

Table 5.4.15 Water Supply–Demand Balance by 2025: Case of Adopting Water-saving Measures

(Unit: m3/sec)

Area \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Month of deficit
Bangkalan	34	18	3	2	-2	-3	-6	-5	-4	-8	-1	10	7
Gresik	39	43	27	57	15	3	-10	-10	-9	-11	-1	19	5
Surabaya	18	19	11	27	7	1	-4	-4	-5	-3	-1	8	5
Lamongan	50	64	42	23	-10	-18	-27	-23	-13	-44	-9	20	7
Mojokerto (K&K)	114	163	149	145	71	72	23	15	32	8	14	61	0
Sidoarjo	54	59	45	77	20	2	-12	-11	-12	-11	2	33	4
GKS zone	309	365	276	331	101	58	-36	-39	-11	-68	5	151	4

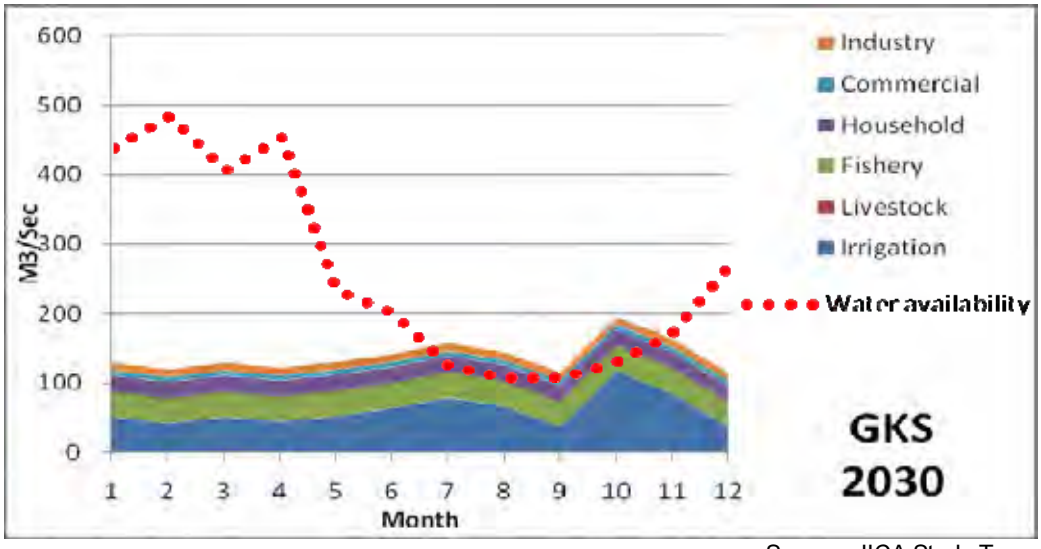
Source: JICA Study Team



Source: JICA Study Team

Figure 5.4.9 Monthly Water Balance by 2030 per Area

Commonly, when the availability of surface water decreases, groundwater is used as an alternative. Although water deficit is significantly felt in the irrigation sector, it does not use groundwater due to its higher costs than river water besides its insufficiency vis-a-vis the irrigation demand. This limits groundwater to the supply of non-irrigation demand. Water deficit is significant in Sidoarjo, Lamongan, and Bangkalan, while there is excess water in Mojokerto.



Source: JICA Study Team

Figure 5.4.10 Water Supply–Demand Balance in GKS Zone by 2030

6) Rough Financial Analysis of NRW Reduction Programs

NRW reduction is targeted to range from 34% to 20%. This is a simulation of the financial feasibility of an NRW reduction. The unit cost of NRW reduction is assumed at USD370 per m3/day based on the JICA Team's experience. The target NRW rate is 20%. In case of current tariffs, the annual profit will be USD6 million. The NRW reduction cost is USD56 million. The return period of investment for NRW reduction is 8.7 years. This shows that the NRW reduction plan is feasible. If tariffs rise by 20%, the return period shortens to 3.4 years, making it even more feasible.

Table 5.4.16 NRW Reduction with Tariff of USD0.23/m3 under 2006 Conditions

Item	Service	Unit Rate	Amount per Year
Service Rate	47%		
Product of Salable Water	585,549 m3/d	USD 0.16 / m3	-US$34,196,062
Product of NRW = **20%**	146,387 m3/d	USD 0.16 / m3	-US$8,549,015
Sales	585,549 m3/d	USD 0.23/ m3	US$49,156,839
Balance			US$6,411,762
NRW reduction costs			-US$55,921,708
Return on Investment			**8.72 year**

Source: JICA Study Team

Table 5.4.17 NRW Reduction with Tariff of USD0.28/m3 under 2006 Conditions

Item	Service	Unit Rate	Amount per Year
Service Rate	47%		
Product of Salable Water	585,549 m3/d	USD 0.16/ m3	-US$34,196,062
Product of NRW = **20%**	146,387 m3/d	USD 0.16/ m3	-US$8,549,015
Sales **(Tariff up 20%)**	585,549 m3/d	**USD 0.28/ m3**	US$58,988,206
Balance			US$16,243,129
	Service	**Unit Rate**	**Amount per Year**
NRW reduction costs			-US$55,921,708
Return on Investment			**3.44 year**

Source: JICA Study Team

By taking into account population growth, future water supply in the GKS will require service augmentation. GKS 2030 aims for a 76% population coverage from the current 47%. This calculation was done through "with" and "without" NRW reduction cases. The unit cost of service augmentation (to shoulder the costs of new water treatment and distribution systems) was assumed at USD320 per m3/d, while the unit cost of NRW reduction was assumed at USD370 per m3/d. Service augmentation that is complemented with NRW reduction is feasible. Without NRW reduction, it is not feasible, unless tariffs are increased. In the case of a 20% tariff increase, the return on investment (augmentation and NRW reduction) will be 14 years.

Table 5.4.18 Domestic Water Supply Plans for 2030

Item	A	B	C
	2007	2030	Augment = B-A
Service Rate	47%	76%	
Product of Salable Water	585,549 m3/d	1,847,706 m3/d	1,262,157 m3/d
NRW Rate	34%	34%	
Product of NRW	297,527 m3/d	951,849 m3/d	654,322 m3/d

Source : JICA Study Team

Table 5.4.19 Domestic Water Supply Plan for 2030 without Reduced NRW and with Tariff of USD0.23/m3

Item	Service	Unit Rate	Amount per year
Product of Salable water	1,847,706 m3/d	USD 0.16/ m3	-US$107,906,030
Product of NRW	951,849 m3/d	USD 0.16/ m3	-US$55,587,955
Sales	1,847,706 m3/d	USD 0.23/m3	US$155,114,919
Annual Balance			-US$8,379,066
Augmentation cost	1,916,478 m3/d	USD 320/ m3/d	-US$613,272,815
ROI			

Source : JICA Study Team

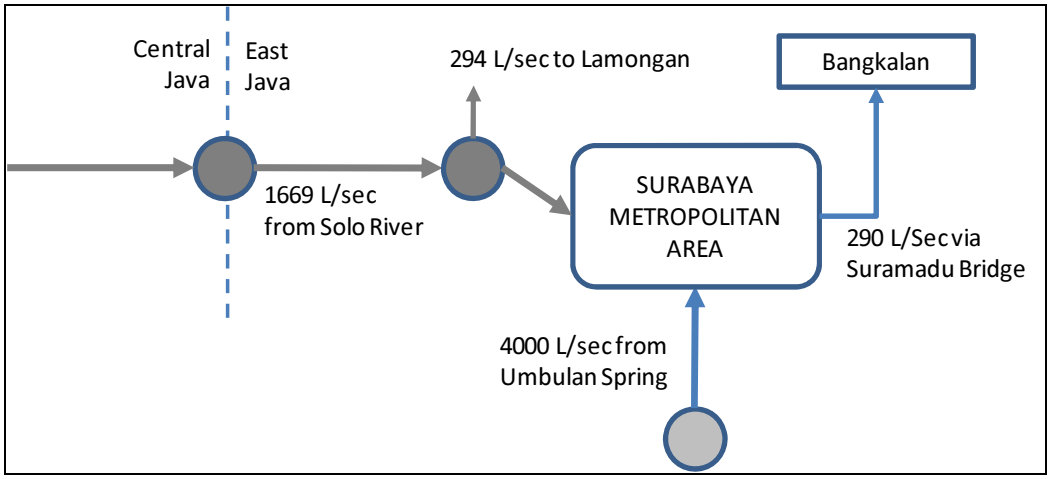
Table 5.4.20 Domestic Water Supply Plan for 2030 with Reduced NRW and with Tariff of USD0.28/m3

Item	Service	Unit Rate	Amount per Year
Product of Salable water	1,847,706 m3/d	USD 0.16 per m3	-US$107,906,030
Product of NRW **= 20%**	583,486 m3/d	USD 0.16 per m3	-US$34,075,589
Sales	1,847,706 m3/d	**(20%up) USD 0.28 per m3**	US$186,137,902
Annual Balance			US$44,156,283
Augment cost	1,548,115 m3/d	USD 320 per m3/d	-US$495,396,834
Cost against NRW	368,362 m3/d	USD 370 per m3/d	-US$136,294,103
ROI			**14.31 years**

Source : JICA Study Team

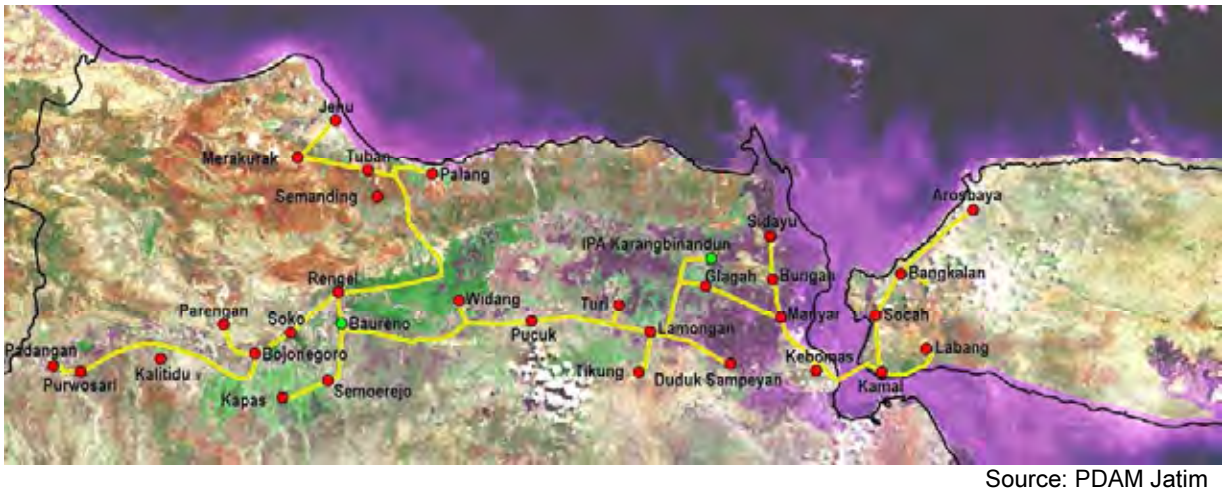
7) Water Diversion Scheme from the Solo River

The provincial government is planning to develop an interprovincial water diversion project to address water deficit. This project aims to divert water from the Solo River and Umbulan spring into the northern coastal area of East Java. The plan's schematic diagram and pipe routes are shown in Figures5.4.11 and 5.4.12.



Source: PDAB Jatim

Figure 5.4.11 Water Diversion Project from Solo River and Umbulan Spring



Source: PDAM Jatim

Figure 5.4.12 Interprovincial Water Diversion Plan

8) Development Strategies

Since water is a crucial element in sustainability and development, water shortages limit regional development. East Java has implemented a progressive approach with regard to water resource management and water use such as the establishment of a river management public corporation which will be in charge of the use of river water and the introduction of privately financed water projects, among other things. Through these advanced efforts, a strategy is needed to strike a balance between demand and supply in the GKS Zone. The following are the development strategies for water supply:

(a) Water resource management

- Watershed conservation for raw water;
- Maintenance and increase of water storage capacity of dams;
- Mitigation of irrigation water losses;
- Demand side management (recycling, efficient water use);
- Mitigation of water supply leakage (34% at present); and
- Interregency utilization of groundwater and surface water.

(b) Groundwater management

The management of groundwater, such as Umbulan water from Pasuruan, needs an interregency water transaction mechanism.

(c) Administrative enhancement

- Establishment of an Interregency Infrastructure Development and Maintenance Regulatory Board, and
- Introduction of a performance indicator system (PIS) for private water works.

9) Proposed Actions

Proposed actions to achieve the above-mentioned strategies are shown in the table below.

Table 5.4.21 Proposed Actions on Water Supply

Action	Description	To be Implemented by	Urgency
Consistency Plan in GKS Plus zone between Land-use Plan and Raw Water Allocation Plan	- Land-use, urban development, industrial development, housing development plans. - Brantas River Basin Master Plan (flood control and water use). - Solo River Basin Master Plan (flood control and water use). - Groundwater and spring water management plan. - PJT1 corporate plan - PDAM corporate plan - PDAB corporate plan	Province, Kota, Kabupaten, PJT1, PDAB & PDAM	High

Action	Description	To be Implemented by	Urgency
Inter-Regency Water Export-Import Project in East Java Province	- Groundwater and spring water management plan. - Feasibility study for inter-regency water export-import project in East Java province. - PDAM corporate plan - PDAB corporate plan	Province, Kota, Kabupaten, PDAB & PDAM	High
Water Supply Facility Expansion Project in each PDAM	- Consistency plan in GKS+ zone between future land-use plan and raw water allocation plan. - Feasibility Study for water supply facility expansion project. - PDAM corporate plan	Province, Kota, Kabupaten & PDAM	High
Non-Revenue Water (NRW) reduction project	- Feasibility study for NRW reduction in each PDAM. - PDAM corporate plan.	Kota, Kabupaten & PDAM	High
Groundwater management plan	- Hydro-geological condition in East Java province. - Groundwater use and conservation plan.	Province, Kota, Kabupaten, PDAB & PDAM	High
PI (Performance Indicator) System Implementation Program for Water Industries	- Establish the performance indicator system to audit the accountabilities of PDAM and other water industries. - Preparation of legal document to effect PI system.	Province, Kota, Kabupaten,	High
Water Saving Program in each Region	- Public awareness campaign for water saving. - Educational campaign for scarcity of water. - Award system for water saver and water recycler.	Kabupaten, Kota, PJT1 & PDAM	High

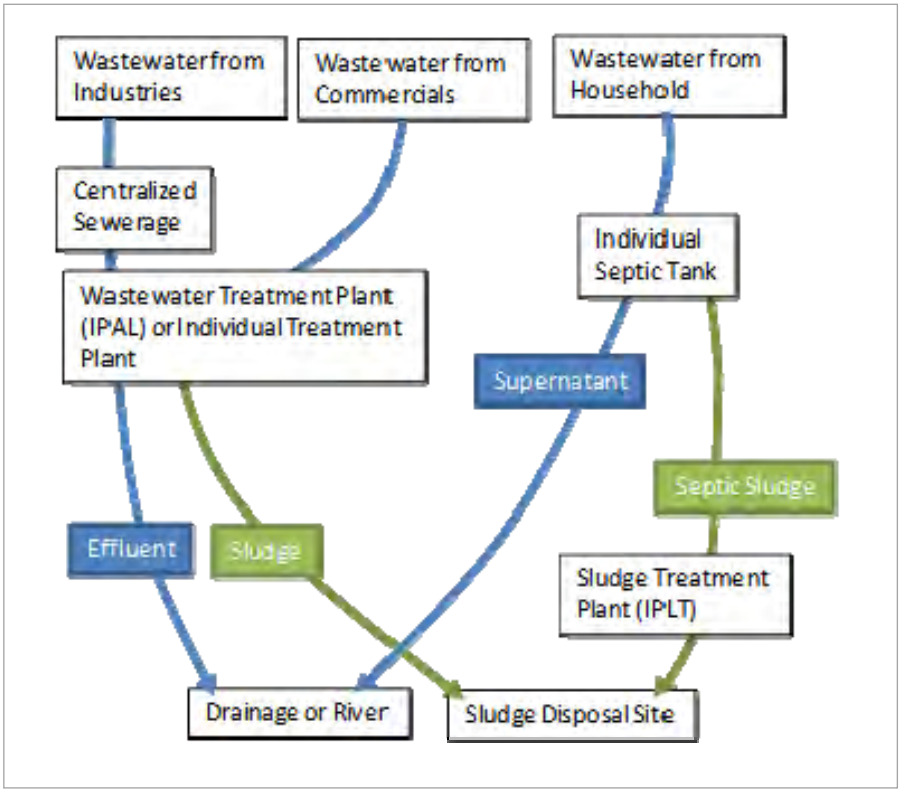
Source: JICA Study Team

5.4.2 Wastewater Management and Drainage Systems

1) Wastewater Management System

Wastewater in the GKS Zone is not adequately managed and is still done in a traditional way. Households are still the major sources of wastewater which is treated mostly through individual septic tanks and separated into supernatant and septic sludge. Supernatant wastewater is either absorbed into the ground or flows into the drainage system, while septic sludge is collected by companies licensed by the Cleaning Office, treated and disposed of in sludge disposal sites. Septic sludge generation from simple septic tanks amounts to about 0.0005 m3/capita/day or 0.5 L/capita/day. Surabaya has a septic sludge treatment plant (IPLT) with a 300 m3/day capacity. The plant covers 300,000 persons (=300 m3/0.001 m3/capita/day), which is quite inadequate to serve the city's population of 3 million.

The required treatment levels for commercial and industrial wastewater are specified by the type of business in the decrees of the Environment State Minister. Commercial and industrial wastewater is mostly treated individually except in industrial estates.



Source: JICA Study Team

Figure 5.4.13 Wastewater Management in GKS Zone

River water quality continues to deteriorate even though there are effluent standards which are stipulated in many administrative rules. As existing effluent standards are aimed at conserving the quality of water resources, the administration must institute measures to counter a decline. The deterioration of raw water quality not only causes health hazards but also significantly reduces the volumes for domestic and industrial intake. Water quality monitoring is carried out at 60 locations in Brantas River and Solo River on a monthly basis by PJT1 as mandated by the relevant decrees. However, exposing those who violate water quality standards has yet to be done even though this has been stipulated in the decrees.

2) River Development

Inundations are either caused by river overflows or faulty drainage systems; but ever since the development of the Brantas and Solo rivers, which took several years to complete, there has been almost no occurrence of inundation in the GKS.

Table 5.4.22 Brantas River Development Projects

Plan	Objective	Project
Master Plan 1 - 1996	Flood control Irrigation Hydropower generation Raw water supply	Sutami Dam (1972) Selorejo Dam (1973) Lengkong Dam (1973) Lahor Dam (1977) Porong River Improvement (1977)
Master Plan 2 - 1973	Flood control Irrigation Hydropower generation Raw water supply	Brantas River Improvement (1977) Wingi Dam (1977) Gunungsari New Dam (1973) Widas Dam (1982) Lodoyo Dam (1983) Tulugagung Drain (1987) Sengguruh Dam (1988)
Master Plan 3 - 1995	Flood control Irrigation Hydropower generation Raw water supply	Brantas River Rehabilitation (1990) Tulugagung Power Sta (1992) Wingi Dam Rehabilitation (1993) Porong River Rehabilitation (1993) Surabaya Flood Control (1995) Wonorejo Dam (1999)

Source: http://www.jasatirta1.go.id

Table 5.4.23 Solo River Development Projects

No.	Name of Project	Name of River
1	Wonogiri Dam	Bengawan Solo
2	Colo Dam	Bengawan Solo
3	Karet Jati Dam	Madiun
4	Karet Sedayu Lawas Dam	Floodway Plangwot Sedayulawas
5	Delimas Dam	Ceper
6	Juranggantung Dam	Lohgede
7	Kalongan Dam	Siwaluh
8	Delingan Dam	Tempuran
9	Dilem Dam	Cemer
10	Catur Dam	Catur
11	Brangkal Dam	Brangkal
12	Junke Dam	Junke
13	Karet Jejeruk Dam	Gandong
14	Gayung Dam	Tinil

Source: http://www.jasatirta1.go.id

Table 5.4.24 Flooding Events by River Basin in 2000–2001

Basin Name	Number of Flooding Events in East Java	Number of Flooding Events in the GKS Zone
Brantas River Basin	64 events	none
Solo River Basin	31 events	none
Madura River Basin	1 event	1 event

Source: Subdinas O&P

3) Urban Drainage Systems

Although flooding due to river overflow has decreased, that due to the overflowing of the drainage system frequently occurs. Drainage systems have been installed in the urban areas to discharge rainwater into the rivers. Design concepts of the drainage systems vary per city and according to local topography.

The following are the potential causes of drainage overflows:

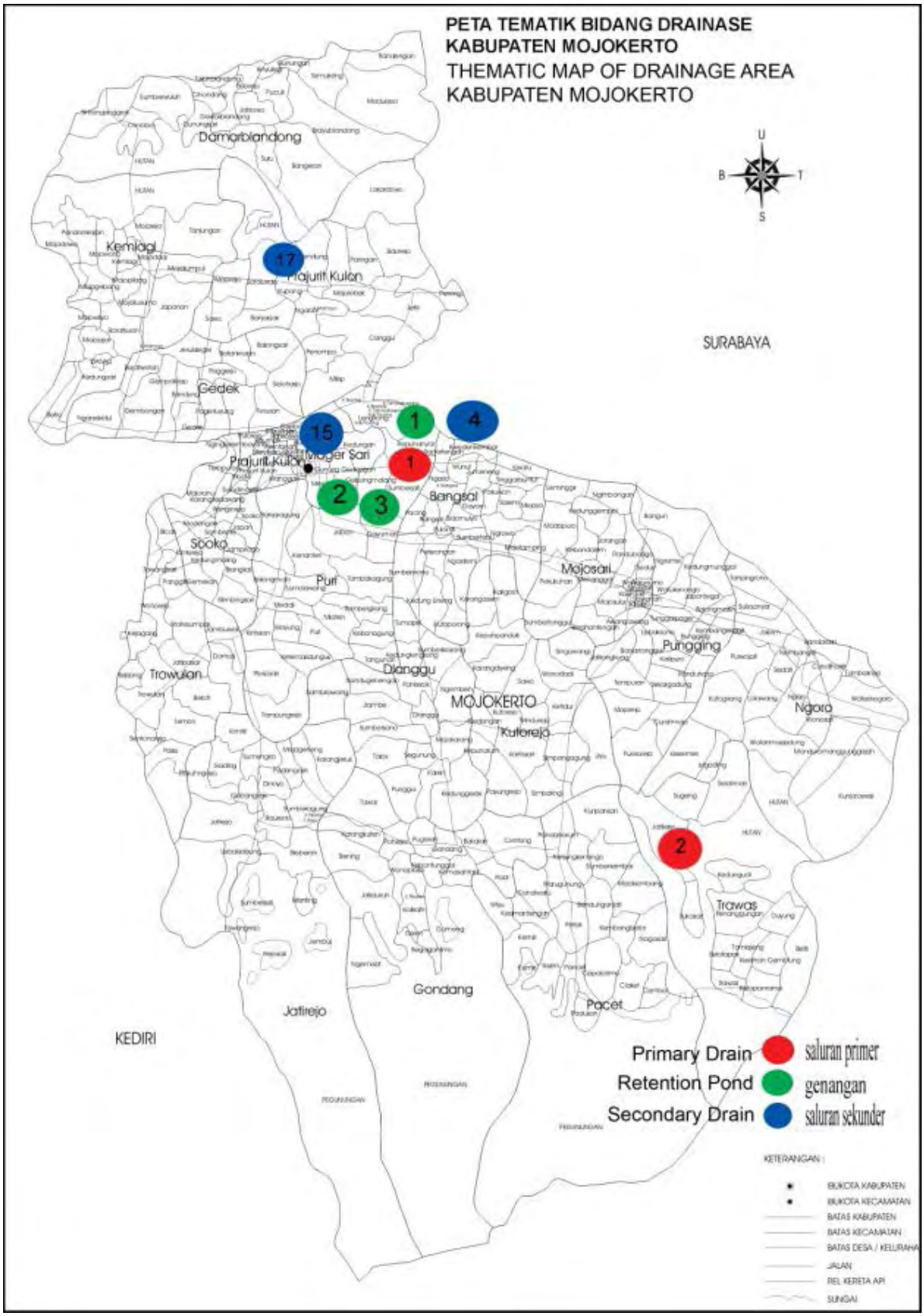
(a) Lack of Drain Channel Capacity: This is a technical issue. Frequent inundation in northern Surabaya caused by the lack of capacity of Gunung Sari Canal is a typical example.

(b) Lack of Maintenance to Maintain Drain Capacity: Drainage overflows are brought about by human factors. Residents commonly dump waste into drains which is a problem in every city. The dumped garbage reduces the capacity of the drains. Even though drain pumps and gates are not frequently used during the dry season, periodic checks and repairs are necessary to ensure that they will function during the wet season; and

(c) Lack of Emergency Response Capacity: Drainage overflows result from the lack of skills of the operating personnel. To minimize damages caused by inundations, administrators and operators should know how to take proper action such as the collection of exact information, appropriate operation of equipment, and appropriate announcement to avoid public confusion. Hence, regular training for staff is indispensable.

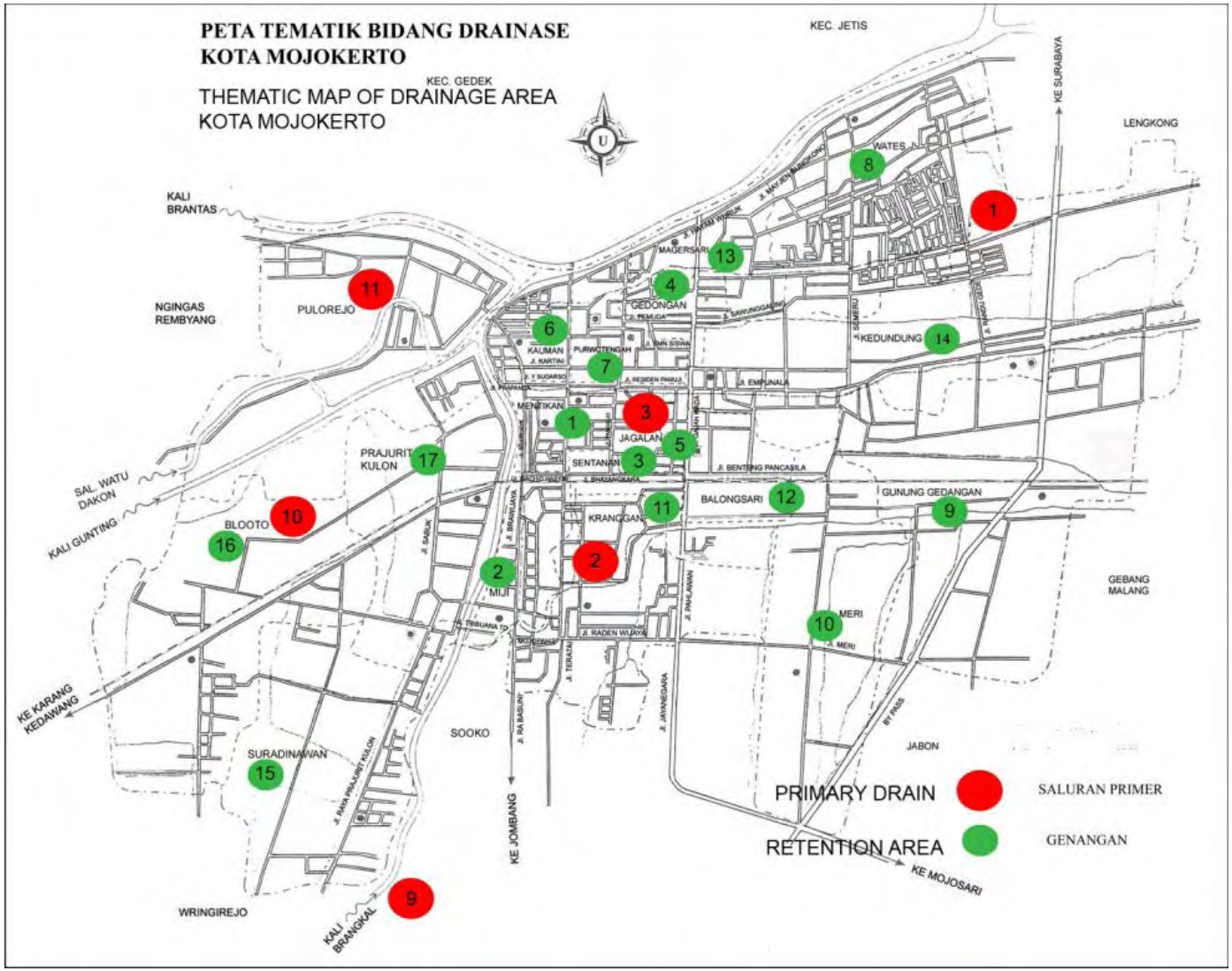
Since the GKS has many low-lying areas, the threat of inundation is always present. And as urbanization sets in or accelerates and urban assets increase, the damage from inundation will increase. The protection of urban assets from inundation damage is an integral part of development which is essential for the further growth of the GKS Zone.

Maps of drainage areas in each kabupaten/kota in the GKS Zone are shown in the next pages.



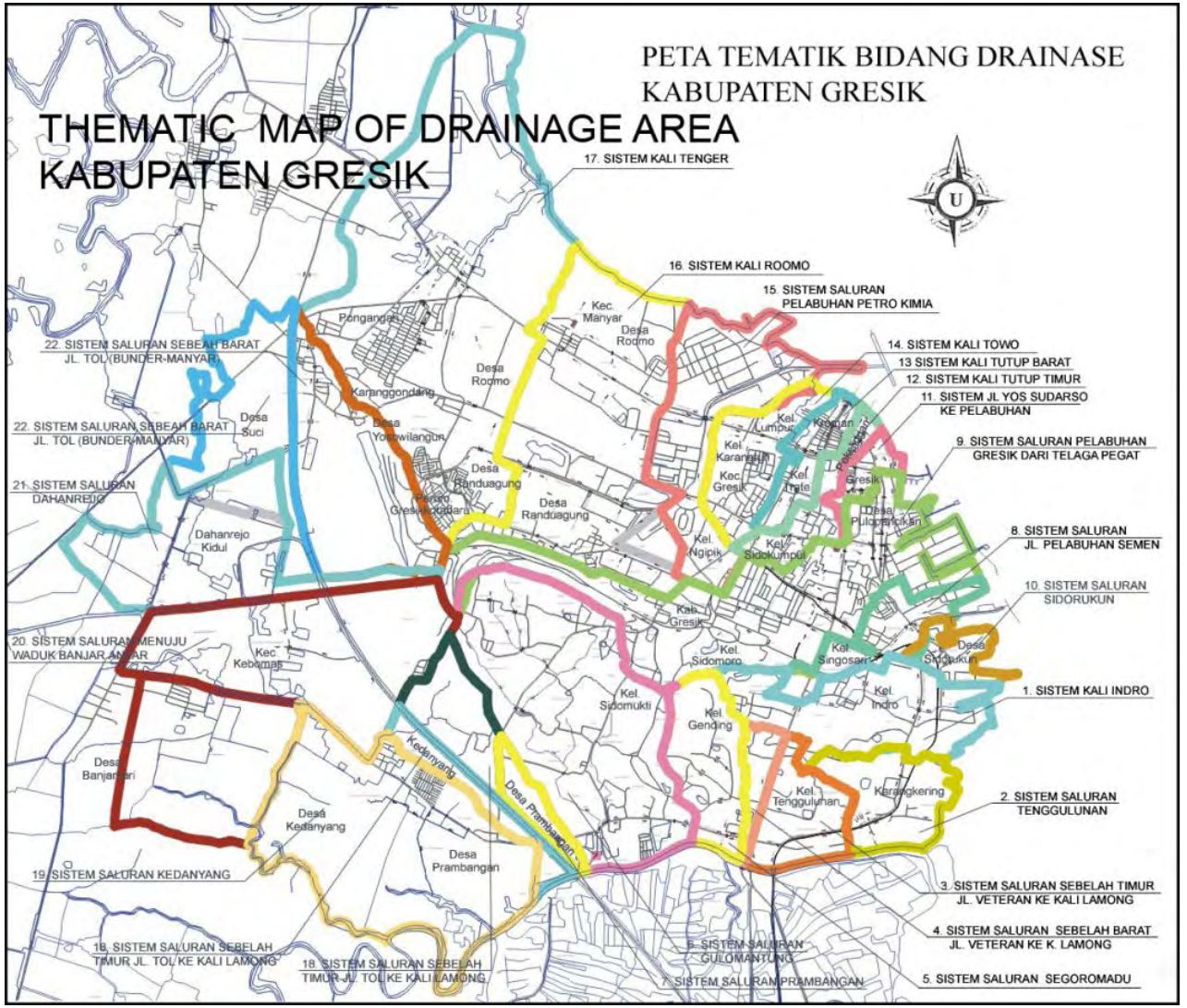
Source: Kabupaten Mojokerto

Figure 5.4.14 Drainage Areas in Kabupaten Mojokerto



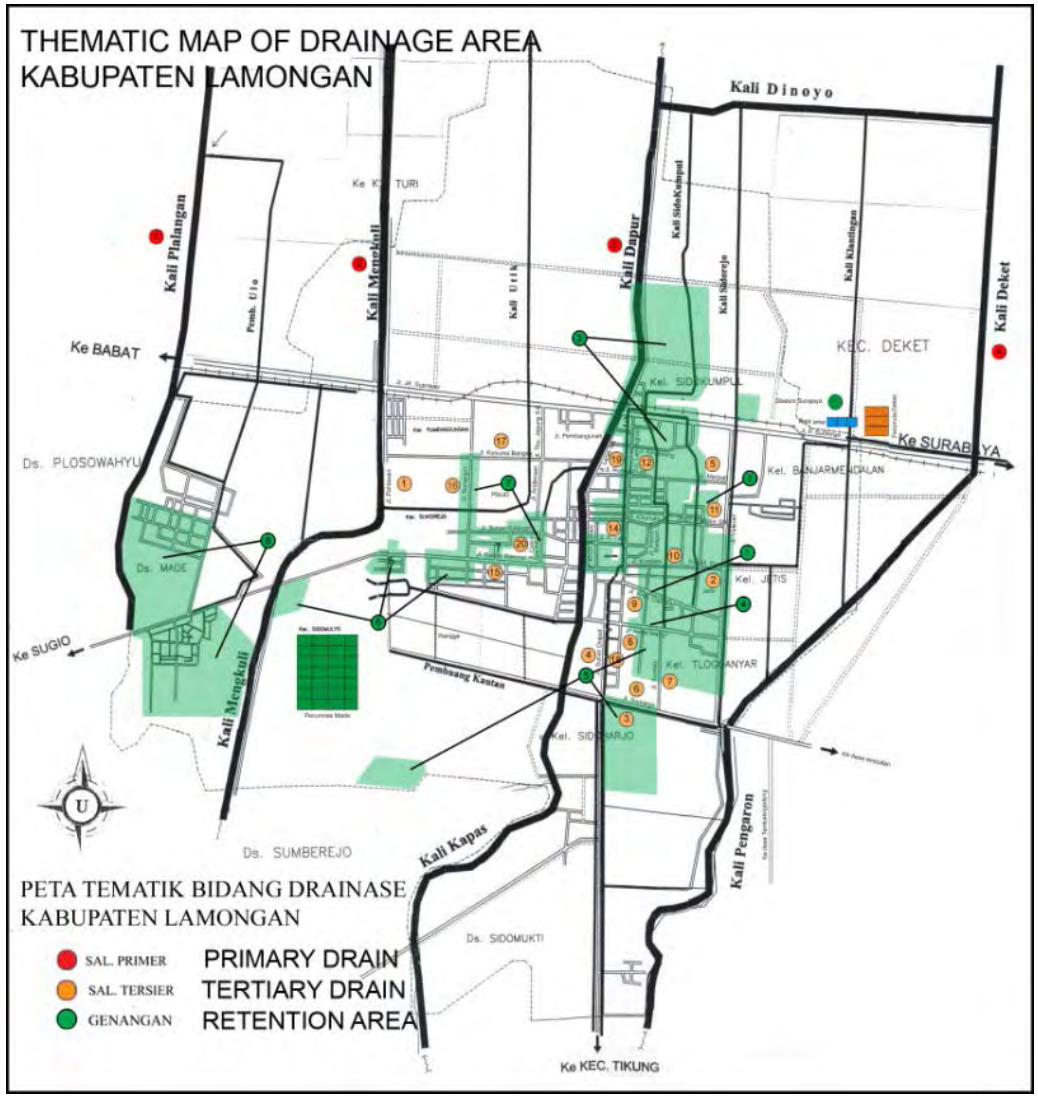
Source: Kota Mojokerto

Figure 5.4.15 Drainage Areas in Kota Mojokerto



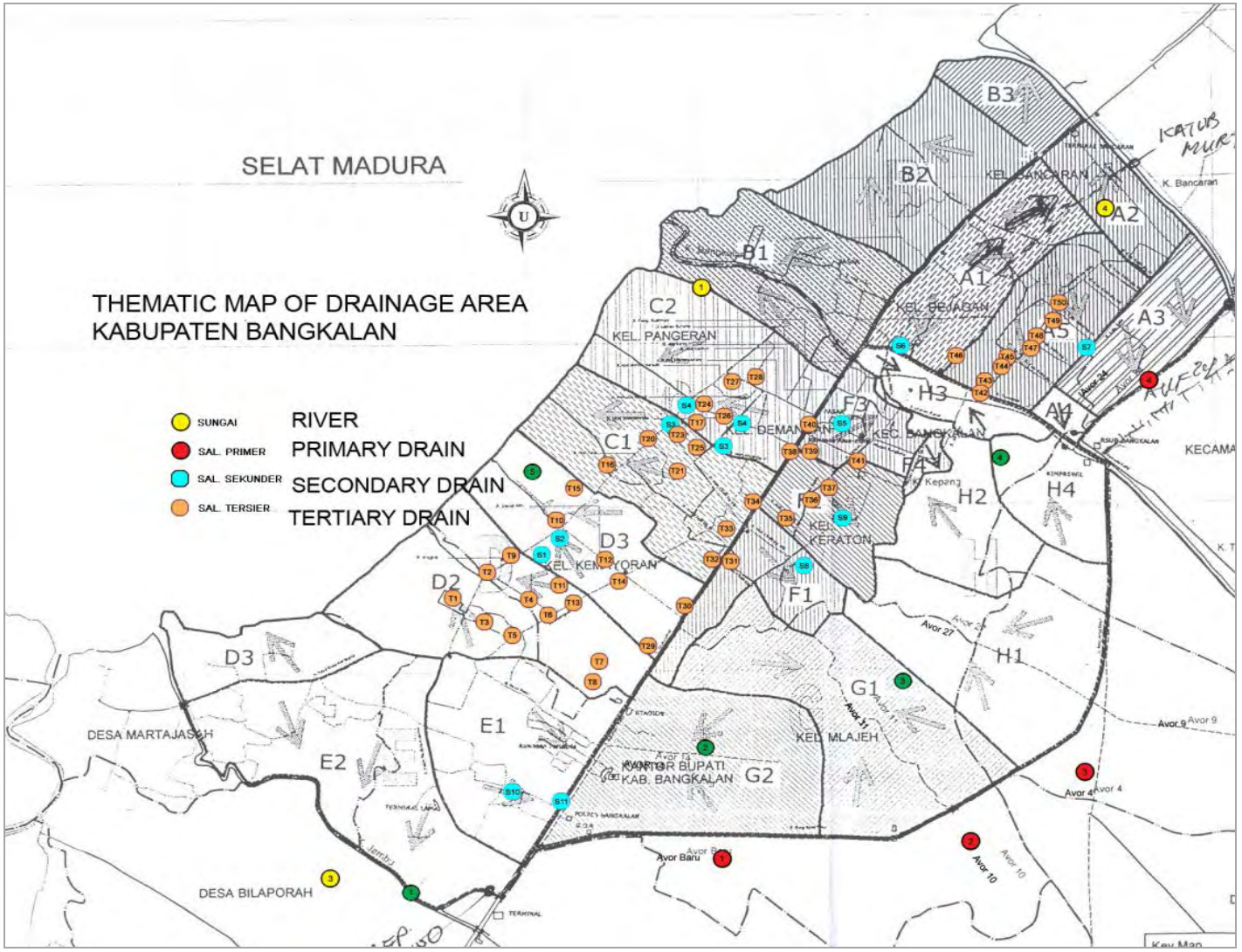
Source: Kabupaten Mojokerto

Figure 5.4.16 Drainage Areas in Kabupaten Gresik



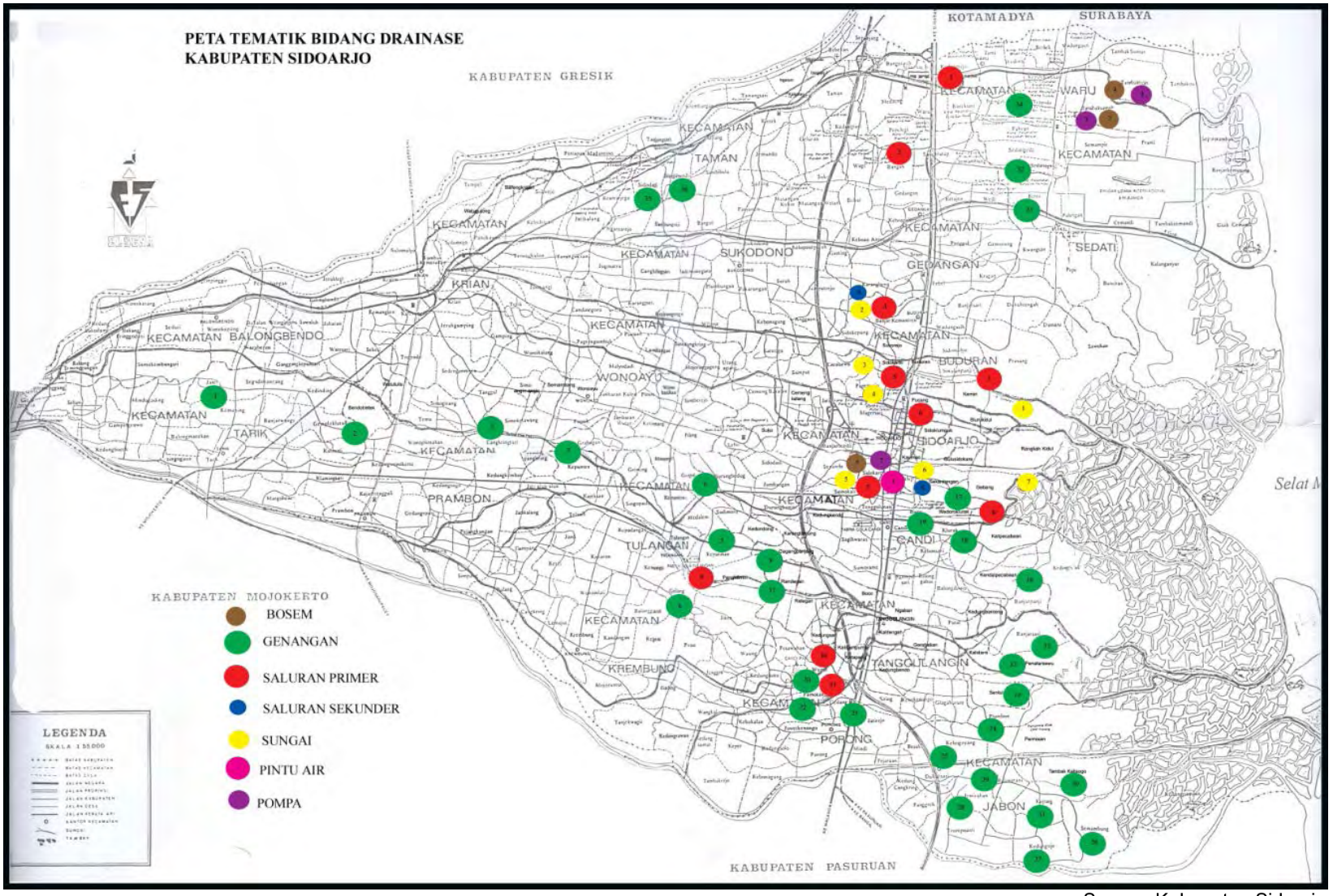
Source: Kabupaten Lamongan

Figure 5.4.17 Drainage Areas in Kabupaten Lamongan



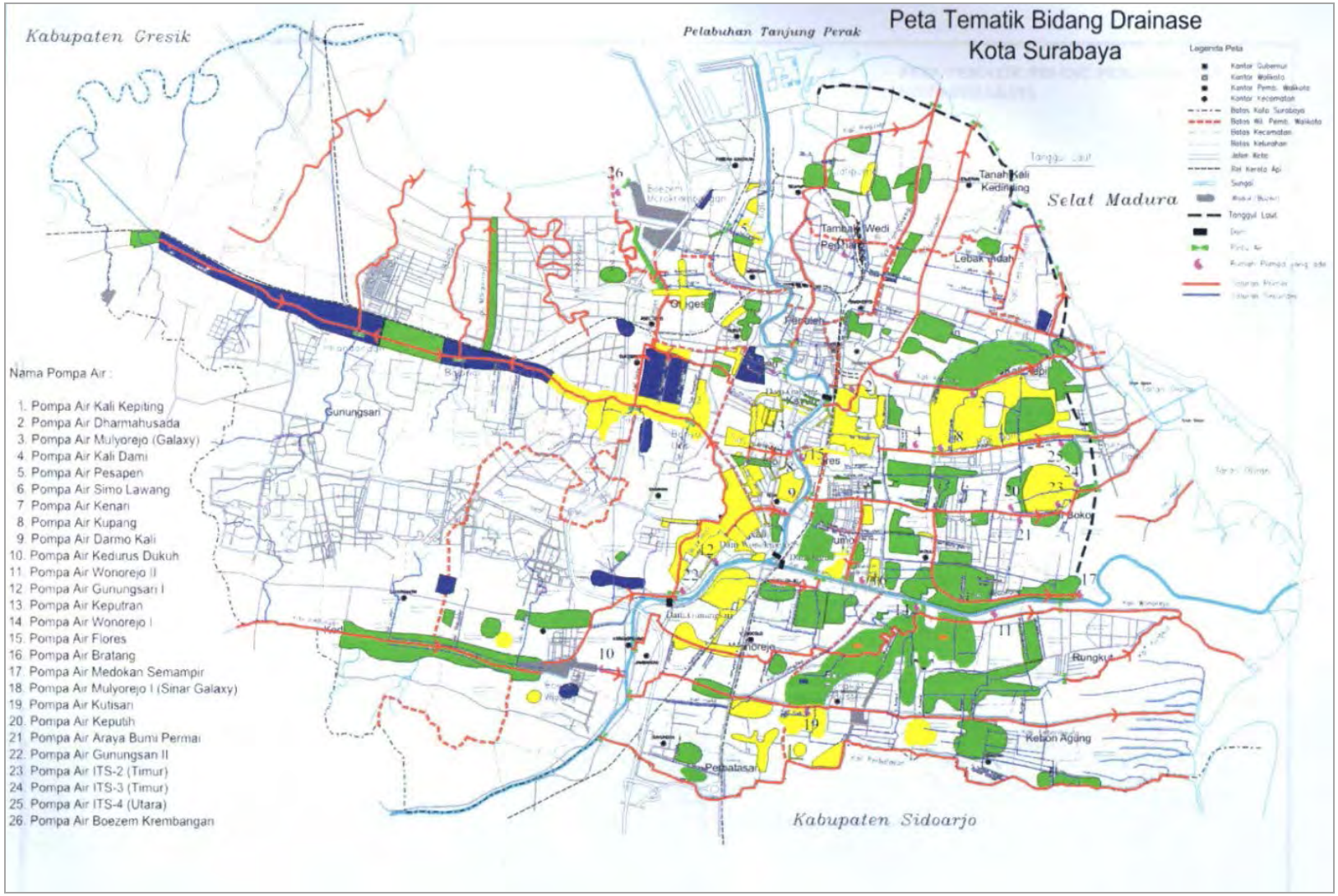
Source: Kabupaten Bangkalan

Figure 5.4.18 Drainage Areas in Kabupaten Bangkalan



Source: Kabupaten Sidoarjo

Figure 5.4.19 Drainage Areas in Kabupaten Sidoarjo



Source: Kota Surabaya

Figure 5.4.20 Drainage Areas in Kota Surabaya

4) Wastewater Treatment Service Levels in the Standard National Guidelines

According to the national standards, wastewater treatment infrastructure should cover 80% of the total urban population, as follows:

- Individual and communal infrastructure for domestic use such as toilets, latrines, and public restrooms;
- On-site treatment systems (Instalasi Pengolahan Limbah Tinja or IPLT treats communal piles of black water, or night soil, which usually comes from industries, while that collected in trucks, i.e., septic tank sludge from communities, are treated by Dinas Kebersihan, or the Cleaning Department of each Kabupaten/Kota).
- Off-site system which consists of modular/full sewerage systems based on sewerage and wastewater treatment of black and grey waters (Instalasi Pengolahan Air Limbah so called IPAL).

In rural areas, wastewater treatment systems cover 50–70% of the total population, or 80–90% in areas with a density of more than 300 inhabitants per hectare. Treatment quantity consists of: (1) septic tanks, public restrooms, and night soil compiled in trucks (2 units): 4 cubic meters for maximum coverage of 120,000 inhabitants; IPLT (pond system): with flows of 50 cubic meters per day, and (3) sludge cleaning every five years.[1]

The existence of national standards notwithstanding, their implementation has not been widely conducted. The above-mentioned wastewater policy is administered by decrees such as: Decree No.82-2001 regarding water quality management and water pollution control, Decree No.42-2008 regarding the management of water resources, Decree KEPMENLH No.112-2003 regarding the quality standards for domestic wastewater, and the decree from the Public Works Minister No.16/PRT/M/2008 regarding the national policy and strategy of developing of domestic waste water treatment system.

5) Required Capacities of the Urban Drainage System

Urban drainage is still a minor part of the urban infrastructure in the GKS Zone. The urban drainage plan is used to update the five-year regional land-use plan (RTRW). Technical drainage requirements are specified through particular projects. The required capacity for primary drainage systems is to accommodate rainfall with a 20-year return period and for secondary and tertiary systems, rainfall with a 2-5 years return period.d

The drainage systems in urban areas in the GKS Zone are insufficient . Ideally, drainage development should be carried out in accordance with levels of urbanization; but the reality is different and rapid urbanization makes it difficult to provide a proper manner of wastewater treatment system. Hence, the development of appropriate drainage and sewerage systems in urban areas in the GKS will take a long time. To accommodate faster urbanization a master plan on urban drainage which is tied to future land use is strongly required.

[1] Housing and Human Settlement Department, "Information in Arrangement Product in terms of Regional Autonomy", 2003

6) Development Strategy for Wastewater Management and Urban Drainage System

(1) Proper Wastewater Management

In the GKS Zone, wastewater disposal is commonly dependent upon individual property owners. Although domestic wastewater disposal is decreed by law, there is no public wastewater disposal service except for septic sludge disposal service. If the current wastewater disposal system will continue, the potential for failing environmental standards is high. The situation is even more serious in the case of water pollution from industrial wastewater because industrial wastewater contains harmful levels of contaminants that either do not decompose or decompose slowly. Hence, proper sanitation and wastewater management are strongly required.

(2) Monitoring, Regulatory, and Punitive Actions on Pollution Control

The quality of domestic and industrial wastewater discharge (effluent standards) is defined by ministerial decrees and supplemented by governor's decisions. The quality of wastewater, particularly industrial wastewater, and river water is monitored by the PJT1 to ensure quality raw water.

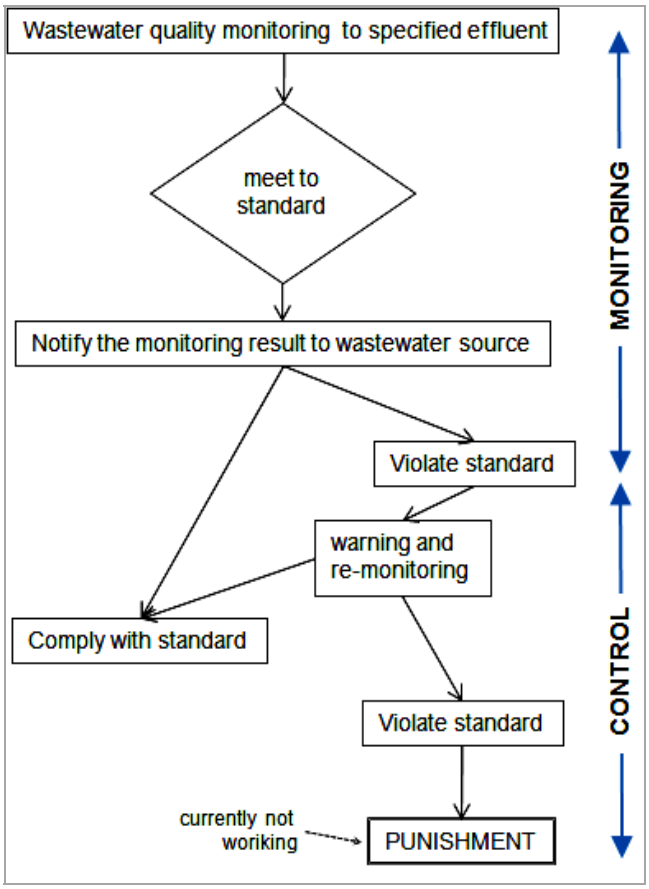
River water pollution has not been curtailed even though a wastewater quality monitoring system has been established. The reason for this is the lack of punitive actions against environmental violators.

So far, priority has focused on economic growth, while environmental protection has not gotten its proper attention. But a threshold is being reached wherein the desired development scenarios cannot advance without taking account of environmental protection. The formulation of a comprehensive wastewater management master plan for the GKS Zone, indicating responsibilities on supervision, is therefore proposed.

(3) Urban Drainage System Improvement

The primary causes of flooding are (1) lack of drain channel capacity, (2) lack of maintenance of drain capacities, and (3) lack of emergency response capacity. Thus, in order to rectify them, the following are to be adopted as strategies:

- Enhancement of drain channel capacities;
- Proper maintenance of channels; and
- Improvement of emergency response capacities.



Source: JICA Study Team

Figure 5.4.21 Wastewater Management Concept for GKS Zone

7) Proposed Actions

Taking into account the present conditions of wastewater treatment and urban drainage systems, action plans are proposed as shown below.

Table 5.4.25 Action Plans for Wastewater Treatment and Urban Drainage

Action	Description	To be Implemented by	Urgently
Preparation of an Urban Drainage and Wastewater Disposal Master Plan for Urban Areas in the GKS Zone	- Urban drainage plan - Land-use, Urban development, industrial development, housing plans in urban areas.	Province, Kota, Kabupaten, and PJT1	High
Human Resources Development for Drainage Administration	- Information network - Standard operation and maintenance manual - Public announcement system	Kota and Kabupaten	High

Source: JICA Study Team

5.4.3 Solid Waste Management

1) Current Situation

(1) Waste Generation, Collection, and Composition

About 3.5 million tons of waste was generated in the GKS in 2007, of which 63% came from urban areas and the balance from rural areas. In 2008, solid waste was collected only in the urban areas, at an average rate of 52.7%. This varied among regencies, with Sidoarjo having the lowest at 13.4% and Surabaya the highest at 83.4%, as shown in Table 5.4.26.

Table 5.4.26 Waste Generation (2007)

Area	Total	Urban Waste		Disposed Urban Waste			Rural Waste
		Collected	Uncollected	Total	Landfill	Compost Pile	
Kab Sidoarjo	695,959	590,173	511,090	79,083	79,083	0	105,786
Kab Mojokerto	397,190	150,138	119,810	30,328	30,328	0	247,052
Kab Lamongan	483,032	66,175	57,109	9,066	8,669	397	416,857
Kab Gresik	432,257	199,703	119,822	79,881	77,027	2,854	232,554
Kab Bangkalan	366,027	56,734	43,799	12,935	12,314	621	309,293
Kota Mojokerto	45,548	45,548	7,607	37,941	37,320	621	0
Kota Surabaya	1,093,076	1,093,076	181,451	911,625	902,876	8,749	0
GKS	3,513,089	2,201,547	1,040,688	1,160,859	1,147,617	13,242	1,311,542

Source: JICA Study Team Calculation

(2) Existing Landfill Capacities

About 99% of the collected waste is dumped in landfill sites. Landfills, however, have limited capacities, and local governments are developing, or securing, new landfills. Table 5.4.27 shows the existing and planned landfills in GKS municipalities Landfill plans appear however to be address current waste disposal problems, not future countermeasures. A sustainable SWM method is strongly required for each municipality.[2]

(3) Collection Ratios

Coverage ratio refers to the proportion of waste collected by the DKP to generated urban waste. Coverage differs among local governments, even though collection services are restricted in the urban areas. Service coverage ratios for urban areas in 2008 are shown in Table 5.4.28.

[2] Local governments in the GKS Zone need plenty of landfill; and, they try to acquire a necessary landfill site in 5-year development plan.

Table 5.4.27 Existing and Planned Landfills

Area	Existing	Mid-term Plan	Long-term Plan
Kab Sidoarjo	7.66 ha (one of them is closed, while others will be closed by 2009)	10 ha expansion	Provision of composting facilities (100 units)
Kab Mojokerto	10.5 ha (No data available on capacity)		Landfill management improvement 0.5–1.0-m height
Kab Lamongan	6.68 ha (No data of how much available)	1 ha expansion and composting facilities	Construction of landfill infrastructure
Kab Gresik	6 ha	Secured 15 ha landfill site	
Kab Bangkalan	2.25 ha	Transfer to a new landfill site	Infrastructure repair
Kota Mojokerto	3.5 ha (it will be closed by 2011)	2.8 ha (nto be opened in 2012)	Improvement of landfill management
Kota Surabaya	37.4 ha (full by 2012)	Expansion 15 ha (operated from 2012) new design for a new landfill in the east	

Source: DKP of each municipality

Table 5.4.28 Coverage of Collection Ratios

Area	Service Coverage Ratio	
Kabupaten Sidoarjo	13.4	(11.3)
Kabupatn Mojokerto	20.2	(7.6)
Kabupaten Lamongan	16.8	(2.3)
Kabupaten Gresik	40.0	(17.1)
Kabupaten Bangkalan	22.8	(3.5)
Kotamadya Mojokerto	83.3	(83.3)
Kotamadya Surabaya	83.4	(83.4)

Source: East JAVA Office and Province Action Plan, PUCKTR, 2008
Note: *( ) denotes the ratio of served population to the total population in the kota/regency.

(4) Composting of Collected Waste

In 2007, 13,242 tons, or 1.15%, of all collected urban waste were composted. Compost capacity, production, and compost centers are summarized in Table 5.4.29.

Table 5.4.29 Compost Production

Area	Capacity for Composting (m^3/d)	Compost Production (m^3/d)	No. of Compost Centers
Kab. Sidoarjo	28.0	14.0	3
Kab. Mojokerto	150	5.0	1
Kab. Lamongan	36.2	18.1	5
Kab. Gresik	59.0	25.1	3
Kab. Bangkalan	6.5	3.3	4
Kota. Mojokerto	5.0	2.5	2
Kota Surabaya	87.5	44.6	13

Source: Interview by JICA Team with DKP

2) Future Demand

(1) Waste Generation Forecasts

i) Target Population

Future waste demand was calculated based on the following population frameworks:

Table 5.4.30 Population Projections in GKS up to 2030

Area	2007	2010	2020	2030
Kabupaten Sidoarjo	1,869,350	2,037,300	2,672,200	3,257,400
Kabupatn Mojokerto	1,066,854	1,140,300	1,424,400	1,653,100
Kabupaten Lamongan	1,297,427	1,333,100	1,625,100	1,795,100
Kabupaten Gresik	1,161,044	1,224,500	1,567,500	1,910,600
Kabupaten Bangkalan	983,150	1,041,800	1,301,400	1,586,500
Kotamadya Mojokerto	122,342	128,600	156,800	191,100
Kotamadya Surabaya	2,752,208	2,819,800	3,008,968	3,212,904
Total (GKS)	9,252,375	9,725,400	3,272,500	3,723,700

Source: JICA Study Team

Table 5.4.31 Assumption of Population Distribution in GKS

Area	Area	2007	2010	2020	2030
Kabupaten Sidoarjo	Urban	0.85	0.88	0.90	0.92
	Rural	0.15	0.12	0.10	0.08
Kabupatn Mojokerto	Urban	0.39	0.48	0.57	0.64
	Rural	0.61	0.52	0.43	0.36
Kabupaten Lamongan	Urban	0.14	0.23	0.33	0.42
	Rural	0.86	0.77	0.69	0.58
Kabupaten Gresik	Urban	0.47	0.55	0.64	0.72
	Rural	0.53	0.45	0.36	0.28
Kabupaten Bangkalan	Urban	0.16	0.33	0.47	0.58
	Rural	0.84	0.67	0.53	0.42
Kotamadya Mojokerto	Urban	1.00	1.00	1.00	1.00
	Rural	0.0	0.0	0.0	0.0
Kotamadya Surabaya	Urban	1.00	1.00	1.00	1.00
	Rural	0.0	0.0	0.0	0.0

Source: JICA Study Team

ii) Unit Waste Generation

At present in the GKS, unit generation is determined through the SNI-Indonesia national standards. However, figures should be maintained periodically, preferably once a year. For the projection of generated waste, unit generation was assumed to be equal to that in 2007, as shown in Table 5.4.32.

Table 5.4.32 Unit Generation for Generation Forecasts

Area	Unit	2007	2010	2020	2030
Kabupaten and Kota Mojokerto	kg/capita/d (ℓ/capita/day)	1.0 (3.0)	1.0 (3.0)	1.0 (3.0)	1.0 (3.0)
Kota Surabaya		1.1 (3.2)	1.1 (3.2)	1.1 (3.2)	1.1 (3.2)

Source: JICA Study Team

iii) Waste Generation Forecasts

Waste generation by 2030 is forecast to be 5.35 million tons, from 3.51 million tons in 2007, as shown in Table 5.4.33.

Table 5.4.33 Waste Generation Forecasts

Area	2007	2010	2020	2030
Kabupaten Sidoarjo	695,959	758,487	994,860	1,212,730
Kabupaten Mojokerto	397,190	424,534	530,304	615,440
Kabupaten Lamongan	483,032	496,313	605,025	668,316
Kabupaten Gresik	432,257	455,881	583,580	711,316
Kabupaten Bangkalan	366,027	387,862	484,511	590,654
Kotamadya Mojokerto	45,548	47,878	58,377	71,147
Kotamadya Surabaya	1,093,076	1,119,799	1,299,575	1,478,756
GKS Total	3,513,088	3,690,754	4,556,232	5,348,367

Source: JICA Study Team

(2) Disposal Capacity Required for Generated Waste

i) Waste for Disposal in Landfills

Assuming that the future collection coverage by the DKP would be the same as in 2007, future waste recycling activities, waste generation and disposal capacities by 2020 and 2030 are shown in Table 5.4.34.

Table 5.4.34 Waste for Disposal in Landfills

Year 2020 (Unit: t/y)

Area	Generated Waste	Collected Waste	Waste for 3Rs	Final Disposal (Required)
Kab. Sidoarjo	994,860	120,380	496	119,883
Kab. Mojokerto	530,304	60,952	18,615	42,337
Kab. Lamongan	605,025	27,519	4,492	23,027
Kab. Gresik	583,580	149,396	9,059	140,337
Kab. Bangkalan	484,511	51,919	621	51,298
Kota Mojokerto	58,377	48,627	621	48,007
Kota Surabaya	1,299,575	1,083,845	9,866	1,073,979
GKS	4,556,232	1,542,638	43,770	1,498,868

Year 2030 (Unit: t/y)

Area	Generated Waste	Collected Waste	Waste for 3Rs	Final Disposal (Required)
Kab Sidoarjo	1,212,730	150,155	496	149,659
Kab Mojokerto	615,449	79,939	18,615	61,324
Kab Lamongan	668,316	38,272	4,492	33,780
Kab Gresik	711,316	203,720	9,059	194,661
Kab Bangkalan	590,654	78,375	621	77,755
Kota Mojokerto	71,147	59,265	621	58,644
Kota Surabaya	1,478,756	1,233,282	9,866	1,223,416
GKS	5,348,368	1,843,008	43,770	1,799,239

Source: JICA Study Team

ii) Required Landfill Areas

Required landfill capacities for waste collected from 2010 to 2030 are summarized in Table 5.4.35.

Table 5.4.35 Required Area of Landfills by 2030

Area	Year (ton/y)			Cumulative Waste (ton)	Required Area (ha)
	2010	2020	2030		
Kab Sidoarjo	88,741	119,883	149,659	2,390,831	80
Kab Mojokerto	22,548	42,337	61,324	842,731	28
Kab Lamongan	11,350	23,027	33,780	455,916	15
Kab Gresik	90,323	140,337	194,661	2,828,286	94
Kab Bangkalan	28,561	51,298	77,754	1,044,564	35
Kota Mojolerto	39,261	48,007	58,644	969,597	32
Kota Surabaya	924,046	1,073,980	1,223,416	21,477,102	716
GKS	1,204,830	1,498,869	1,799,238	30,009,027	1,000

Source: JICA Study Team
Note: Cumulative waste denotes a summary of waste to be disposed of in landfills from 2010 to 2030.

(3) Improvement of Collection Rates

Collection services should expand because efficient solid waste management, i.e. recycling and composting, will be promoted, and landfill capacities will decrease in the middle to long term.

When the coverage of collection spreads, the DKP will be able to collect more waste. This means that unless more enhanced recycling and composting activities are executed, the burden on landfills will increase. For better sanitary living conditions, higher collection targets should be planned and accomplished. Thus, it seems to be rational to set targets for the middle and long term according to population increases. The planned targets are shown in Table 5.4.36.

Table 5.4.36 Collection Coverage Targets

Year / Area	2007	2010	2020	2030
Kab Sidoarjo	0.130	0.145	0.179	0.213
Kab Mojokerto	0.202	0.212	0.254	0.295
Kab Lamongan	0.137	0.141	0.155	0.169
Kab Gresik	0.400	0.420	0.497	0.575
Kab Bangkalan	0.228	0.240	0.289	0.338
Kota Mojokerto	0.833	0.875	1.000	1.000
Kota Surabaya	0.834	0.851	0.900	0.980

Source: JICA Study Team
Note: Figures show the expansion ratios based on one in 2007.

The targets are predicted to expand roughly in proportion to population increase. Taking the coverage targets into account, the predicted loads on the landfills are shown in Table 5.4.37.

Table 5.4.37 Wastes Hauled to Landfills and Required Landfill Area (3R was the same as in 2010)

Area	Year (ton)			Cumulated waste (2010-2030) (ton)	Required Area (ha)
	2010	2020	2030		
Kab Sidoarjo	96,758	171,584	261,153	3,505,401	117
Kab Mojkerto	25,382	62,765	123,865	1,280,811	43
Kab Lamongan	11,786	29,978	48,460	601,008	20
Kab Gresik	95,754	192,637	326,181	4,036,044	135
Kab Bangkalan	30,302	68,105	125,853	1,461,823	49
Kota Mojokerto	41,255	57,756	70,526	1,136,475	38
Kota Surabaya	942,724	1,142,033	1,379,848	23,096,902	770
GKS	1,243,961	1,724,858	2,335,886	35,118,463	1,171

Source: JICA Study Team

(4) Reduced, Reused, Recycled Waste

i) 3Rs and Waste Reduction Targets

- Reduced Waste at Source

The reduction of waste at source is represented by a unit generation decrease. As a key indicator for SWM performance, generated waste should keep to the levels shown in Table 5.4.38. The reduction rates are 10% by 2020 and 20% by 2030 from their 2007 levels. The 20% target was based on the assumption that the GKS should aspire for a reduced target of at least below 1.0kg/capita/day as in other industrialized countries, with the assumption that most citizens would cooperate with government policies. Based on these reduction targets, waste forecasts are shown in Table 5.4.39.

Table 5.4.38 Target Reduction Rates

Year / Area	Unit	2007	2010	2020	2030
Kabupaten and Kota Mojokerto	kg/capita/d	1.0	1.0	0.9	0.8
Kota Surabaya		1.1	1.1	1.0	0.9

Source: JICA Study Team

Table 5.4.39 Forecast of Waste Collected by DKP at Source

(Unit: t/y)

Year / Area	2007	2010	2020	2030
Kab Sidoarjo	79,083	97,255	154,873	209,320
Kab Mojokerto	31,291	43,997	73,242	49,092
Kab Lamongan	9,006	16,278	31,023	42,362
Kab Gresik	81,264	104,813	181,527	268,192
Kab Bangkalan	13,352	30,923	61,853	101,179
Kota Mojokerto	37,941	41,876	52,539	56,918
Kota Surabaya	911,625	952,590	1,042,443	1,111,771
GKS	1,163,562	1,287,732	1,597,500	1,838,834

Source: JICA Study Team

- Recycled Waste

In the intermediate treatment process, recycling technology has yet to be properly adopted. The waste composition data from DKP and the possible maximum amounts of recycled products are shown in Tables 5.4.40 and 5.4.41. Recyclables include metal, paper, and plastics. Recycled waste will presumably reach 10% by 2020 and 20% in 2030.

To make this recycling activities successful, it is strongly required that market research on compositing products be executed. At the current stage, recycling is just starting in the community level.

Table 5.4.40 Recycling Potential of Waste by Area

Area	Recycling Potential (%)
Kab Sidoarjo	7
Kab Gresik	30
Kab Lamongan	13
Kota Mojokerto	10
Kota Surabaya	30

Source: JICA Study Team
Note: Regencies that are not in Table have no data.

Table 5.4.41 Possible Maximum Recycling Amounts

(Unit: ton/year)

Year / Area	2010	2020	2030
Kab Sidoarjo	0	1,084	2,930
Kab Mojokerto	0	732	1,982
Kab Lamongan	0	931	1,271
Kab Gresik	0	1,815	5,364
Kab Bangkalan	0	433	1,417
Kota Mojokerto	0	683	1,480
Kota Surabaya	0	31,101	66,706
GKS	0	36,779	81,150

Source: JICA Study Team

In some regencies, recyclables are collected and sold in the community level. In Sidoarjo, four communities recycle voluntarily. This activity requires active administrative leadership.

- Composting

The production rate of compost is not yet so high, however demand will expand if quality will improve. Composting products are used for plantation fertilizer in parks and streets that are not used for food production fields due to the quality of the generated compost.

Possible composting ratios are shown in

Table 5.4.42. The composting ratio represents a ratio of the organic component of waste.

Table 5.4.42 Ratio Potential for Composting

Area	Composting Ratio (%)
Kab Sidoarjo	60
Kab Gresik	50
Kab Lamongan	70
Kota Mojokerto	75
Kota Surabaya	50

Source: JICA Study Team
Note: Regencies that are not in Table have no data

The volume of waste used for composting is shown in Table 5.4.43. Composting achievement targets a 10% rate by 2020 and 20% rate by 2030.

Table 5.4.43 Potential Waste Amounts for Composting

(Unit: ton/year)

Year / Area	2010	2020	2030
Kab Sidoarjo	496	12,973	30,652
Kab Mojokerto	18,615	9,174	20,398
Kab Lamomgan	4,492	5,232	11,041
Kab Gresik	9,059	32,725	45,763
Kab Bangkalan	621	7,392	17,675
Kota Mojokerto	621	3,678	7,968
Kota Surabaya	29,697	75,243	164,403
Total	63,601	146,416	297,901

Source: JICA Study Team

ii) Waste Generated Using all 3R Measures

The adoption of the 3R method will dramatically reduce the amount of solid waste to be disposed of in landfills. The reduction will be from 2.39 million tons/year to 1.59 million ton/year by 30 % by 2030.

Table 5.4.44 Waste Generation through an Intensive 3Rs

Year / Area	2007	2010	2020	2030
Kab Sidoarjo	79,083	96,758	144,496	181,271
Kab Mojokerto	31,291	25,382	67,016	82,247
Kab Lamomgan	8,669	11,786	28,541	35,584
Kab Gresik	77,027	95,754	150,667	222,599
Kab Bangkalan	12,314	30,302	57,708	87,621
Kota Mojokerto	37,320	41,255	48,179	47,469
Kota Surabaya	902,876	942,724	959,047	933,888
GKS	1,148,580	1,243,961	1,455,654	1,590,679

Source: JICA Study Team

(5) Required Landfills while Utilizing 3R measure

As shown in Table 5.4.45, large tracts of landfills will be required by 2030 in the GKS, especially in Surabaya, Gresik and Sidoarjo. Municipalities are trying to secure landfill areas through mid- and long-term development plans. However, a long-term demand forecast has not yet been envisioned. The plan should include long-term

targets for landfill requirements.

The result indicates that reduction, recycling, and composting activities should immediately be undertaken. If their plans are realized, the Mojokerto, Lamongan, and Gresik landfills are expected to last 10 more years. However, results will be based on the assumed low collection coverage, and if coverage increases, landfill waste will correspondingly increase.

As a result, there is certainty that landfills will be filled to their capacities, as shown in Table 5.4.45. In the GKS, a land-use plan will be implemented in a fast pace, thus necessitating the need to secure new landfill sites. It should be noted that securing landfills is not a sustainable method; alternatives to waste disposal will have to be considered after 2030.

Table 5.4.45 Required Final Disposal Area with an Intensive 3R Measure

Area	Cumulated Waste from 2010 to 2030 (ton)	Required Total Area (ha)	Secure capacity (ha) in mid-term plan	Requirement factor	Additional Requirement
Kab Sidoarjo	2,835,107	95	10	10	85
Kab Mojkerto	1,208,306	40	5	8	35
Kab Lamongan	522,264	17	1	17	16
Kab Gresik	3,098,439	103	15	7	88
Kab Bangkalan	1,166,700	39	-	-	39
Kota Mojokerto	925,409	31	3	11	28
Kota Surabaya	18,973,535	632	15	43	617
GKS	28,729,760	957	49	20	908

Source: JICA Study Team

(6) Development Strategies

Strategies for solid waste management are as follows:

i) Paradigm Shift from End-of-Pipe Approach (waste disposal to landfill) to 3R method

The present waste management system is heavily dependent on the landfill system. But since the availability of landfills is limited, waste reduction should be promoted through other alternatives, i.e. the 3R method (reduce, reuse, recycle), composting, waster separation, etc. should be promoted.

ii) Securing Landfill Sites

As seen in the capacity-demand gap, even with a strong 3R measure, 921 hectares of land in the GKS (with 630 ha for Surabaya alone) is needed to accommodate the increase in waste generation. New landfills should be established along the following options, with careful environmental study and stakeholder agreement:

a) New Landfill Methods in Swamp Areas

- Ocean landfills. Waste collected at Depo/TPS will be transported to the sea

coast for dumping.

- Wetland landfills. Wetlands can be used for landfill sites. Swamp area in the eastern Kota Surabaya is a possible candidate for this purpose. After the Keptih closed in the eastern area of Surabaya, the Benowo landfill in the west side has served the waste disposal services in Surabaya City. In order to efficiently collect and transport waste, a landfill in the eastern area of Surabaya will be required. Benowo is located very far from the eastern area.

b) Landfill Reclamation/Excavation

In Kota Mojokerto, dumped garbage is planned to be excavated again with the aim of reviving a landfill. This procedure could be recommended for other municipalities. The problems arising from this process are how much amount could be used for fertilizer and the fact that contribution to waste reduction will be very low.

c) Adoption of Cross-Regional Disposal System

In principle SWM places the responsibility of implementation on local governments. Considering the complexity of waste management in the GKS such as waste generation and land procurement it could be more practicable if waste treatment could be done with the cooperation of other neighboring regencies. This method has been done successfully in several cases in Japan, and it brings the advantage of consistent facility operation, budget sharing, etc.

In the GKS, the "Environment Recycling Park" project is being planned as an adoption of this system. However the ERP project has hit a snag due to land acquisition issues. Land acquisition has the highest priority in the development of new disposal facilities. In this project, the landfill acquisition has mainly been done by Gresik. Land acquisition has no yet been done at all according to the PUCKTR of East Java.

d) Advantageous Areas for Lateral Municipalities, etc.

When one municipality has a need to dispose of its waste and another has a demand for jobs and land use, the mutual municipalities could negotiate to construct a landfill in the demanding municipality. This scenario is possible not only between two municipalities but also between two regions?? areas in a municipality.

iii) Upgrading of SWM Quality and Services

Illegal open dumping is still prevalent. This causes not only degradation in the surrounding environment but also human moral degradation. There are some reasons why high quality service cannot be provided to all areas in a municipality. This is due to insufficient SWM institutional capacities. Moreover, in order to accomplish a firm and sound 3R society, the collection of all recyclables in all concerned areas should be achieved.

In order to upgrade quality and service of solid waste management, (1) rehabilitation of infrastructure, (2) improvement of regulation and strengthening of institutional capacity,

and (3) development of education curriculum on environmental and solid waster management issues are required.

iv) Introduction of Appropriate SWM Technologies

Based on the characteristics of solid waste generated in the GKS, various advanced technology systems from collection to disposal will be introduced.

v) Introduction of New Technologies for Waste reduction

Taking into account the limited available landfill sites, the introduction of new technologies that can be used in landfills and further incineration should be considered.

vi) Improvement of Data Management System

The following are the minimum necessary SWM collection data: Waste, staff and equipment (facility), operational factors (number of trips, number of working staff and hours, etc), collection coverage, and other information and findings.

Collected data should be filed and secured from the intrusion of strangers and unexpected accidents. Data should be regularly revised on a monthly or annual basis, and periodically disseminated to stakeholders. The dissemination can be achieved through publication either in the form of statistics, brochures on SWM activities, pamphlets, and municipal publications.

vii) Improvement of Institutional Capacities

Although the role of the community in SWM is decreed by law there is no strong institution that implements SWM, even among municipal organizations. Hence, a strong integrated department on solid waste management is required and it should cover the whole procedural gamut such as recycling and composting, collection and transportation, equipment procurement, landfill management, well trained staffs, etc.

At present, there are national regulations and/or laws (ACT) on SWM such as No. 18 2008 on solid waste management which defines the roles and responsibilities of relevant SWM entities. However, this regulation doesn't contain departmental responsibilities. Law No.4, 2006 on revenues appear to be a more streamlined SWM policy. Periodic policy reviews and revisions in order to meet current conditions are needed.

(7) Development Projects and Implementation Plans

i) Development Projects

Although the lack of and difficulty in constructing new landfills are highly apparent, waste generation continues to increase every year. In order to make SWM sustainable, an intensive reduction at source should be undertaken because recycling and composting have their limitations.

And because of the inherent problems on land acquisition, incineration technology must be studied to promote sustainable waste reduction. To promote integrated SWM, a master plan covering two decades will be recommended, with 2030 as target. The last

master plan, the Surabaya City Development Plan on Solid Waste Management, was formulated 17–18 years ago. The proposed development projects in the integrated SWM master plan are shown in Table 5.4.46.

Table 5.4.46 Development Projects in the Integrated SWM Master Plan

No.	Development Project	Implementation Plan	Physical Component	Soft Component	Priority
1	Improvement of Existing Facilities and Equipment	Survey/rehabilitation plan of existing facility/equipment	Improvement of quality of infrastructure from the sanitary point of view	Strategy-building of restore/ close landfills	1st
2	Disposal Capacity Development	3R Enhancement Plan			1st
		Discharge/collection System Renovation	Improvement of capacity and quality of infrastructure-containers, bins, depots & construction of new transfer stations	Implementation of a model project for source separation; and planning of new transportation systems (including use of railway)	2nd
		Intermediate Treatment System Renovation	Provision of necessary recycling / composting facilities by DKP Additional construction of compost center by DKP Plan of separation technology at TS (?)	Recycling / composting market development; and establishment of an association for management	1st
		New Waste Reduction Technology Plan			1st
		New Technology Introduction	Adoption of Incineration Technology		2nd
		New Landfill Seeking Plan			1st
		Development of Final Disposal Methods	Seeking a new landfill site & waste excavation at landfill for recycling	Strategic planning for land acquisition	1st
3	Development of Cross-Regional Disposal System	Development of Regional Disposal System	Plan/ construction of an Integrated Recycling Management Center	Development program of regional disposal system	2nd
4	Institutional Capacity Building	Institutional Capacity Building Plan	-	Enactment of regulations and establishment of enhanced the SWM organization	2nd
		Public Awareness raising Program	-	Preparation of educational programs and materials on SWM for each stake holders group	3rd
5	Development of an Information System on SWM	Establishment of Data Collection and Management System	Introduction of a waste amount measuring system	Enhancement of data collecting & monitoring systems	2nd
6	Formulation of SWM Master Plan			Study of an GKS SWM Master Plan over 2030	1stt

Source: JICA Study Team

ii) Implementation Plans

In the implementation of the SWM master plan, it is important to set milestones for effective budget spending and avoid waste. The milestones will be the achievement of targets in a particular period. If difficulties occur in the plan, it should be revised. Implementation schedules should be considered. The recommended schedule is presented in Table 5.4.47 reference.

Table 5.4.47 Recommended Project Implementation Schedule

	Implementation Plan (Components of MP)	Implemented By	Mid-term		Long-term	
			2010–2020		2021–2030	
1	Survey/rehabilitation of appropriate assets/conditions	DKP	———	———		
2	Disposal Capacity Development Plan	BAPPEKO/DKP	———	———	———	———
3	Data collection and control system establishment	PUCKTR/DKP	———			
4	Cross-regional Disposal System Development Plan	BAPPEDA/BAPPEKO	———	———	———	
5	Institutional capacity building Plan	BAPPEDA/BAPPEKO		———	———	
6	Public awareness raising Plan	DKP/Community	———	———	———	———
7	Formulation of Master Plan	DKP/BAPPEKO	———	———	———	———
	5-year Development/Strategic Plan	DKP/BAPPEKO	↓	↓	↓	↓
			5 year plan should incorporate the above activities from next plan			

Source: JICA Study Team

5.4.4 Energy Systems

1) Current Situation and Problems

(1) Service Providers for Electric Power

Electric power services in Indonesia are managed by the state-owned energy corporation, Perusahaan Umum Listrik Negara Persero (PLN). Pursuant to the 1985 Electricity Law, PLN is responsible for electric power generation, transmission, and distribution. Other independent power producers provide supplementary power to PLN from their own power plants. PLN's service is divided into three areas: the Java-Bali operations area in Java and Bali, Western Indonesia operations area in Sumatra and West Kalimantan, and the Eastern Indonesia operations area comprising Central and East Kalimantan, Sulawesi, Nusa Tenggara, Maluku, and Papua. Over the years, PLN was divided into 18 separate companies. The GKS Zone is located in the Java–Bali operations area and is served by PLN East Java.

(2) Current Electric Power Sources

PLN East Java handles 55 power generating units with a total generating capacity of 6,456 MW, plus 35 thermal units (steam, combined cycle and gas turbine types) and 20 hydro units.

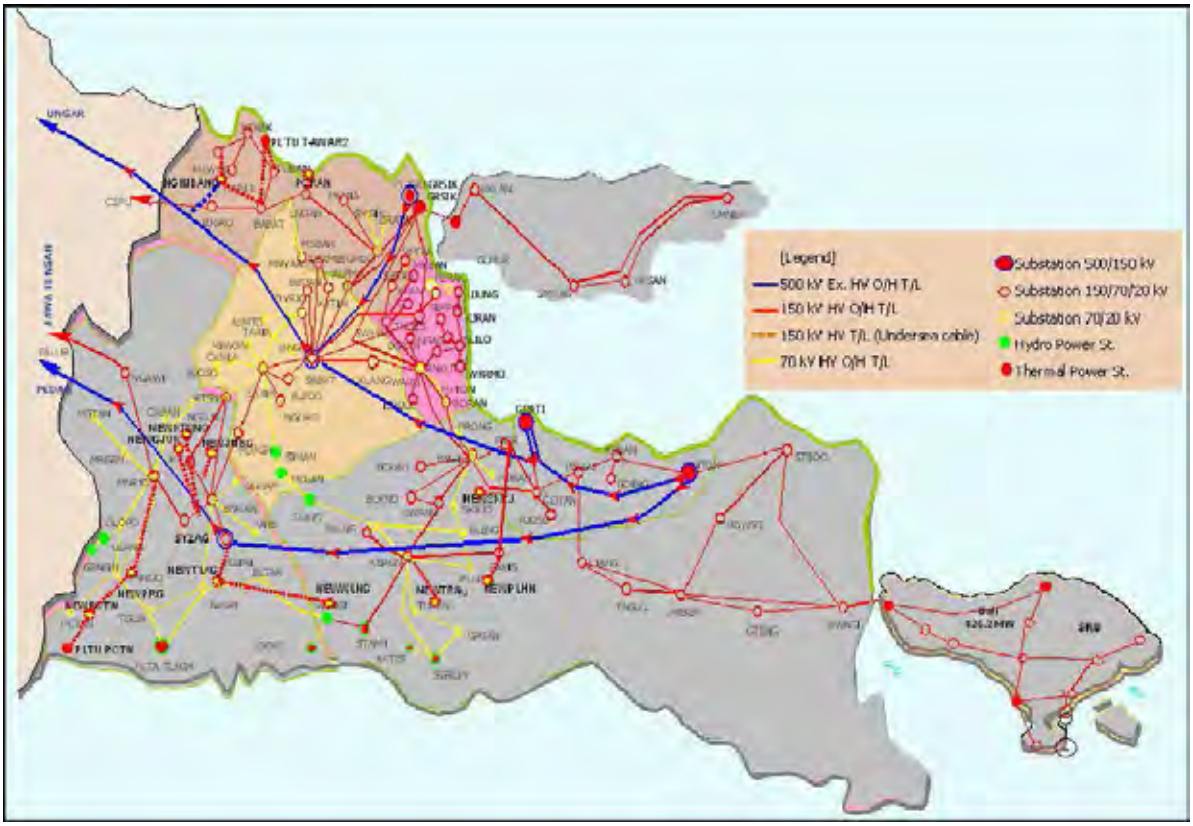
Table 5.4.48 Power Plants in East Java

Power Plant	Type	Installed MV	Available MV	Power Plant	Type	Installed MV	Available MV
Gresik	Steam	600	562	PLTA Wlingi	Hydro power	54	54
Gresik Block 1	Combined cycle	526	450	PLTA Ldoyo	Hydro power	5	5
Gresik Block 2	Combined cycle	526	450	PLTA Slrjo	Hydro power	5	5
Gresik Block 3	Combined cycle	526	450	PLTA Sqruh	Hydro power	29	29
Granti Block 1	Combined cycle	462	447	PLTA Tlgng	Hydro power	36	36
Granti Block 2	Combined cycle	302	297	PLTA Wnrjo	Hydro power	6	6
PLTU Perak	Steam	100	82	PLTA Mdlan	Hydro power	23	22
PLTU Paiton	Steam	3,330	2,910	PLTA Siman	Hydro power	11	0
PLTG Gresik	Gas turbine	40	32	PLTA Glang	Hydro power	3	3
PLTG Glmur	Gas turbine	43	32	PLTA Gmgn	Hydro power	3	3
PLTA Stami	Hydro power	105	105	PLTA Ngbel	Hydro power	2	2
					Total	6,456	5,712

Source: PLN East Java

(3) Electric Power Transmission System

The electricity supply system in East Java is part of the Java–Bali interconnection system. Its transmission line voltages are three 500kV for the lines from power station to primary substation, forming the national grids (Backbone); 150kV for the lines from the primary substation, as provincial grids; and 70kV for the lines forming as regional grids. The GKS zone receives electric power from the two national grids in the Java-Bali system, one is the Northern Line leading to Ungaran and the other is the Southern Line to Pedan in Central Java (which finally connects up to West Java) 150 kV undersea power cables are used between “Java and Madura” and “Java and Bali”.



Source: PLN East Java

Figure 5.4.22 Grid Map of East Java

(4) Electric Power Distribution System

After the transmission lines, electric power comes surges into the distribution network, which are medium voltage distribution networks with 20kV and low voltage distribution networks with 380-220V. Consumers receive electric power supply through 20 kV/380-220 V distribution transformers. Large capacity, high/medium voltage are required for large industrial customers.

The power distribution network facilities in East Java were developed through consecutive years. The physical development growth of the distribution network from 2007 to 2008 were 0.92% for the 20 kV medium voltage distribution network and 0.13% for the low voltage distribution network in parallel with increasing distribution transformers by 0.62% (refer to Table 5.4.49).

Table 5.4.49 Augmentation of the Distribution System in East Java

Year / Level	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Medium Voltage (Km)	25,944	26,101	27,516	27,747	28,452	28,546	28,924	29,730	29,929	30,205
Low Voltage (Km)	44,601	46,483	46,612	49,933	51,395	51,439	53,066	55,642	57,989	58,067

Source: PLN East Java

(5) Current Electric Power Consumption

As of 2008, the total consumption of electric power in East Java was 20,334GWh, which is 172% to that of 1998. Within the total consumption in East Java, electric power consumption in the GKS and in the GKS Plus was 11,197GWh and 13,268GWH respectively, The figures are equivalent to 55% and 65% of the total consumption in East Java. Please refer to Table 5.4.50.

Table 5.4.50 Area Offices of PLN East Java and Power Consumption in 2008

Zone	Area Office	Connected Capacity (MW)	Energy Sales (kWh)
GKS	Surabaya Selatan	1,350,767	2,871,135
GKS	Surabaya Selatan	979,276	1,882,324
GKS	Mojokerto	824,734	1,923,546
GKS	Gresik	460,087	1,114,942
GKS	Sidoarjo	714,712	1,624,743
GKS	Surabaya Barat	599,938	1,780,525
GKS Plus	Bojonegoro	591,581	1,576,256
GKS Plus	Pamekasan	312,731	494,897
	Malan	799,692	1,432,837
	Pasuruan	817,237	2,071,953
	Kendiri	693,410	1,224,599
	Madiun	377,791	576,058
	Jember	415,517	684,074
	Banyuwangi	276,273	456,943
	Situbondo	156,853	274,161
	Ponorogo	249,240	345,170
	Total of East Java	9,619,839	20,334,163
	Total of GKS Plus	5,833,826	13,268,368
	Total of GKS	4,929,514	11,197,215

Source: PLN East Java and JICA Team

The following were the power consumption growth rates by sector: domestic 198%, commercial 326%, industrial 166%, and social 231%. Population and GRDP respectively increased by 113% and 164% for the same period. The following were the composition of power consumption in East Java in 2008: domestic 36.7%, commercial 12.5%, industrial 45.0%, and social 5.8%. On the other hand, the following were the power consumer composition for 2008: domestic 92.5%, commercial 4.6%, industrial 0.2%, and social 2.8%. Power consumption per customer for 2008 was the following: domestic 1171 kWh, commercial 8041 kWh, industrial 830200 kWh, and social 6156 kWh (refer to Tables 5.4.51 to 5.4.53).

Table 5.4.51 Number of Connections in East Java by Sector

Year / Sector	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Domestic	5,090,348	5,236,232	5,391,876	5,558,643	5,697,684	5,831,893	5,956,586	6,085,181	6,225,726	6,373,245
Commercial	162,368	192,092	241,759	263,080	278,396	294,092	304,876	303,202	309,282	315,469
Industrial	9,325	9,794	10,181	10,567	10,688	10,816	10,909	10,910	10,969	11,032
Social	133,836	138,782	144,565	150,830	156,566	162,954	168,578	174,276	182,845	190,505
Total	5,395,877	5,576,900	5,788,381	5,983,120	6,143,334	6,299,755	6,440,949	6,573,569	6,728,822	6,890,251

Source: PLN East Java

Table 5.4.52 Electric Power Consumption (GWh) in East Java by Sector

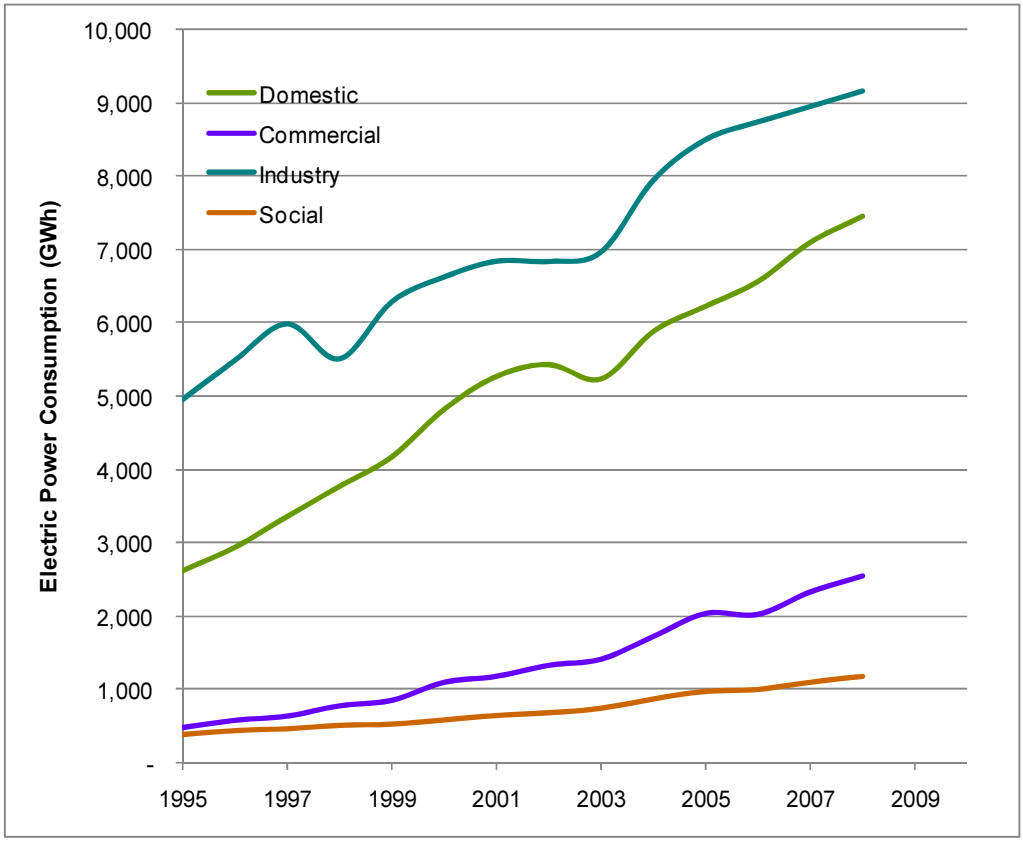
Year / Sector	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Domestic	4,182	4,829	5,280	5,441	5,245	5,892	6,237	6,575	7,107	7,466
Commercial	854	1,097	1,178	1,327	1,410	1,717	2,029	2,016	2,319	2,537
Industrial	6,292	6,629	6,844	6,841	6,968	7,946	8,498	8,737	8,947	9,159
Social	521	579	640	677	737	866	968	995	1,094	1,173
Total	11,849	13,135	13,941	14,286	14,361	16,421	17,732	18,323	19,467	20,334

Source: PLN East Java

Table 5.4.53 Electric Power Consumption (kWh) per Connection in East Java by Sector

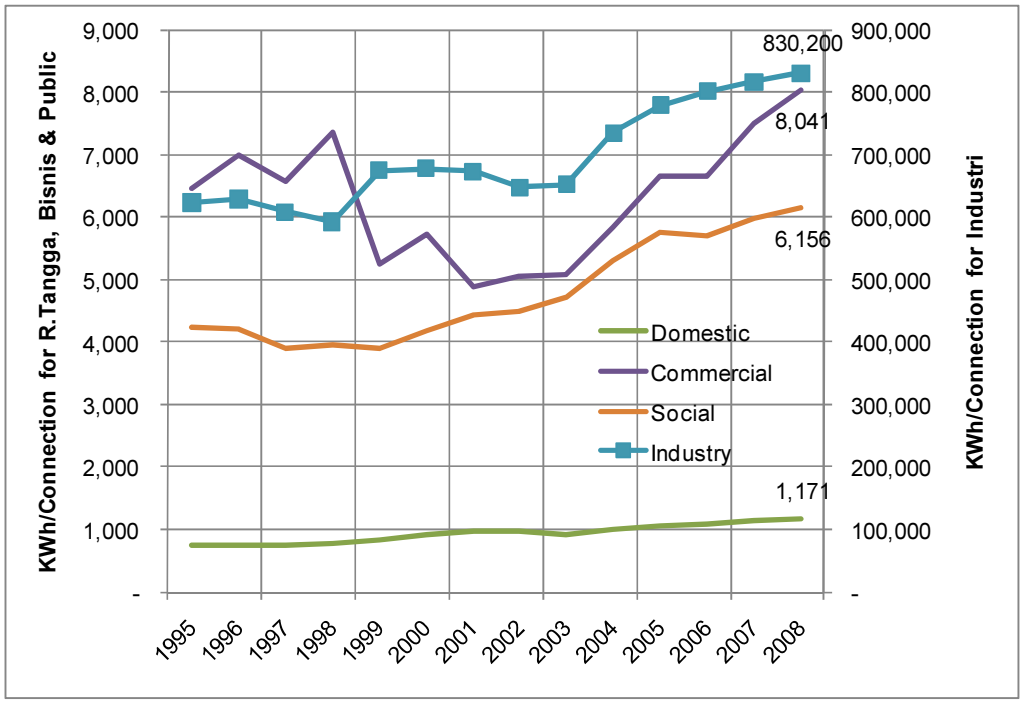
Year / Sector	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Domestic	822	922	979	979	921	1,010	1,047	1,080	1,142	1,171
Commercial	5,257	5,710	4,871	5,043	5,064	5,839	6,655	6,650	7,498	8,041
Industrial	674,774	676,881	672,250	647,411	651,947	734,631	778,949	800,855	815,662	830,200
Social	3,894	4,174	4,425	4,491	4,710	5,312	5,742	5,708	5,983	6,156
Average	2,196	2,355	2,408	2,388	2,338	2,607	2,753	2,787	2,893	2,951

Source: PLN East Java



Source: PLN East Java

Figure 5.4.23 Growth of Electric Power Consumption by Sector



Source: PLN East Java

Figure 5.4.24 Electric Power Consumption per Connection in East Java by Sector

(6) Peak Loads and Load Factors

Peak load in East Java has increased every year. In 2008, the peak load was 3,461 MW including approximately 1,400 MW in the GKS. The maximum peak load in 2009 was 3,541.4 MW, recorded on 20 October. As a conventional pattern, electric power consumption increases from 5:00 p.m., reaching its peak after 7:00 p.m. and then progressively decreasing until 12:00 midnight. During the off-peak on weekdays, power demand ranges from 2,300 MW to 3,000 MW, and this decreases on weekends.

In order to avoid overloading transformers, the load factor and total installation capacity of a substation divided by peak load should be less than 80%, which is a PLN criterion. The load factor in East Java has been controlled below 80%, as shown in Tables 5.4.54 and 5.4.55.

Table 5.4.54 Peak Loads and Load Factors in East Java

Item \ Year	2004	2005	2006	2007	2008
Peak Load [MW]	3,127	3,265	3,276	3,384	3,461
Load Factor [%]	68.0	68.1	75.0	75.5	76.8

Source: PLN East Java and JICA Team

Table 5.4.55 Distribution of 20kV Transformers in East Java in 2008

Service Area	1 Phase		3 Phase		Total	
	Units	kVA	Units	kVA	Units	kVA
South Surabaya	1,476	65,963	3,764	583,225	5,240	649,188
North Surabaya	81	2,475	4,907	454,580	4,988	457,055
Malang	612	26,855	1,557	392,560	2,169	419,415
Pasuruan	962	41,470	2,413	468,190	3,375	509,660
Kediri	665	25,690	2,488	315,965	3,153	341,655
Mojokerto	55	3,808	2,375	292,352	2,430	296,160
Madiun	461	18,492	1,856	226,335	2,317	244,827
Jember	351	16,135	1,955	252,875	2,306	269,010
Bojonegoro	478	16,850	2,352	218,625	2,830	235,475
Banyuwangi	458	19,340	1,107	118,475	1,565	137,815
Pamekasan	76	3,070	2,390	180,345	2,466	183,415
Situbondo	293	13,000	830	81,345	1,123	94,345
Gresik	426	16,575	535	103,385	961	119,960
Sidoarjo	680	30,450	1,667	367,460	2,347	397,910
West SURABAYA	132	5,560	1,088	165,675	1,220	171,235
Ponorogo	710	28,175	1,042	127,260	1,752	155,435
Total	7,916	333,907	32,326	4,348,652	40,242	4,682,559

Source: PLN East Java

(7) Electrification Ratios and Village Electrification Ratios

Electrification ratio (or the number of connections / number of households) in 2008 was 65.91% while the national average was approximately 57%. The electrification ratios in the last five years in East Java are shown in Table 5.4.56.

Table 5.4.56 Electrification Ratios in East Java (2004–2008)

Item	Unit	Year				
		2004	2005	2006	2007	2008
Population	Million persons	36.58	36.97	37.07	37.80	37.90
Population Growth	%	1.06	1.06	0.27	1.96	0.27
Household	Million HH	9.03	9.13	10.11	10.28	10.89
Household Growth %	%	1.31	1.06	10.77	1.61	5.98
Connection	Million	5.83	5.96	6.09	6.73	7.18
Connection Growth	%	2.36	2.14	2.16	10.56	6.67
Electrification	%	64.56	65.25	60.18	65.48	65.91

Source: PLN East Java and JICA Team

The village electrification ratio (or the number of electrified villages / number of villages) in East Java already reached 99% since year 2000 according to PLN, as shown in Table 5.4.57. At present, some villages cannot access power supply either due to distance from the transmission grids or geographical difficulties in accessing off-grid power supply.

Table 5.4.57 Electrification Ratios in Villages in East Java (2004–2008)

Year / Item	2004	2005	2006	2007	2008
Number of Villages	8,484	8,484	8,484	8,483	8,492
Number of villages electrified	8,424	8,424	8,425	8,427	8,429
Village electrification ratio	99.29%	99.29%	99.30%	99.34%	99.26

Source: PLN East Java

(8) Distribution Losses

There are two kinds of distribution loss: “technical loss” due to system/hardware specification and “non-technical loss” due to irregular/illegal use by consumers. Both these losses can be improved through the following measures:

<For Technical Loss>

- Reconfiguring the network;
- Upsizing conductors; and
- Inserting distribution transformers.

<For Non-technical Loss>

- Tightening supervision of irregular/illegal connection of wires without kWh

meters;

- Tightening security for kWh meters from illegal revamping or updating transaction points; and
- Properly switching street lighting at night.

Table 5.4.58 shows the distribution loss in the last five years gradually improving every year. Distribution loss in 2008 fell to 7.22%.

Table 5.4.58 Distribution Losses in the Power System in East Java (2004–2008)

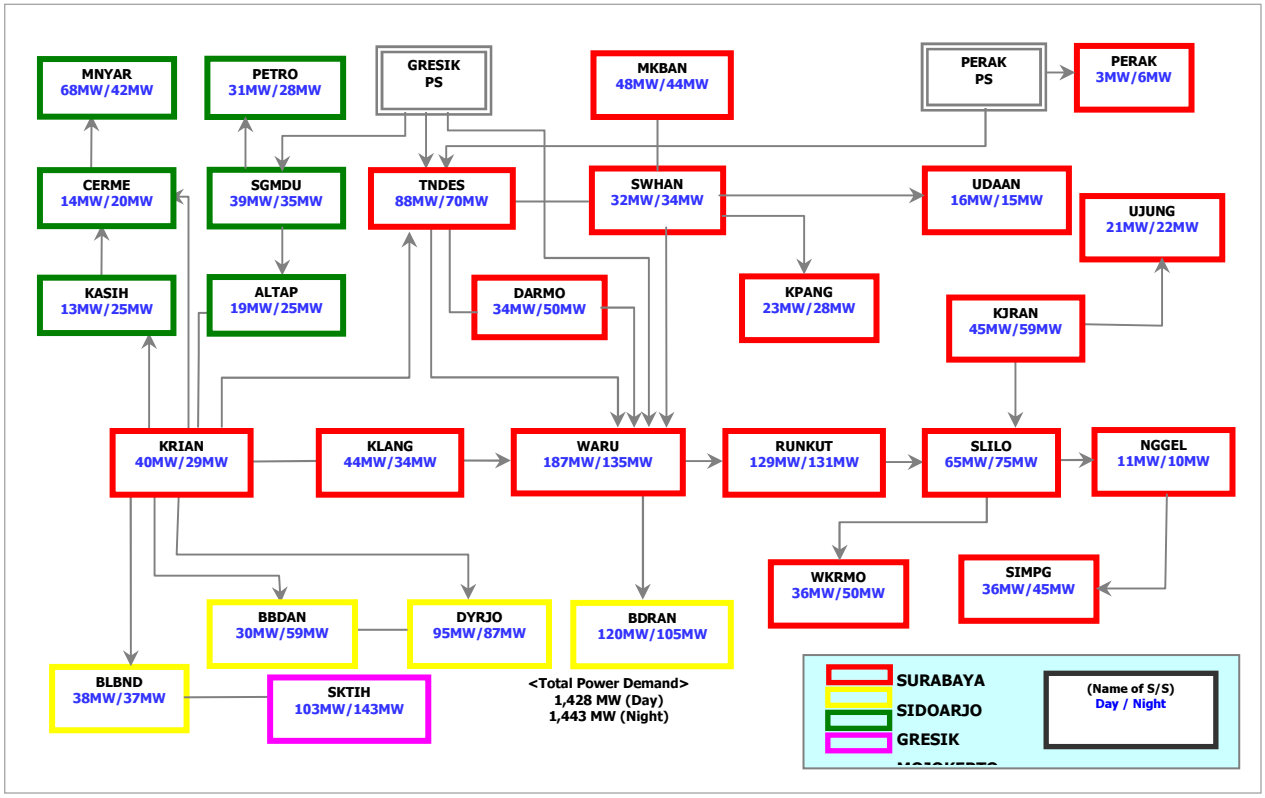
	2004	2005	2006	2007	2008
Distribution Loss (%)	8.97	8.38	8.32	7.58	7.22

Source: PLN East Java

i) Necessary Capacity Augmentation by PLN

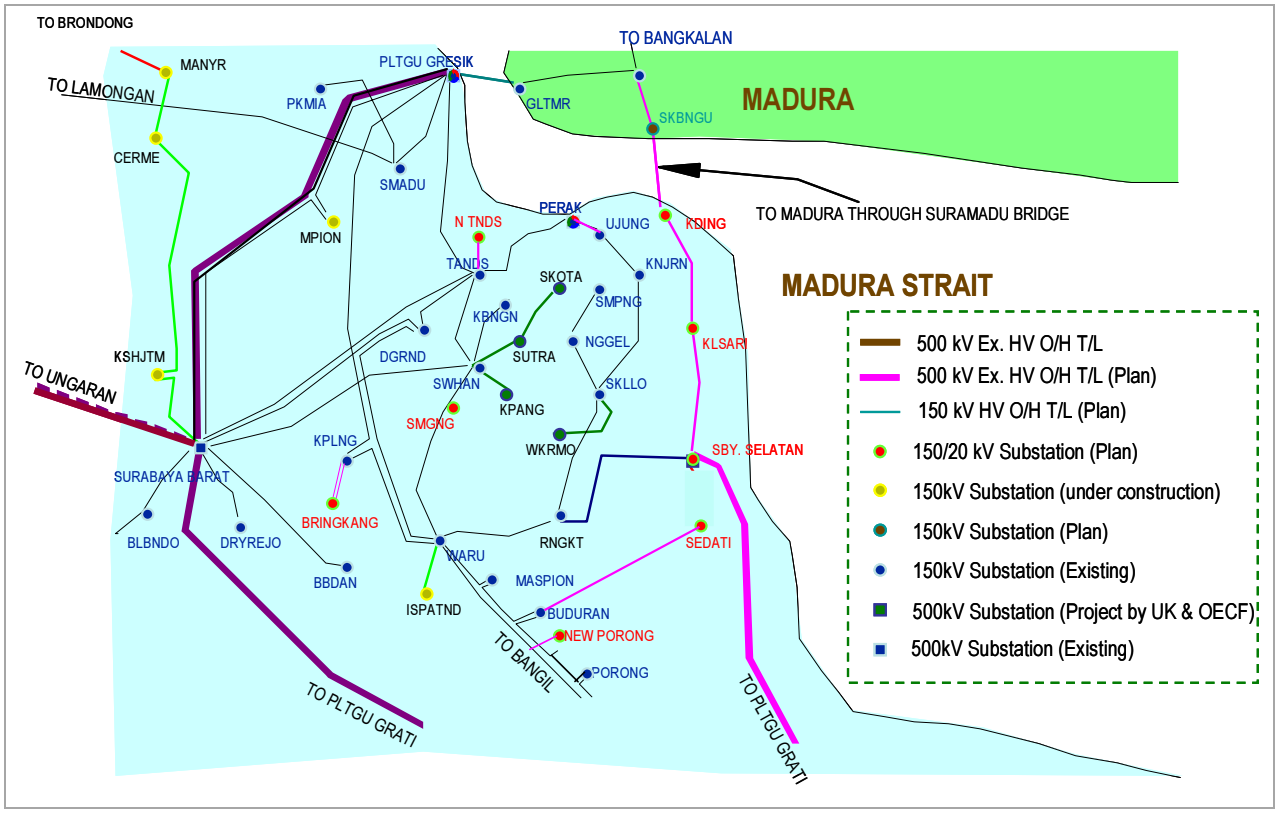
PLN East Java's Decade Power Development Plan, called RUPTL 2010-2019, states that electricity supply in East Java, which included the GKS up to the year 2008, was mostly fulfilled. However, the following issues and problem issues were found:

- In some places the voltage condition is 10% below the nominal voltage, resulting to consumer complaints, especially industrial customers who are supplied insufficient voltage.
- About 34 of the 94 power transformers units in the substations in East Java are overloaded beyond the 80% permissible load.
- Current electricity supply situation in Surabaya is critical because the power supply to most part of the city is dependent upon the Waru Primary Substation as shown in Figure 5.4.255. Hence an interruption of 150 kV transmission line between Waru and Rungkut will paralyze Surabaya since power supply cannot reach its downstream substations. In addition, the load factor of the existing 500/150 kV transformers in the Krian Substation, which is located upstream of Waru Substation, has reached a 93% load factor, which require additional transformers in order to keep the nominal load factors less than 80%.
- To make this current network in Surabaya City more reliable, the expansion of the network exactly requires the forming of a loop system.
- In order to solve the above voltage drop and overloading on the transformers, reinforcement of the medium- and low-voltage distribution network is ongoing. The availability of investment funds for PLN is key to overcoming this issue.



Source: PLN East Java

Figure 5.4.25 Power Demand in GKS Zone in 2009



Source: PLN East Java

Figure 5.4.26 Current Transmission Network in Surabaya City

2) Demand Forecasts

(1) Demand Forecasts by PLN and the JICA Study Team

Demand forecasts until 2025 were made by PLN East Java . Demand projections were calculated through Model DKL 3.02 Program made by PLN. The demand forecasts were based on the economic growth in East Java as projected by BAPPENAS which set the rates of 5.99% until 2010, 6.29% from 2011 until 2015, and 5.99% from 2016 onwards. With reference to these demand forecasts, the JICA Study Team calculated its own demand forecast for the GKS Zone until 2030.

Table 5.4.59 summarizes the demand–supply balance for PLN's and JICA Team's forecasts. With an existing available capacity of 5,932 MW, demand will increase and reach 11,644 MW by 2030.

In respect of relevant studies, the Study on Optimal Electric Power Development in Java-Madura-Bali in the Republic of Indonesia was conducted by JICA in December 2008. The Java-Madura-Bali electric study includes power development plans for reinforcement of power generating plants and an extra-high voltage transmission line network in the national grid in the whole Java-Madura-Bali area, but not power development plans particularly for the GKS zone. This JICA Study mainly covers a development plan of high voltage transmission and distribution line networks in the GKS zone based on relevant information provided by PLN East Java, which focuses on regional power development plans for the GKS zone. Accordingly, there is no contradiction between the JICA Study and the Java-Madura-Bali electric power study because of the voltage class difference

Table 5.4.59 Demand–Supply Balance Forecast in East Java and GKS

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Population (Million)																					
East Java by PLN	37,470	37,645	37,812	37,971	38,120	38,259	38,387	38,505	38,607	38,692	38,760	38,870	38,963	39,057	39,150	39,243	NA	NA	NA	NA	NA
GKS by JICA Team	9,725	9,937	10,154	10,375	10,602	10,832	11,030	11,232	11,437	11,647	11,860	12,064	12,271	12,482	12,697	12,913	13,136	13,363	13,595	13,830	14,068
East Java by JICA Team	39,540	39,975	40,415	40,860	41,309	41,754	42,213	42,677	43,147	43,621	44,133	44,619	45,109	45,606	46,107	46,695	47,255	47,822	48,396	48,977	49,453
Population Growth (%)																					
East Java by PLN	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	NA	NA	NA	NA	NA
GKS by JICA Team	2	2.2	2.2	2.2	2.2	2.2	1.8	1.8	1.83	1.83	1.83	1.72	1.72	1.72	1.72	1.72	1.73	1.73	1.73	1.73	1.73
East Java by JICA Team	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2
GRDP Growth (%)																					
East Java by PLN	6	6.3	6.3	6.3	6.3	6.3	6	6	6	6	6	6	6	6	6	6	NA	NA	NA	NA	NA
GKS by JICA Team	5.8	5.6	5.6	5.6	5.6	5.6	4.3	4.3	4.3	4.3	4.3	3.8	3.8	3.8	3.8	3.8	3.5	3.5	3.5	3.5	3.5
East Java by JICA Team	6.6	5	5	5	5	5	4	4	4	4	4	3.5	3.5	3.5	3.5	3.5	3.2	3.2	3.2	3.2	3.2
Peal Load (MW)																					
East Java by PLN	3,840	4,159	4,548	4,978	5,455	5,974	6,555	7,184	7,866	8,581	9,334	10,139	10,978	11,883	12,840	13,858	NA	NA	NA	NA	NA
GKS by JICA Team	1,557	1,680	1,813	1,957	2,111	2,278	2,419	2,570	2,729	2,899	3,079	3,251	3,432	3,624	3,826	4,040	4,254	4,479	4,716	4,965	5,228
Peak Load without saving	3,947	4,139	4,445	4,775	5,136	5,522	5,876	6,247	6,637	7,034	7,438	7,808	8,176	8,564	8,961	9,371	9,787	10,222	10,676	11,149	11,644
Power Generation (MW)																					
Installed capacity	6,737	8,042	8,087	8,887	9,487	9,487	9,487	9,487	9,487	9,487	9,487	11,287	11,287	11,287	11,287	11,287	13,087	13,087	13,087	13,087	13,087
Available capacity	5,982	7,156	7,197	7,917	8,457	8,457	8,457	8,457	8,457	8,457	8,457	10,077	10,077	10,077	10,077	10,077	11,697	11,697	11,697	11,697	11,697
Additional Capacity (MW)		1,305.00	45	800	600	-	-	-	-	-	-	**1,800.00**	-	-	-	-	**1,800.00**	-	-	-	-
Pacitan (PLN)		630																			
New Paiton (PLN)		660																			
Gresik Power Indonesia (IPP)		15																			
Petrokimia Gresik Steam (IPP)			15																		
PLTU Gasuma Tuban (IPP)			30																		
PLTGU Paiton III-IV (IPP)				800																	
Tanjung Awar-Awar (PLN)					600																
(Target by 2020)												**1,800.00**									
(Target by 2025)																	**1,800.00**				

Source: PLN and JICA Study Team

(2) Demand Forecast with Power Saving

To reduce demand, various power-saving measures have been adopted throughout the world. Three such measures, shown in the table below, have been employed to recalculate future power demand.

Table 5.4.60 Power-saving Measures Adopted Globally

Measure	Description
Use of LED Lighting	A light-emitting-diode (LED) lamp is a solid-state type lighting that has more than three times the life span and 25% of the power consumption of the regular fluorescent lamps although initial costs are higher than the regular lamps. In general, about 16% of the total energy consumption of consumers is used up through lighting. Which means that around 12% of energy saving will be attained if all consumers use LED lamps instead of incandescent or fluorescent lamps. It is assumed that popularity of LED lamps will be realized after five years (Year 2015) in Indonesia, increasing gradually every year, then the expected 12% energy saving will be achieved in the next ten (10) years when most people will be using LED lamps. Technology of LED lamps is developing and will attain higher efficiency and they will be of wide use of thier initial costs will become lesser.
Proper Use of Air Conditioning	Public awareness of energy saving on proper use of air-conditioning is also very important and it is a practical measure under the demand side management. Some people use air-conditioning by maximum fan-speed with minimum temperature setting and by such manner achieve a heavy load on the air-conditioning thereby shortening its lifespan. The proper way is to set up proper room temperatures (around 25 ºC) under “Automatic” fan speed control. People should start this measure as soon as possible by way of announcements through governmental advertisement (or other media) and this is one of the easiest measures for people to realize energy-saving measures in their daily lives. Around 5% of energy saving will be expected if all the customers follow this measure.
Use of Renewable Energy	Photovoltaic power (solar power) and biomass generating facilities are expected to be used by consumers at least in principle. Especially photovoltaic power generating equipment which can cover 15% of energy consumption if they get direct sunshine at least six hours in a day. These facilities will come to be used by a large number of people in five years around (Year 2016) in Indonesia, comparing with 1.0 % of those diffusion ratios in Japan in 2008. In case that the same ratio is expected in Indonesia in 2016, about 0.1 % of energy saving will be expected and this will increase slightly every year.

Source: JICA Study Team

With these power-saving measures, by 2030, total demand will be 9,409 MW, which is a reduction of around 20% from that without power-saving measures. Without adopting such measures, demand will surpass supply by 2016, and even with such measures, supply will have a shortfall by 2018 (refer to Table 5.4.61 and Figure 5.4.27).

To address the demand issue, PLN has a development plan to meet the demand until 2018. To meet further demand, a capacity augmentation of 1,800 MW by 2021 and 2026, as proposed by the JICA Study Team, should be carried out.

Table 5.4.61 Demand–Supply Forecast in East Java and GKS

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Population (Million)																					
East Java by PLN	37,470	37,645	37,812	37,971	38,120	38,259	38,387	38,505	38,607	38,692	38,760	38,870	38,963	39,057	39,150	39,243	NA	NA	NA	NA	NA
GKS by JICA Team	9,725	9,937	10,154	10,375	10,602	10,832	11,030	11,232	11,437	11,647	11,860	12,064	12,271	12,482	12,697	12,913	13,136	13,363	13,595	13,830	14,068
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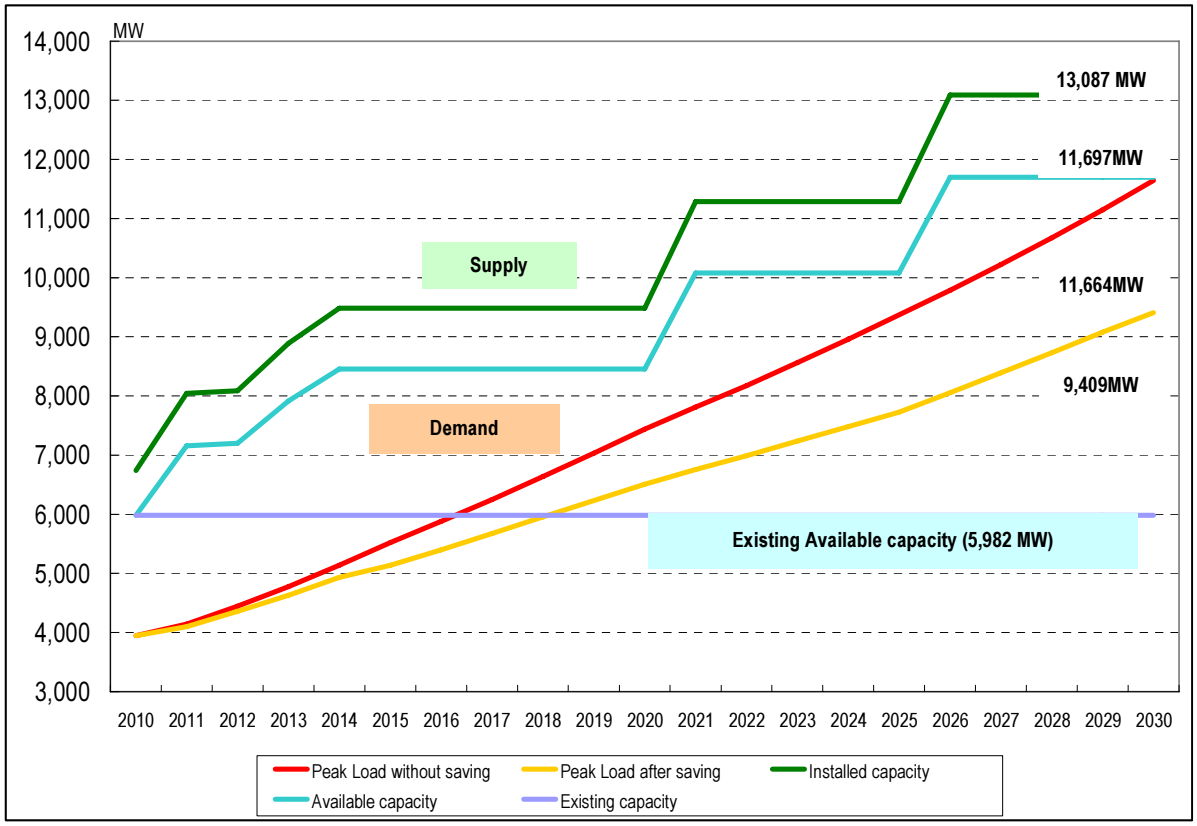
Population Growth (%)																					
East Java by PLN	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	NA	NA	NA	NA	NA
GKS by JICA Team	2	2.2	2.2	2.2	2.2	2.2	1.8	1.8	1.83	1.83	1.83	1.72	1.72	1.72	1.72	1.72	1.73	1.73	1.73	1.73	1.73
East Java by JICA Team	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2
GRDP Growth (%)																					
East Java by PLN	6	6.3	6.3	6.3	6.3	6.3	6	6	6	6	6	6	6	6	6	6	NA	NA	NA	NA	NA
GKS by JICA Team	5.8	5.6	5.6	5.6	5.6	5.6	4.3	4.3	4.3	4.3	4.3	3.8	3.8	3.8	3.8	3.8	3.5	3.5	3.5	3.5	3.5
East Java by JICA Team	6.6	5	5	5	5	5	4	4	4	4	4	3.5	3.5	3.5	3.5	3.5	3.2	3.2	3.2	3.2	3.2
Peal Load (MW)																					
East Java by PLN	3,840	4,159	4,548	4,978	5,455	5,974	6,555	7,184	7,866	8,581	9,334	10,139	10,978	11,883	12,840	13,858	NA	NA	NA	NA	NA
GKS by JICA Team	1,557	1,680	1,813	1,957	2,111	2,278	2,419	2,570	2,729	2,899	3,079	3,251	3,432	3,624	3,826	4,040	4,254	4,479	4,716	4,965	5,228
East Java by JICA Team	3,947	4,139	4,445	4,775	5,136	5,522	5,876	6,247	6,637	7,034	7,438	7,808	8,176	8,564	8,961	9,371	9,787	10,222	10,676	11,149	11,644
Power Saving (% & MW)																					
by LED lightings (%)						2	3	4	5	6	7	8	9	10	11	12	12	12	12	12	12
by Air-conditioning (%)		1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
by Renewable energy (%)							0.1	0.2	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.9	1.2	1.6	2.2
Peak Load after saving	3,947	4,097	4,356	4,632	4,931	5,135	5,400	5,672	5,954	6,232	6,508	6,754	6,991	7,237	7,483	7,722	8,055	8,392	8,733	9,076	9,409
Power Generation (MW)																					
Installed capacity	6,737	8,042	8,087	8,887	9,487	9,487	9,487	9,487	9,487	9,487	9,487	11,287	11,287	11,287	11,287	11,287	13,087	13,087	13,087	13,087	13,087
Available capacity	5,982	7,156	7,197	7,917	8,457	8,457	8,457	8,457	8,457	8,457	8,457	10,077	10,077	10,077	10,077	10,077	11,697	11,697	11,697	11,697	11,697
Additional Capacity (MW)		1,305.00	45	800	600	-	-	-	-	-	-	**1,800.00**	-	-	-	-	**1,800.00**	-	-	-	-
Pacitan (PLN)		630																			
New Paiton (PLN)		660																			
Gresik Power Indonesia (IPP)		15																			
Petrokimia Gresik Steam (IPP)			15																		
PLTU Gasuma Tuban (IPP)			30																		
PLTGU Paiton III-IV (IPP)				800																	
Tanjung Awar-Awar (PLN)					600																
(Target by 2020)												**1,800.00**									
(Target by 2025)																	**1,800.00**				

Source: PLN and JICA Study Team



Source: JICA Study Team

Figure 5.4.27 Demand–Supply Forecast for East Java and GKS

3) Strategies

(1) Improvement and Reinforcement of Network

In order to solve the above mentioned issues and to meet increasing electricity demand, the existing transmission and distribution network should be improved and reinforced by considering the following actions:

- Extend transmission/distribution lines.
- Increase the number of substations or install additional transformers.
- Reduce distribution loss (technical loss) by replacing existing equipment with larger sized conductors or high-efficiency transformers, or inserting capacitors.

(2) Demand-side Management

In order to overcome shortages, a demand side management (DSM) should be instituted to reduce network overloads, especially by promoting the following strategies:

- Promote educational campaigns in the use of lights, energy-saving equipment and energy conservation.
- Initiate load shifting from peak time in the evening to low-consumption time in the morning/afternoon with incentives to customers.
- Tighten control in Non-technical losses (irregular/illegal connections, revamping

kWh meters, etc.)

(3) Promotion of Captive Power

Government Regulation No. 3 of 2005, which amended Government Regulation No. 10 1989, states that power supply in Indonesia can be implemented by business entities other than PLN to engender the growth of individual power providers and instill competition.

i) Promotion of Captive Power

The quest for alternative power sources should have primacy among regional energy policy makers in terms of synergy with the national and regional power. It should be emphasized, or regulated, that excess power from among the alternative power sources should be fed to PLN network in order to encourage the IPP scheme.

ii) Small-scale Scattered Power

Based on Decree of the Minister of Energy and Mineral Resources No.1122.K/30/MEM/2002, 12 June 2002 on guidelines for power plant utilization of scattered small-scale power plants (scattered PSK), generating less than 1 MW through the use of renewable energy, could be saleable to PLN subject to the requirements of PLN. In East Java, the scattered small-scale power plants can be promising in providing rural electricity.

iii) Renewable Energy

East Java, especially Surabaya, has many studies on renewable energy sources, such as waste-to-energy, biomass power, solar power, and wind power. However, the promotion of renewable energy is still constrained by low viability due to high investment costs and the price of electricity. The key to the success of promoting renewable energy is to set a feasible electricity purchase price from energy providers.

4) Action Plans

(1) Power Generation

To cope with increasing electricity demand in East Java, PLN East Java is planning to install generators until 2014 at several locations, as shown in the table below. In addition, the JICA Study Team proposes more generators to be built by 2021 and 2026, as shown in the table below.

Table 5.4.62 Power Generation Plan

Item \ Calendar Year	2011	2012	2013	2014	2021	2026	Total
Additional Capacity (MW)	1,305	45	800	600	1,800	1,800	6,350
Pacitan (PLN)	630						630
New Paiton (PLN)	660						660
Gresik Power Indonesia (IPP)	15						15
Petrokimia Gresik Steam (IPP)		15					15
PLTU Gasuma Tuban (IPP)		30					30
PLTGU Paiton III-IV (IPP)			800				800
Tanjung Awar-Awar (PLN)				600			600

Item \ Calendar Year	2011	2012	2013	2014	2021	2026	Total
JICA Team proposed					1,800	1,800	3,600

Source: PLN East Java and JICA Study Team

(2) Transmission Network

To distribute the electricity generated by the power plants, PLN East Java is planning to extend transmission lines for specific sections, as shown in Table 5.4.63.

Table 5.4.63 Transmission Extension Plans

No.	From	To	Voltage (kV)	Length (km)	Fund Source	Remark
1	Balungbendo	Incomer	150	0.5	Unallocated	-
2	Kabel Jawa Madura	Suramadu	150	3	Unallocated	Undersea cable
3	Buduran II (Sedati)	Buduran	150	10	Unallocated	Uprating
4	Rungkut II	Surabaya Selatan	150	20	Unallocated	-
5	Banaran	Suryazigzag	150	12.5	Unallocated	-
6	Driyorejo	Miwon	70	1	Unallocated	-
7	Driyorejo II	Driyorejo	150	10	Unallocated	-
8	Pandaan II	Inc (Bdran-Prong)	150	2	Unallocated	-
9	Sekarbungu	Kedinding	150	60	Unallocated	-
10	Turen II	Inc (kbagn-Pakis)	150	20	Unallocated	-
11	Waru	Bangil	150	21.75	Unallocated	-
12	Kertosono	Ploso	70	25	Unallocated	-
13	Polehan II	Incomer	150	4.1	Unallocated	Uprating
14	Bangil	Incomer	500	5	Unallocated	-
15	Bangil New	Bangil	150	5	Unallocated	-
16	Pare II	Kediri Baru	150	5	Unallocated	-
17	Ponorogo II	Tulungagung II	150	65.5	Unallocated	-
18	Manisrejo	Kediri	500	50	Unallocated	-
19	Nganjuk II	Inc (Mnrjo-Kdri)	150	5	Unallocated	Uprating
20	Ngimbang	Tanjung Awar-awar	500	50	Unallocated	-
21	Ngimbang	Manisrejo	500	50	Unallocated	-
22	Porong II	Bangil	150	12	Unallocated	Uprating
23	Babadan II	Babadan	150	5	Unallocated	-
24	Krembangan II	Krembangan	150	10	Unallocated	-
25	Suryazigzag	Incomer	150	5	Unallocated	Double circuit
26	Krian II	Krian	150	5	Unallocated	-
27	Bringkang II	Bringkang	150	6	Unallocated	-
28	Sekarputih II	Sekarputih	150	10	Unallocated	-
29	Tandes II	Tandes	150	8	Unallocated	-
30	Karangpilang II	Karangpilang	150	5	Unallocated	-
31	Ngoro	Incomer	500	10	Unallocated	-
32	Ngoro New	Ngoro	150	0.6	Unallocated	-
33	Simpang II	Simpang	150	5	Unallocated	-
34	Mranggen	Incomer	150	11	APLN	-
35	Blimbing II	Incomer	150	7	APLN	-
36	Ngawi	Incomer	150	6.3	APLN	-
37	Babat	Ngimbang	150	20	APLN-APBN	-
38	Ngimbang	Mliwang	150	72	APLN-APBN	-
39	Perak	Ujung	150	5	IBRD	-
40	Ngimbang New	Incomer	150	0.5	APLN JBN	-
41	Bringkang	Incomer	150	2	KE – III	-
42	Brondong (Paciran)	Lamongan	150	15	KE – III	-
43	Jombang	Jayakertas	150	20	KE – III	-
44	Kedinding	Kalisari	150	20	KE – III	-
45	Ngimbang	Inc. (Sbrat-Ungar)	500	4	KE – III	-
46	Simogunung	Incomer	150	2	KE – III	-

No.	From	To	Voltage (kV)	Length (km)	Fund Source	Remark
47	Surabaya Selatan	Kalisari	150	20	KE – III	New
48	Tulung Agung II	Kediri	150	40	KE – III	New
49	Wlingi II	Tulungagung II	150	40	KE – III	New
50	Surabaya Selatan	Grati	500	80	UK mix	-

Source: PLN East Java

(3) Loop System in Transmission Lines

Especially for the GKS Zone, the first priority is to complete a 150 kV transmission line between the edge of the existing line in Ujung Substation and Perak Substation to form a loop so that the supply system for Surabaya City can become more reliable.

(4) Distribution Network

To reinforce the distribution network and meet the expected demand and relieve overloading of existing networks, PLN East Java is planning to extend its distribution lines and provide new distribution transformers and monitoring equipment. Furthermore, to reduce distribution loss, meet customer growth, and ensure quality and reliability of electricity supply, PLN East Java also plans to improve upstream transformers by building new substations, as shown in Tables 5.4.64 and 5.4.65, as well as install new transformers in existing substations.

Table 5.4.64 New Substation Plan

Year	Capacity		
	60 MVA (no.)	120 MVA (no.)	Total (MVA)
2009	2	-	120
2011	2	-	120
2012	6	2	600
2013	-	3	360
2014	-	1	120
2015	1	3	420
2016	-	2	240
2017	-	2	240
2019	1	4	540
2020	-	1	120
2021	-	2	240
2022	-	1	120
	12	21	3,240

Source: PLN East Java

Table 5.4.65 Distribution Network Reinforcement Plans

Year	MV Distribution (km)	LV Distribution (km)	District Transformer (no.)	Cubicle 20kV (no.)	Additional Customer (connection)
2010	1,769	2,167	1,605	52	346,874
2011	1,624	1,990	1,474	64	383,977
2012	1,732	2,133	1,572	78	403,918
2013	1,847	2,263	1,677	86	424,906
2014	1,968	2,412	1,787	95	446,99
2015	2,097	2,569	1,903	104	470,255
2016	2,130	2,609	1,933	116	471,871

Year	MV Distribution (km)	LV Distribution (km)	District Transformer (no.)	Cubicle 20kV (no.)	Additional Customer (connection)
2017	2,261	2,770	2,052	126	495,319
2018	2,400	2,940	2,178	136	519,949
2019	2,547	3,121	2,312	143	545,819
Total	20,375	24,974	18,493	1,000	4,062,888
Average /year	2,038	2,497	1,849	100	

Source: PLN East Java

(5) Alternative Energy Sources

The participation of captive power plants (a power plant set up by any person to generate electricity primarily for his own use) by non-PLN providers for backup power supply in case of PLN power shortages, especially for remote areas apart from the PLN's national grid, is expected.

Renewable energy sources by photovoltaic power (solar power), wind power, biomass, especially for Surabaya through the conversion of solid waste to energy have been considered by PLN and other international/domestic organizations.

5) Priority Actions

The following is a summary of future actions that will be taken between 2010 and 2030:

- Growth of energy sales through an average of 8.8%, or 52,806.2 GWh, by 2019;
- Peak load growth with an average of 8.7 %, or 8,581 MW, by 2019;
- Electrification ratio of 95.7% by 2019;
- Additional distribution transformers with 8,490 MVA total capacity by 2019;
- Additional power generators with 2,750 MW (1890 MW by PLN and 860 MW by IPPs) under 10,000 MW power project;
- Extension of medium voltage distribution network with 20,374 km or an average of 2,037 km per year;
- Additional distribution transformers of 18,492 units, or 2,145,072 kVA, by 2019;
- Extension of low voltage distribution network with 24,965 km, or an average of 2,496 km per year;
- Additional 4,509,888 subscribers and electrification ratio of 95.7% in 2019;
- Securing an investment for distribution network facilities in the amount of Rp.11,648 billion, or an average of Rp. 1164 billion per year; and
- Securing investments for construction of additional power generation of 2700 MW in amount of Rp 40,500 billion including public funds and private investments (assuming USD1.5million per cost of 1 MW power plant).

5.4.5 Telecommunications Network

1) Current Situation

The development of telecommunications in Indonesia has entered into a new phase apace

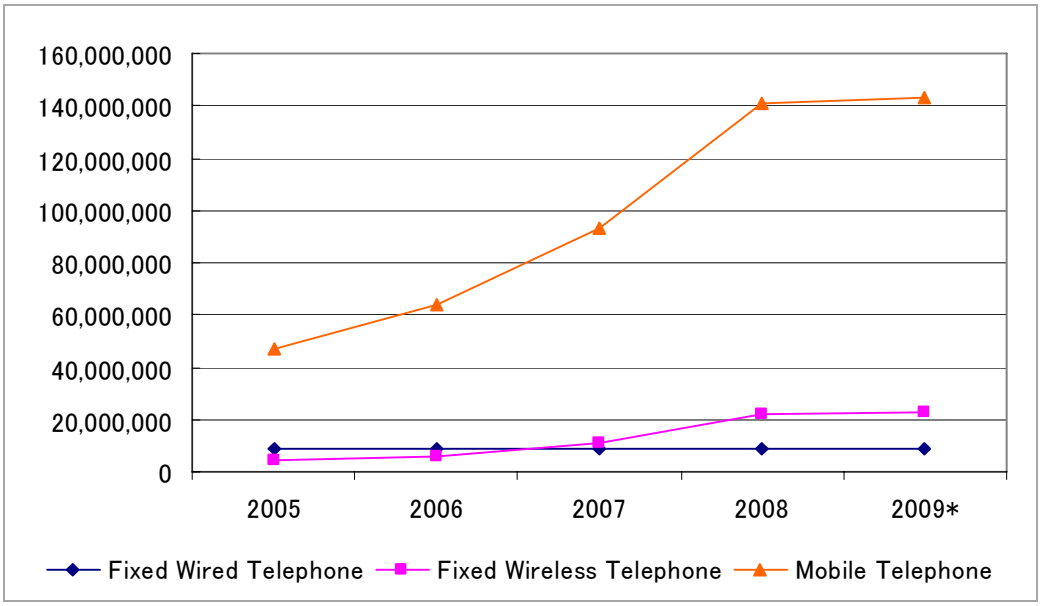
with the advent of rapidly developing information technology. Mobile phone coverage reaches all provinces and most districts/cities. Telecoms services, especially subscribers of mobile phones, have risen exponentially.

In contrast, for the last five years, there has been a fluctuating trend in fixed wire telephone service. Its growth seems to have stagnated, increasing a little in 2006, then decreasing again by 2007. The growth of the fixed wireless service has shown a rapid trend. The number of fixed wireless phone consumers in 2009 increased approximately five times its 2004 numbers, maintaining a robust 97% p.a. rate.

This growth has been due to two main operators Telkom Flexi and Bakrie Telecom which grew by 87.1% and 160.5% per year, respectively, in the last five years. The rapid increase in the number of fixed-wireless phone consumers cannot be separated from the intense competition among operators, who each try to attract consumers in buying their services and products.

The number of consumers in the mobile phone market has increased since 2005. The total number of mobile phone consumers reached more than 140 million in March 2009, likewise the number of operators increased from four, in 2004, to eight, in 2009. Most mobile phone customers are prepaid users, sharing 97.5% of the total mobile phone market.

The growth of mobile phone consumers from 2005 to 2009 was 204.4%, an average of 33.6% per year. The increasing trend appears to be nearing market saturation due to the tight competition among operators and the end of the first wave of popularization.



Source: Directorate of Post and Telecommunication

Figure 5.4.28 Number of Telephone Customers by Service (2005–2009)

Table 5.4.66 Number of Telephone Customers by Service (2005–2009)

No	Type	2005	2006	2007	2008	2009*
A	**Fixed Wired Telephone**	**8,710,385**	**8,738,343**	**8,717,872**	**8,674,228**	**8,701,445**
1	PT. Telkom	8,686,131	8,709,211	8,685,000	8,629,783	8,657,000
2	PT Indosat I-Phone	21,724	26,632	30,479	42,145	42,145
3	PT. BBT	2,530	2,500	2,393	2,300	2,300
B	**Fixed Wireless Telephone**	**4,683,363**	**6,014,031**	**10,811,635**	**21,703,843**	**22,460,425**
1	PT Telkom Flexi	4,061,800	4,175,853	6,363,000	13,305,181	13,399,000
	Prepaid	3,240,500	3,381,426	5,535,000	12,568,620	12,715,000
	Postpaid	821,300	794,427	828,000	736,561	684,000
2	PT. Indosat StarOne	249,434	358,980	627,934	761,589	698,774
	Prepaid	229,726	338,435	594,203	681,362	621,529
	Postpaid	19,708	20,545	33,731	80,227	77,245
3	PT. Bakrie Tel-Esia	372,129	1,479,198	3,820,701	7,304,543	8,030,121
	Prepaid	351,826	1,414,920	3,695,817	7,196,518	7,931,221
	Postpaid	20,303	64,278	124,884	108,025	98,900
4	PT. Mobile-8				332,530	332,530
	Prepaid					
	Postpaid					
C	**Mobile Telephone**	**46,992,118**	**63,803,015**	**93,386,881**	**140,578,243**	**143,043,785**
1	Telkomsel	24,269,000	35,597,000	47,890,000	65,299,991	72,133,000
	Prepaid	22,798,000	33,935,000	45,977,000	63,359,619	70,179,000
	Postpaid	1,471,000	1,662,000	1,913,000	1,940,372	1,954,000
2	Indosat	14,512,453	16,704,729	24,545,422	36,510,246	33,266,296
	Prepaid	13,836,046	15,878,870	23,945,431	35,591,033	32,267,029
	Postpaid	676,407	825,859	599,991	919,213	999,267
3	Excelcomindo	6,978,519	9,527,970	15,469,000	26,015,517	24,892,000
	Prepaid	6,802,325	9,141,331	14,988,000	25,599,297	24,500,000
	Postpaid	176,194	386,639	481,000	416,220	392,000
4	Mobile 8	1,200,000	1,825,888	3,012,801	2,701,914	2,701,914
	Prepaid	1,150,000	1,778,200	2,920,213	2,552,975	2,552,975
	Postpaid	50,000	47,688	92,588	148,939	148,939
5	STI	10,609	134,713	310,464	784,343	784,343
	Prepaid		133,746	310,176	784,129	784,129
	Postpaid		967	288	214	214
6	Natrindo	21,537	12,715	4,788	3,234,800	3,234,800
	Prepaid		10,155	4,788	3,234,800	3,234,800
	Postpaid		2,560	-	-	-
7	Hutchison	-	-	2,039,406	4,500,609	4,500,609
	Prepaid			2,036,202	4,490,202	4,490,202
	Postpaid			3,204	10,407	10,407
8	Smart Telecom	-	-	115,000	1,530,823	1,530,823
	Prepaid				1,456,372	1,456,372
	Postpaid				74,451	74,451
Total		**60,385,866**	**78,555,389**	**112,916,388**	**170,956,314**	**174,205,655**

*: until March 2009
Source: Directorate of Post and Telecommunication

2) Development Strategies

The following are the development strategies for the telecommunications network:

(1) Proper Coordination with Private Operators

Telecom services in Indonesia, has already been privatized, and each operator surveys the market positively in order to increase its share and expand service coverage, taking into account the existing urban and regional development plans.

However, in the past years, the mobile phone market is nearing saturation due to tight competition among operators. Indonesia's telecom sector has been competitive and operator's are not disclosing information about market strategies and plans.

(2) Development of an Affordable Telecommunications System

In order to meet the telecom needs of the communities and allow them easy access to telecommunication's facilities, the government, through the Department of Communication and Information, has initiated a community improvement program accessing affordable telecoms services. This program is an implementation of the Telecommunications Universal Service (Universal Service Obligation/USO) policy which is an embodiment of the implementation of the ITU Information Society Declaration. It is implemented in the villages through the allocation of the telecommunications universal service area (WPUT).

In 2009, 36,471 villages, spread throughout the archipelago, except DKI Jakarta, were identified as targets for the universal service area. Sumatra had the largest number of recipient villages in the WPUT program followed by Java. Although the areas in Java had easier access to telecom services, there were still a lot of areas without access to communications services and which were prioritized in the WPUT program. East Java belongs to WPUT XI and 28.7% of the total number of villages were selected as target areas, compared with 78.0% in the WPUT IX (Maluku and Maluku Utara), which had the highest ratio. WPUT XI has a low proportion of villages in the WPUT program mostly because the villages in this region had already been reached by other telecom services.

5.5 Housing and Public Services

5.5.1 Housing Supply

1) Current Situation and Problems

Housing provision in East Java is mainly constructed individually by community. Only about less than 20% is provided by developers. There is a shift in situation in Surabaya, Kabupaten Sidoarjo and Kabupaten Gresik where formal housing by developers has been growing faster compared to houses self-built by community.

Currently in Surabaya, houses in Kampong areas are mainly concentrated in the urban center with slight expansion to the urban fringe. By contrast, formal houses by developers have been experiencing rapid growth during the last decade in urban fringes. Kabupaten Sidoarjo and Kabupaten Gresik are following this trend.

Housing demand in East Java until the year 2017 is estimated to reach 590,000 units. In fact, the realization of the construction of settlements is only about 60,000 to 70,000 units per year by public and private sectors.

The high price of land in the middle of the city is one of the reasons the housing needs of low-income communities cannot be fulfilled, and they have to contend with limited land provision. On the other hand, the interest of developers to build rental flats (RUSUNAWA) and flats for sale (Rusunami) is still low, although the need for housing in the urban area is high. This is because the investment value of rental flats and flats for sale is relatively small. The developer prefers to build apartments for a middle income class.

Other constraints that hamper development for a healthy and simple house is the building permit cost, and the permit issuance procedure in each Kabupaten or Kota is not the same. There is a local building permit that equates the cost of the construction permit for a healthy and simple house with a house for middle to upper income. Access to housing credit for low-income communities is still constrained by high mortgage rates that reached up to 14% per year.

2) Housing Backlog

The average family household (HH) size in the GKS Kabupaten and Kota varied from 3.46 persons/HH to 4.14 persons/HH. Each Kabupaten and Kota has data about family size in the urban area, but not for the rural area. The family size of rural areas is taken from the average of rural family size in East Java Province surveyed by SUPAS. Housing backlog normally is measured by computing the difference between housing need (based on ideal standard) and current housing. However, in the social and cultural life of Javanese communities, it is still considered that two families living in one house is sometimes an ideal situation.

The following situation is described based on a common standard for housing provision of ***one house, one family***.

Table 5.5.1 summarizes the condition of existing housing development in each Kabupatena/Kota in the GKS in 2007 for urban and rural categories.

Table 5.5.1 Current Condition of Housing Development in GKS in 2007

	Average HH size (person/HH)		2007 Population (person)		Existing Housing up to 2007 (unit)		Housing Needs (unit)		Housing Backlog (unit)	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Surabaya	3.46	-	2,749,630	-	549,926	-	795,134	-	245,208	-
Kota Mojokerto	3.84	-	119,888	-	29,972	-	31,223	-	1,251	-
Gresik	3.91	3.6	536,363	598,833	101,140	135,571	137,284	166,343	36,144	30,772
Bangkalan	4.14	3.6	152,124	806,707	33,069	182,159	36,767	224,085	3,698	41,926
Sidoarjo	3.94	3.6	1,578,043	283,286	329,836	57,047	400,572	78,691	70,736	21,644
Mojokerto	3.56	3.6	403,469	638,021	98,075	159,505	113,375	177,228	15,300	17,723
Lamongan	3.78	3.6	178,032	1,113,685	37,226	240,346	47,043	309,357	9,817	69,011
GKS	-	-	5,717,549	3,440,532	1,179,244	774,628	1,561,398	955,704	382,154	181,076

Source: Worked out by Study Team from East Java Provincial Action Plan 2008
Note: Average household size is referred from SUPAS, 3.6 persons/HH.

In Surabaya, about 30.84% of houses should have been provided to meet the housing need for each family in Surabaya. What this means is that there are still a number of situations where one family is living with another family in one house. And most of them are living in the Kampong areas. Some of them have migrated from other Kota to work in Surabaya, and they stay in leased houses for many years.

In Kota Mojokerto, the number of houses nearly meets the standard need. Only 4.17% of families still join with another family to share accommodation.

In Kabupaten Gresik, housing backlog is about 26.33% in the urban area and 18.50% in the rural area. The number of families living in shared accommodation in the urban area is high, almost equal to Surabaya's. This situation is pushed by the increasing industrial work opportunity in Gresik.

In Kabupaten Bangkalan, housing backlog is about 10.06% in the urban area and 18.71% in the rural area. The average family size in Bangkalan is higher than that of other Kabupaten and Kota. Housing provision is not yet a problem here because land is widely available. But there are some cases in the rural area of two families living in one house.

In Kabupaten Sidoarjo, housing backlog is about 17.66% in the urban area and 27.50% in the rural area. Even though the urban population is much higher compared to that of the rural area in Sidoarjo, the need for houses is higher in rural areas. The trend shows that in some rural areas there are new industrial places sprouting and absorbing the new workforce population.

In Kabupaten Mojokerto, housing backlog is about 13.50% in the urban area and 10.00% in the rural area. The urban area in Kabupaten Mojokerto grows slightly and has almost the same expansion rate as in the rural area. Therefore housing need in this district is low.

In Kabupaten Lamongan, housing backlog is about 20.87% in the urban area and 22.31% in the rural area. The need of houses in rural areas is as high as in the urban area. Both urban and rural families have strong social ties, and often, two families live in one house.

3) Land Banking

The availability of land for housing in urban areas is declining yearly due to expensive land prices, which in average costs more than one million dollars per meter. The high land prices have made it difficult for developers to provide healthy and simple houses for the middle to lower income people. Each local government does not have a program to provide land for housing. Considering this situation, agencies are needed to manage a state-owned land bank to guarantee the availability of land for housing development.

4) Housing Loan

Bank Tabungan Negara (BTN) is the largest national banking institution to provide housing loan in Indonesia. This bank covers almost 25% of national housing demand. In the GKS Zone, most developers also cooperate with BTN to provide loan for mainly low to middle income people with various types. The lowest interest rate of BTN credit for housing loan is 10.5% for a low cost healthy and simple house. BTN also provides access to various types of housing demand loan credit to support the national formal housing program. In addition to BTN's loans, there are various banks to provide loans as seen in Table 5.5.2

Loan subsidy is provided only for formal workers that join the housing savings program. The subsidy is very useful for low income people that may reduce price for a healthy and simple house up to 20%. .

Table 5.5.2 Housing Loans by Bank, Type, Rate, and Time Period

	Bank	Type of Credit	Annual Interest Rate (%)	Target Group	House Type	Maximum Loan (Rp.)	Repayment Period (Year)
1	Bank Tabungan Negara (BTN)/ *National Saving Bank*	a. KPR Bersubsidi *(KPR subsidised)*	10.5	Starter family of low income	Healthy Simple House	55,000,000	20
		b. Kredit Griya Utama *(Loan for main house)*	12	Young professional	T.36/90	100,000,000	15
		c. KPR Platinum	11.75	Young professional	T.45/120	150,000,000	15
		d. KP Apartemen *(Aartment loan)*	13	Young professional	T.21, 30	100,000,000	15
		e. Kredit Griya Multi *(Loan for mult-house)*	14.5	Public	Renovation	100,000,000	10
		f. Kredit Ringan Batara *(Loan for light saving)*	10.5	Formal Employee		100,000,000	5
		g. KP Ruko *(Loan for shop-house)*	13.5	Private	T.36, 45	100,000,000	15
		h. Kredit Swa Griya *(Loan for Own house)*	15	Land owner	-	70% of Construction cost	10
		i. Kredit Swadana *(Loan for self-fund)*	Saving+2	All	-	-	-
2	Bank JATIM / *East Java Bank*	KPR Bersubsidi *(KPR subsidised)*					
		KPR	12	Public & Private	All	500,000,000	15
3	Bank Niaga *National Bank*	KPR	12.5	Public & Private	All	70% - 90% of house price	20
		KPR Syariah *(Muslim KPR)*	13	Public & Private	All	200,000,000	10
4	BCA (*Bank Central Asia)*	KPR BCA	12.5	Public & Private	All	-	20
		KPR BCA Xtra *(Extra KPR BCA)*	10.5	Public & Private	All	-	15
		KP Apartemen *(Apartment KPR)*	10.5	Public & Private	All	-	20

	Bank	Type of Credit	Annual Interest Rate (%)	Target Group	House Type	Maximum Loan (Rp.)	Repayment Period (Year)
5	BNI *Indonesia National Bank*	KPR Griya *(House KPR)*	13	Public & Private	All	5 billion	20
		KPR Syariah *(Islam role KPR)*	8.25	Public & Private	All	200,000,000	10
6	BRI (*Bank Rakyat Inonasia)*	KPR	14.5	Public & Private	All	5 billion	20
7	Bank Permata	KPR	12	Public & Private	All	200,000,000	10
8	Bank Panin	KPR	13	Public & Private	All	200,000,000	13
9	BII (*Indonesia Intenational Bank)*	KPR Express	12.5	Public & Private	All	5 billion	15
10	Bank Mandiri	KPR Mandiri *(Independent KPR)*		Public & Private	All	5 billion	15
		KPR Multiguna *(Multi-functional KPR)*		Public & Private	All	1 billion	10
11	Bank Syariah Mandiri	KPR	16.1	Public & Private	All	200,000,000	10

Source: Website of Each Bank
Note: KPR denotes Kredit Pemilikan Rumah, or Loan for House Ownership

5) Urban Slum Area

The urban slum area is a matter that has not been addressed in Action Plan 2002 of the Housing Sector. According to the Settlement Development Directorate, Director General of Copyright and Department of Public Works, the criteria for categorizing an area as slum are divided into three aspects: the physical aspect (population density, housing conditions, the density of buildings, number of occupants, and air circulation), aspect of facilities and infrastructure (clean water, public toilets, garbage, drainage, and path), and aspect of vulnerability to disasters (floods, landslides, and tsunami). In Review Settlement Area Action Plan 2007, the scope of urban slums is limited to the capital city and district.

Urban slum areas are identified through a secondary survey to delineate urban slum on the map, through interviews with policy-making authorities, and through studies relating to the identification of slum areas in East Java Province. According to the Development and Improvement of Local Housing and Settlement Plan (RP4D), slum areas are identified as shown in Table 5.5.3.

Table 5.5.3 Identified Slum Areas in GKS

No	No of Slum Areas	Slum Area (Ha)
Surabaya	18	1,848.90
Kota Mojokerto	18	37.05
Gresik	2	21.86
Bangkalan	3	31.71
Sidoarjo	2	121.53
Mojokerto	8	1.00
Lamongan	Not identified	

Source: Development Plan and the provision of Local Housing and Settlement (RP4D), Kota Surabaya; Slum Area Identification Study in East Java Province 2005 for Kota Mojokerto; Development Plan and the provision of Local Housing and Settlement (RP4D), Gresik; Primary Data Deliniasi District Map for Bangkalan; Primary Data Deliniasi District Map for Sidoarjo; Studies Formulation Development Service Level Evaluation of the Settlement of East Java Province, 2003 for Mojokerto

6) Planning Issues

Planning for housing has been directed in the document of Development and Improvement of Housing and Settlement Plan, or so called RP4D. The Directorate General of Human Settlements, Department of Public Works, has formulated the General Guideline for Technical Formulation of RP4D for each Kabupaten and Kota since 2002. Kota Surabaya has just finished its RP4D document in early 2009 after a delay of some years. Kabupaten Sidoarjo has obtained the RP4D document in 2003 under the technical assistance of the Department of Public Works. Kabupaten Lamongan has formulated RP4D Database in 2007. Another kabupaten and kota are in the level of Database of RP4D.

The Kabupaten/ Kota, as the government agency responsible for the implementation of activities of RP4D, so far, has yet to make the RP4D as their principal and reference document for the implementation of environmental improvement program activities in their areas, such as the current program NUSSP in the case of the Kota. Each Kabupaten and Kota also do not have an executing agency to implement RP4D programs.

For example Surabaya has only the Department of Building and Land Management that has close relation to the Housing Program, which consists only of (i) Procurement and Security Division, (ii) Land Utilization Division, (iii) Building Utilization Division, and (iv) Controlling Division. There is no Implementation of Housing Program Division. Kabupaten Sidoarjo, Gresik, Lamongan, Mojokerto, Bangkalan and Kota Mojokerto have only the Section of Housing and Settlements under the Division of Human Settlement Sanitation in the Department of Public Works, Human Settlements and Spatial Planning.

7) Related Policy, Plan and Projects

The land and housing policy relies on planning regulations, particularly the use of statutory plans and development permits. The translation of the legal, normative land and housing policy into workable policy instruments is still facing some problems. In the housing policy, the 1:3:6 and the Location-Permit policies, which are, arguably, a good tool, are open for abuse. The use of spatial plans for directing residential land development has been largely ineffective due to the weak enforcement and the possibility for private developers to influence the spatial plans.

The current National Housing Policy based on Ministry of Public Works Regulation Number 217/KPTS/M/2002 is about National Strategy and Policy of Housing and Settlement. The Vision of National Strategy and Policy of Housing and Settlement until 2020 is:

"Each Indonesian household is able to afford health care, live in security and harmony in a sustainable environment, in order to perform productively with self-help approach, and achieve a sense of community identity".

To obtain the vision, the Indonesia government has three missions, namely:

1) To empower community and other housing stakeholders in the implementation of housing and settlements;
2) To facilitate and encourage the creation of a conducive climate in the implementation of housing and settlements; and

3) To optimize supporting resources use in the implementation of housing and settlements.

The National Housing Policy is formulated into three (3) main structures related to institution, housing demand, and meeting housing quality standard. They are as follows:

1) **To institutionalize** the implementation of the housing and settlements systems with community engagement as the main actor. And the strategy is: Improvement of laws and regulations and stabilization of housing and settlement institutions and facilitation of a transparent and participatory approach to implementation of spatial settlement zones.
2) **To provide the housing needs** of all community levels, as one basic human need. And the strategy is: To provide affordable housing with the poor and low income community as priority.
3) **To realize healthy, secure, hamonized and sustainable settlements** to support community productivity, self-help and identity development. And the strategy is: To realize healthy, secure, harmonious and sustainable environment settlements through: (i) improvement of settlement environment quality with priority for slums settlements in urban and coastal zones, (ii) improvement of settlement basic infrastructure and services provision, and (iii) implementation of settlements environment arrangement.

8) Development Strategies

Taking into account all the discussions above, housing development strategies are proposed as follows:

1) Implementation of Comprehensive KIP program

The Comprehensive KIP program is being replicated to other slum settlements areas in GKS with the learnings from the Surabaya experience, to relieve each local government's budget woes, to alleviate poverty and improve basic infrasutructure through sustainable community-based development programs, as a part of incentives program from province and local government.

2) Promotion of housing development for lower income families

Motivating each local government to provide lower land price and land banking for developers and groups of low income families for long term, and to encourage both actors to provide multi-story housing rather than one-story houses. Assisting local government to improve research and applied technology for environmentally friendly, low-cost housing construction.

3) Improvement of living environment (residential areas)

A national standard for housing and environmental quality should be introduced and implemented using more technical and local based resources through technical assistance directly for developers and community groups. Encourage local government to socialize their infrastructure planning to the level of developers and community in order to integrate the whole infrastructure development implementation in all levels, to minimize disaster impact.

4) Establishment of Local Institution for housing development and management

Each Local Housing Planning and Development Guideline (RP4D) is targeted to be finished in a couple of years, and followed by establishing a Housing Development and Management Institution in each Regency and Municipality. This institution's availability is also very important for the National Housing Agency to distribute housing program incentives and subsidy for the low income group to overcome the problem of sub-standard housing and housing backlog. The previous BP4D should be revitalized as local housing agency to implement the RP4D. This institution is also to be encouraged to control the use of land for housing development and to guarantee the abundant supply of land and housing provision; to facilitate the revitalization of the housing program, land consolidation, settlements renewal, and relocation due to disaster impact.

5) Improvement of funding alternatives and mechanism

Facilitate to improve funding alternatives, access and mechanism for the low income group based on formal funding institutions (banks) or/and community self-help group with equal opportunity for all in the GKS Zone.

6) Encouragement of community groups to establish their own appropriate housing needs based on self-help and "Tridaya" concept

Motivating each local government and provincial government to provide incentives for low income community groups to encourage self-help housing by developing basic infrastructure needs (street, drainage, water connection, sanitation, and electricity), and to provide technical assistance to enhance their skills and build capacity, increase their economic income, and improve their environment.

5.5.2 Pubic Services

1) Educational Facilities

(a) Current Situation and Problem

Educational facilities are one of the most important facilities for citizens. As educational facilities except for higher education like universities and colleges, there are kindergarten, primary, junior high school, and senior high school facilities in GKS. The number of educational facilities is as shown in Table 5.5.4. In comparing the numbers required by the standard with the existing number of facilities, it is known that the numbers of educational facilities are not met by the existing facilities, except for the number of elementary schools of Kabupaten Bangkalan.

Only primary schools of Bangkalan fulfill the standard. Most educational facilities are short in number, with the shortage of senior high schools most severe, followed by kindergarten school shortage. The lack of educational facilities causes the present practice of two-shift education system. Also, distribution of school facilities should be well planned to serve the citizens evenly with prioritized school districts.

Table 5.5.4 Number of Educational Facilities in GKS (2007)

		Kota Surabaya	Kota Mojokerto	Kab. Gresik	Kab. Bangkalan	Kab. Sidoarjo	Kab. Mojokerto	Kab. Lamongan	GKS
Population		2,720,156	119,051	1,142,817	965,568	1,869,350	1,041,269	1,281,176	9,139,387
Kinder-garten	Existing	1,250	50	488	185	645	374	844	3,836
	Required	2,720	119	1,143	966	1,869	1,041	1,281	9,139
	Shortage	1,470	69	655	781	1,224	667	437	5,303
Primary School	Existing	945	61	477	654	614	506	666	3,923
	Required	1,700	74	714	603	1,168	651	801	5,712
	Shortage	755	13	237	-	554	145	135	1,789
Junior High School	Existing	277	17	94	101	143	96	129	857
	Required	567	25	238	201	389	217	267	1,904
	Shortage	290	8	144	100	246	121	138	1,047
Senior High School	Existing	168	16	46	28	57	34	59	408
	Required	567	25	238	201	389	217	267	1,904
	Shortage	399	9	192	173	332	183	208	1,496

Source: Dalam Angka 2008 of Jawa Timur, and JICA Study Team Calculation
Note: Required numbers are calculated based on the planning standards described in each Spatial Plans of Kabupaten and Kota: 1 Kindergarten per 1,000 habitants; 1 Primary School per 1,600 habitants; 1 Junior and Senior High Schools per 4,800 habitants.

(b) Planning Issues

Educational facilities, that is, kindergarten, and primary, junior high, and senior high schools are generally in short supply. It is imperative for all Kota and Kabupaten to provide the required educational facilities.

Facing the population growth in the future, the local governments should face more burdens to provide schools with a big backlog. And the facilities should be planned to place the facilities to cover the school district evenly.

Of course, provision of such facilities is not easy because of difficulty of land acquisition and development cost burden. As described in the case of Japanese local governments, in new developments, developers are asked to donate some land for urban facilities such as parks and educational facilities, or money, in order to provide urban facilities adequately. In order to secure land area for parks in congested built-up areas, it is worth considering an urban redevelopment project to create public space.

(c) Future Demand

Table 5.5.5 shows the total required number and the additional required number of educational facilities in Pushed Growth scenario in 2030. In the whole GKS Zone, 10,232 kindergarten schools, 4,870 primary schools, 2,074 junior high schools and 2,523 senior high schools are required to be developed over the next 20 years to meet the demand fully.

Table 5.5.5 Additionally Required Number of Educational Facilities in Pushed Growth Scenario (2030)

	Population	Kindergarten		Primary School		Junior High School		Senior High School	
		Required	Additional	Required	Additional	Required	Additional	Required	Additional
Kota Surabaya	3,668,900	3,669	2,419	2,293	1,348	764	487	764	596
Kota Mojokerto	182,300	182	132	114	53	38	21	38	22
Gresik	2,006,600	2,007	1,519	1,254	777	418	324	418	372
Bangkalan	1,586,500	1,587	1,402	992	338	331	230	331	303
Sidoarjo	3,178,600	3,179	2,534	1,987	1,373	662	519	662	605
Mojokerto	1,736,400	1,736	1,362	1,085	579	362	266	362	328
Lamongan	1,708,900	1,709	865	1,068	402	356	227	356	297
GKS	14,068,200	14,068	10,232	8,793	4,870	2,931	2,074	2,931	2,523

Source: Worked out by JICA Study Team based on Dalam anka 2008, Standards of RTRW
Notes: 1 Kindergarten school per 1,000 habitants; 1 Primary School per 1,600 habitants; 1 Junior and Senior High Schools per 4,800 habitants

2) Medical and Health Facilities

(a) Current Situation and Problems

Health facilities to be planned in RTRW include a General Hospital, Health Center (Puskesmas), Sub-Health Center (Puskesmas Pembandu), BKIA & Maternity House, Medical Center, Practical Doctor and Pharmacy. Existing numbers, required number and shartage of General Hospitals, Health Centers and Sub-Health Centers in all Kabupaten and Kota in 2007 are shown in Table 5.5.6.

Health centers are sufficiently provided, hospitals and sub-health centers are almost supplied, with only 3 hospitals short in Bangkalan, and 21 sub-health centers in Surabaya and 5 sub-health centers in Sidoarjo are lacking.

These numbers show health and medical facilities in quantity, but do not explain the quality of these facilities such as number of health services, medical staff, hospital beds, and geographical distribution. These should be further analyzed including human resource indicators such as infant mortality and average life expectancy.

Table 5.5.6 Current Situation of Medical and Health Facilities

		Kota Surabaya	Kota Mojokerto	Kab. Gresik	Kab. Bangkalan	Kab. Sidoarjo	Kab. Mojokerto	Kab. Lamongan	GKS
Population		2,720,156	119,051	1,142,817	965,568	1,869,350	1,041,269	1,281,176	9,139,387
General Hospital	Existing	36	7	6	1	12	6	5	73
	Required	11	0	5	4	8	4	5	38
	Shortage	-25	-7	-1	3	-4	-2	0	-35
Health Center	Existing	53	5	32	22	25	27	33	197
	Required	23	1	10	8	16	9	11	76
	Shortage	-30	-4	-22	-14	-9	-18	-22	-121
Sub-Health Center	Existing	70	14	74	70	57	55	108	448
	Required	91	4	38	32	62	35	43	305
	Shortage	21	-10	-36	-38	5	-20	-65	-143

Source: Dalam Angka of each Kabupaten and Kota (2008), and JICA Study Team's calculation

Note: Required numbers are calculated at the rate of: 1 Hospital per 240,000 habitants; 1 Health center per 120,000 Habitants; 1 Sub-health center per 30,000 habitants, based on the planning standards

(b) Planning Issues

Health and medical facilities are very important for human development. As seen above, the amount of hospitals, health centers, and sub-health centers are sufficient in 2007 except for hospitals in Bangkalan and sub-health centers in Sidoarjo. Therefore, the lacking facilities at present has a priority to be provided.

For the future, not only the aggregated quantity or the facilities, but measures to improve quality of health and medical system and distribution of the facilities should be carefully planned.

Of course, provision of such facilities is not easy because of difficulty of land acquisition and development cost burden. In the case of Japanese local governments, in new developments, developers are asked to donate some land for urban facilities such as parks and educational facilities, or money, in order to provide urban facilities adequately. In order to secure land area for public facilities like parks in congested built-up areas, it is worth considering an urban redevelopment project to create public space.

(c) Future Demand

Table 5.5.7 shows the total required number and the additional required number of educational facilities in 2030 in Pushed Growth scenario In the whole GKS Zone, 13 hospitals, 1 heath center and 104 sub-health centers are required to be developed over the next 20 years to meet the demand fully. The existing hospital and health center facilities are almost satisfactory in general. Additional facilities are needed, in particular, sub-health centers in Surabaya and Sidoarjo.

Table 5.5.7 Additionally Required Number of Health Facility Needs in Pushed Growth Scenario (2030)

	Population	Hospital		Health Center		Sub-Health Center	
		Required	Additional	Required	Additional	Required	Additional
Kota Surabaya	3,668,900	15	-	31	-	122	52
Kota Mojokerto	182,300	1	-	2	-	6	-
Gresik	2,006,600	8	2	17	-	67	-
Bangkalan	1,586,500	7	6	13	-	53	-
Sidoarjo	3,178,600	13	1	26	1	106	49
Mojokerto	1,736,400	7	1	14	-	58	3
Lamongan	1,708,900	7	2	14	-	57	-
GKS	14,068,200	59	13	117	1	469	104

Source: JICA Study Team
Notes: Required numbers are calculated at the rate of: 1 Hospital per 240,000 habitants; 1 Health center per 120,000 Habitants; 1 Sub-health center per 30,000 habitants

3) Worship Facilities

(a) Current Situation and Problems

As worship facilities, there are the Mosque, Small Mosque, Church, Temple, and Monastery in the districts of GKS. The numbers of existing, required and shortage of Worship facilities

are as shown in Table 5.5.8.

Table 5.5.8 shows that, for Islamic facilities, mosques are sufficient while Small Mosques are in short supply in Surabaya. On the contrary, facilities of other religions like Christianity and Buddhism are relatively lacking.

It seems, however, that, taking account of the dominance of Muslims in GKS compared with Christians and Buddhists, the requirement for churches, temples and monasteries altogether, or one unit for 30,000 habitants which is set at the same rate as mosques, is set too high to meet the standard.

Table 5.5.8 Current Situation of Worship Facilities (2007)

		Kota Surabaya	Kota Mojokerto	Kab. Gresik	Kab. Bangkalan	Kab. Sidoarjo	Kab. Mojokerto	Kab. Lamongan	GKS
Population		2,720,156	119,051	1,142,817	965,568	1,869,350	1,041,269	1,281,176	9,139,387
Mosque	Existing	118	168	1,211	902	835	1,004	1,628	5,866
	Required	113	5	48	40	78	43	53	381
	Shortage	-5	-163	-1,163	-862	-757	-961	-1,575	-5,485
Small Mosque	Existing	597	283	3,200	23,588	4,100	3,667	4,324	39,759
	Required	1,088	48	457	386	748	417	512	3,656
	Shortage	491	-235	-2,743	-23,202	-3,352	-3,250	-3,812	-36,103
Church	Existing	15	23	4	9	38	50	47	186
	Required	91	4	38	32	62	35	43	305
	Shortage	76	-19	34	23	24	-15	-4	119
Temple	Existing	0	3	1	5	2	4	1	16
	Required	91	4	38	32	62	35	43	305
	Shortage	91	1	37	27	60	31	42	289
Monastery	Existing	1	3	1	1	1	2	0	9
	Required	91	4	38	32	62	35	43	305
	Shortage	90	1	37	31	61	33	43	296

Source: Dalam Angka 2008 of Jawa Timur, and the JICA Study Team's calculation.
Notes: Required number of facilities: 1 Small Mosque per 2,500 inhabitants; 1 Mosque per 30,000 inhabitants ; 1 Church, Temple and Monastery per 30,000 inhabitants.

(b) Planning Issues

Living a religious and pious life is very important to a happy and peaceful life. Accordingly, the worship facilities should be provided to accommodate religious citizens, especially, in short term, Surabaya is suffering from the shortage of Small Mosques and this should be filled.

Worship facilities should be planned to be distributed evenly to cover all the citizens. Thus areas lacking in religious facilities should be identified to formulate a concrete development plan.

(c) Future Demand

Table 5.5.9 shows the total required number and the additional required number of health and medical facilities in 2030 in the Pushed-Growth scenario case. In the whole GKS Zone,

35 Mosques, 871 Breaks, 107 Churches, 122 Temples and 121 Monasteries are required additionally to be developed over the next 20 years to meet the demand fully. Islamic facilities are already sufficiently provided except for Surabaya, with 15 mosques and 681 breaks to be built. Churches and Temples are to be developed in all Kota and Kabupaten by 2030 to meet the demand.

Table 5.5.9 Additionally Required Number of Worship Facilities in Pushed Growth Scenario (2030)

	Population	Mosque		Break		Church, Temple, Monastery		Temple		Monastery	
		Req'd	Addit'n	Req'd	Addit'n	Req'd	Addit'n	Req'd	Addit'n	Req'd	Addit'n
Kota Surabaya	3,668,900	153	35	1,468	871	122	107	122	122	122	121
Kota Mojokerto	182,300	8	-	73	-	6	-	6	3	6	3
Gresik	2,006,600	84	-	803	-	67	63	67	65	67	65
Bangkalan	1,586,500	66	-	635	-	53	44	53	48	53	52
Sidoarjo	3,178,600	132	-	1,271	-	106	68	106	104	106	105
Mojokerto	1,736,400	72	-	695	-	58	8	58	54	58	56
Lamongan	1,708,900	71	-	684	-	57	10	57	56	57	57
GKS	14,068,200	586	35	5,627	871	469	300	469	476	469	460

Source: JICA Study Team
Notes: Required number of facilities: 1 Small Mosque per 2,500 inhabitants;1 Mosque per 30,000 inhabitants ; 1 Church, Temple and Monastery per 30,000 inhabitants.

4) Green Open Space of Surabaya

(a) Current Situation and Problem

As the amended Spatial Planning Law stipulates in Art. 29, **30% or more of the area** should be green area to secure ecosystem balance, which will increase the availability of fresh air needed by society, and also increase city aesthetic value. And it is also stipulated that to increase the function and proportion of open green space in the city, government, society and the private sector are urged to grow plants on the top of buildings.

Of the stipulated 30% of green area, **20% or more should be secured by the government.**

Of all the Kabupaten and Kota in GKS, **only Surabaya does not meet this standard**, therefore, a detailed analysis of Surabaya's green open space data is made. Table 5.5.10 shows the Park area, Grass area, Shrub area, and Sports facility area of Surabaya in 2007.

The total area of these green open spaces is 160.2 ha, or **0.49% of the land area of Kota Surabaya**, about 32,627 ha, which is far below the requirement. And this area accounts for only **0.59 m^2/person** (green space total), and **0.25 m^2/person** (park area). Thirty percent (30%) of the land area of Surabaya, or 9,788.1 ha, should be green per the requirement, which accounts for 36 m^2/person. Such a small amount of green open space in Kota Surabaya is quite a serious matter.

According to the RTRW of Kota Surabaya (2010-2030), green open space in Kota Surabaya is generally managed by the Regional Government (Green Administration) and by the public

and private sectors. Green open spaces managed by the Government are in the form of parks, green lines, sports fields, and cemeteries, while environmental parks and sports fields and the relatively small park in the cemeteries are largely managed by the community.

The situation of the various types of green open space in Kota Surabaya is as follows:

- *City parks:* Tugu Pahlawan park, Surya park, Gardens hump, Mayangkara park, park under the highway Bunderan etc., whereas the form of environment park includes Barunawati parks, Bratang nurseries, gardens in the neighborhood real estate, environmental settlements, and others.
- *Sports fields*: include the Hayam Wuruk field, Brawijaya field, Bogowonto field, Darmawangsa hockey field, Tambaksari field, Flores Field, Golf Course and others.
- *Cemetery area*: the cemetery and the Hero's Cemetery. Taman Makam Pahlawan (TMP) in Surabaya, the total area of approximately 21.80 ha and spread on 3 locations (Jl. Maj. Gen. Sungkono, Kusuma Bangsan and Ngagel).
- *Green Line*: Beach, which stretches about 11 km from the coast to the mouth of the River Kenjeran Wonokromo largely overgrown by mangrove and the estimated area of about 55 ha to 75 ha. Riverside green lines along Kali Surabaya and Kali Mas Canal, but also a form of grass plants ornamental plants and shade plants. Green lines in the center of the road or the edge of the road include Darmo, Diponegoro, Arjuno, Silver East / West, Ahmad Yani. In large areas of West Surabaya of Lakarsantri, there are many natural plants of which large green open space has not been utilized.
- *Surabaya Zoo* is located in Wonokromo with an area of 15ha.

(b) Planning Issues

In green open space, the following planning issues are addressed.

1) Maintenance of green area to meet the standard and thereby avoiding reduction

It should be quite a challenge for Surabaya to meet the requirement stipulated in the amended Spatial Planning Law. Meanwhile, the other Kabupaten and Kota of GKS should maintain the current level of green open space to meet the requirement as there are found urban development cases encroaching protected areas that tend to reduce important green. Kabupaten and Kota should aim at further increasing their green space in a more positive and strategic manner for better ecological situation.

2) Proper Provision of green open space and park system for citizens

In the amended Spatial Planning Law, it is required to maintain the minimum requirement from an environmental point of view, but not from the viewpoint of amenity for citizens. When it comes to planning of urban facilities for citizens, park area and green space per person, and distribution of such facilities should be discussed and planned. In this sense, the neighborhood unit concept is important for planning urban facilities.

Green space on the median of the streets and green on building roofs are good measures to entire green space and urban amenity; however, they are spaces citizens cannot access and

engage in recreational activities easily. Green facilities and park system that citizens directly enjoy also should be planned.

3) Establishment of Green Network

Green network is a good option to create space for urban amenities that citizens can enjoy. Accordingly, the green line concept of Surabaya should be progressed.

4) Introduction of development guideline to secure green open space and parks in new developments and redevelopment system in built-up areas

Of course, provision of such facilities is not easy because of difficulty of land acquisition and development cost burden. As described in the case of Japanese local governments, in new developments, developers are asked to donate some land for urban facilities such as parks education facilities, or money, in order to provide urban facilities adequately. In order to secure land area for parks in congested built-up areas, it is worth considering an urban redevelopment project to create public space.

Table 5.5.10 Existing Condition of Green Open Space of Kota Surabaya (2007)

(unit: m^2)

	Kecamatan	Park Area	Grass	Shrub	Sport Facility Area	Total
1	Tegalsari	72,893.20	30,557.00	35,936.20	2,376.00	141,762.40
2	Genteng	76,935.45	39,694.34	22,214.60		138,844.39
3	Bubutan	22,350.61	12,304.00	8,304.21	2,112.00	45,070.82
4	Simokerto	3,771.33	3,555.00	152.65		7,478.98
5	Pabean Cantikan	9,965.90	5,729.00	4,193.86	12,500.00	32,388.76
6	Semampir	11,888.85	6,228.85	4,745.34		22,863.04
7	Krembangan	32,282.46	17,230.00	5,574.22	33,777.00	88,863.68
8	Kenjeran	1,482.77	1,250.00	232.77	30,972.00	33,937.54
9	Bulak					
10	Tambaksari	9,862.15	7,599.00	1,969.08	13,990.00	33,420.23
11	Gubeng	102,278.53	59,907.87	20,011.35	30,432.00	212,629.75
12	Rungkut	20,945.22	11,543.07	4,669.15	16,810.00	53,967.44
13	Tenggilis Mejoyo	49,354.20	38,519.42	6,154.70	4,186.00	98,214.32
14	Gunung Anyar					
15	Sukolilo				7,974.00	7,974.00
16	Mulyorejo	25,666.00	5,461.00	6,388.00	7,630.00	45,145.00
17	Sawahan	22,644.55	7,230.00	11,706.00	12,303.00	53,883.55
18	Wonokromo	65,410.95	40,104.67	19,050.09	23,250.00	147,815.71
19	Karangpilang				11,453.00	11,453.00
20	Dukuh Pakis	8,159.33	6,444.00	1,715.33		16,318.66
21	Wiyung	3,957.00	3,057.00	900.00	25,905.00	33,819.00
22	Wonocolo	15,072.00	5,043.02	4,936.98		25,052.00
23	Gayungan	10,836.08	6,804.00	2,182.08		19,822.16
24	Jambangan	384.28		384.28	15,561.00	16,329.56
25	Tandes	31,478.80	7,033.00	13,269.00	24,677.00	76,457.80
26	Sukomanunggal	72,290.70	60,284.28	10,721.42		143,296.40
27	Asemrowo	18,363.00	7,919.00	5,451.00	5,535.00	37,268.00
28	Benowo	1,250.00	800.00	450.00	29,601.00	32,101.00
29	Pakal				10,376.90	10,376.90
30	Lakarsantri				15,390.00	15,390.00
31	Sambikerep					
	Total	689,523.36	384,297.52	191,312.31	336,810.90	1,601,944.09

Source: Dalam Angka 2008 of Kota Surabaya

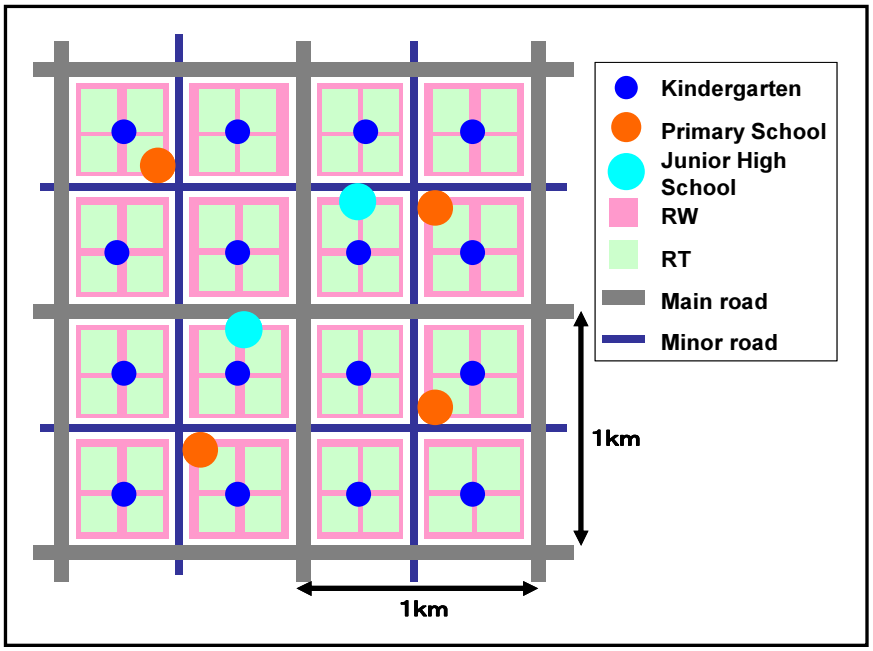
5) Development Strategy of Urban Service Facilities

Provision of urban facilities, particularly educational facilities which are under-provided as compared with other urban facilities, is a big challenge to the local governments. As explained above, a shortage of public facilities, especially educational facilities, is expected to become a serious problem due to population growth. Therefore, it is necessary to formulate a plan to develop educational facilities to meet the future growing demand in particular. In order to achieve the objective fully, the following strategies are stated.

1) Urban Facility Development Based on Residential Neighborhood Unit Concept

These targets are based on the Standard for Improvement of Urban Public Facilities in GKS, which are confirmed in the RTRW of each Kota and Kabupaten. It, however, would not be developed enough because the standards, as already pointed out in Chapter 11, do not have a planning standard in the concept of residential neighborhood unit, which is popularly used in developed countries to plan and develop urban facilities.

Such urban facilities are usually planned based on the theory of neighborhood unit, which is usually a size of primary school district of an area with a population of 8,000 to 10,000 people, and a size of about 1 km by 1 km. Such a neighborhood area is the base to plan various urban facilities as shown in Figure 5.5.1.



Source: JICA Study Team

Figure 5.5.1 Concept of Neighborhood Residential Area

In case of Japan, public facilities are designated as “Urban facilities” under the Urban Planning Law. These facilities are planned in accordance with service coverage area as shown in Table 5.5.11 Once these urban facilities are designated, the development area is legally secured for construction of these facilities. In case of GKS, public facilities such as schools, hospitals and parks of city level should be planned.

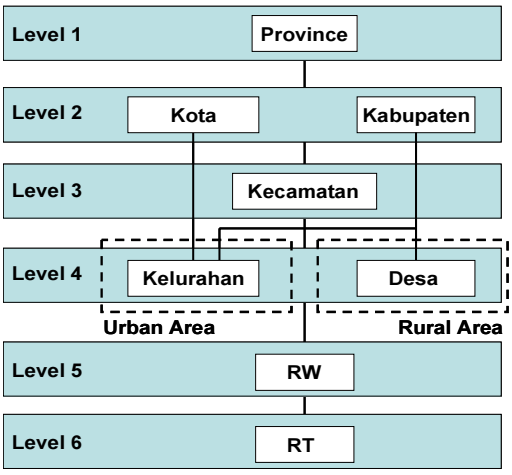
Table 5.5.11 Public Facilities with Planning System

	Block center	Community center	Neighboring center	District center	Central business district (CBD) center
Population	1,000-2,000	4,000-5,000	8,000-10,000	20,000-60,000	150,000
Public facility			Police box, post office	Police, fire station	HQ of Police, fire station, post office, telecom office
Infrastructure facility					Electricity and gas supply facility
Community facility			Community center	District center	Civic hall
Health facility			Clinic	Hospital	Hospital
Educational facility		Kindergarten school	Complex school		University
Social welfare facility			Children's nursery center		Nursing center for the elderly
Commercial facility		Market, shop, bathroom	Supermarket, shop	Supermarket, commercial street	Shopping center, department store
Business facility			Office	Bank, office	Hotel, business center
Amusement facility		Internet	Sports facility	Amusement facility	Amusement center
Park and open space	Community park	Block park	Neighborhood park	District park	City park, special park, sports park, etc.

Source: JICA Study Team

It is better to introduce the Neighborhood Unit concept for urban facilities development in the GKS Spatial Planning. And also in the planning process, involvement of community is important. There is an administrative and social structure including communities in Indonesia, as shown in Figure 5.5.2.

The structure consists of local administrative units of six tiers within Province. From the first to the fourth tiers are public administration; the fifth and sixth tiers are RW (Rukun Warga) and RT (Rukun Tangga) respectively, which are community organizations based on the relationship of everyday-life. Their detailed standards of scale or authority are summarized in Table 5.5.12. In GKS, from the size of administrative and community territories, such neighborhood unit area may be determined based on coherency of communities between Kelurahan/Desa to RW, which should be further discussed.



Source: JICA Study Team

Figure 5.5.2 Administrative and Social Structure in Indonesia

Table 5.5.12 Summary of Authority of Administrative and Community Territories in East Java

District	Population	Area (Ha)	Typical Size	Way of Selecting Leader	Authority	Source of Revenue	Expenditure
Province	37 million	5,700,000	University; Hospital Type A+; Integrated Waste Management; Regional Market	Direct election	Governor: Decision maker for provincial planning and development	APBD I, APBN	All development
Kota	0.2 million ～3 million	1,700 ～ 35,000	University; Hospital Type B+; Town Square, Amusement Park; Great Mosque, Great Chapel; Stadium; Traditional Market Center; Landfill	Direct election	Mayor: Decision maker for municipal planning and implementation of development	APBD II, APBD I, APBN	All development
Kabupaten	1 million～ 3 million	85,000 ～ 190,000	University; Hospital; Town Square; Great Mosque, Great Chapel; Stadium; Traditional Market Center; Landfill	Direct election	Regent: Decision maker for regency planning and implementation of development	APBD II, APBD I, APBN	All development
Kecamatan	50,000～ 200,000	400～20,000	High School; Community Health Center; Mosque, Chapel; Park; District Office; Multipurpose Hall; Sports Hall; Transfer Depot	Appointed by Mayor/ Regent	The Head of District: Coordinator for Sub-districts/villages	APBD II	Coordination/meeting; administration; data collection; Sub-district physical and social improvement
Desa	10,000～ 15,000		Elementary School; Mosque; Park; Community Administrative & Development (Sub-district) Office	Elected by community	The Head of Village: Coordinator & Monitoring for village scale of infrastructure and utility development; administrative assignments, data collection	APBD II	Transportation of garbage
Kelurahan	5,000 ～ 40,000		Elementary School, Junior High School; Community Health Center; Mosque; Park; Community Administrative & Development (Sub-district) Office; Traditional Market; Transfer Depot	Appointed by Mayor	The Head of Sub-district: Coordinator & Monitoring for sub-district scale of infrastructure and utility development; administrative assignments, data collection	APBD II	Coordination/meeting; administration; data collection; Neighborhood physical and social improvement
RW (Rukun Warga)	1,000 ～ 8,000	5 ～25	Kindergarten School; Mother & Infant Care; Small Mosque; Community Hall; Community Park	Elected by community	The Head of RW: Coordinator for RTs activities	Community	Transportation of garbage; security
RT (Rukun Tangga)	200 ～ 400	0.8 ～2	Moslem pre-school	Elected by community	The Head of RT: Coordinator in neighborhood unit scale for solid waste collection; neighboring infrastructure, utilities & environment, social and health improvement; administrative assignments	Community	Transportation of garbage; security

Source: JICA Study Team

2) Diversification of Green Open Space and City Parks

Hierarchical park system. There should be various functions, sizes and locations for urban amenities. For example, in the Urban Planning Law of Japan, hierarchical park planning system is proposed, as shown in Table 5.5.13. In addition, since it is difficult to secure open space for parks in existing residential areas, it is proposed to develop a "community park", which is a small neighboring open space with benches and many recreational equipment. This park would be attractive especially for the elderly and children who have difficulty accessing other parks. These community parks can be planned and developed by self-efforts of residents. This hierarchical park system is better introduced in planning city parks in the GKS Zone.

Green Network system. The Green Network system in the urban area shall also be pursued to create a city area with high amenity, by utilizing the major roads and riversides and other green spaces.

Table 5.5.13 Hierarchical Park Planning System in Japan

Level	Type of park	Purpose/ main user	Size	Service Coverage
City-level	City park	Recreation for citizen	-	-
	Special park	Park with special purposes (zoo, botanical garden, historical park, etc.)		
	Sports park	Sports activities for citizen		
District and community level	District park	Residents of same residential area	approx. 4 ha	1,000 m
	Neighborhood park	Neighboring community	approx. 2 ha	500 m
	Block park		approx. 1 ha	250 m
	Community park		-	-

Source: JICA Study Team

3) Introduction of Housing Development Guidelines

The development guidelines provide certain design standards for developments for the purpose of the creation of good, healthy living environment with a well-planned land use and orderly formation of urbanized area in cooperation with developers.

In the development of public facilities, responsibilities and roles to develop public facilities should be determined among the government, the developer, and the land owners based on the design standard stipulated in the guideline.

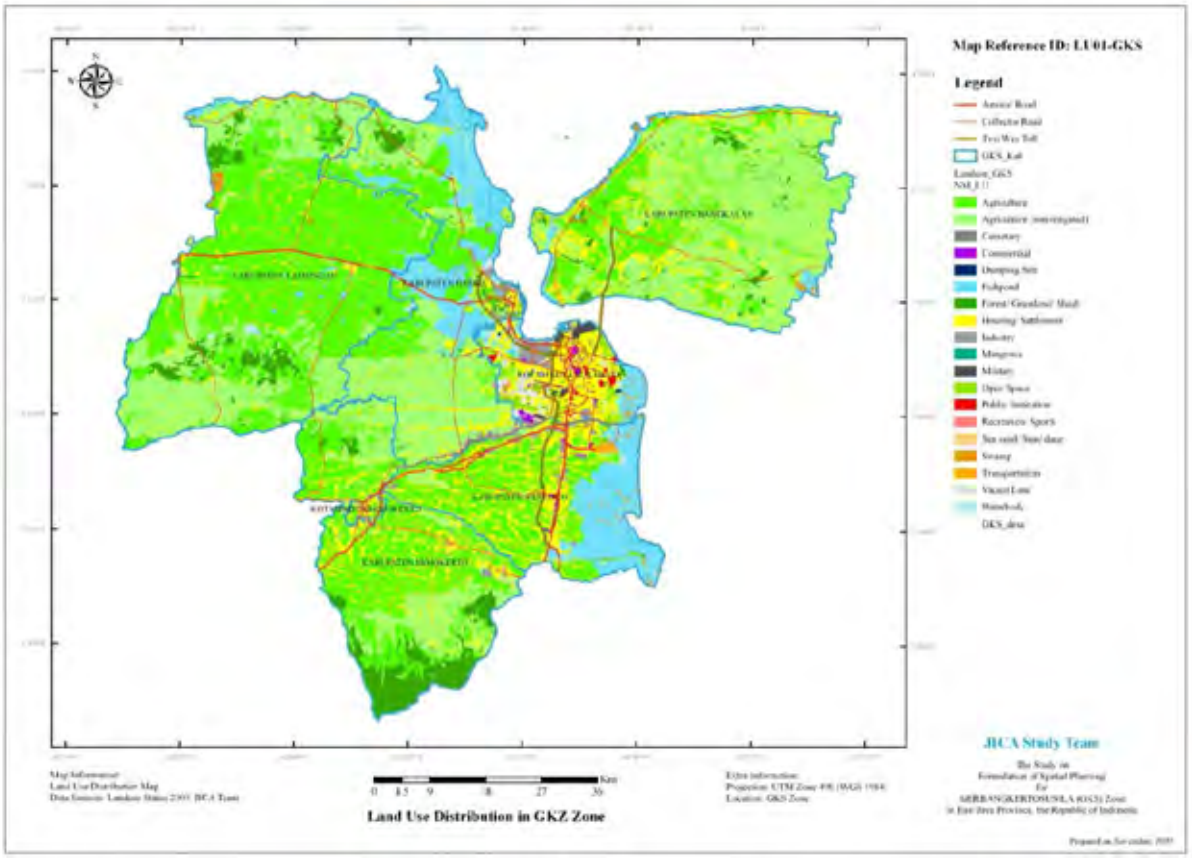
To this end, in addition to the design standard, development finance is also needed, which is called "development financial cooperation" from the developers. It is appropriated to development of infrastructure and public facilities like road, park, water, power, heating, etc. In financing for development of infrastructure and public facilities, the responsibilities and roles among the government, the developer, and the land owners shall be demarcated clearly. Basically, the developers and landowners will bear a financial burden within the value increase of their property accrued from the development.

6. SPATIAL PATTERN PLANNING

6.1 Existing Land Use Patterns and Analysis

6.1.1 Current Conditions

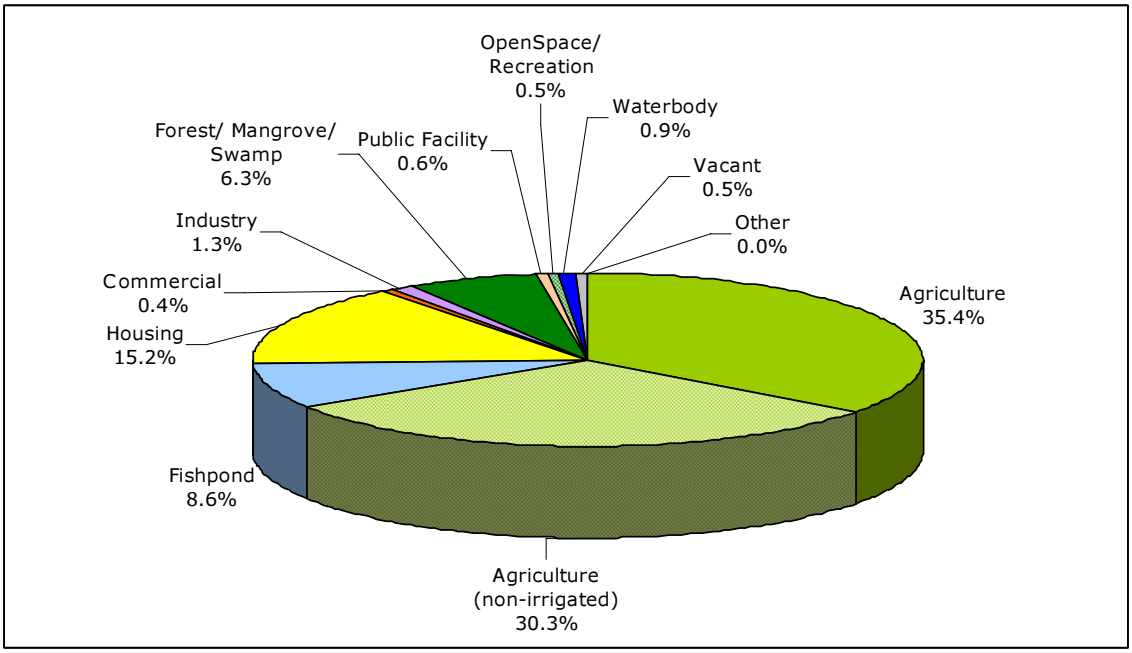
Land use pattern was one of the critical methods used in understanding the current spatial condition in the GKS Zone. In 2009, the JICA Study Team, established 19 land uses using GIS in combination with a variety of data and information, satellite images, and field surveys (refer to Figure 6.1.1).



Source: JICA Study Team

Figure 6.1.1 Map of Existing Land Uses in GKS Zone

The major land use in the GKS comprises agricultural land with a 65.7% share of the total land area, followed by built-up areas (17.5%), for residential, commercial, industrial, and other urban uses. The shares of various land uses are illustrated in Figure 6.1.2, while land use by area in each kabupaten and kota is shown in Table 6.1.1.



Source: JICA Study Team

Figure 6.1.2 Share of Land Uses in GKS Zone

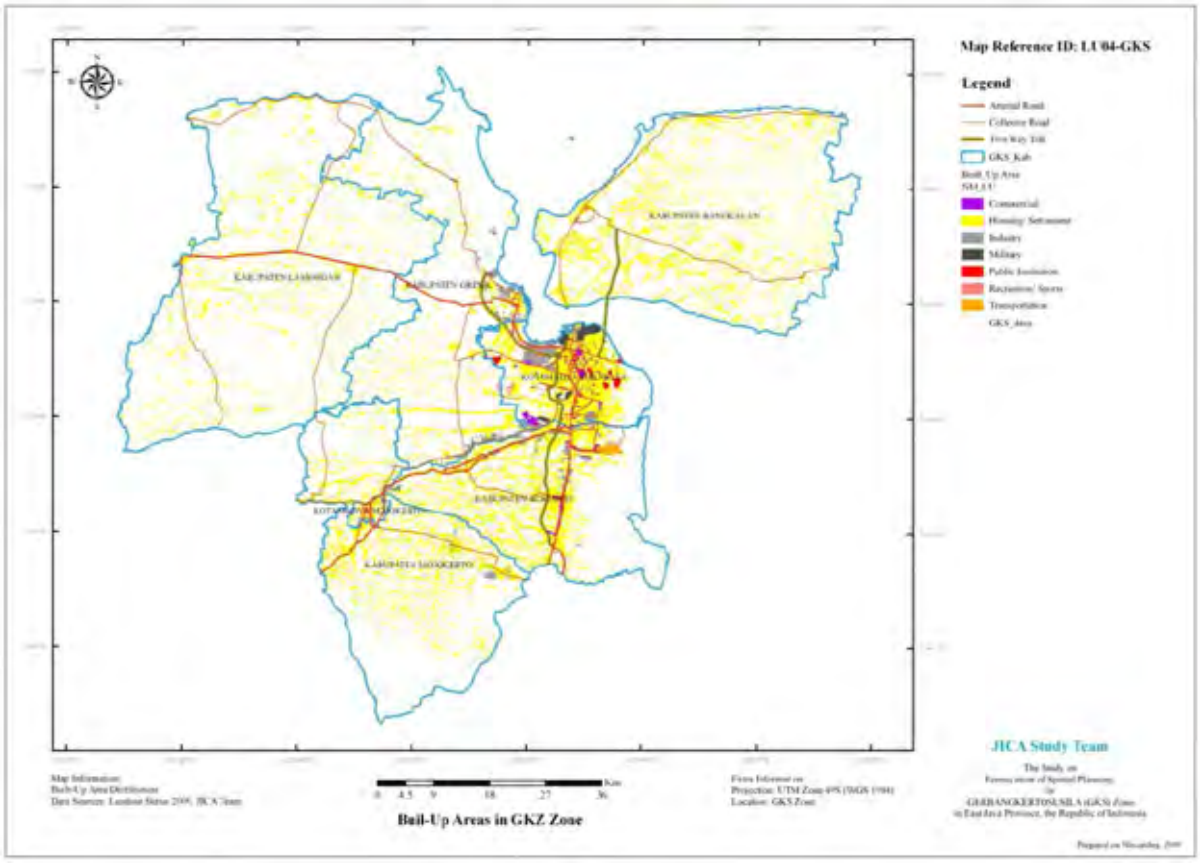
Table 6.1.1 Land Use by Area

Land Use \ Area		Kab. Sidoarjo	Kab. Mojokerto	Kab. Lamongan	Kab. Gresik*	Kab. Bangkalan	Kota Mojokerto	Kota Surabaya
Agriculture	(km^2)	258.53	305.43	1,000.42	218.14	265.77	6.42	5.11
	(%)	(36.2%)	(44.1%)	(55.2%)	(22.0%)	(21.1%)	(39.0%)	(1.6%)
Agriculture (non-irrigated)	(km^2)	21.59	159.30	510.09	376.97	695.77	0.98	9.63
	(%)	(3.0%)	(23.0%)	(28.1%)	(37.9%)	(55.2%)	(5.9%)	(2.9%)
Fishponds	(km^2)	188.23	0.25	32.11	226.52	28.98	0.00	37.18
	(%)	(26.4%)	(0.0%)	(1.8%)	(22.8%)	(2.3%)	(0.0%)	(11.4%)
Housing	(km^2)	179.74	112.38	141.19	96.60	210.57	7.17	127.17
	(%)	(25.2%)	(16.2%)	(7.8%)	(9.7%)	(16.7%)	(43.5%)	(39.0%)
Commercial	(km^2)	6.03	0.36	0.41	1.63	0.87	0.63	14.92
	(%)	(0.8%)	(0.1%)	(0.0%)	(0.2%)	(0.1%)	(3.9%)	(4.6%)
Industry	(km^2)	22.15	4.27	0.69	20.11	0.11	0.04	27.89
	(%)	(3.1%)	(0.6%)	(0.0%)	(2.0%)	(0.0%)	(0.2%)	(8.5%)
Forest/Mangrove/ Swamp	(km^2)	19.44	105.51	111.87	35.80	51.62	0.36	18.78
	(%)	(2.7%)	(15.2%)	(6.2%)	(3.6%)	(4.1%)	(2.2%)	(5.8%)
Public Facility	(km^2)	6.17	3.60	0.00	0.42	0.41	0.29	23.23
	(%)	(0.9%)	(0.5%)	(0.0%)	(0.0%)	(0.0%)	(1.8%)	(7.1%)
Open/ Recreation	(km^2)	0.00	0.25	0.37	0.56	0.01	0.12	27.81
	(%)	(0.0%)	(0.0%)	(0.0%)	(0.1%)	(0.0%)	(0.7%)	(8.5%)
Water Body	(km^2)	12.34	0.00	14.90	13.54	5.94	0.46	7.33
	(%)	(1.7%)	(0.0%)	(0.8%)	(1.4%)	(0.5%)	(2.8%)	(2.2%)
Vacant	(km^2)	0.00	0.01	0.25	3.10	0.05	0.00	27.23
	(%)	(0.0%)	(0.0%)	(0.0%)	(0.3%)	(0.0%)	(0.0%)	(8.3%)
Other	(km^2)	0.01	0.80	0.49	0.33	0.03	0.00	0.09
	(%)	(0.0%)	(0.1%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)	(0.0%)

Notes: * Kabupaten Gresik does not include Bawean Island.
Source: JICA Study Team

6.1.2 Urbanization and Suburbanization

Urbanization has become a common occurrence in the GKS Zone. The area continues to receive a steady influx of people expecting to find better employment opportunities or better living conditions. Urbanization in the GKS has risen in recent years especially in Kota Surabaya and its surrounding areas. Figure 6.1.3 illustrates the built-up areas, including those for residential, industrial, and other urban uses.



Source: JICA Study Team

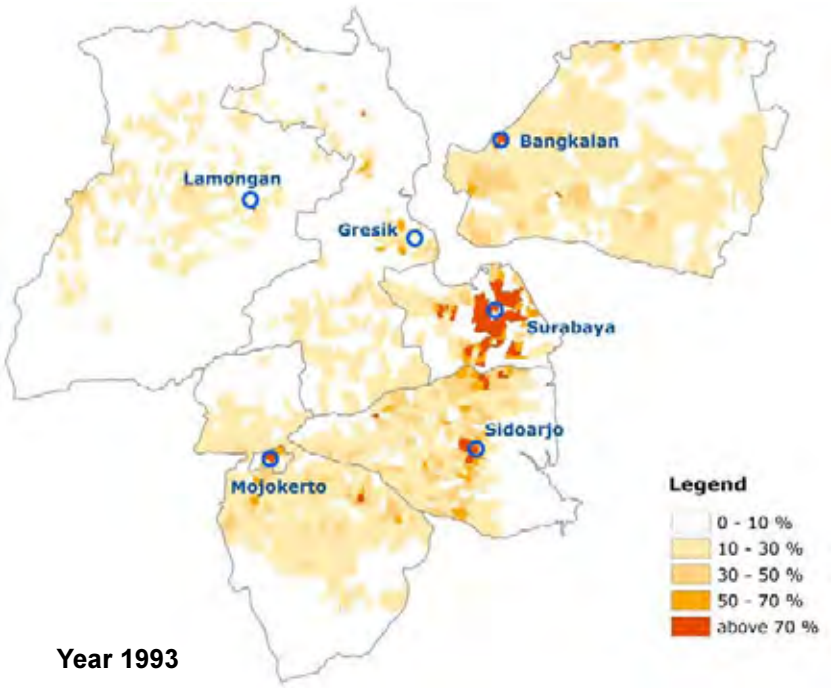
Figure 6.1.3 Built-up Areas in GKS Zone

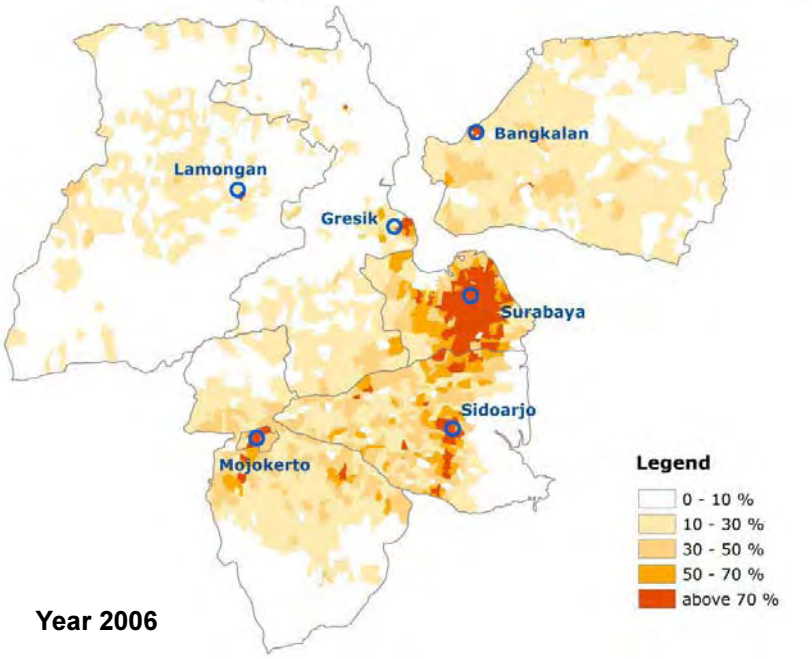
Urbanization has ratcheted up the density levels in the zone and the city center of Kota Surabaya has a remarkably high density. Suburbanization, on the other hand, was started by private developers developing suburban areas located in the urban fringes. They started developing well-planned real estate enclaves in the fringes to attract middle- to high-income households, and these have encouraged urban sprawl in the GKS Zone.

According to population data, the population of Kota Surabaya has reached its highest ever figure and its growth rate has started to decline due to incredibly high densities in the area. Population growth has shifted from Kota Surabaya to the neighboring kabupaten, such as Gresik and Sidoarjo. The further progress of urban sprawl without appropriate urban guidance will lead to diseconomies and lower competitiveness.

The dynamics explained above also applies to land use. A comparison of the land use data between 1993 and 2006 shows the expansion of built-up areas, as shown in Figure 6.1.4. The maps illustrate the spread of built-up areas by desa/kelurahan. The dark color indicates

high density. The contrast of these two maps indicates that the built-up areas have expanded from Kota Surabaya to the surrounding areas, such as Gresik and Sidoarjo, resulting in demographic changes, as well.

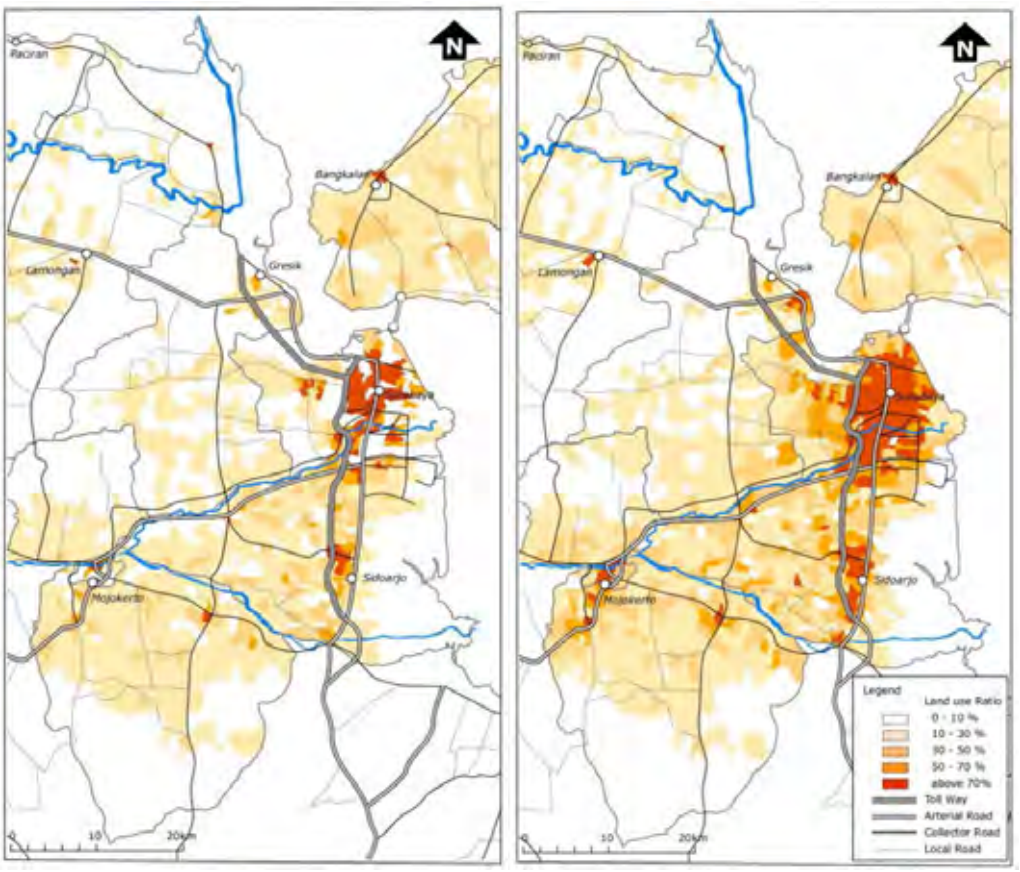




Source: JICA Study Team

Figure 6.1.4 Share of Built-up Areas in GKS (1993 and 2006)

Data analysis further showed that land development has spread from the central part of Kota Surabaya toward the north, west and south, as shown in Figure 6.1.5. The developments tend to be concentrated along major roads, contributing to traffic congestion on roads radiating from/to the city center of Kota Surabaya.



Year 1993 **Year 2006**

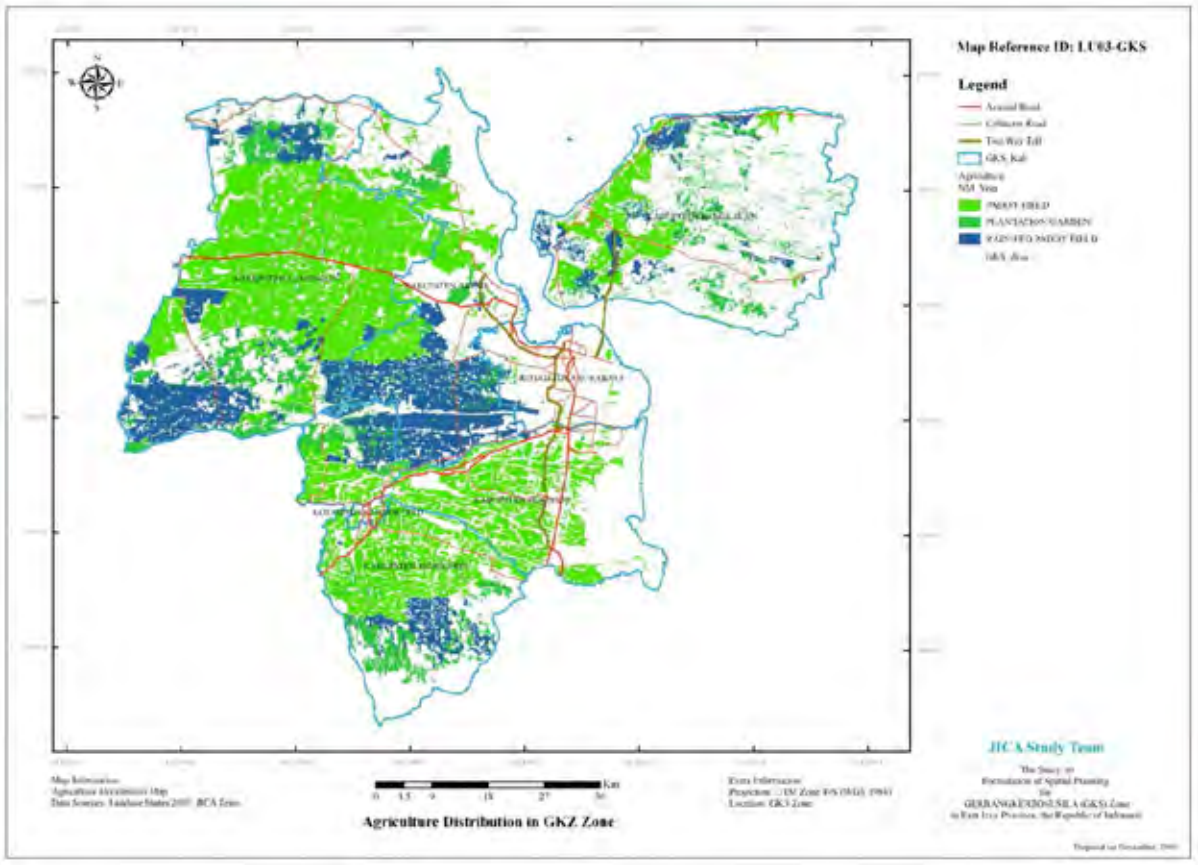
Source: JICA Study Team

Figure 6.1.5 Urbanization in the Surabaya Metropolitan Area (1993 and 2006)

In human settlement development, sprawl happens in the absence of urbanization control in the land use plans or RTRW of each kabupaten and kota.

6.1.3 Agricultural Land Use

Based on GIS data, agricultural land covers a total of 4,049 km^2 in the GKS, or an equivalent to 64.6% of the zone's total area. Lamongan and Bangkalan had the highest shares of agricultural land, accounting for more than 70% of their total. Table 6.1.2 illustrates the distribution of agricultural areas.



Source: JICA Study Team

Figure 6.1.6 Agricultural Areas in GKS

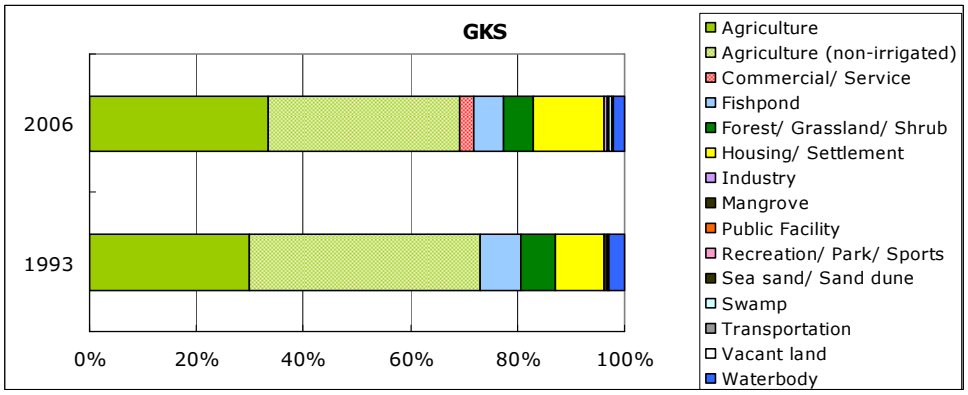
Table 6.1.2 Area of Agricultural Land in GKS

(Unit:km^2)

Area	Paddy Field	Non-irrigated Dry Field/ Farm	Rain-fed Paddy Field	Plantation/ Garden	Total
GKS	1,613.6	306.5	513.3	355.9	3,128.5
Kab. Sidoarjo	252.1	7.2	0.1	0.6	260.0
Kab. Mojokerto	210.8	46.7	42.3	141.0	440.8
Kab. Lamongan	807.0	98.9	77.5	212.1	1,195.4
Kab. Gresik*	178.6	14.9	205.5	172.2	571.3
Kab. Bangkalan	143.7	74.6	387.9	18.1	624.3
Kota Mojokerto	6.4	0.6	-	-	7.0
Kota Surabaya	4.9	0.2	21.4	3.1	29.6

Notes: * Kabupaten Gresik does not include Bawean Island.
Source: JICA Study Team

A study of agricultural land area showed that harvest areas have declined over the years. A comparison of 1993 and 2006 data revealed a cumulative decrease of 3.9%, or 232 km^2, of the total agricultural land, as shown in Figure 6.1.7. On the other hand, residential, industrial, and commercial uses gained 7.3%, or an equivalent to 439 km^2.



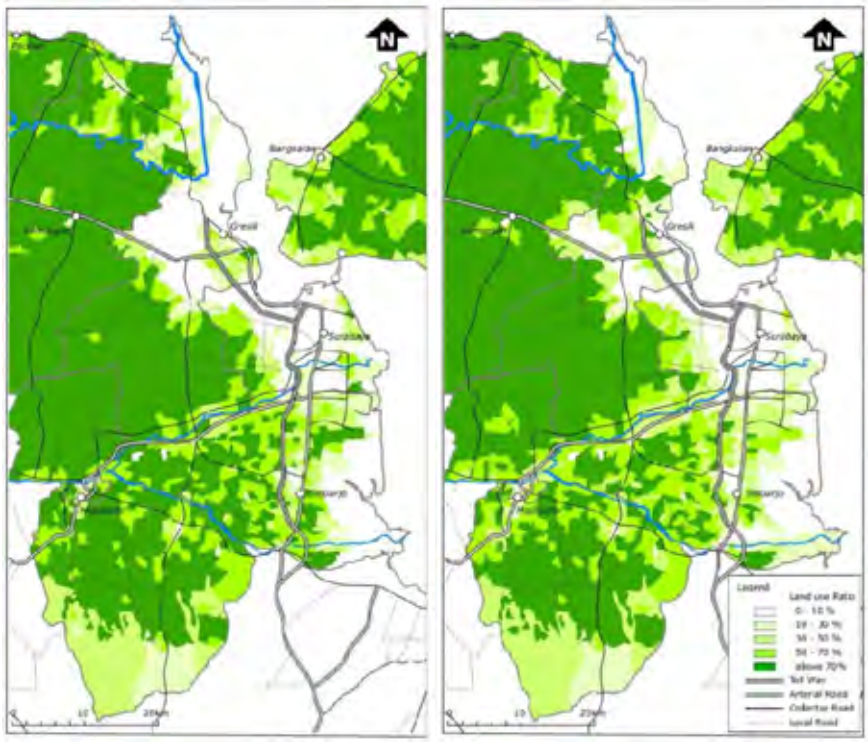
Source: JICA Study Team

Figure 6.1.7 Land Use Ratios in GKS (1993 and 2006)

The expansion of built-up areas is strongly related to land conversion, such as agricultural lands being shifted to housing, industrial, and commercial purposes. According to the Ministry of Agriculture, land conversion in the last five years in East Java, amounted to 38 km^2 per year, or 190 km^2, over a period of five years. This has been cited as one of the reasons why there seems to be a marked decline of farmers passing down their agricultural assets on to the next generation.

The 1993 and 2006 land use data also showed that the substantial reductions were happening in areas around Surabaya, particularly in Gresik and Sidoarjo (see Figure 6.1.8).

Even as agricultural productivity is expected to improve in the future due to modern farming techniques and better agricultural policies from the Ministry of Agriculture, the necessity of preventing inappropriate land conversion can never be downplayed because a diminishing trend in agricultural land would in the end adversely affect agricultural productivity. Unabated agricultural land conversion could result in a scenario wherein farmlands become mere patchwork, interspersed between built-up areas and other land uses. Mixed land use might be an attractive option but it prevents effective and efficient integration of infrastructure and cause unexpected traffic congestion. Securing agricultural land will also help in the food security program in Indonesia.



Year 1993 **Year 2006**

Source: JICA Study Team

Figure 6.1.8 Share of Agricultural Areas in and around Surabaya (1993 and 2006)

6.1.4 Industrialization and the Environment

1) Industrialization

During the period from the latter half of the 1980s until just before the Asian currency crisis in 1997, Indonesia's economy drew high expectations, as can be gleaned from a 1993 World Bank report entitled "East Asian Miracle: Economic Growth and Public Policy," which cited Indonesia as one of the East Asian economies that attained sustained economic growth. At present, the Indonesian economy is still in the developing stage, and in accordance with the traditional of industry-led growth in other countries, Indonesia's industrialization policy is meant to drive the country's growth. The policy on industrialization led to the formulation and implementation of various national development strategies.

In eastern Indonesia, the GKS Zone was selected by the Indonesian government as the center for natural and industrial development. In fact, industrialization is progressing at a rapid rate in the area, centering in Surabaya. Meanwhile, intensive investment in infrastructure and services has taken place in Sidoarjo, Gresik, and Surabaya.

The positive economic impacts of industrial activities in the GKS Zone are directly manifested in robust local job generation, increases in people's incomes, and GDP growth.. Exports and imports have grown tremendously in the past years channeled through the Surabaya international port and Gresik export harbor. In Surabaya, these amounted to more than four million tons in 1988, which was expected to triple in the early and middle 2000s. The bulk of exports and imports involve Asian countries, with Japan as the major partner. Movement of goods to and from North America is primarily associated with the United States.

Although the expectation is that sustained economic growth in the GKS will be transformative, liberating the people from poverty, hunger, and diseases, industrialization may also result urban problems such as rising unemployment; lack of urban services; overburdening of existing infrastructure; lack of access to land, finance and adequate shelter; rising crime rates; and environmental degradation. As seen in other countries, while industrialization revs up the national output, a decline in the quality of life among the poor often offset the benefits of national economic growth. Thus, industrialization and its related causal factors often impose significant burdens on sustainable development.

2) Environmental Implications

In the same vein, positive socioeconomic results from industrial growth can often be accompanied by serious environmental degradation and occupational hazards. Despite positive economic variables, many areas in the GKS Zone are plagued by various environmental problems (refer to section 6.6 for details). Some of the major problems are as follows:

- Water and air pollution, especially at the household and community levels;
- Health risks posed by pesticides and industrial effluents;
- Productivity is adversely affected by traffic congestion;
- The conversion of agricultural land and forests for urban uses and infrastructure are associated with the widespread removal of vegetation which places additional pressure on areas that are even more ecologically sensitive;
- Urbanization in coastal areas has led to the destruction of sensitive ecosystems and have altered the hydrology of coasts and their natural features such as mangroves, swamps, reefs, and beaches that serve as barriers against erosion and form important habitats for vital flora and fauna; and
- Weak environmental protection.

The intensive and extensive exploitation of natural resources to support industrialization and urban activities contributes to the degradation of natural support systems and the irreversible loss of critical ecosystems, such as hydrological cycles, carbon cycles, and biological diversity, in addition to potential conflicts that arise from the rural uses of such limited resources. Other effects can be felt such as the pollution of waterways and long-range air pollution which impacts on human health, vegetation, and soil even at considerable distances.

6.1.5 Land Use Planning Issues

Certain fundamental issues should be addressed in order to formulate an appropriate land use plan. In terms of land use, there is a conflicting dichotomy between urbanization and protection of the natural environment and agricultural land. And because urbanization and suburbanization are often a consequence of growth, more land areas will be needed to provide urban services, accommodate increasing population, and develop industrial zones. As the appetite for more land grows so is the need to protect the area from disorderly development, environmental degradation, unabated agricultural land conversion, and disasters, such as floods and landslides. The fact that urbanization control areas have yet to be designated in current land use plans only fuels such dire scenarios. Furthermore, even with the existence of regulations prescribing proper land uses, the reality is that existing land

use does not comply with them, for example Regulation No.26/2008.

In this JICA study thus the future land use plan was formulated based on the following considerations:

1) Identification of Spatial Carrying Capacities through an Analysis of Constrained and Protected Areas

Through the land use analysis, spatial carrying capacity in the GKS Zone is identified. The methodology is described in the following section, 6.2. The most crucial objective of the analysis is to logically delineate areas to be protected from urban development pressures and from environmental degradation.

- Protected areas: Environment protection areas, forest and agricultural land, prioritizing those with potential/existing high productivity and agricultural suitability; and
- Constrained areas: flood- and landslide-prone areas.

2) Designation and Prioritization of Major Service Centers

Urban centers and/or human settlement centers are hierarchically identified in the entire spatial structure which should be the most functionally workable to encourage economic and social activities over the GKS Zone. This shall be composed with the following spatial elements:

- Variety of urban functions;
- Their absorptive capacities of urban and public services; and
- Future transportation network.

3) Forecast of Demand for Housing, Urban Services, and Industrial Development by 2030

All activities require space and location. Future demands for land use can be forecasted, based on the framework of socioeconomic activities in future through the following procedure:

- Analyses of current urbanization characteristics, future urbanization scenarios, and industrialization patterns;
- Computation of areas to be urbanized as human settlements and for urban services by 2030; and
- Computation of land area requirements for industrial use to realize the preferred economic growth scenario.

4) Review of the RTRW of East Java and Each Kabupaten/Kota

The existing and/or officially committed land use plans are reviewed and coordinated with the GKS land use plan. The GKS Zone should be coherent with the upper spatial plan of East Java Province as well as the spatial plan of each Kabupaten/Kota through:

- Review of development areas designated by the RTRW; and

- Coordination of future development plans and the RTRW.

5) Formulation of the Optimal Land Use Pattern for Balanced Development

The land use plan needs to guarantee the optimality of land use in future, accommodating all people's expected social and economic activities in the limited space. The plan should also ensure the most appropriate balance between environment and development, taking into account:

- Locations: Analyses of past trends in land use, existing population accumulation, future transportation network, future development scenarios, and major service centers; and
- Capacities: Projections of spatial capacity of service centers.

6) Designation of Urbanization Control Areas and Environmentally Sensitive Areas for Appropriate Growth Management

Government Regulation No.26/2008 (National Spatial Plan) aims to achieve the optimal utilization of space, land and natural resources over the nation for Indonesian people to enjoy sustainable development and well-being. This national target needs to be realized, narrowing the differences between existing land use and such a legal target. To this end, some administrative enforcement against disorderly development activities and illegal actions should be undertaken through:

- Area designation of "Environmentally Sensitive Areas", in consideration of protection and conservation of invaluable natural resources for environment and disaster management; and
- Adjustment of the existing legal framework for Law No. 41/1999 (Forestry and Forest Conservation)1 and Law No. 41/2009 (Sustainable Food and Agricultural Land Protection)2.

[1] Law No.41/1999 stipulates that forest zone area shall exceed 30% of planned area, or watershed area.
[2] Law No.41/2009 addresses that agricultural land can only be converted for public purposes, such as disaster relief and/or mitigation, not for residential and industrial purposes.

6.2 Development Suitability Analysis

1) Objective and Methodology of the Analysis

Development suitability analysis is meant to identify spatial carrying capacity and assure a balanced land use pattern in the GKS Zone. In this analysis, environmentally sensitive areas were assessed along the concepts of natural resource conservation and/or protection. Striking a balance between economic development and environmental protection was theoretically pursued.

2) Methodology of the Analysis

Development suitability analysis was carried out using GIS. The factors used in the analysis were classified into two groups: the group comprising the **development constraints component** of areas that should be protected, conserved, and/or reserved against urban development activities; and the other group comprise **development potential components,** which include such factors as accessibilities and/or availabilities of urban services, i.e., transportation, service centers, and infrastructure. The first group was recognized as constraints to development, while the latter was considered as potentials for development.

The factors that were considered in the analysis are shown in Table 6.2.1 to 6.2.3. Constraint factors and evaluation scoring system is as shown in Table 6.2.1. Development potential factors and their evaluation scoring system are indicated as shown in Table 6.2.2 for the existing condition at present (2009), and in Table 6.2.3 for the future condition in 2030. As seen in the table, each element has several scores reflecting the degree either of severity or importance. In theory, a piece of land has negative and positive scores, and the sum of the two is the final score given to that land. A negative final score means the land should be protected, even if it has a certain level of development potential. The score of the land or area being evaluated was computed using the following formula:

$$LP\,i = \alpha_j \sum_{1}^{N} PF_i + \beta_k \sum_{1}^{N} CF_i$$

Where, *i*: Land or area being evaluated (*i*-cell)

LP*i* : Total score of *i*

PF*i* : Score of development potential factor of *i (positive)*

CF*i* : Score of development constraint factor of *i (negative)*

αj : Weight given to development potential factor

βk: Weight given to development constraint factor

Table 6.2.1 shows the process of determining the development potential of an area using GIS and the analysis as discussed above. As seen in this figure, development constraints at present (as of 2009) will be the same in the future (i.e., 2030), because environmental values do not diminish over time. On the other hand, the development potential of an area will drastically change by 2030 when new infrastructure, especially roads, becomes available in surrounding areas.

Table 6.2.1 Constraint Elements Used for Land Suitability Analysis and Scoring System

<Constraint Factors>

Constraint Factors	Attributes of Constraint Area	Score				
		--5	--4	--3	--2	--1
Mangrove area	1km buffer area from existing Mangrove area	0-200m	200-400m	400-600m		
Military area	1km buffer area from existing Military area	0-200m	200-400m	400-600m	600-800m	800-1000m
Poring Mud Flow area	5km buffer area from Porong mud flow area	0-1000m	1000-2000m			
Swamp/ Fish pond	Existing swamp/ fish pond area	Fish pond	Swamp			
Irrigated agriculture	Existing irrigated agriculture area				Irrigated agriculture	
Dumping site	2km buffer area from existing dumping site	0-200m	200-400m	400-800m	800-1200m	1200-2000m
Forest	1km buffer area from existing forest area	0-200m	200-400m	400-600m		
Flood potential area	JaTIM flood potential area	Flood potential area				
Airport	5km buffer area from airport	0-1.0km	1.0-2.0km	2.0-3.0km	3.0-4.0km	4.0-5.0km
Production forest	JaTIM production forest area	Production forest area				
Protection forest	JaTIM protection forest area	Protection forest area				
Soil Condition (erosion)	JaTIM soil condition	High		Medium		Low
Land stability	GKS-ISP land stability analysis	Preservation zone		Conservation zone	Restoration zone	
Water catchment	JaTIM water catchment	Water catchment area				
Conservation area	JaTIM conservation area	Conservation area				

Source: JICA Study Team

Table 6.2.2 Development Potential Elements and Scoring System in 2009

<Positive Potential Factors Year 2009>

	Positive Factor	Buffer for Evaluation	Score						
			20 ~11	10~5	5	4	3	2	1
Distance from Urban center	Distance from Surabaya city center	Distance from Surabaya (Km)	0 – 9.0	9.0 – 13.7	13.7-14.5	14.5-15.4	15.4-16.3	16.3-17.1	17.1-18.5
	Distance from Gresik/ Sidoarjo	5km from Sidoarjo/ Gresik (m)	n/a	n/a	0-500	500-1000	1000-2000	2000-3000	3000-5000
	Distance from Bangkalan/Labang/Menga/Kerian	4km from Bangkalan /Labang/ Menga/ Kerian (Km)	n/a	0 – 2.5	2.5-2.9	2.9-3.2	3.2-3.4	3.4-3.7	3.7-4.0
	Distance from Lamongan/ Mojokerto/Gempol/ Babat	3km from Lamongan/ Mojokerto/ Gempol/ Babat (m)	n/a	n/a	0 - 500	500 - 1000	1000 - 2000	2000 – 3000	n/a
Distance from Bus service	Distance from Bus terminal (Inter Prov.)	5km from existing Inter Prov. Bus terminal (m)	n/a	n/a	0 - 1000	1000 - 2000	2000 – 3000	3000 - 4000	4000 - 5000
	Distance from Bus terminal (2nd level Bus terminal)	2km from existing 2nd level bus terminal (m)	n/a	n/a	n/a	0 - 500	500 - 1000	1000 - 1500	1500 - 2000
	Distance from Bus terminal (3rd level Bus terminal)	2km from existing 3rd level bus terminal (m)	n/a	n/a	n/a	0 - 500	500 - 1000	1000 - 1500	1500 - 2000
	Distance from bus routes	3km from existing bus routes (m)	n/a	n/a	n/a	n/a	0 - 1000	1000 - 2000	2000 - 3000
Distance from Port	Distance from Port (1st level Port)	25km from existing 1st level port (km)	n/a	n/a	0 - 5	5 - 10	10- 15	15 - 20	20 - 25
	Distance from Port (2nd level Port)	4km from existing 2nd level port (m)	n/a	n/a	n/a	n/a	0 - 1000	1000 - 2000	2000 - 4000
Railway service	Distance from Railway Station	2km Euclidean distance from existing railway stations (m)	n/a	n/a	0 - 200	200 - 400	400 - 600	600 - 800	800 - 200m
Distance from terminal	Distance from Industrial Estate	5km from existing industrial estates (m)	n/a	n/a	0 - 1000	1000 - 2000	2000 - 3000	3000 - 4000	4000 - 5000
	Distance from freight terminal	5km from existing freight terminal (m)	n/a	n/a	0 - 1000	1000 - 2000	2000 - 3000	3000 - 4000	4000 - 5000
Distance from road & airport	Distance from secondary arterial road	5km from existing secondary arterial road (m)	n/a	n/a	0 - 500	500 - 1000	1000 - 1500	1500 - 2000	2000 - 5000
	Distance from toll road	10km from existing toll road (m)	n/a	n/a	0 - 2000	2000 - 3000	3000 - 4000	4000 - 5000	5000 - 10000
	Distance from collector road	5km from existing collector road (m)	n/a	n/a	0 - 500	500 - 1000	1000 - 1500	1500 - 2000	2000 - 5000
	Distance from ramp	10km from existing toll road ramp (m)	n/a	n/a	0 - 2000	2000 - 3000	3000 - 4000	4000 - 5000	5000 - 10000
	Distance from local road	2km from existing local road (m)	n/a	n/a	0 - 250	250 - 500	500 - 750	750 - 1000	1000 - 2000
	Distance from arterial road	5km from existing arterial road (m)	n/a	n/a	0 - 500	500 - 1000	1000 - 2000	2000 - 3000	3000 - 5000
	Distance from airport	20km from existing airport (km)	n/a	n/a	0 – 2.5	2.5-5.0	5.0-7.5	7.5-10.0	10.0-20.0
Time Distance from SBY	Time-distance 60 min. area	1kmfrom time-distance 60 min. area from Surabaya CBD (m)	n/a	n/a	0 - 200	200 - 400	400 - 600	600 - 800	800 - 1000
	Time-distance 30 min. area	1km from time-distance 30 min. area from Surabaya CBD (m)	n/a	n/a	0 - 200	200 - 400	400 - 600	600 - 800	800 - 1000

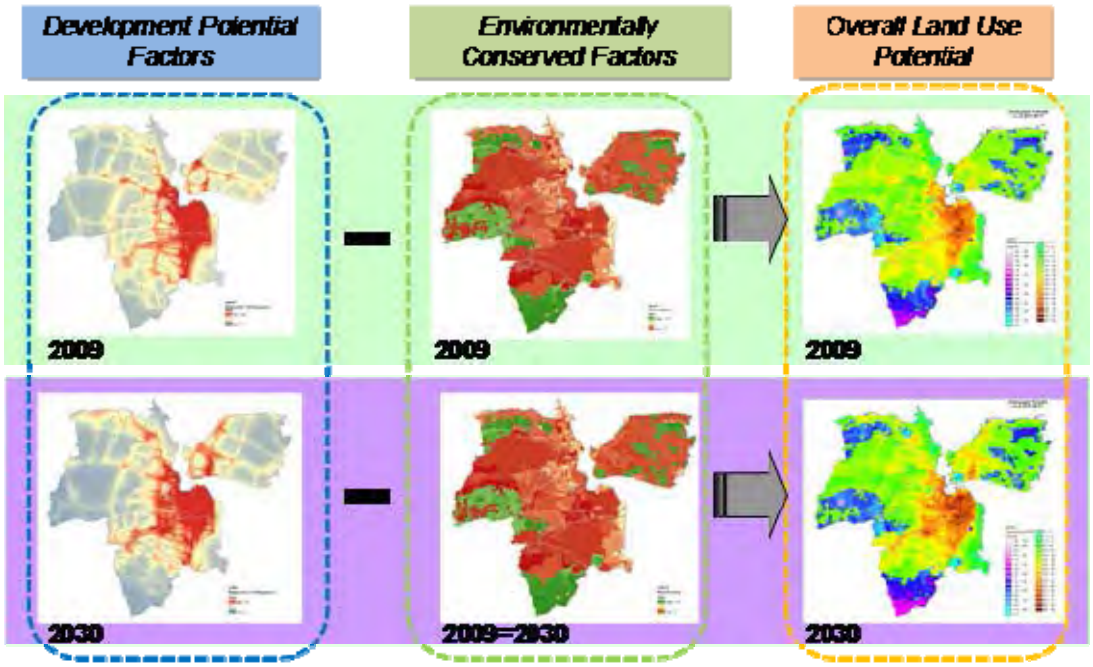
Notes: Distance is measured with the Euclidean distance..

Table 6.2.3 Development Potential Elements and Scoring System in 2030

<Positive Potential Factors Year 2030>

	Name of Constraint Factor	Descriptions of positive factor	Score					
			20~15	5	4	3	2	1
Distance from Urban Center	Distance from Regional center	Distance from Surabaya (km)	0 – 13.7	13.7 – 14.5	14.5-15.4	15.4-16.3	16.3-17.1	17.1-18.5
	Distance from SMA level center	5km from the proposed SMA level center (m)	n/a	0-500m	500-1000	1000-2000	2000-3000	3000-5000
	Distance from GKS Kab.center	4km from GKS Kab. Center (m)	n/a	2531-2875	2875-3156	3156-34378	3438-3719	3719 - 4000
	Distance from GKS sub-center/ SMA sub-center/ other Kab. Sub-center	3km from GKS sub-center/ SMA sub-center/ other Kab. Sub-center (m)	n/a	0 - 500	500 - 1000	1000 - 2000	2000-3000	3000-5000
Distance from Bus service	Distance from Bus terminal (Inter Prov.)	5km from proposed Inter Prov. Bus terminal (m)	n/a	0 - 1000	1000-2000	2000-3000	3000-4000	4000 - 5000
	Distance from Bus terminal (2nd level Bus terminal)	2km from proposed 2nd level bus terminal (m)	n/a	n/a	0-500	500-1000	1000-1500	1500-2000
	Distance from Bus terminal (3rd level Bus terminal)	2km from proposed 3rd level bus terminal (m)	n/a	n/a	0 - 500	500-1000	1000-1500	1500-2000
	Distance from bus sub-terminal	5km from proposed bus sub-terminal (m)	n/a	0-500	500-1000	1000-1500	1500-2000	2000-5000
	Distance from bus routes	3km from proposed bus routes	n/a	n/a	n/a	0-1000	1000-2000	2000-3000
Distance from Port	Distance from Port (1st level Port)	Distance from the proposed 1st level port (km)	n/a	0 - 5	5 - 10	10-15	15 - 20	20 - 25
	Distance from Port (2nd level Port)	4km from the proposed 2nd level port (m)	n/a	n/a	n/a	0 - 1000	1000 - 2000	2000 - 4000
Railway	Distance from Railway Station	2km from the proposed railway stations (m)	n/a	0 - 200	200 - 400	400 - 600	600 - 800	800 - 2000
Accessibility to/from road	Distance from secondary arterial road	5km from proposed the secondary arterial roads(m)	n/a	0 - 500	500 - 1000	1000 - 1500	1500 - 2000	2000 - 5000
	Distance from toll road	10km from the proposed toll roads(m)	n/a	0 - 2000	2000 - 3000	3000 - 4000	4000 - 5000	5000 - 10000
	Distance from collector road	5km from the proposed collector roads(m)	n/a	0 - 500	500 - 1000	1000 - 1500	1500 - 2000	2000 - 5000
	Distance from ramp	10km from proposed toll road ramps(m)	n/a	0 - 2000	2000 - 3000	3000 - 4000	4000 - 5000	5000 - 10000
	Distance from local road	2km from the proposed local roads (m)	n/a	0 - 250	250 - 500	500 - 750	750 - 1000	1000 - 2000
	Distance from arterial road	5km from the proposed arterial roads (m)	n/a	0 - 500m	500 - 1000	1000 - 2000	2000 - 3000	3000 - 5000
Accessibility to airport	Distance from airport	20km from the proposed airport (km)	n/a	0 – 2.5	2.5-5.0	5.0-7.5	7.5-10	10-20
Time-distance from Surabaya	Time-distance 60 min. area	1km from time-distance 60 min. area from Surabaya CBD (m)	n/a	0 - 200	200 - 400	400 - 600	600 - 800	800 - 1000
	Time-distance 30 min. area	1km from time-distance 30 min. area from Surabaya CBD (m)	n/a	0 - 200	200 - 400	400 - 600	600 - 800	800 - 1000
Others	Distance from Industrial Estate	5km from existing industrial estates (m)	n/a	0 - 1000	1000 - 2000	2000 - 3000	3000 - 4000	4000 - 5000
	Distance from freight terminal	5km from existing freight terminal (m)	n/a	0 - 1000	1000 - 2000	2000 - 3000	3000 - 4000	4000 - 5000
	Distance from New bus transit corridor	3km from NBTC corridor (m)	n/a	0 - 500	500 - 1000	1000 - 2000	2000 - 3000	n/a
	Distance from New bus transit station	5km from NBTC station (m)	n/a	0 - 500	500 - 1000	1000 - 2000	2000 - 3000	3000 - 5000

Notes: Distance is measured with the Euclidean distance.



Source: JICA Study Team

Figure 6.2.1 Development Suitability Analysis Using GIS

3) Distribution of Land with Development Constraints (2009–2030)

The GIS technique revealed a distribution pattern with high development constraints, as illustrated in Figure 6.2.2. The figure shows a gradation in the accumulated negative scores. Areas with high negative scores are colored dark brown and those with low negative scores are colored dark green. From this map, areas in the GKS Zone that must not be subject to urban development, or land conversion, are easily identifiable.

4) Distribution of Land with Development Potentials (2009 and 2030)

The GIS analysis also revealed the distribution of land with development potential for both 2009 and 2030, as shown in Figure 6.2.3. Areas with higher scores are colored dark brown. The analysis showed that land development will expand along with the provision of transportation. Notable changes in a comparison between 2009 and 2030 will take place in the western suburban area of Surabaya, the northern coastal areas along Gresik and Lamongan, and the Suramadu Bridge corridor in Bangkalan.

5) Overall Evaluation of Development Constraints and Potentials

Superimposing the two maps resulted in an overall evaluation of development suitability, as shown in Figure 6.2.4. The figure represented the basic conditions to be taken into account in land use planning and environmental policy making.

The scores and sizes of the evaluated areas are tabulated in Table 6.2.4. The table shows that if an area gets a negative score, it must strictly be conserved or preserved, because the area's negative factor is stronger than its positive factors. An area could only accept development activities if it received an overall high positive score. Negative scorers

account for a land area totaling 165,000 ha or 26.0% of the entire GKS Zone by 2030, while the positive scorers occupy 470,000 ha, or 74.0% share. The latter includes agricultural land.

Table 6.2.4 Results of the Development Suitability Analysis of GKS Zone

Score	Attribute	Y2009				Y2030			
		Area (ha)		Categorized Area		Area (ha)		Categorized Area	
less than -81	High Constained	288	0.0%	157,188	24.8%	520	0.1%	164,892	26.0%
-71 - -80		652	0.1%			424	0.1%		
-61 - -70		5,460	0.9%			8,424	1.3%		
-51 - -60		4,960	0.8%			4,272	0.7%		
-41 - -50		18,856	3.0%			23,880	3.8%		
-31 - -40		72,020	11.3%			71,448	11.3%		
-21 - -30		28,604	4.5%			21,068	3.3%		
-11 - -20	Low Constrained	4,024	0.6%			5,952	0.9%		
-1 - -10		22,324	3.5%			28,904	4.6%		
0-10	Low Potential	50,028	7.9%	477,712	75.2%	58,172	9.2%	470,008	74.0%
11-20		235,028	37.0%			197,956	31.2%		
21-30		111,012	17.5%			99,392	15.7%		
31-40		38,796	6.1%			46,148	7.3%		
41-50		18,820	3.0%			29,824	4.7%		
51-60	High Potential	18,420	2.9%			24,252	3.8%		
more than 60		5,608	0.9%			14,264	2.2%		
		634,900	100.0%	634,900	100.0%	634,900	100.0%	634,900	100.0%

Source: JICA Study Team

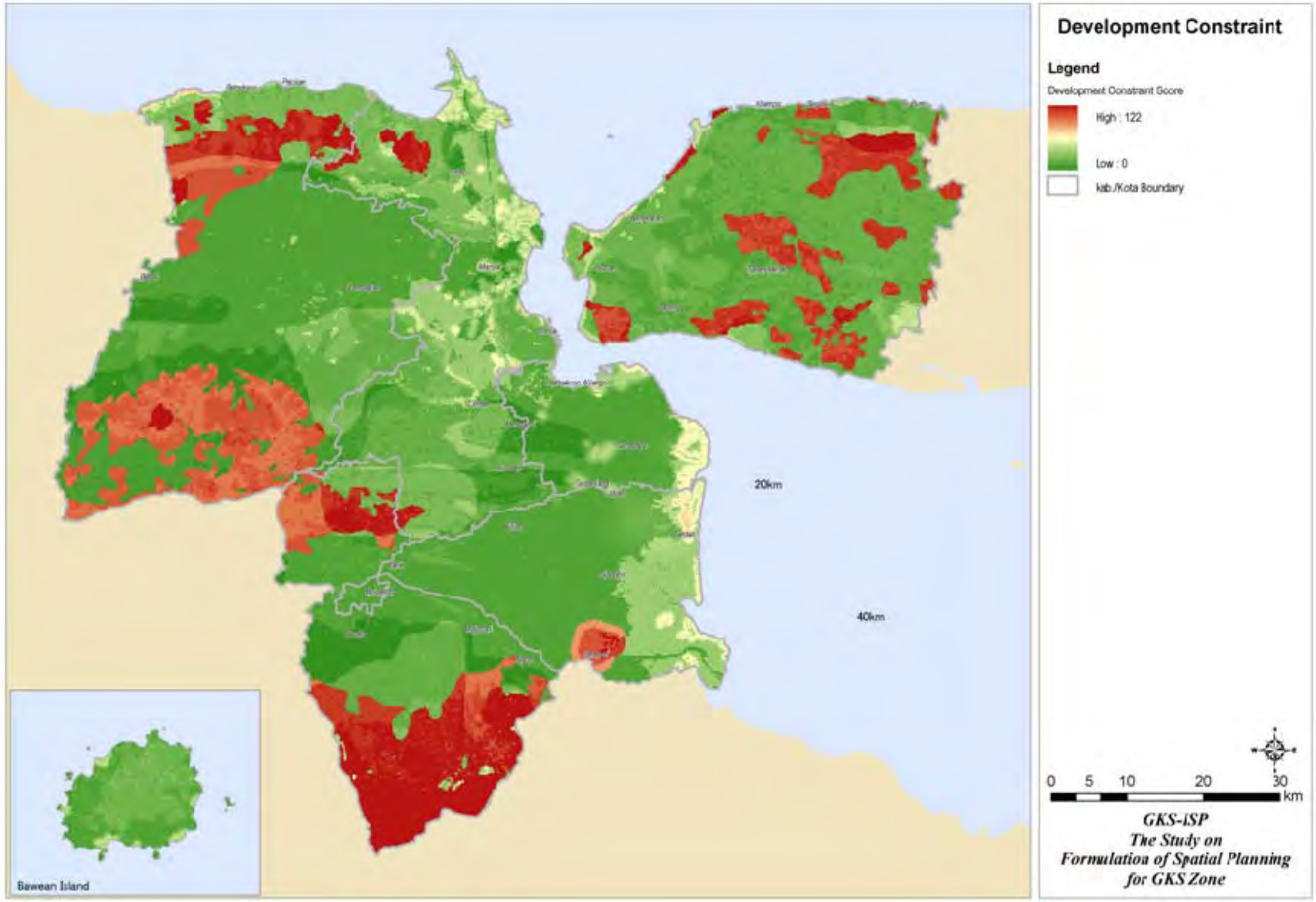


Figure 6.2.2 Distribution of Land with Development Constraints

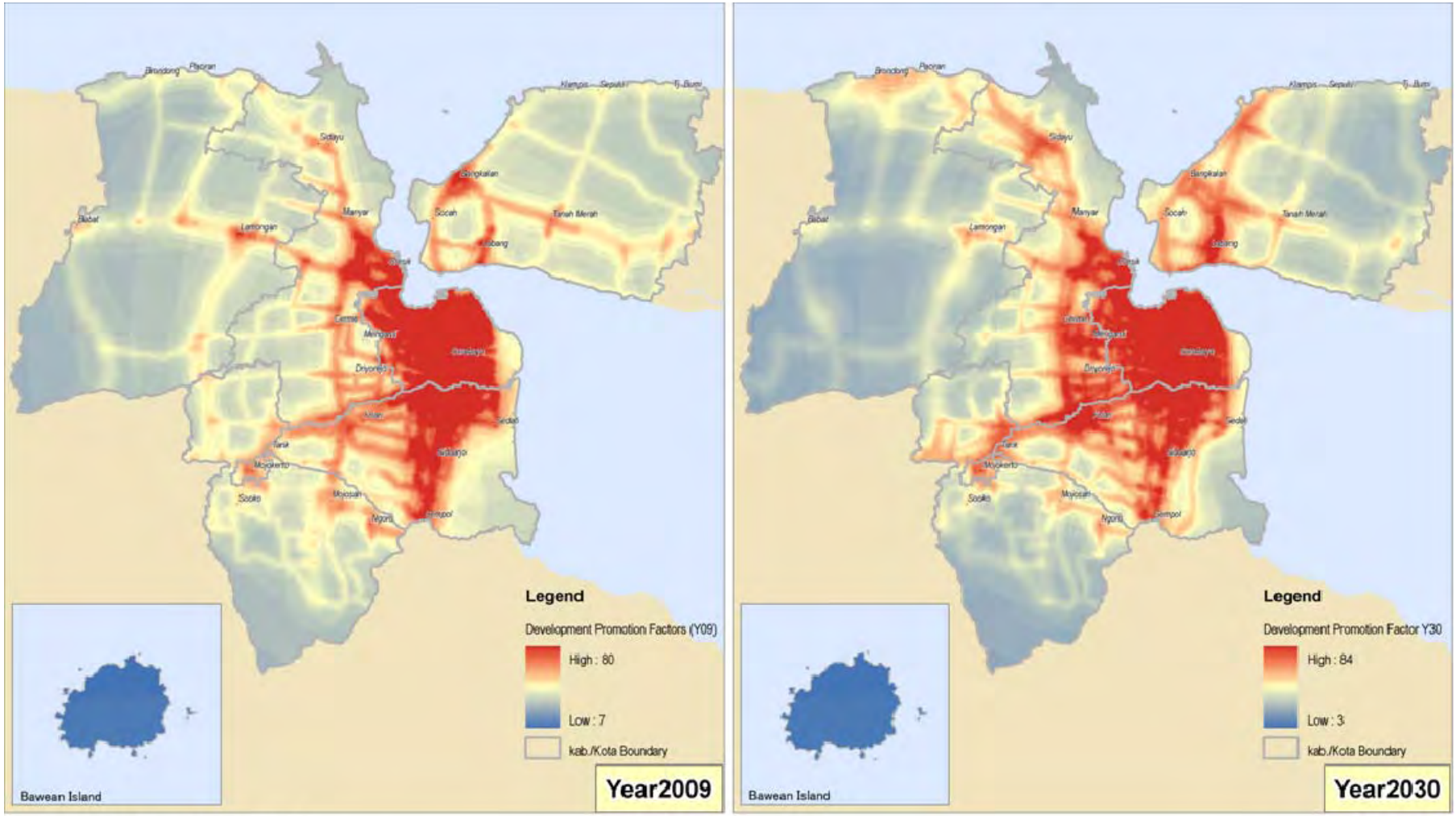


Figure 6.2.3 Distribution of Land with Development Potentials (2009 and 2030)

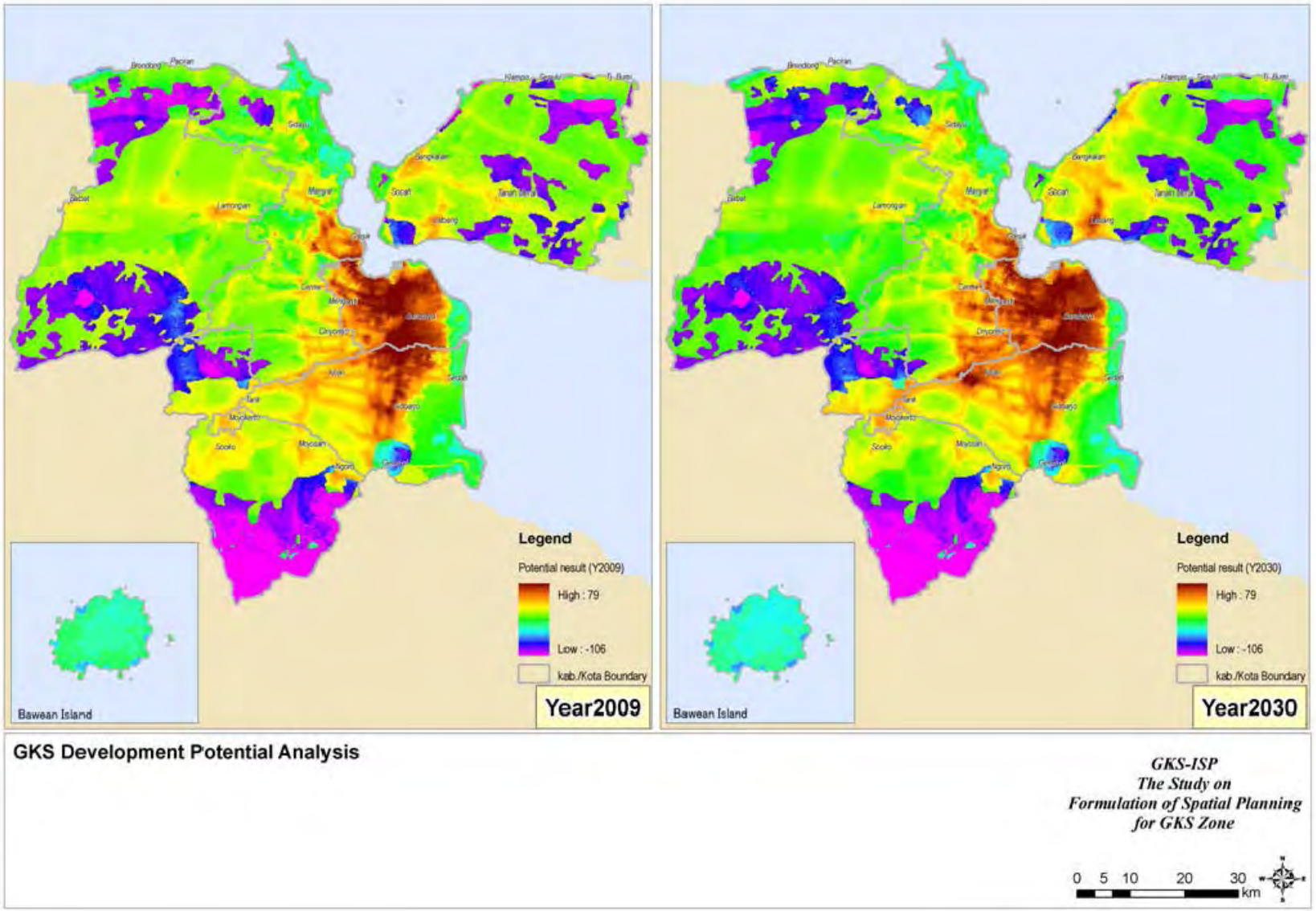


Figure 6.2.4 Comparison of the Development Suitability of Lands (2009 and 2030)

6.3 Development Control and Environmental Management

6.3.1 Development Control Measures for Environmental Protection

Attention should be paid to development constraints, taking note of land suitability, natural disasters, and environmental vulnerability from the points of view of environmental protection, conservation, and rehabilitation and in accordance with national and local laws on environmental management. These areas are critical in order to ensure food security, water resource management, and disaster management. Even though local communities pay opportunity costs, the requisite protection and conservation measures are necessary; otherwise more social and environmental burdens will be shouldered by the next generations.

Figure 6.3.1 indicates the development control measures which are key components of a spatial pattern or land use plan. These and the results of the development suitability analysis also serve as guides when setting development policies.. The following are the development control measures:

1) Environmental Protection Areas

Although there are no national protection areas in the GKS, provincial protection areas should be established, like the natural park named Great Forest Park (Taman Hutan Raya) in the mountainous areas of Kabupaten Mojokerto.

2) Forest Protection Areas

There are several types of forest protection areas in the GKS, as follows:

- Protected forest areas;
- Production forest areas; and
- Conservation forest areas.

These forest protection areas should be strictly maintained to protect watersheds, guard against soil erosion, and prevent flooding. This is mandated by Law No. 41, 1999. Protected forests should be strictly managed in compliance with existing laws, while production forests may be absorbed into conservation areas, where some socioeconomic activities are allowed to some extent.

3) Regulated Green and Open Spaces

Law No. 26, 2007, on spatial management, stipulates that at least **30%** of open areas in every watershed area should be maintained. In order to comply with this law, all existing forest areas should strictly be conserved and further restored through enhanced forestation activities, and at the same time, buffer zones should be established around them.

4) Wellhead Protection and Water Catchment Areas

Wellhead protection areas and water catchments should be strictly protected through legal

enforcements. Most of them are included in "protected forest areas" listed under Law No. 41, 1999. However, some remain unregulated and community support should be mobilized to conserve these areas.

5) Irrigated Agricultural Lands

The Agriculture Department of East Java has dictated that existing agricultural lands should be maintained because increasing pressure from urbanization tends to encourage their conversion for housing and/or industrial uses. This trend should be minimized, or controlled, particularly when irrigated lands are involved because of their importance to food production and security. Another caveat in agricultural land conversion is that a shift to other uses, such as industrial, is irreversible. Also, economic losses accruing from land conversion are sometimes greater than economic benefits.

6) Coastal Swamps and Flood-prone Areas

Vast coastal swamps spread out over the eastern and northern coasts of the GKS Zone. In principle, these areas should be conserved because of their ecological uniqueness and importance to maintaining biodiversity and symbiosis with fishing activities.

The vast flood-prone area along the Solo River should be conserved while controlling land use conversion for housing, industrial, and commercial purposes. Instead, agricultural use may be promoted by adopting engineering measures to improve drainage.

7) Coastal Area Management for Fishery and Marine Industries

Fishponds located along the coastal areas are conserved in principle in order to protect not only livelihood of fishery families, but also environmental resources from disorderly development activities. Diversification of marine industries such as salt-production, aqua-farming, culture fishery and fish-processing should be enhanced by using the coastal areas under the appropriate management by the authorities concerned.

8) Lapindo Mud Flow Areas

The Lapindo mud flow in Sidoarjo has direct and indirect impacts on the GKS. The Indonesian government created an agency for the mitigation of the Sidoarjo mud flow (Badan Penanggulangan Lumpur Sidoarjo/BPLS), which has the following mandates: (1) mitigate the effects of the mud flow, (2) handle efforts to avert mud inundation, (3) manage social impacts, and (4) manage impacts on infrastructure.

The Lapindo area should be conserved for the time being until the phenomenon ceases and its geological stability is certain. In the future, the area may be developed for recreation and tourism.

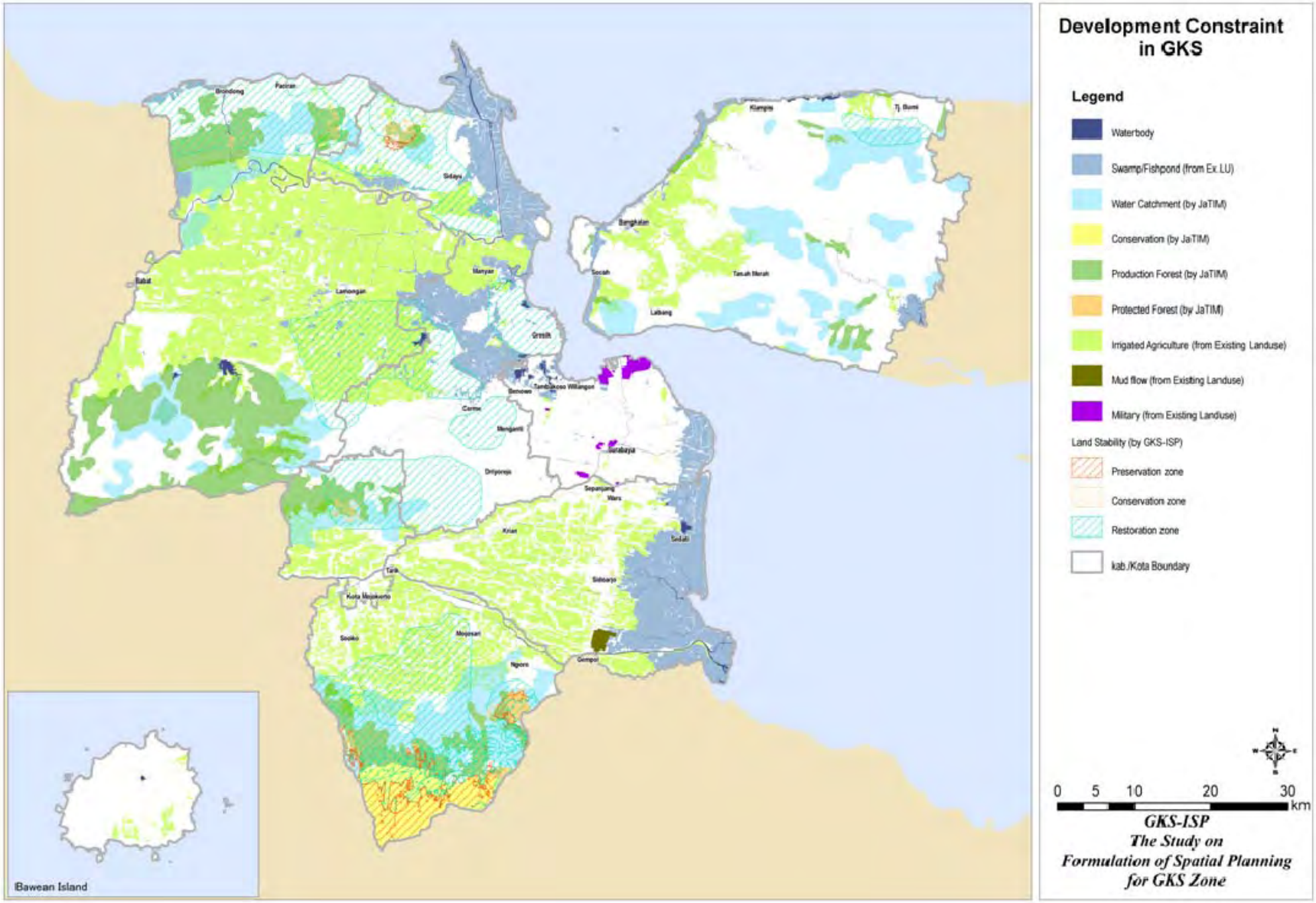


Figure 6.3.1 Development Control Measures Considered in Spatial Pattern and Land Use Planning

6.3.2 Strategies for Environmental Management

1) Environmental Problem Structures in the GKS Zone

The environmental problems in the GKS Zone mainly arise from land use and its topography, such as the problems distinct to hilly rural and urban areas. Problems in hilly areas are related to forest and soil conservation, particularly in Mojokerto. In the urban areas, concerns are tied to population growth, which are related to industrialization and urbanization.

It has also been noted that development pressures in the zone move from downstream to upstream, as manifested in the conversion of agricultural lands into industrial and housing areas. The pressure can also flow inversely from upstream to downstream, as seen in the inappropriate conversion of forest cover in hilly areas into agricultural lands.

2) Need for an Environmental Management Strategy

The economic growth in the GKS has already resulted in environmental problems due to industrialization and urbanization, and this condition will deteriorate further if the requisite measures are not taken.

Since growth-caused blight might be a norm in Indonesia's progressive urban centers the GKS could function as a model of sustainability and area development for the entire country. But in order to sustain such status the GKS Zone should vigorously promote sustainable area development through a workable balance between economic growth and environmental protection. The following policy considerations are key toward this goal:

- Symbiosis with environment for sustainable prosperity;
- Ensuring natural environment and restoring damaged environment; and,
- Contributing to global environmental issues especially climate change.

6.3.3 Management of Environmentally Sensitive Areas

The introduction of an environmentally sensitive area (ESA) management system is a strategic tool in sustainable area development, taking into account valuable and/or vulnerable landscapes and ecosystems. An ESA map, which will indicate the locations of environmentally sensitive areas, will be prepared as one of the common zoning maps. The A map will identify the areas that should be preserved, conserved, or restored, bearing in mind the following principles:

- To preserve environmentally important and critical areas, and their unique features;
- To protect critical habitats, ecosystems, and ecological processes;
- To avoid conflicts with human activities; and
- To minimize the effects of human activities in inland and coastal waters.

As stated earlier, the emphasis is to find a balance among development demand, socio-economic development, and environmental conservation. Since an ESA map indicates the locations of areas that should be preserved, conserved, and restored, they are also used as basis for land use planning and infrastructure development in order to achieve sustainable area development. The ESA map can also be used in setting guidelines on spatial planning, infrastructure development, and environmental impact assessment.

In particular, three environmental elements should be envisaged in the ESA map:

- "Land stability" to protect the area from disasters such as landslides and floods;
- "Forest ecosystem" to protect critical habitats and ecological processes; and
- "Mangrove ecosystem" to protect coastal resources.

Further discussion on the ESA policy is provided in Section 6.6, Chapter 6 of this Report.

Figure 6.3.2 Environment Policy Mechanism

6.3.4 Urbanization and Demand for Urban Land

1) 2030 Population

Because the process of urbanization usually entails land conversions in one form or another, such as for housing, commercial, and industrial purposes, land use demand is commonly concomitant with social and economic development. Thus, population forecasts are translatable to future land demand.

As discussed in Chapter 3, the population in the GKS Zone by 2030 was forecast and shown in Table 6.3.1. The population by that year was projected to be 14,117,500, compared to 9,345,655 in 2008, or an increase of about 4.77 million, which means increased demand for new residential spaces.

Table 6.3.1 2030 Population Forecasts for GKS Zone

Area	2008	2030	Increment
Sidoarjo	1,920,312	3,257,400	1,337,088
Mojokerto	1,074,879	1,653,100	578,221
Lamongan	1,302,605	1,795,100	492,495
Gresik	1,169,347	1,910,600	741,253
Bangkalan	990,711	1,586,500	595,789
Kota. Mojokerto	123,566	191,100	67,534
Kota. Surabaya	2,764,245	3,723,700	959,455
GKS	9,345,665	14,117,500	4,771,835

Source: JICA Study Team

2) Urbanization Scenario

Based on the current population distribution, it was assumed that about 39% of the total 2030 population would reside in rural villages and 61% will likely reside in urban and suburban areas. This translates to 5,487,700 rural residents and 8,629,800 urban residents in the GKS Zone.

3) Land Demand for Housing and Urban Services

In order to project land demand, a residential density analysis was made. In general, the population density of rural villages is, more or less, 60 persons/ha, which is regarded as a natural trend in human settlement.

Meanwhile, urban areas were classified into three areas, namely high-, medium-; and low-density areas. Population densities were assumed for these three areas, which are 180, 120, and 60 persons/ha, respectively. Although highly dense areas can have more than 200 persons/ha, and sometimes 400 persons/ha in the CBD and its vicinities, the density of more or less 180 persons/ha on average is an acceptable assumption..

Based on these assumptions, the demand for land for housing and urban services by 2030 were projected (refer to Table 6.3.2). A total of 170,590 ha would be required to accommodate the future population of the GKS, out of which about 79,090 ha would be dedicated as urban areas, and about 91,500 ha as rural areas (refer to Figure 6.3.3).

Table 6.3.2 Demand for Housing and Urban Service Land in GKS for 2030

Area	Classification	Land Requirement		Density	Population Distribution	
		(ha)	(%)	(pop./ha)	Residents	(%)
Urban	High Density	11,870	7.0%	180	2,136,600	15.1%
	Medium Density	41,000	24.0%	120	4,920,000	34.9%
	Low Density	26,220	15.4%	60	1,573,200	11.1%
	Urban Total	79,090	46.4%	109	8,629,800	61.1%
Rural	Villages	91,500	53.6%	60	5,487,700	38.9%
Total		170,590	100.0%	83	14,117,500	100.0%

Source: JICA Study Team

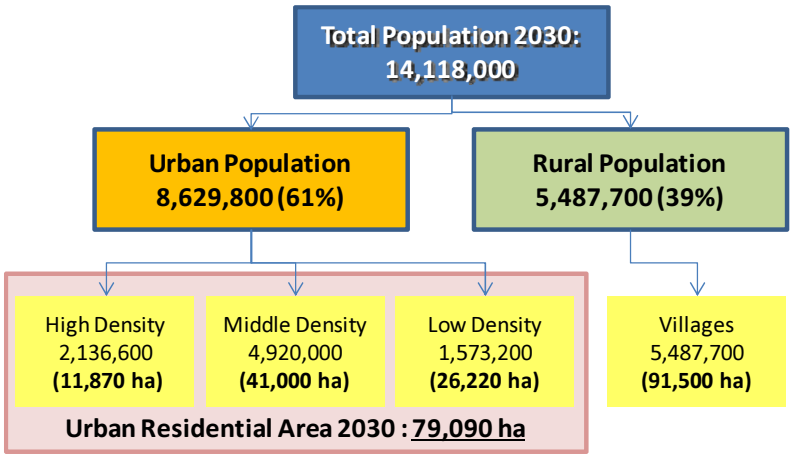


Figure 6.3.3 Demand for Housing and Urban Service Land in GKS by 2030

4) Land Demand for Industries

Land requirements to accommodate industrial activities as planned in the GKS Zone were computed based on the employment forecast in the industrial sector. Between 2007 and 2030, a total of about 777,000 jobs will be created in the formal industrial sector. Out of this, 612,000 jobs or 78.8% of the total will be provided by large industries and 164,000 or 21.2% will be provided by small industries, as shown in Table 6.3.3. In this table, small industries are classified into two, namely microenterprises (with less than 10 employees) and small and medium enterprises (SMEs, with less than 30 employees).

Microenterprises include cottage and household industries. Cottage industries that have 5–9 employees and fewer, were not considered in the calculation of the demand for industrial land because most of them are usually operated not in industrial estates but in mixed-use buildings.

Table 6.3.3 Additional Jobs in Formal Industries by Company Size (2007–2030)

Area	No. of Employees				Assumed Ratio	
	Micro-enterprise	SME	Large	Total	Miciro+SME	Large
Bangkalan	17,483	23,462	10,236	51,181	80.0%	20.0%
Gresik	1,477	37,387	220,231	259,095	15.0%	85.0%
Lamongan	6,773	34,528	10,325	51,627	80.0%	20.0%
Mojokerto	514	20,896	49,956	71,366	30.0%	70.0%
Sidoarjo	2,991	9,470	236,755	249,216	5.0%	95.0%
Kota Mojokerto	82	150	2,086	2,317	10.0%	90.0%
Kota Surabaya	1,453	7,743	82,765	91,961	10.0%	90.0%
GKS	30,773	133,636	612,354	776,763	21.2%	78.8%

Source: JICA Study Team
Note: Microenterprises and SMEs are industries with less than 10 and 30 employees, respectively.

Additional land requirement to support formal industrial activities was computed based on the assumption of "employment density" by company size. The 2007 data and statistics

identify that the average employment density of selected existing industrial estates is ***83 persons/ha*** at present.. The results of the projection are summarized in Table 6.3.4 and illustrated in Figure 6.3.4.

Results show that a total of ***8,682 ha*** more will be required to accommodate industrial activities from 2007 to 2030. Out of this, about ***7,654 ha*** will be needed for large industries, which will be located in industrial estates or industrial parks where utilities are well-developed. In addition, land approximately ***1,000 ha*** in size will be required to accommodate SMEs in the GKS, as a whole.

Looking into the distribution of the demand, industrial estates for large enterprises will be in great demanded in Sidoarjo (2,959 ha), Gresik (2,753 ha), and Surabaya (1,035 ha), while, industrial land for SMEs will be required in Lamongan (258 ha), Bangkalan (256 ha), and Gresik (243 ha).

Table 6.3.4 Demand for Additional Industrial Land in GKS Zone up to 2030

	Large Scale (ha) (80 pax/ha)	SMEs (ha) (160 pax/ha)	Total (ha)
Bangkalan	128	256	384
Gresik	2,753	243	2,996
Lamongan	129	258	387
Mojokerto	624	134	758
Sidoarjo	2,959	78	3,037
Kota Mojokerto	26	1	28
Kota Surabaya	1,035	57	1,092
GKS	7,654	1,028	8,682

Source: JICA Study Team

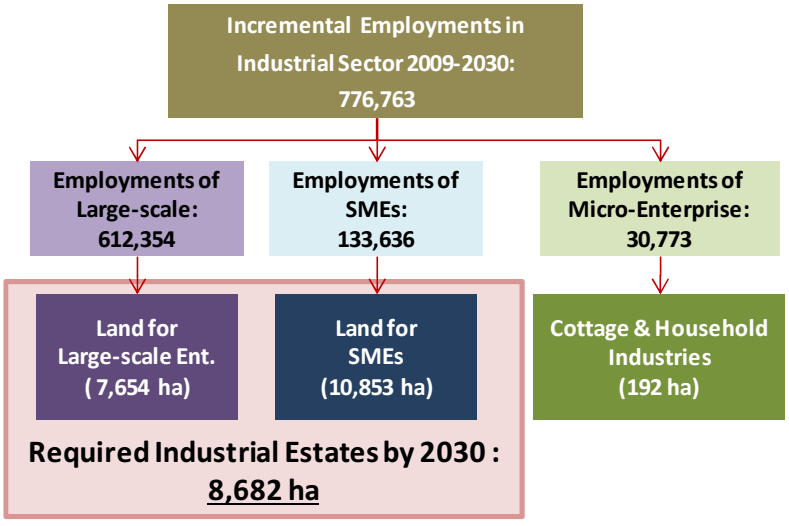


Figure 6.3.4 Demand for Industrial Land in GKS Zone up to 2030