WATER, SANITATION & LOW-INCOME HOUSING SECTOR
This chapter covers the following four main subsectors: piped water, waste water management, solid waste management, and low-income housing.

1. Water
1.1 Subsector overview
The supply of piped water service in Thailand is the responsibility of different agencies in each service area. There are two main agencies responsible for providing piped water, the Metropolitan Waterworks Authority (MWA) and the Provincial Waterworks Authority (PWA). MWA and PWA are responsible for sourcing, production and distribution of water. In addition, the government, through local authorities, supplies non-piped water to rural populations. Some areas are also served by private water suppliers.

**Bangkok and vicinity:** MWA is responsible for providing water service in Bangkok and its vicinity. In 2006, MWA’s production capacity reached 5.52 million cubic meters per day. Water production and distribution capacity is 1,699.7 million cubic meters for the whole year or 4.66 million cubic meters per day. MWA’s water sales were 1,173 million cubic meters in 2006. The rate of water loss along the pipe and distribution line was around 30% in 2006. MWA has 1.75 million subscribers covering around 7.79 million people. Water is delivered through MWA’s pipe network covering around 95% of the responsible area or 91% of the population served. Average monthly water consumption per customer is 55.69 cubic meters. The average water tariff rate is 12.0 Baht per cubic meter.

**Provincial area:** PWA provides water services in 73 provinces. In 2006, there were 2.48 million subscribers covering around 10.66 million people or 96.42% of the total population in responsible areas. In 2006, PWA’s water production reached 981 million cubic meters per year and water sales were at 722 million cubic meters. The rate of water loss along the pipe and distribution lines was 26.31% in 2006. An average water sale is 25.146 cubic meter per customer per month.
Rural areas: For areas that are not served by MWA and PWA, mainly rural areas, four government agencies, namely, the Department of Public Works and Town and Country Planning, the Department of Health, the Department of Mineral Resources and the Accelerated Rural Development Office are responsible. According to the latest survey by the Ministry of Interior in 2007, there were 69,763 villages in the rural area. Approximately 78% of total villages, or
54,447 villages, had access to piped water, while 15,316 villages did not. Among these villages, there were 89,244 installed piped systems, 81,828 of which (or 92%) were in use at the time of the survey. For villages without installed piped water systems, water is connected from nearby villages.

According to the survey, 7,613,674 households from a total of 7,926,620 in villages and communities countrywide have access to clean drinking water. This represents 96.66% of households. The average volume of drinking water consumed is five liters per person per day with two liters for drinking and three liters for other purposes.

**Industrial areas:** Water in industrial areas is supplied by the Eastern Water Resources Development and Management Public Company Limited (East Water) and the Industrial Estate Authority of Thailand (IEAT). East Water is a public company established by PWA in 1992. It provides raw water supply and a range of water services (tap water, drinking water, and piped water business) to industrial operators in the eastern region. As of 2006, East Water had 328 millions cubic meters of water distribution capacity. The total volume of water distributed in 2006 was 199.36 million cubic meters. The company has a total of 307 kilometers of water pipelines with a capacity to distribute 423 million cubic meters of water per year. East Water has two subsidiaries responsible for providing tap water to the eastern region. In 2006, the combined tap water production capacity was 98.68 million cubic meters. The total amount of tap water distributed was 39.45 million cubic meter per year. The rate of water loss was less than 20%. The Industrial Estate Authority of Thailand (IEAT) also provides water services in many industrial zones.

Given the current level of water allocated and the rising demand for water in the region, it is forecasted that the industrial estates along the eastern seaboard might face water shortages in the near future. The current level of piped water allocated for industrial use is 145 million cubic meters per year. However, demand was forecasted to reach 232.19 million cubic meters per year in 2013. Additional water supply will be needed to appropriately respond to potential water shortages in the area, which is the industrial center of the country.

<table>
<thead>
<tr>
<th>Piped water Demand (million m³/year)</th>
<th>2003</th>
<th>2013</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>For consumption</td>
<td>28.13</td>
<td>72.37</td>
<td>118.42</td>
</tr>
<tr>
<td>For Industrial Use</td>
<td>111.67</td>
<td>159.82</td>
<td>221.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>139.80</td>
<td>232.19</td>
<td>339.82</td>
</tr>
<tr>
<td>Allocated</td>
<td>145.00</td>
<td>145.00</td>
<td>145.00</td>
</tr>
<tr>
<td>Excess (Shortage)</td>
<td>5.20</td>
<td>(87)</td>
<td>(195)</td>
</tr>
</tbody>
</table>

*Source: Water Management Plan*

22 East Water Resources Development Management Annual Report 2006
\textbf{Water pricing:} MWA and PWA use a cost-plus pricing method to set the price of piped water. The price of water varies according to different categories of user, such as residents, state enterprise, commercial, and industrial. The water tariff is set progressively varying with volumes of water consumed. Water tariffs of MWA and PWA are set separately. On average, MWA’s rate is slightly higher than PWA’s rate. In 2006, the average water tariff for MWA and PWA was 12.00 Baht per cubic meter and 11.75 Baht per cubic meter respectively. MWA’s water charge is adjusted every year to reflect the increase in the costs of production. However, PWA has not adjusted its water price since 1998 due to the government’s price control policy. Since 1998, PWA’s water price has been controlled and the average water tariff is ThB 11.75 per cubic meter. The controlled price has been well below actual cost per unit of water sold as shown below. In addition, there is a cross-subsidy among PWA’s different groups of water users. Water sold to residential customers is priced much below cost while water sold to government agencies and small businesses is priced more or less at a break-even point. In contrast, water sold to industrial consumers is priced at commercial level. Profit made from industrials sales are used to subsidize losses incurred from residential sales.

\begin{figure}[h]
\centering
\includegraphics[width=0.45\textwidth]{figure56.png}
\caption{MWA Average Price and Cost}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.45\textwidth]{figure57.png}
\caption{PWA average price and cost per unit}
\end{figure}

For piped water supplied by municipal authorities in areas not covered by PWA, most municipalities collect a fixed rate of ThB 4-5 per cubic meter.\textsuperscript{23} There is a large difference between PWA’s rate and tariffs set by other service providers. This might be explained by PWA’s pricing method, which sets a uniform water tariff rate in all operating areas despite differences in costs of water production in each area.

For raw water tariffs, East Water’s prices vary according to costs of raw water supply in each area. Tariff ranges from ThB 0.50 to 1.00 per cubic meter.\textsuperscript{24}

\textsuperscript{23}NESDB, \textit{A study on Infrastructure Development Strategy for Enhancing Competitiveness}, 2004
\textsuperscript{24}NESDB, \textit{A study on Infrastructure Development Strategy for Enhancing Competitiveness}, 2004
1.2 Policy and institutional framework

The major policy goal in the water sector is to provide piped water for every village by 2008, to be in line with the UN Millennium Development Goals. MWA and PWA also aim to expand the service area. Other policy targets include reducing water losses and groundwater usage in Bangkok and industrial areas, promotion of efficient water usage, and expansion of clean water services in important tourist areas.

In the water sector, policies are formulated by three agencies which are responsible for different areas of the water system. The Department of Water Resource is responsible for national water policy. Groundwater policy is the responsibility of the Department of Groundwater Resources. The Royal Irrigation Department is responsible for agricultural water policy. The Water Regulatory Commission (WRC) is planned as an independent regulatory agency to regulate the water sector. As the Commission is still to be established, the regulatory functions currently lie with the policy agencies. There are several implementing agencies responsible for providing piped water, raw water and ground water supply in different areas of the country. Water service providers come from several agencies: state-owned enterprises like MWA, PWA and IEAT, line agencies such as the Department of Public Works and the Department of Mineral Resources, as well as the private sector, such as East Water. MWA and PWA supplies piped water in the urban and suburban areas. The Department of Public Works assists 117 municipalities not served by PWA to produce and distribute piped water. The Department of Mineral Resources provides services in the construction of artesian wells for rural villages. The Department of Health provides rural piped water supply for villages in remote areas.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Policy</th>
<th>Regulation and Monitoring</th>
<th>Implementation</th>
</tr>
</thead>
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<tr>
<td>Department of Water Resources</td>
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<tr>
<td>Ministry of Natural Resources and Environment</td>
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<tr>
<td>Department of Ground Water</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ministry of Natural Resources and Environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Royal Irrigation Department</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ministry of Agriculture and Agricultural Cooperatives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Waterworks Policy and Monitoring Commission</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Metropolitan Waterworks Authority</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Provincial Waterworks Authority</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Department of Public Works and Town &amp; Country Planning, Ministry of Interior</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
1.3 Sector performance and international comparison

Selected performance indicators include average volume of water use, percentage of population with access to piped water, water loss/leakage ratio, and water tariff.

In 2004, the percentage of the population with access to improved drinking water was 99% of the total population. In terms of distribution of services, the rate of access was slightly higher in the rural area (100%) than the urban area (98%). The access rate in Thailand is considered satisfactory compared to other countries in the region, especially in terms of access for the rural areas.

Figure 58: Access to Improved Drinking Water Sources (%) in 2004

Source: Millennium Development Goals, 2007
Thailand has the highest volume of water use compared to other East Asian countries. In 2003, the average volume of water use was 8.6 cubic meters per household per week in Thailand, while the figure was 6.7 in Indonesia and 4.4 in China. The average water tariff rate for Bangkok in 2003 was US$ 0.29 per cubic meter which is higher than the tariffs in Shanghai and Hanoi but lower than Beijing. The rate of water loss of MWA and PWA is relatively moderate compared with other major cities in Asia.

**Figure 59: Average Volume of Water Use**

![Average volume of water use by World Bank (2003) (cu.m./household/week)](image)

**Figure 60: Comparison of Water Loss**

![Water Loss/Leakage in 2001 (%)](image)

**Figure 61: Comparison of Water Tariff**

![Water Tariff 2003 (US$/cu.m.)](image)

**Box 3: Water Loss/Leakage**

During 2001, water loss ratios for MWA and PWA were at 37.30% and 29.69%, respectively. The reasons for the high level of water loss include budget constraints, lower quality pipes, and equipment that exceeds their lifespan.

Both MWA and PWA were able to reduce much of the water loss in order to achieve the target of 30% and 25% by 2006 and 2007, respectively. They repair broken pipes at about 4% of the total length each year and use a district metering area (DMA) system to check for leakages in order to accelerate the repairs. The DMA system can measure water pressure at designated location, where the data is sent to the control room. The rate of flow and pressure is constantly measured, which helps get repairs done in a timely manner. The SCADA and DMA system are also linked for better management of water loss.
1.4 Private sector participation and privatization

Private sector participation in the water sector takes several forms including granting concessions for the supply of water, and lease and management contracts. PWA engages the private sector to participate in the provision of water services by producing and distributing water to PWA in bulk sale specifically in the areas where the government has set targets to reduce groundwater usage. PWA grants two types of concessions: build own operate transfer (BOOT) and build own operate (BOO). As of 2006, PWA had four BOOT projects in Pathumtani-Rangsit, Chachengsao, Bangpakong and Nakornsawan and five BOO projects. PWA granted the first private sector water contract in 1995 to the Pathumthani Waterworks Co., Ltd. to supply tap water in Pathumthani province. The BOOT contract allows the company to be the sole producer and distributor of tap water in Pathumthani and Rangsit area for 25 years. The company invested in the entire construction of the production system and part of the distribution system. Under the contract, a minimum quantity of water sale is guaranteed by PWA and any shortages in the water supply less than the guaranteed amount will be compensated to the company by PWA. In addition to water supply contracts, PWA also has a lease contract with a private company to manage and operate waterworks. PWA also engages private companies under management contracts to provide technical services such as efficiency improvement and leakage control. For areas outside PWA service, concessions must be obtained from the relevant provincial authority. In addition to private participation through concessions, the private entity established by PWA, East Water, has an extensive role in the provision of the water supply. East Water was listed in the stock exchange in 1997 resulting in dilution of PWA’s ownership in the company. Nevertheless, PWA is still the major shareholder of the company, holding 40% of shares in 2006.

After the crisis in 1997, both MWA and PWA were initially slated for privatization in 2003. However, the privatization plan for MWA and PWA were later abandoned due to public sentiment against privatization. Privatization of PWA and MWA is not expected in the near future.

1.5 Investment prospects

In the water sector, the investment priority is to expand water services to ensure an adequate supply of water in response to rising demand. Investment will be concentrated mainly in the area served by MWA and PWA. In metropolitan areas, demand is expected to continue to rise due to residential and commercial growth and a demand shift from groundwater supply. According to MWA’s projection, existing capacity of water supply will be able to meet rising demand until the year 2011. Additional investment will be needed to prevent water shortages, especially in the eastern area of Bangkok and in Samutprakan province. According to MWA’s 8th Plan (2007-2013), production will be expanded at Bang Khen and Mahasawasdi production facilities by adding 400,000 cubic meters capacity at each production site. Additional
facilities are expected to adequately serve growing demand until the year 2017. MWA also plans to invest in an additional 1,000 kilometers of pipeline to extend the service area. The total investment during 2007-2013 is estimated at THB 7,800 million. Financing will be drawn from MWA’s earnings (48.8%), while domestic and foreign loans will fund about half the total. Planned investment is expected to provide an additional 200 km² of service area, equivalent to 1.6 million people.

For PWA, investments are planned for upgrading and expansion of existing infrastructure which were transferred from local governments. Major investment projects for PWA will be on pipeline improvement, pipeline extension to increase service area coverage, and development of water sources. In addition to investment in service improvement and expansion, quality and quantity of raw water will become a major issue in piped water production. Therefore, future investment will also be channeled to construct and develop water sources to secure sufficient raw water supply. Despite growing investment needs, PWA faces certain financial constraints. Currently, more than 60% of PWA’s investment budget is subsidized by the government. Whether PWA’s investment will go as planned will depend largely on the budget allocated by the central government in each year.

1.6 Key issues

Service expansion – The future expansion of service by MWA and PWA is inevitable. Growing demand will result from both increasing economic activities as well as the need to replace groundwater usage, especially in industrial areas. Excessive groundwater use in recent years, especially by industry, resulted in over-exploited groundwater resources. To remedy this problem, a groundwater usage charge has been raised and substitution of the tap water supply for groundwater has been promoted by the government. MWA has a goal to reduce groundwater usage by 700,000 cubic meters per day, the equivalent amount of which must be compensated with an alternative water supply. Such reduction goals will put additional pressure on piped water demand.

Reducing water loss - Water loss is also an important issue, especially in enhancing efficiency of water supply. The problem of water leakage is mainly caused by low quality and outdated pipelines. Both MWA and PWA set a goal to reduce water leakage along the pipelines and met with some success. With proper leakage control, the cost of production and unnecessary expansion/investment can be avoided, and longer-run sustainability can be achieved. Reducing water loss should be carried out in parallel with MWA’s and PWA’s other efficiency improvements.

Water resources – Sources of water, used for the production of piped water for consumption and industrial purposes, is also a crucial issue. In recent years, Thailand has been experiencing
a lower level of surface water and natural water resources. Securing raw water supply will become a major challenge for water service provision in the near future. Particularly in the dry season, insufficient water supply may affect consumption, industry, agriculture, and tourism. This issue, however, has to be addressed in the larger context of integrated water management at the national level.

**Investment** – Investment constraints are also an important issue in the water sector as in other areas of infrastructure. In PWA’s case, a price control policy imposed constraint on its operations and investment capacity, forcing them to rely on government budgets. A pricing policy might need to be reconsidered to increase PWA’s operational flexibility and enable them to invest in expanded service coverage and improved service quality, while still maintaining affordability of services. Private participation can play an increasing role in the water sector to complement state investments. Private investment in water utilities can be enhanced, especially to serve industrial and tourism sectors, which has special demand and supply patterns. For example, supplying water to the islands requires special techniques in water production. Demand in these sectors, which are expected to grow significantly, can be served by private operators which have better access to new technology and more flexibility in investment and operation.

**Absence of regulatory body** – Another obstacle for water sector development is the absence of a regulatory body. As a result, pricing decisions are politically motivated, not reflective of actual economic costs. For example, price adjustments to compensate changes in costs for PWA has not been approved by the Cabinet. As a result, PWA has been operating with persistent losses and inadequate resources for service expansion.

2. **Wastewater Management**

2.1 **Subsector overview**

Wastewater is considered wastewater discharged from households and industry. Wastewater discharged by industrial plants must be treated by a plant’s own treatment facility. Public wastewater treatment facilities only treat wastewater discharged from households.

The total volume of wastewater discharged by households is approximately 14 million cubic meters per day. Household wastewater discharged from municipalities was approximately 2.5 million cubic meters per day. Bangkok and Pattaya discharges around 2.5 million cubic meters per day. The remaining 9 million cubic meters per day is discharged from areas under control of Tambon Administrative Organizations (TAOs).
In 2006, there were 95 central wastewater treatment plants. Seven systems are in Bangkok and owned by BMA. Two plants are located in Pattaya and another 82 plants belong to municipalities around the country. The other three plants belong to TAOs. Capacity of existing systems in operation was 2,318,884 cubic meters per day in 2006. When all the existing wastewater treatment plants become operative, the total capacity will reach 2,969,490 cubic meters per day. The utilization rate of the total capacity currently stands at 60%. However, only 14% of total wastewater generated each day by households countrywide is treated. From the total of 80 plants already completed, only 59 plants are up and running while others are either under repair or awaiting operations to commence. For the majority of the treatment facilities, the utilization rate is less than 50% of the total capacity. Most facilities are under-utilized because network coverage of wastewater pipeline is still not sufficient and some households still have not connected their drainage system with the central system. Thus, wastewater is discharged into public waterways instead of going into the central treatment system. According to the system evaluation done by the Pollution Control Department in 2006, operations of six treatment facilities were below standard. The majority of the systems are stabilization ponds which utilize low-technology treatment systems. Other systems are aerated lagoons, activated sludge and oxidation ditches. The table below summarizes the location and status of wastewater treatment systems in Thailand.
The seven wastewater treatment systems in Bangkok have a maximum capacity of 992,000 cubic meters per day, which accounts for 34% of total capacity in the country. The central region has the second highest treatment capacities at 27%.

Currently, there are only four municipalities that collect fees for wastewater treatment. Fees are collected based on types of user. The average fee collected for the four municipalities is ThB 0.6175 million per cubic meter while the average expense for the system operation is...
ThB 0.895 million per cubic meter. In three municipalities, revenue from users’ fees could not cover expenses and wastewater services required subsidies. For the remaining municipalities, no fee was collected for wastewater treatment services. Every municipality is entitled to receive subsidy for operations of the facilities in the first four years at a regressive rate. This might give rise to a sustainability issue once the financial assistance runs out.

2.2 Policy and institutional framework

The role of local government in controlling, preventing, reducing and managing pollution is strongly emphasized. Local and municipal governments are tasked to provide collective wastewater treatment systems in an effective and efficient manner. The policy is based on the principle that polluters should be responsible for providing necessary treatment on pollution they emit. The policy also encourages coordinated efforts among state, private sector and community to manage wastewater.

Policy on wastewater treatment at the national level is set by the National Environment Board as part of the national environmental protection plan. The Pollution Control Committee, a subcommittee working under the Board, will then focus specifically on pollution issues and is responsible for formulating policies for pollution-related areas including wastewater treatment. There are also two line agencies under the Ministry of Natural Resources and Environment (MONRE) responsible for setting policies on wastewater treatment: the Office of Natural Resources and Environmental Policy and Planning and the Pollution Control Department. There are four agencies which regulate different activities in the wastewater treatment system. Department of Public Works and Town and Country Planning (DPT) is responsible for controlling the construction standards of wastewater treatment systems for LAOs. The Department of Industrial Works and IEAT regulate wastewater treatment of industrial plants. The Wastewater Management Authority, which is a state enterprise under MONRE, is an implementing agency and has responsibility in project design, operation and maintenance of the system. Aside from the state enterprise, DPT also carries out similar function in constructing the treatment facilities. Operations of the plants are transferred to LAOs once the construction is complete. Technical and financial support will be provided by the central agency, MONRE, to assist local authorities in running the system.

2.3 Sector performance and international comparison

The service coverage ratio for wastewater treatment services in urban areas is only 34%, compared to 100% in high income countries such as Japan, Canada, and Singapore. This indicates that the wastewater treatment system in Thailand is still in beginning stages of development. The proportion of water treated to the total amount of wastewater released at 14% in 2006 also paints a similar picture. In terms of affordability, BMA does not charge any tariff for wastewater treatment service in Bangkok. In Had Yai municipality, the tariff for the wastewater treatment service as a ratio to one unit of water tariff is 0.60, much lower than rates charged in other big cities. The absence of a pricing mechanism in wastewater treatment services partly explains the deficiency in wastewater treatment facilities, as there is no financial incentive for investment in the sector.

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NESDB, A Study on Infrastructure Development Strategy for Enhancing Competitiveness, 2004
2.4 Private sector participation and privatization

The private sector participates in water supply mainly as operators while constructions of facilities are fully government financed. Many wastewater treatment systems in Bangkok are operated by private parties (e.g. Chong Non-tri and Nongkhem-Phasi Charoen systems). Several local wastewater treatment systems (under LAOs), for example those in Cha-am, Pattaya, Phuket, are also operated by private sector. The government encourages increased private participation in the sector, primarily as system operators. In addition, there is private participation in joint ventures. The Ministry of Industry, IEAT, and the private sector co-founded a company called GENCO to provide industrial waste treatment services in industrial estates. Services for the project are fully provided by the private sector. The Wastewater Management Authority also has a policy to enter into joint ventures with the private sector and hold 30% or less of the total investment.

2.5 Investment prospects

Further investment in wastewater treatment facilities is expected in order to increase service coverage in the area of Bangkok. There are plans to build wastewater treatment facilities in Klongtoey (360,000 cubic meters per day) and in Thonburi (575,000 cubic meters per day).
Both projects are under feasibility studies. For provincial areas, investment will be made to utilize capacity of the existing treatment facilities. To do this, funding will be used for repair and restore facilities to make them operational. Financial support will also be provided to assist local authorities to operate and maintain the system, and building capacity of local authorities. Training, as part of future investment plans, is crucial for the long-run sustainability of the system and will ensure that the systems are properly managed and maintained.

2.6 Key issues

**Financing** - One of the most important issue for wastewater treatment systems is financing. Construction is government-funded; thus, the problem has more to do with how to keep the system running once it becomes operational. Often, budgets allocated at the municipal level cannot cover operational and maintenance costs. This often causes a temporary disruption in operations or sometimes permanent suspension of some facilities. Therefore, efficiency of the system is compromised since capacity of existing systems cannot be fully utilized. Closely related to this problem is the tariff issue. Tariff collection in the wastewater sector is a major bottleneck which prevents development of wastewater treatment systems. The current tariffs, where they are collected, do not reflect actual costs of wastewater management and are not based on a polluter-pay principle. Even when the tariffs are in place, tariff collection is a problem. As a result of public resistance toward wastewater treatment projects, tariffs cannot be collected without a community’s willingness to pay. Without sufficient financial support, sustainability of the systems cannot be attained in the long run.

**Local capacity** – There is a lack of the skilled labor required to operate the wastewater treatment facilities, especially at local level. As a result, the systems cannot be operated in an efficient manner and are often operating at higher maintenance costs. How to keep the plants functioning properly and well-maintained are major challenges commonly faced by local administrators once the plants are put in place. There is a need for training and capacity building for staff who operate and maintain the wastewater treatment system.

**Public acceptance** – There is still lack of understanding among communities regarding the importance of wastewater treatment systems. In addition, there have been complaints and resistance from nearby communities which are environmentally affected by the construction and operation of wastewater treatment systems. Public hearings and Environmental Impact Assessments are often demanded by affected communities, although there is no legal obligation to perform them. Acceptance and understanding for the need of wastewater treatment system and measures to cushion against environmental impact are crucial factors in the sector.
Transparency and good governance – Accountability and transparency when embarking on land acquisition, selection of project locations and technology selection, are necessary to gain public acceptance. Unclear explanations for location selection or selection of outdated or inappropriate technologies reduces credibility for projects and undermines public support needed for implementation.

3. Solid Waste Management

3.1 Subsector overview

Household Waste - In 2006, households around the country generated approximately 14.63 million tons of waste or 40,082 tons per day, representing an increase of 2% from 2005. From the total amount of household waste, only 36% (14,373 ton per day) of total waste is treated according to sanitary standards. The city of Bangkok generated 8,473 tons of waste in 2006 which accounts for 21% of total waste generated. In 2006, 47% of waste was generated outside municipalities while the other 32% of waste, was generated in municipal areas and the city of Pattaya. During 2000-2006, the volumes of waste grew at a marginal rate or an average of 1%. Interestingly, the trend of waste generation for Bangkok saw some decrease in the last two years, especially in 2005.

Figure 66: Volume of Waste Generated, 2000-2006

In 2006, 3.19 million tons of waste,\textsuperscript{27} or 22%, of the total waste were recovered. The majority of this amount was recycled, while organic waste was used to produce soil conditioner.

\textsuperscript{27}Data as of October 31, 2006
Hazardous waste  Hazardous wastes comprise industrial hazardous waste and household hazardous waste. It was estimated that in 2006, the total amount of hazardous waste was approximately 1.81 million tons.\textsuperscript{28} The amount of industrial hazardous waste was around 1.41 million tons while the remaining 0.40 million tons was household waste. In terms of sources of hazardous wastes, 49\% was generated in Bangkok and the vicinity. It is estimated that most of the household hazardous waste are disposed of with non-hazardous household waste.\textsuperscript{29} This is partly because collection sites for hazardous wastes are not sufficient and the public is still not familiar with proper methods of disposal. Without a proper collection system and safe disposal behavior, hazardous waste may contaminate the food chain and the environment.

Industrial waste  In 2006, the amount of non-hazardous industrial wastes was around 12.66 million tons. Industrial wastes are mostly treated by private waste treatment operators, which provide services to industrial operators. It is estimated that around 50\% of the total amount of industrial waste in Bangkok and the vicinity are treated. Some non-hazardous industrial wastes such as packaging materials are re-used. In 2006, the amount of re-used industrial waste was around 8.24 million tons or 65\% of the total amount of industrial waste.\textsuperscript{30}

In 2006, there were 117 sanitary solid waste management facilities but only 91 facilities were up and running.\textsuperscript{31} The majority of the facilities are sanitary landfills. Bangkok and the municipal areas have standardized solid waste treatment systems. BMA engages private operators to manage solid waste, including operating waste treatment and landfill facilities, and also to transport waste from the transfer sites in Bangkok to landfills. Around 70\% of total waste generated in Bangkok is transferred to the landfill site in Kam Pang Saen, Nakorn Prathom Province, while

\textsuperscript{28}Data as of October 31, 2006
\textsuperscript{29}Thailand Pollution Report, Pollution Control Department, 2006
\textsuperscript{30}Thailand Pollution Report, Pollution Control Department, 2006
\textsuperscript{31}Thailand Environment Report 2006, Ministry of Natural Resources and Environment
the remaining 30% is transferred to the landfill in Phanom Sarakham, Chachengsao province. In municipal areas and Pattaya, there are 96 sanitary solid waste treatment facilities which are up and running. The majority of these facilities are sanitary landfills. There are also three incinerators and three facilities that use mixed technologies. In municipal areas, 37% of waste is treated according to sanitary standards, while the remaining is treated by unsanitary means, such as open dumping and open site burning. In non-municipal areas, LAOs are responsible for solid waste management. However, waste management in these areas is usually not up to sanitary standards. Most waste is dumped or burned in open sites as in municipal areas. Only 6% of waste generated in non-municipal areas is treated in sanitary waste treatment facilities. In remote areas, each household is responsible for its own waste.

3.2 Policy & institutional framework

The government’s primary aim in solid waste management is to reduce the amount of waste generated. The target set by MONRE is to reduce the rate of waste generated in Bangkok to less than 1 kilogram per person per day. The target rates for municipalities are 0.6-0.8 kilogram per person per day. The target rate at Tambon level was set at 0.4 kilogram per person per day. The government also promotes recycling and waste separation to reduce waste volume. Policy increasingly emphasizes sanitary waste management to gradually reduce unsanitary waste handling (e.g., open dumping and burning) and effective management and control of hazardous waste and substances. Waste management in Thailand is decentralized and local authorities are empowered to manage waste and control treatment facilities. Local authorities are the principal implementing agencies and they are encouraged to take ownership of the facilities. A cluster approach to waste management, which emphasizes utilizing waste benefits, such as composting and waste-to-energy approaches, is promoted by government.

There are several actors in solid waste management. The National Environment Board and the Pollution Control Department are responsible for formulating overall policies on pollution and environmental standards, including waste management. Committee on Hazardous Substances was specifically set up to control hazardous materials. The Pollution Control Department, the Ministry of Public Health and IEAT act as regulators in different areas of waste management. As community-based management of waste is emphasized, implementation functions are decentralized to local governments at local, provincial and Tambon levels.
The waste generation rates indicate efficiency in the system reflecting waste reduction and waste recycled. Thailand has a relatively high waste generation rate compared to other countries in the region. In 2007, Bangkok’s waste generation rate was 0.88 kilograms per day. The proportion of reused waste is still small, although the indicator has shown a positive trend in recent years. There is a lot of room for improvement in solid waste management in terms of capacity expansion, collection methods, technologies used and promotion of re-use program.

Figure 69: Waste Generation Rate

3.4 Private sector participation and privatization

Private participation at the local level varies from location to location and from activity to activity. In some LAOs, Lampang municipality, for example, a single private company handles the whole waste management system (including collection, treatment, and fee collection). In other LAOs, several private companies are contracted to handle different functions of waste management. For example, several private operators are contracted to handle the same collection activity in different areas of a municipality. Some LAOs contract private operators to handle only some part of waste management and operate some activities themselves. There are several forms of private participation in the sector. Some private companies are contracted as operators of the systems owned by the municipal government. Some projects receive investment and are operated by private entities under concession with municipal organizations in the form of BOO, BOT and BOOT. Private sector also participates as service providers in areas such as garbage collection, fee collection, cleaning services and waste separation. Some LAOs, which engage private sector in waste management, are Kanchanaburi, Viengsa, Dan Samrong, Bangplee Yai, Lampang, Praksa, Had Yai, Chiang Mai, and Phuket.

In Bangkok, waste treatment systems are outsourced to private companies, while BMA collects waste from households and businesses. The transportation of waste from transfer to landfill sites and the operations of the landfill sites, are the responsibility of private companies under contracts with BMA. Medical waste facilities are wholly owned and operated by a private company. In addition, BMA also contracts a private company to run its composting plant.

3.5 Investment prospects

A cluster concept of waste management is encouraged by the government. Based on the cluster concept, LAOs in nearby areas cluster to invest in and jointly use a waste treatment center. The center should utilize an integrated system for waste management, for example, by utilizing both composting and waste-to-energy approaches within the center. Investment in waste separation centers and recycling businesses is also encouraged. Private investment in
waste management businesses with sound environmental quality are welcome to complement state investment. There is also a plan to establish a waste information center to disseminate information on best practices and knowledge-sharing on waste utilization.

3.6 Key issues

**Budget allocation** – Similar to other issues in infrastructure services, budget allocation is a major constraint in the development of an effective waste management system. An insufficient budget results in several waste management facilities operating below sanitation standards and without proper maintenance.

**Public resistance** - Due to insufficient budget allocation and poor operation, some waste management facilities generate pollution and negative externalities, for example, leakages and smells, onto local communities. Public resistance thus ensues and a vicious cycle is created. Public resistance which is triggered by poor system operations discourages the community to pay for the service. Consequently, insufficient fee collection then leads to lack of funding for the services which in turn resulted in inefficiencies in facility operations.

**Institutional capacity building** – With decentralization of waste management, most local governments are required to manage the waste of their local communities. However, local government may lack expertise and experience in sanitary solid waste management and hazardous waste management. Insufficient expertise and manpower to operate the system reduces efficiency of the services. Some facilities, although financed and built, do not have enough qualified staffs to become operational. Capacity building at the local institutional level is needed to complement the decentralization process of waste management, especially introduction to new technologies and staff training.

4. Low-income Housing

4.1 Subsector overview

In 2005, there were 18.45 million units of housing. Approximately 3.65 million units of which were in Bangkok and its vicinity (19.78%).
A particular segment in the housing sector that requires government intervention is housing for low-income populations. In 2006, around 1.7 million households registered with the Poverty Alleviation Center indicating that they had housing problems. However, 58% of the registrants do not require government support. For households that need support from the government, 83,728 households have received it, while 292,399 households are expecting it. However, another 372,908 households still have not received any support from the government.

According to the Community Organization Development Institute (CODI), in 2002, Thailand had approximately 5,500 slums communities (equivalent to 1,500,000 households or 6.75 million populations) in 300 cities nationwide. Around half of these communities have been assisted by government development programs. However, there still remain around 2,950 communities or 680,000 households which need development assistance.

**4.2 Policy & institutional framework**

The government aims to accomplish a goal of ‘Cities without Slum’ by 2008. To achieve this, the government has initiated two major low-income housing projects, Baan Eua-arthon and Baan Mankong, to provide housing for low-income households and to upgrade living environments of slum communities.

The National Housing Authority (NHA) and CODI are the two main government agencies responsible for the provision of low-income housing. NHA is a state enterprise under the Ministry of Social Development and Human Security, and is assigned to implement the Baan Eua-arthon project to provide housing to low-income households. Under the project, 601,727 units will be built during 2003-2009. CODI is a public organization responsible for Baan-Mankong project, which aims to improve the slum areas by building houses in state-owned land for household with income below ThB 10,000/month. The project will cover 1,826 communities and is expected to improve living conditions for 285,000 households or 1,425,000 beneficiaries. For the Baan Eua-arthon project, the government provides subsidy of around 17% of the overall
costs of house constructions. For Baan-Mankong project, the government subsidy is around 33% of total costs.

Institutionally, there is currently no government agency directly responsible to set policy on low-income housing; rather, they are set on an ad hoc basis by the cabinet. The Department of Land and DPT regulate the housing sector in general. NHA and CODI are implementing agencies, responsible for providing housing services, upgrading slum communities, and for assisting low-income groups to achieve tenure security. In addition, two state-owned banks play an important role providing credit to low-income groups for housing.

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4.3 Sector performance & international comparison

Information on the low-income housing segment is relatively scarce. One indicator which provides insight into sector performance is the number of demand served. As discussed, 50% of registrants which sought government support in housing have been assisted. However, there are still more than 372,908 registrants seeking government support for housing that have not yet been assisted by government. In 2002, there were also around 2,950 slum communities or 680,000 households, which represents existing demand for low-income housing.

According to NHA, during January 2004 to June 2007, NHA provided assistance in upgrading slums and providing loans for housing for 980 communities in 220 cities/districts.
However, by international comparison, the number of slums in Thailand as a percentage of urban population is relatively small.

4.4 Private sector participation and privatization

The private sector plays a large role in the government’s Baan Eua-arthon project. NHA allows private companies to participate in turn key projects under which they procure land, obtain funding and undertake construction. NHA also has a plan to purchase 5,160 units of developed properties from the private sector partly to relieve the burden of non-performing loans for financial institutions. However, as most of these properties do not pass NHA’s quality tests, only 200 units have been purchased from the private sector to date.

4.5 Investment prospects

Government will continue to invest in low-cost housing to promote home ownership among low-income groups, including civil servants. Additional investment will also be channeled to upgrade slum communities and improve living standards of slum populations. However, investment in the low-income housing sector is being reprioritized because of government policy shifts. According to the original Baan Eua-arthon plan, NHA will continue to invest in the next phase in 2007. However, the December 2007 Cabinet resolution\(^{32}\) gave new direction to the development of Baan Eua-arthon, effectively downsizing the project from the planned 600,000 units to only 300,504 units (including 78,000 units already completed).

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\(^{32}\)The Cabinet Resolution on December 18, 2007.
4.6 Key issues

*Budget allocation* - To provide low-income housing, a large amount of investment is required. Partial, or sometimes full, subsidy is required to support home ownership among low income groups; giving rise to sustainability issues as government budgets are depleted. New slums also emerge due to rapid urbanization. The government, thus, faces recurring urbanization challenges and emerging housing needs under constant budget constraints.

*Low-income group credit and project sustainability* – A low-income group’s ability to pay back loan is very limited since they have uncertain income streams while credit terms are fixed. Often, NHA buys back loans from households and shoulders the debt with the banks. As for upgrading slums, relocation is sometimes not successful as social and economics aspects are not taken into account along with the provision of physical housing. For example, sometimes individuals cannot find income earning opportunities in the new environment. The problem of slums is not only economic, but also social, such as in the case of drug addiction. Education and career building for low-income people are concerns which are closely related to the challenges in the new housing development and upgrading of slums communities. Hence, the challenge is how to tie in the aid with a capacity building component to help individuals support themselves for the longer term.