Chapter XII

Water Resources

CHAPTER XII

Water Resources

I. INTRODUCTION

12.01 Priority has been accorded to the development of the water resources sector to meet the requirements for domestic, industrial and agricultural demands as well as for hydropower development. Under the Fifth Malaysia Plan, continued efforts were undertaken to provide adequate water to meet the increasing requirements mainly through the development of new sources and extending the water supply systems, particularly to new demand centres. The period also witnessed an increase in the water supply coverage whereby a greater proportion of the users had access not only to safe water but also enjoyed improved levels of service. Despite the progress made, there were still some areas having low water pressure and other supply-related problems and programmes were continously being implemented to reduce these.

12.02 Under the Sixth Malaysia Plan, the water resources sector will be singled out for rapid expansion to preserve and secure water resources as well as provide sufficient water supplies. Adequate water will be made available for domestic use and to meet the rapid growth in demand by industries. The main thrusts of development in the sector will be on the optimal utilization of existing water resources through developing new sources; upgrading, rehabilitating and improving the efficiency of existing facilities; preservation of the quantity and quality of existing sources by controlling pollution and implementing pollution abatement measures as well as conservation and protection of catchment areas through controlled land development and deforestation. These programmes will ensure that increasing demands for water will always be met through increased supplies. Private sector participation in the development of this sector will be intensified to complement the Government's efforts to spearhead its development.

II. PROGRESS, 1986-90

12.03 The development strategy during the Fifth Plan continued to be focussed on the development of water resources projects to ensure adequate supply to meet the needs of the various users. In order to ensure sufficient water for abstraction by treatment plants, storage dams were constructed to regulate river flows. Groundwater was tapped to supplement surface sources wherever feasible.

Water Resources

12.04 During the Plan period, efforts were directed towards the development of surface water as the major source of raw water supply since surface runoff constituted about 56 per cent of the annual total rainfall, which was estimated to be 990 billion cubic metres (bcm), while groundwater accounted for only 6 per cent. Due to the uneven distribution of water resource potential and the need to increase the availability of water, dams were constructed to store surplus water during wet periods. Hence, the development of multi-purpose dams, especially in water-stress regions, and the implementation of inter-basin and inter-state water transfers from water-surplus to water-deficit areas or states were given priority.

12.05 At present, there are 54 dams in operation with a total live capacity of 12 bcm which is available to meet the demand of the various users. Of these, 11 were developed for hydropower while the remaining dams were for water supply, irrigation and flood mitigation. During the period, the construction of five dams, which commenced in the first half of the eighties, was completed. These dams provided an additional active storage capacity of 264 million cubic metres (mcm). In addition, seven dams were at various stages of implementation, as shown in *Table 12-1.* Feasibility studies were undertaken for a number of new dams. The location of these dams are as shown in *Chart 12-1* and *Chart 12-2.*

Water Supply

12.06 In line with the policy of providing safe water to all as well as ensuring adequate supply for domestic and industrial uses, various programmes were implemented. The overall performance of the urban and rural water supply programmes were enhanced with the implementation of various project components, such as developing storage and treatment plant capacities, laying of distribution systems and utilizing groundwater sources.

TABLE 12-1

WATER RESOURCES DEVELOPMENT, 1986-90

Dam	*State*	*Purpose*	*Completion Year*	*Yield (Mcm)*
Completed				
Layang	Johor	W	1987	90.0
Terip	Negeri Sembilan	I,W	1987	25.0
Batu	Selangor	F,W	1987	42.3
Malut	Kedah	W	1988	6.0
Ahning	Kedah	I,W	1988	100.4
Construction				
Bekok	Johor	F,W	1991	24.0
Timah-Tasoh	Perlis	F,I,W	1991	48.0
Juaseh	Johor	W	1991	36.5
Upper Muar	Johor	I,W	1991	36.5
Pedas	Negeri Sembilan	W	1991	3.4
Mersing	Johor	W	1991	3.0
Linggiu	Johor	W	1994	48.4

Notes:

F: Flood Mitigation
I: Irrigation
W: Water Supply

12.07 For the development of storage and treatment plant capacities, 14 major projects with a total capacity of 1,478 million litres per day (mld) were completed, as shown in *Table 12-2*. These included the Ahning, Phase I; Sungai Semenyih; Johor Bahru, Phase IA and Greater Kuantan water supply schemes. In addition, five new projects were in various stages of implementation. The target of 6,713.5 mld under the Fifth Plan was almost met through the completion of various projects which contributed to an increase in the total treatment capacity by 57.2 per cent, as shown in *Table 12-3*. The quantity supplied also increased by 40.4 per cent to 4,979 mld. Although the water supply and demand balance in the country was fairly satisfactory, certain states such as Johor, Kelantan, Melaka, Negeri Sembilan and parts of the Klang Valley periodically suffered from low water pressure or shortage during the dry periods. This was due to the mismatch between the distribution of water sources and the areas of high water demand.

CHART 12–1

LOCATION OF DAMS IN PENINSULAR MALAYSIA

CHART 12-2

LOCATION OF DAMS IN SABAH AND SARAWAK

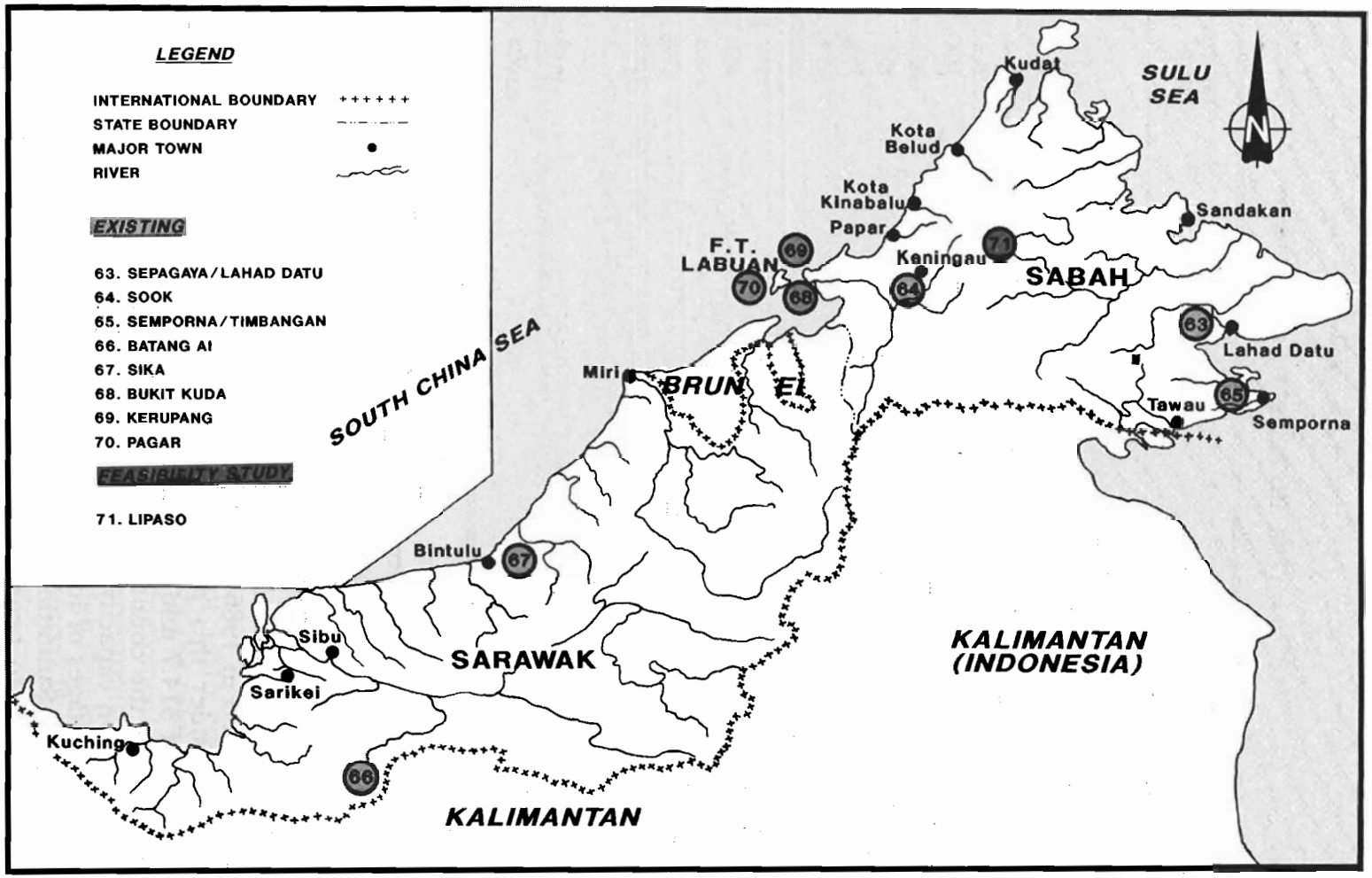

TABLE 12-2

WATER SUPPLY PROJECTS, 1986-90

Project	*Capacity (Mld)*
Urban Projects	
Ahning Water Supply, Phase I	112.5
Greater Kuantan Water Supply	136.5
Johor Bahru Water Supply, Phase IA/IB	45.0
Johor Barat Water Supply, Phase I (Macap)	25.0
Johor Barat Water Supply, Phase II (Bekok/Semberong)	55.0
Kedah Tengah Water Supply	68.0
Kluang Water Supply	85.0
Langkawi Water Supply, Phase I	16.5
South Coastal Terengganu Water Supply	98.0
Sungai Muda Water Supply, Phase IIIA	68.0
Sungai Semenyih Water Supply	546.0
Sungai Terip Water Supply, Phase I	40.0
Sabah Water Supply	118.0
Sarawak Water Supply	64.0
Other Projects	721.5
Rural Project	
Special Rural Water Supply Programme	181.0
Total	**2,380.0**

12.08 The implementation of the rural water supply programme was given greater emphasis under the Fifth Plan to enable more rural people, especially those in remote areas, to have access to potable water. Alongside the normal rural water supply schemes, a special programme was launched in 1986 to increase the source development works for rural areas. Under this programme, 134 schemes with a total production capacity of 514.7 mld were approved for construction on a turnkey basis throughout the country. At the end of the Plan period, 59 projects with a production capacity of 181 mld were completed, while the others were in various stages of implementation. In addition, under the Rural Water Supply and Sanitation Programme, 18,314 water supply projects were implemented to benefit 496,515 people living in the rural areas.

TABLE 12-3

WATER TREATMENT CAPACITY AND SUPPLY, 1985-95
(Mld)

State	1985		1990		1995	
	Treatment Plant Capacity	*Quantity Supplied*	*Treatment Plant Capacity*	*Quantity Supplied*	*Treatment Plant Capacity*	*Quantity Supplied*
Johor	431	431	983	529	1,520	931
Kedah	237	237	478	374	837	602
Kelantan	135	104	149	116	441	187
Melaka	150	114	143	137	184	175
Negeri Sembilan	208	182	230	230	483	370
Pahang	276	201	528	369	822	542
Perak	552	468	644	564	838	722
Perlis	24	24	54	43	139	63
Pulau Pinang	418	343	494	452	695	577
Sabah	249	188	367	363	708	488
Sarawak	324	183	388	282	709	433
Selangor[1]	1,000	1,000	1,793	1,406	2,768	2,475
Terengganu	158	71	291	114	335	201
Malaysia	**4,162**	**3,546**	**6,542**	**4,979**	**10,479**	**7,766**

Note:

[1] Includes Wilayah Persekutuan Kuala Lumpur

12.09 With respect to the Federal Land Development Authority (FELDA) schemes, 34 projects with a total capacity of 36.4 mld were constructed, while seven schemes with a production capacity of 11 mld were completed in the Regional Development Authority (RDA) areas. These programmes benefited an additional 32,000 settler families and about 15,000 households in the RDA areas.

12.10 During the Plan period, about 970 out of 1,315 estates were supplied with piped water, thus enabling 62,000 from the total of 82,000 households to enjoy safe drinking water. This achievement was partly due to measures taken to extend the rural water supply systems to neighbouring estates to overcome the problems of high development cost and scarcity of suitable water sources being encountered by some estate managements.

12.11 As a result of these programmes, water supply coverage increased resulting in 78.3 per cent of the total population of the country having access to piped water by 1990. Despite an increase of 7.7 per cent in coverage, this achievement was still below the Fifth Plan target of 82.4 per cent. The total urban population provided with this amenity improved from 93 per cent to 96 per cent in 1990, as shown in *Table 12-4*. The urban coverage for all states, except Johor, Kelantan, Negeri Sembilan, Sarawak and Terengganu, exceeded the national urban coverage. As for the rural areas, the coverage increased from 57 per cent to 66 per cent, thus meeting the Plan target. With regard to state distribution, Melaka and Pulau Pinang recorded the highest rural coverage while the coverage in Kelantan, Sabah, Sarawak and Terengganu was still below the national rural average, as shown in *Table 12-5*. This was mainly due to the scattered nature and remoteness of the villages from water sources.

TABLE 12-4

URBAN WATER SUPPLY COVERAGE, 1985-95

State	1985		1990		1995	
	Persons	(%)	Persons	(%)	Persons	(%)
Johor	673,992	92	888,960	96	1,145,473	97
Kedah	175,275	95	215,915	97	257,838	98
Kelantan	199,355	65	261,096	69	399,670	85
Melaka	114,800	100	126,400	100	139,200	100
Negeri Sembilan	207,904	89	265,880	92	345,504	96
Pahang	241,965	95	272,930	98	301,056	98
Perak	625,730	98	700,920	99	784,575	99
Perlis	15,252	93	20,273	97	26,900	100
Pulau Pinang	556,934	98	697,158	99	881,100	100
Sabah	292,900	100	392,800	100	540,700	100
Sarawak	283,765	95	353,856	96	450,500	100
Selangor[1]	1,892,400	95	2,478,714	98	3,266,200	100
Terengganu	255,000	85	350,010	90	481,555	95
Malaysia	**5,535,272**	**93**	**7,024,912**	**96**	**9,020,271**	**98**

Note:

[1] Includes Wilayah Persekutuan Kuala Lumpur

TABLE 12-5

RURAL WATER SUPPLY COVERAGE, 1985-95

State	1985		1990		1995	
	Persons	(%)	Persons	(%)	Persons	(%)
Johor	687,836	61	792,342	67	936,546	78
Kedah	597,632	58	768,758	67	963,732	77
Kelantan	216,900	30	316,080	40	433,347	51
Melaka	311,108	82	375,030	90	441,392	98
Negeri Sembilan	295,425	75	335,495	85	370,215	95
Pahang	485,745	65	594,160	70	774,595	79
Perak	937,800	72	1,084,278	78	1,212,796	83
Perlis	74,600	50	108,030	65	148,680	80
Pulau Pinang	412,250	85	436,608	96	370,440	98
Sabah	381,710	38	594,152	52	1,002,800	80
Sarawak	414,447	33	656,731	47	1,145,150	74
Selangor[1]	724,671	73	833,000	85	715,528	94
Terengganu	135,560	40	195,199	53	241,280	65
Malaysia	**5,675,684**	57	**7,089,863**	66	**8,756,501**	79

Note:

[1] Includes Wilayah Persekutuan Kuala Lumpur

12.12 Under the Fifth Plan, a number of feasibility studies on the development of water resources were carried out to ensure the identification of a sustainable number of projects for implementation. The most significant study that was completed in 1989 pertained to the study on unaccounted for water losses. This study revealed that in 1988, the unaccounted for water losses was 43 per cent on the average for the whole country. This was attributed to meter under-registration, system leakages and other losses. In order to reduce such losses, the study recommended that upgrading and rehabilitation of the existing treatment plants and distribution systems be undertaken to ensure more efficient and effective utilization of water resources as well as existing facilities and in the process reduce the pressure to develop new sources to support the rapid socio-economic growth of the country.

12.13 In line with the privatization policy, several projects related to the water subsector were privatized during the Plan period. These schemes included the construction and subsequent operation of the Labuan Water Supply Project; Greater Ipoh, Phase II as well as Krian, Larut and Matang, Phase II water supply projects on a Build, Operate and Transfer basis. The Sungai Layang, Sungai Terip and Sungai Semenyih water treatment plants were also privatized through management contract to the private sector.

Sewerage

12.14 The threat of pollution of water sources, coastal waters and beaches is increasing due to population growth, the rapid rate of urbanization and industrialization as well as the inadequate provision of sanitary facilities. This problem is further aggravated by the discharge of untreated or partially treated domestic wastewater which includes sewage and sullage, industrial effluents as well as agricultural and animal wastes into water courses. While pollution arising from the disposal of industrial wastes is under control, the discharge of untreated or inadequately treated sewage and sullage as well as animal waste is still of major concern since these pollutants are the major sources of pollution.

12.15 For the preservation and conservation of water resources and catchment areas as well as to improve the health and socio-economic well-being of the general public, various types of sewerage systems were implemented. The most comprehensive facility is the centralized sewerage system whereby domestic wastewater will be treated centrally to a stipulated effluent quality standard. However, due to its huge investment outlay as well as financial and human resources constraints being faced by most local authorities, the implementation of the sewerage programme had not been given emphasis in the past. As a result, only nine projects out of a total of 19 feasibility studies on centralized sewerage system for state capitals and major towns were implemented.

12.16 In order to control pollution arising from sewage and sullage, measures were instituted by the Government to enforce regulations which require developers of houses, hotels, tourist resorts and other developments to provide communal treatment plants and centralized sewerage system in their respective project areas. The development of decentralized sewerage systems, whereby treatment plants will be provided to cater for smaller and more viable zones, was also encouraged to accelerate its implementation.

12.17 The continued implementation of the sewerage programme during the Plan period increased marginally the total population being provided with centralized sewerage system. However, the coverage of the other acceptable facilities expanded by 12 per cent. This increase was attributed to the development of housing estates equipped with septic tanks or communal treatment plants and the implementation of pour flush latrines under the Rural Water Supply and Sanitation Programme. In addition, consistent with the policy to replace the unacceptable methods of sanitation with satisfactory systems, the usage of the bucket, pit and hanging latrines declined from 14.7 per cent to 6.7 per cent in 1990. The percentage of population that did not have any sanitary facility was reduced from 10.2 per cent to 6.3 per cent at the end of the Fifth Plan.

Urban Drainage

12.18 One of the adverse effects of rapid urbanization is the increasing occurrence of flash floods in some of the major cities and towns. In order to overcome this problem, the Government embarked on a long-term programme to mitigate urban flooding with the implementation of several drainage improvement works. Under the Fifth Plan, the implementation of urban drainage works in Alor Setar, Kangar, Kota Bharu, Kuala Lumpur, Pekan and Seremban, which were initiated in the previous Plans, were continued. In addition, five new projects are under construction, namely the canalization of Sungai Pari, Sungai Pinang and Sungai Tiram as well as two urban drainage works in Terengganu. These projects, which are implemented in stages, have to some extent provided some degree of flood protection.

12.19 Besides the above projects, comprehensive flood mitigation studies were carried out for the Klang River Basin and Pulau Pinang. The Drainage Master Plan for the Klang River Basin was completed in 1989. One of the recommendations of the Plan was that the improvement of Sungai Klang under the Kuala Lumpur Flood Mitigation Project should be extended to include the lower reaches of Sungai Klang to provide flood protection for Klang.

III. PROSPECTS, 1991-95

12.20 The long-term objectives of the sector will be to develop adequate water resources for all users, preserve and protect the quantity and quality of existing resources as well as identify and conserve potential

water sources to meet future needs. However, in terms of priority, greater emphasis will be given to water supply development in the light of increasing demand in the Sixth Plan. Particular attention will be given to planning for dam construction in view of the urgent need to protect potential water sources. Apart from fulfilling water requirements, these storage dams will also provide benefits arising from flood mitigation and urban drainage as well as the abatement of pollution through proper regulation of river flow. Besides the construction of multi-purpose projects, the development of inter-state and inter-basin water transfers will be further pursued during the period to address the problem of uneven distribution of water resources in the country.

12.21 Apart from the development of new sources, priority will be accorded to the implementation of a comprehensive programme to upgrade treatment plant capacities and rehabilitate the distribution system to reduce the high unaccounted for water losses. In addition, efforts will be made to reduce recurring water-related problems, such as the deterioration of water quality and occurrence of flash floods in urban areas.

Water Resources

12.22 While the availability of surface water sources remains relatively unchanged, total water demand for domestic and industrial uses is forecasted to increase steadily from 11.6 bcm in 1990 to 13.5 bcm in 1995. Water demand for irrigation, which consumes a major share of the total water resources, is expected to rise only marginally and its overall share is projected to drop from 78 per cent to 73 per cent due to the gradual improvement in irrigation efficiency and the reduction in new irrigation projects. On the other hand, domestic and industrial water demand is forecasted to increase substantially by 46 per cent, from 2.6 bcm to 3.8 bcm.

12.23 Measures will also be undertaken to meet the medium - term water requirements of the various users in the context of rapid industrialization. The construction of the Bekok, Juaseh, Linggiu and Mersing dams in Johor; the Pedas and Upper Muar dams in Negeri Sembilan and the Timah-Tasoh dam in Perlis, which were initiated under the Fifth Plan, will be completed to give an annual combined storage capacity of 262 mcm and an annual yield of 200 mcm. Apart from providing medium-term improvements to the water supply and demand situation in the country, especially in the water-stress states, these projects will further mitigate the flooding and urban drainage problems.

12.24 Efforts will be made to address the problem of uneven distribution of water resources through the implementation of inter-state and inter-basin water transfers. Apart from ongoing projects, the Gemencheh and Kelinchi dams will be constructed as inter-basin water transfer projects in Negeri Sembilan, while the Sungai Muar Project will be developed for inter-state water transfer to meet the long-term water requirements of Melaka, as shown in *Table 12-6* and *Table 12-7*. From the completed feasibility studies, detailed engineering designs for six water supply and flood mitigation dams as well as two hydropower dams will be initiated to provide the necessary continuity for future water resources development. These projects will provide an estimated additional annual yield of 666 mcm. The hydropower dams will also function to conserve and store water to meet future needs.

TABLE 12-6

WATER RESOURCES DEVELOPMENT, 1991-95

Dam	*State*	*Purpose*	*Completion Year*	*Estimated Yield (Mcm)*
Design/Construction				
Gemencheh	Negeri Sembilan	W	1996	40.2
Kelinchi	Negeri Sembilan	W	1997	56.0
Feasibility Study				
Sungai Buloh	Selangor	W	1986	69.4
Jengeli	Johor	W	1987	47.5
Reman	Kedah	W	1987	164.0
Beris	Kedah	I, W	1988	68.0
Lebak	Johor	W	1988	47.5
Lebir	Kelantan	F	1988	270.0
Pergau	Kelantan	H	1988	69.4
Lipaso	Sabah	H	1990	n.a

Notes:

F: Flood Mitigation
I: Irrigation
W: Water Supply
H: Hydropower
n.a: Not Available

TABLE 12-7

WATER SUPPLY PROJECTS, 1991-95

Project	*Capacity (Mld)*
Urban Projects	
Construction	
Bentong Water Supply	45.0
Gemas Water Supply	36.0
Johor Bahru Water Supply, Phase IB	45.0
Johor Bahru Water Supply, Phase II	270.0
Kulim Water Supply, Phase II	34.0
Langkawi Water Supply, Phase II	18.2
North Kelantan Water Supply	239.5
Pelubang Water Supply, Phase II	113.6
Sungai Lebam Water Supply, Phase II	27.0
Sungai Muar Water Transfer	160.0
Sungai Petani Water Supply, Phase II	68.0
Sungai Selangor Water Supply, Phase II	454.0
Sungai Terip Water Supply, Phase II	128.0
Temerloh/Mentakab Water Supply, Phase III	68.2
Upgrading of Treatment Plants Capacity[1]	500.0
Rehabilitation of Distribution Systems[2]	250.0
Sabah Water Supply	341.0
Sarawak Water Supply	321.0
Other Projects	484.8
Design	
Kota Tinggi Water Supply, Phase I	n.a.
Muar Water Supply, Phase III	n.a.
Sri Iskandar Water Supply, Phase II	n.a.
Rural Project	
Special Rural Water Supply Programme	333.7
Total	**3,937.0**

Notes:

[1] Restoration of capacity of existing treatment plants and reduction of losses

[2] Increasing the efficiency of distribution systems to reduce water losses

n.a Not Available

12.25 A management information system on water resources will be developed to support the comprehensive and integrated planning objective. Apart from incentives, the institutional setting such as legal provisions will be streamlined to facilitate greater focus and introduce cost-effective developments in the sector. This will also allow legislative support for the preservation and conservation of existing water resources and catchment areas as well as the control and reduction of pollution of water sources so that long-term requirements are satisfied through sustainable development of the sector.

Water Supply

12.26 The immediate objective of water supply development will be to meet the industrial and domestic requirements, particularly in areas that are identified as new growth centres as well as areas without access to this facility. The special need to accommodate the water requirements of high technology industries will be addressed once the location of industrial estates has been finalized. In addition, as part of the Government's efforts to promote economic development and improve the quality of life in the rural areas, the development of rural water supply programmes will continue to be given emphasis.

12.27 Several major programmes have been designed for implementation during the Sixth Plan. These include the completion of major schemes which were initiated during the Fifth Plan period and the construction of 16 new projects with a production capacity of 2,369 mld such as Johor Bahru, Phase II; North Kelantan and Sungai Selangor, Phase II water supply schemes, as shown in *Table 12-7.* Detailed engineering design will also be prepared for projects, such as Kota Tinggi; Muar, Phase III and Sri Iskandar, Phase II. In addition, several source development works and improvements to existing water supply systems will be implemented to ensure adequate, reliable and uninterrupted supply is made available to industrial areas and designated tourist resorts such as Desaru, Kulim, Nilai/Pajam, Pulau Langkawi and South Johor.

12.28 The ageing of treatment plants and distribution systems will be reviewed to reduce the high unaccounted for water losses. Initially, this new programme which entails changing of water meters, replacing old pipelines and refurbishing treatment plants will be carried out in several priority areas to ensure its effectiveness before it is replicated throughout the country. This will not only reduce the pressure on new source development but also improve the levels of service to existing users. The unaccounted for water losses for the whole country will also be decreased

from 43 per cent in 1988 to 32 per cent in 1995. In addition, the efficiency to be derived from this programme will contribute towards greater financial viability of the operating entities.

12.29 The high investment cost associated with the development of the sector will require cost recovery and tariff structures to be analyzed in conjunction with the consumers' affordability and willingness to pay. Since, in the future, more water supply projects will be privatized, the implementation of commercial accounting systems and increasing efficiency in revenue collection need to be addressed. In addition, studies will be undertaken on projects to be privatized to ensure that the affordability of consumers and competitiveness of industrial users will be safeguarded.

12.30 Concomitant with the Government's policy to increase accessibility to safe water, the implementation of the Special Rural Water Supply Programme will be continued. About 75 projects with a production capacity of 333.7 mld will be completed by 1992, thus benefiting 4.5 million people. In addition, about 2,420 projects will be implemented under the normal rural water supply programme. The main focus of this programme is on the installation of reticulation systems to distribute water mainly from the newly completed source works to the rural households. Groundwater and rainwater sources will be exploited to ensure that potable water will be made available to these consumers. Under the Rural Water Supply and Sanitation Programme, 46,868 water supply schemes benefiting 1.5 million people and 198,146 sanitation projects benefiting 990,730 people will be implemented.

12.31 In the FELDA schemes, 39 projects with a total production capacity of 47.3 mld will be implemented while 13 projects will also be constructed in the RDA areas. This programme will benefit 41,160 new settler families and 26,000 households in the RDA areas. To ensure that safe and reliable water supply is made available to estate workers, the implementation of the water supply programme in estates will also be stepped up.

12.32 The commissioning and implementation of water supply projects, especially those in the urban areas, will increase the treatment plant capacities from 6,542 mld in 1990 to 10,479 mld in 1995. As for the quantity supplied, it is expected to increase by 56 per cent, from 4,979 mld to 7,766 mld, as shown in *Table 12-3*. It is envisaged that 87.7 per cent of the total population will enjoy piped water supply by the end of the Plan period. Urban coverage is expected to reach almost 100 per cent in most states, except Kelantan, as shown in *Table 12-4*. On the

other hand, the coverage of rural water supply is projected to increase from 66 per cent in 1990 to 79 per cent in 1995. The completion of the Special Rural Water Supply Programme and the emphasis on extension of pipelines to rural areas will enable the rural coverage in Melaka, Negeri Sembilan, Perak, Perlis, Pulau Pinang, Sabah and Selangor to exceed the national rural water supply coverage, as shown in *Table 12-5*.

12.33 The rapid growth in the scope and complexity of water supply systems over the last few years underscore the need to manage and operate the systems efficiently. The emphasis on the rehabilitation and upgrading of water treatment plants and distribution systems in the Sixth Plan also requires studies on adoption and application of appropriate new technologies and materials to achieve the most cost-effective solutions. Hence, efforts on research and development will be intensified to upgrade the technological advancement in the water supply sector.

Sewerage

12.34 In line with the Government's objectives to preserve the quality and quantity of water resources as well as to promote public health and tourism, sewerage development will be accorded higher priority under the Plan. Efforts to provide centralized sewerage facilities to state capitals, major urban centres and designated tourist resorts will be continued. In addition, appropriate sewerage treatment facilities will be provided to areas where the risk of sewage contamination to water intake is great. Besides further enforcement of the requirement that developers of houses, hotels, tourist resorts and other developments construct communal treatment plants and centralized sewerage systems in their project areas, industries will be encouraged to pretreat and discharge their effluents into sewerage treatment plants. In the light of the high development cost of centralized sewerage systems, incentives will be provided to ensure that sewerage projects will be viable for implementation and feasible to be privatized.

12.35 The construction of the Seremban Sewerage Project, which commenced in 1986, will be completed. Sewerage schemes will also be implemented in the designated tourist resorts of Desaru, Langkawi and Pangkor to complement the Government's efforts to promote tourism. In addition, detailed engineering design will be prepared for projects for which feasibility studies had been completed. Studies will also be carried out to determine the feasibility of implementing sewerage schemes for Kangar, Kuching and Taiping. Suitable sanitation systems will also be provided, as an integral part of infrastructure development, to improve the environment and living conditions of coastal villages.

12.36 The implementation of sewerage and sanitation programmes under the Sixth Plan will enable almost the entire population to be provided with acceptable facilities. Of this, 8.5 per cent of the population will be equipped with centralized and decentralized sewerage systems by 1995. In addition, research and development on low-cost systems using appropriate technologies will be intensified to increase the coverage of modern sewerage facilities, especially in urban fringe areas and new growth centres.

Urban Drainage

12.37 As part of the efforts to reduce loss of life and damage to properties as well as to improve the socio-economic well-being of the people, more urban drainage facilities will be provided during the Sixth Plan. In addition, a more comprehensive planning approach based on the Master Plan for Drainage will be adopted. In this respect, non-structural measures, such as the use of flood retention ponds, flood zoning and other water retention concepts will be encouraged. Whilst the emphasis under the Plan will be on the completion of urban drainage projects, such as those in Alor Setar, Kangar, Kota Bharu, Kuala Lumpur and Seremban, this programme will be extended to include other potential growth centres of commerce, industry and tourism. Besides the 12 ongoing projects, 18 new drainage improvement schemes will be implemented. Some of the major projects will involve the preparation of drainage master plans, such as for Labuan and Pulau Pinang where implementation will be carried out in stages.

IV. ALLOCATION

12.38 The allocation for the water resources sector during the Sixth Malaysia Plan period will be $3,773 million, as shown in *Table 12-8*. The major proportion of this allocation, amounting to $2,855 million will be for water supply development. Of this, $1,717 million will be for source development works, $350 million for the upgrading of existing treatment plants and rehabilitation of distribution systems and $787 million for reticulation systems development. As for sewerage development, the allocation will be increased substantially to $551 million. The urban drainage programme will be allocated $368 million.

V. CONCLUSION

12.39 In view of the need to develop water resources and implement programmes to support the promotion of economic development and population growth as well as to improve the quality of life, concerted

efforts will be made to conserve the catchment areas and protect the potential sources for future development. A comprehensive and integrated approach will be adopted towards water resources planning, development and management to ensure efficient use of this depleting resource and facilitate the implementation of multi-purpose projects as well as inter-basin and inter-state water transfers. To accelerate the development of the sector, privatization of the development and management of water resources projects, particularly water supply and sewerage, will be encouraged.

12.40 Sewerage development will be accorded higher priority under the Plan due to environmental concerns and efforts to control and abate water pollution. The implementation of projects for state capitals, major towns, designated tourist resorts and towns above the water intake points will continue to be given emphasis. In addition, in line with Government's efforts to improve the socio-economic well-being of the people and to mitigate the adverse effects of rapid urbanization, the development of the urban drainage programme will be continued.

TABLE 12-8

DEVELOPMENT ALLOCATION FOR WATER RESOURCES, 1986-95

($ million)

Programme	*5MP*		*6MP*
	Allocation	*Expenditure*	*Allocation*
Water Supply	**2,716.2**	**2,467.0**	**2,854.5**
Source Works	2,446.0	2,219.7	1,717.2
Upgrading and Rehabilitation	—	—	350.0
Reticulation	270.2	247.3	787.3
Sewerage	**64.5**	**57.2**	**550.9**
Urban Drainage	**173.4**	**143.0**	**367.9**
Total	**2,954.1**	**2,667.2**	**3,773.3**

12.41 The implementation of the programmes under the Plan period will ensure that the existing and potential water resources will be developed efficiently and effectively to meet the long-term water requirements of the various sectors. Meanwhile, new water supply programmes will continue to be developed to meet the increasing demand of industrial users as well as to improve the level of services.