

Chapter 6. Supporting Local Action

The critical role of local authorities in promoting resource efficiency should not be overlooked. Because local governments have jurisdiction over the large populations living and working within their boundaries, they are in a good position to influence the habits that cause high resource consumption.

This chapter looks at some important ways in which local governments are improving resource efficiency. One key lesson is that local governments must not view lack of resources or national support as an excuse for inaction. They can take immediate action by encouraging public participation and promoting community-based programs. Moving forward, the best local solutions will likely involve the application of appropriate technology combined with local insight. Technology alone, however, is meaningless without fair and effective local management.

Local initiatives are most effective when supported by comprehensive national legislation and national programs, especially those that provide incentive mechanisms for local governments.¹⁹² Community-based organizations and NGOs also play an essential role in local programs, especially in the areas of public awareness and education. Meanwhile, international agencies and organizations can do their part by coordinating financial and technical support and by fostering collaboration to provide a common platform to share ideas, experiences, and knowledge.

¹⁹² Kitakyushu Initiative for a Clean Environment. 2006, June 23. International Workshop on Local Initiatives Addressing Transformation of Lifestyles Toward Achieving Sustainable Development in Asia and the Pacific. Tokyo, Japan. Summary of Discussions.

Local Solid Waste Management

In the economically more advanced urban centers of Australia; Hong Kong, China; Japan; Republic of Korea; and New Zealand, local leaders are finding that integrated approaches to waste management offer economic benefits through cost savings, income generation, new employment, and promotion of new business opportunities. Pursuing integrated approaches can help maximize the economic potential of resource recovery. Some of the key factors that affect this potential are the cost of the separated material, its purity, its quantity, and its location with regard to the intermediate and final processing facilities. The costs of storage and transport are also major factors.¹⁹³

New practices such as volume-based collection fees and curbside collection, along with public education, have resulted in a high degree of waste reduction, separation at source, and recycling. For instance, the Republic of Korea extended a volume-based fee system to all towns in 1995, which helped to decrease the amount of waste for disposal by 20–30%.¹⁹⁴ These measures can affect public attitudes about the importance of the 3Rs (Box 6.1).

In developing countries, however, most urban areas still struggle to deal with their garbage. In the cities of developing Asia, 30–60% of the solid municipal waste that is generated is not collected and is instead dumped indiscriminately in streets, drains, rivers, and ravines,

¹⁹³ Zurbrugg, Christian. 2002. Urban Solid Waste Management in Low-Income Countries of Asia: How to Cope with the Garbage Crisis. Presented to the Scientific Committee on Problems of the Environment (SCOPE) Urban Solid Waste Management Review Session. Durban, South Africa. November.

¹⁹⁴ UNEP. International Environmental Technology Centre. 2002, March. *International Source Book on Environmentally Sound Technologies (ESTs) for Municipal Solid Waste Management (MSWM)*. Available: http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/RO/asia/topic_a.asp

Box 6.1: Successful Recycling Program in Nagoya, Japan

In Nagoya City, the 2.2 million residents generated 1 million tons of solid waste per year and faced a waste crisis when a proposed landfill was cancelled and the city's incinerator closed. Citizens were challenged to work together to reduce waste generation by at least 20%. Through recycling and charging businesses for the collection of general waste, this goal was achieved within one year. As neighborhood associations and citizens' groups became more involved in recycling, purchase patterns started to change and the waste generated fell even further. The current plan is to reduce waste generation to 620,000 tons by 2010 and to reduce the waste sent to landfills to 10% of the 2000 level. As shown in Nagoya, awareness and information campaigns can help change attitudes toward the environment and can result in environmental, economic, and social benefits.

Source: Asian Development Bank. 2005. *Asian Environmental Outlook: Making Profits, Protecting Our Planet*. Manila.

while the collected waste is often disposed of in unsafe, open dumps. Inadequate waste disposal creates serious environmental problems that affect human health and cause serious economic and other welfare losses. These problems include contamination of surface water and groundwater through leachate, soil contamination through direct waste contact or leachate, and air pollution by burning of wastes.

Unfortunately, many cities that are starting to address their waste problems are turning to costly conventional solutions to maximize refuse collection and upgrade disposal facilities, while ignoring lower cost and socially desirable options that incorporate



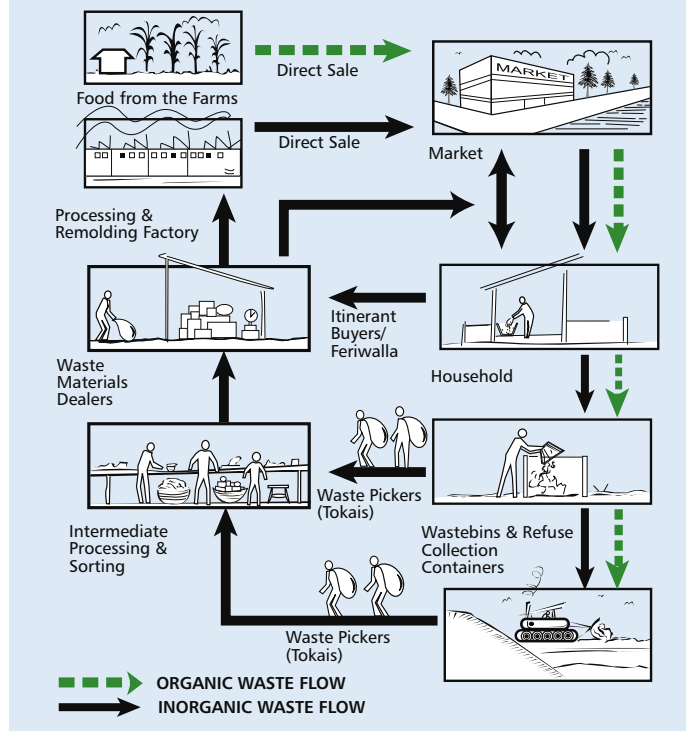
Source: C. Visvanathan.

resource efficiency. Experience in many cities has shown that conventional solutions fail to consider the profound differences between developed and developing countries, such as consumption patterns, available capital, and institutional capacity (see Chapter 7 for a discussion of conventional solid waste management versus systems that given greater attention to resource recovery and recycling).¹⁹⁵

The cities that have enjoyed the most success in managing their waste have typically combined conventional solutions with affordable and community-based solutions that work well in a developing world context (Table 6.1). Local programs, often supported by NGOs, help create jobs, protect the environment, promote community participation, and encourage and support entrepreneurship.

Successful programs in developing cities must also consider the contribution of informal waste collectors and resellers, often called waste pickers

Figure 6.1: Role of the Informal Sector in Materials Recovery and Recycling



Source: Md. Maqsood Sinha, A.H. 2006. *Community-based Solid Waste Management through Public-Private-Community Partnerships: Experience of Waste Concern in Bangladesh*. Presentation in 3R South Asia Expert Workshop. Kathmandu, Nepal, 30 August.

¹⁹⁵ Medina, Martin. 2002. *Waste Picker Cooperatives in Developing Countries*. Mexico: El Colegio de la Frontera Norte.

Table 6.1: Examples of Community-Based Solid Waste Management Projects in Asia

Country	Project
Indonesia	A number of cities have introduced organized citizen participation and involvement in primary collection schemes. In Yogyakarta, neighborhood units use handcarts for house-to-house collection. These play a significant role in the city's solid waste management system.
Lao People's Democratic Republic	In 2003, a nongovernment organization introduced solid waste collection to 11 villages with a population of 12,000 people. The project proposed to collect and dispose of municipal solid waste from the local market and to promote hygienic practice. ^a
Nepal	In the city of Lalitpur, the Women's Environment Preservation Committee, supported by the Danish International Development Agency, started a pilot project to promote source segregation and composting. The project is already servicing 500 households with primary collection. The sweepers sort out the recyclables and sell them to waste traders, while the organic waste is composted. The organization sells 1,200–1,500 kilograms of compost monthly. This method has spread extensively in Nepal. ^a
Philippines	As part of the Asian Development Bank's Poverty Environment Program, the Smokey Mountain Remediation and Development Project aims to reduce the health risks of poor communities due to exposure to remaining wastes in the old dump site while improving the livelihood of those who rely on waste as source of income.
Sri Lanka	As part of the Environmental Pioneer Brigade Programme, school children are educated about the environment to help raise awareness and change behaviors. In 2000, the program was expanded from 1,850 to 3,005 schools. ^b
Thailand	In Nonthaburi, city officials started a campaign to reduce waste by public participation and public awareness in communities, schools, department stores, apartments, and temples. Presently, solid waste generation is 350 tons/day and waste separation is 59 tons/day. (Recycling rate 17%). Nonthaburi built composting facilities, separated organic solid waste from municipal waste, and produced fertilizer for agricultural use. ^c

^a Glawe, U., C. Visvanathan, and M. Alamgir. 2005. Solid Waste Management in Least Developed Asian Countries – A Comparative Analysis. International Conference on Integrated Solid Waste Management in Southeast Asian Cities. 5–7 July, Siem Reap, Cambodia.

^b United Nations Economic and Social Commission for Asia and the Pacific. Available: http://www.unescap.org/DRPAD/VC/CONFERENCE/ex_1k_16_epb.htm

^c Kitakyushu Initiative for a Clean Environment. 2006. International Workshop on Local Initiatives Addressing Transformation of Lifestyles Toward Achieving Sustainable Development in Asia and the Pacific. *Summary of Discussions*. 23 June, Tokyo, Japan.

or scavengers. Well adapted to local conditions, the informal sector uses labor-intensive methods and simple equipment, such as push carts, and can collect waste in places where conventional trucks owned by local governments or large companies cannot enter, especially in low-income neighborhoods, slums, and squatter settlements.¹⁹⁶

As shown in Figure 6.1, informal waste collectors gather materials at every stage of the waste management process, for example:

- Informal collectors purchase source-separated recyclables from residents or from collection crews, as is common in the Philippines and Thailand.

- In areas not served by formal collection systems, informal refuse collectors charge a fee to residents to pick up their garbage and then retrieve the recyclables it contains.
- In many cities, collectors pick up litter from streets, public places, and even canals and rivers.
- In some countries, waste pickers still live and work in municipal open dumps, sorting out recyclables.¹⁹⁷

From informal collectors, recyclable products typically enter a chain of dealers who perform useful services to industry by further sorting and processing materials and then selling them in the amounts that industry demands. However, the existence of these

¹⁹⁶ Zurbrügg, Christian. 2002. *Urban Solid Waste Management in Low-Income Countries of Asia: How to Cope with the Garbage Crisis*. Presented at the Scientific Committee on Problems of the Environment (SCOPE) Urban Solid Waste Management Review Session. Durban, South Africa. November.

¹⁹⁷ Medina, Martin. 1999. Informal Recycling and Collection of Solid Wastes in Developing Countries: Issues and Opportunities. *Working Paper* No. 24. Tokyo: United Nations University and Institute of Advanced Studies.

Box 6.2: ADB Support of the Informal Sector in the Lao People's Democratic Republic

The Solid Waste Management and Income Generation for Vientiane's Poor Project aims to improve the living conditions of the poor household and waste pickers in Vientiane through an improved sanitary environment, better access to waste collection services, and improved standards of living through acquisition of entrepreneurial skills.

- The solid waste infrastructure improvements component aims to improve conditions at the municipal landfill site, establish a waste pickers' multipurpose center (WMC), and improve management capability of the municipal landfill authority. The WMC will provide a sorting area, recycling facilities, and training and administration rooms.
- The community-based solid waste management component aims to enable communities to participate actively in solid waste separation, collection, and recycling. A community-based fee collection system will be introduced, whereby the community will bear the cost of collection. Actual site selection will be based on community willingness to contribute resources.
- The income-generation and entrepreneurship development component comprises training and skills development in waste recycling, marketing and entrepreneurship, composting organic waste and vermiculture, and accounting and bookkeeping.

Source: ADB.

dealers can lead to exploitation of waste pickers, especially in cases of a monopolistic market.¹⁹⁸

Despite the lack of data at the national level, various studies have highlighted the economic importance of informal collection and recycling activities. In the late 1980s, it was estimated that, in Bangkok, Jakarta, Kanpur, Karachi, and Manila, scavenging saved each city an average of at least \$23 million per year from reduced imports of raw materials and reduced need for personnel, facilities, and equipment for collection, transport,

¹⁹⁸ Medina, Martin. 2005. Waste Picker Cooperatives in Developing Countries. Paper prepared for WIEGO/Cornell/SEWA Conference on Membership-based Organizations of the Poor, Ahmedabad, India. January.

Box 6.3: Health and Safety Issues of Scavenging

While informal source separation and recycling provides a livelihood for many people in the developing world, this sort of recycling presents health and safety issues to those involved. The scavengers that sift through the waste are exposed to clinical material, fecal matter, and hazardous wastes. In places like Phnom Penh, many waste pickers are children below 18 years (51% in 1998), both in the streets and in the dumpsites. In addition, working conditions and safety procedures employed in recycling operations are poor and workers are exposed to unreasonable risks—risks that the developed countries would not accept or allow in their own nations.

Source: United National Environment Programme, International Environmental Technology Centre, and ASEAN Working Group for Multilateral Environmental Agreements. 2002. *State of Waste Management in South East Asia*.

and disposal.¹⁹⁹ In Indonesia, waste pickers reduce by one third the amount of garbage that needs to be collected, transported and disposed of, with the benefit of extending the life of disposal facilities.²⁰⁰ And in Bangladesh, the entire operation of plastic recycling employs a chain of actors from scavengers to brokers. Economically, this sector generates over 22,000 jobs and saves foreign exchange of \$52 million per year by avoiding import of virgin plastics and resins. Scavenging also renders significant environmental benefits, because recycling materials saves energy and water and generates less pollution than obtaining virgin materials.



Source: ADB.

¹⁹⁹ Baldisimo, J. 1988. Scavenging of Municipal Solid Waste in Bangkok, Jakarta and Manila. *Environmental Sanitation Reviews* No. 26. Bangkok: Asian Institute of Technology.

²⁰⁰ Ibid.

Unfortunately, most authorities in Asian countries do not fully realize the social, economic, and environmental benefits that informal waste collectors provide, and development banks tend to ignore their role, although ADB has recently initiated a number of projects that focus on the social aspects of solid waste management (Box 6.2). Consequently, the informal sector has usually overlooked when designing solid waste management policies and plans.

When the informal sector is considered, the focus is often on its negative aspects, particularly on health and safety issues (Box 6.3), and the objectives are to eliminate or punish them.²⁰¹ Removing squatters from landfills without offering them alternatives for survival creates a conflict between the economic goal of poverty reduction and the social goal of healthful habitat for the poor.²⁰²

Despite indifferent or negative national policies toward waste pickers, some cities started taking steps to integrate informal waste collectors into formal solid waste management programs. As part of this shift, the formation of waste picker cooperatives has gained impetus in Asia over the last few years to help waste pickers organize themselves, obtain higher incomes, and improve their working and living conditions. Such programs have job creation and poverty reduction benefits.

At the same time, local waste management services and environmental conditions can also be improved through better integration of the formal and informal sectors. For example, if cities offer waste pickers incentives to bring the waste they collect to transfer stations, waste pickers are less likely to dump their collected waste illegally in vacant lots, river banks, or ravines. At the same time, the city avoids the need to purchase collection trucks and service is improved, particularly in slum areas.²⁰³

Perhaps the most successful program in the region is being implemented in Bangladesh. In 1995, the NGO Waste Concern, with the help of UNDP, started a pilot composting plant in Mirpur, Dhaka on land donated by the Lions Club. Making use of

the existing network of waste pickers and of simple technology, Waste Concern was able to demonstrate the benefits of a community-based approach.

With support from the government, Waste Concern replicated their model (Box 6.4) in four other poor communities around the capital. After this initial replication, it took 5 more years before the biggest hurdle for more widespread replication—access to land—was finally cleared. Dhaka's Municipal Corporation and Public Works Department provided government land on which to establish more community-based composting plants, and then the project took off.²⁰⁴

Waste Concern was able to initiate a large-scale (700 tons/day) composting plant in Dhaka, producing 50,000 tons of organic fertilizer per year. The organization looks forward to this project's reducing 1 Mt of GHGs over 8 years under the clean development mechanism.²⁰⁵ International donors are now supporting the implementation of similar schemes in 20 cities and towns in Bangladesh.²⁰⁶ The projects are small in scale (1–5 ton capacity), labor intensive, use simple technology (aerobic windrow system) and are combined with primary solid waste collection services.

Another successful program was implemented in Madras, where the NGO EXNORA created a waste collection program in low-income neighborhoods to formalize scavenging activities. Under the program, waste pickers were incorporated as waste collectors (called "street beautifiers"), while communities obtained loans to purchase tricycle carts to be used as refuse collection vehicles by the street beautifiers. Before disposal, the street beautifiers recover the recyclables contained in the collected wastes. Residents pay \$0.30 per month for having their refuse collected and these fees are used to pay back the loans and to pay the street beautifiers' salaries. About 900 collection units involving waste pickers exist in slums, as well as in middle- and upper-

²⁰¹ Medina, Martin. 2002. *Waste Picker Cooperatives in Developing Countries*. Mexico: El Colegio de la Frontera Norte.

²⁰² Gonzales, Eugenio. 2003. From Wastes to Assets: The Scavengers of Payatas. *Conference Paper Series No. 7*, Tagaytay City, Philippines: Political Economy Research Institute and Center for Science and the Environment. January.

²⁰³ Footnote 201.

²⁰⁴ Ashoka. *Cash for Trash: Solving Dhaka's Waste Problems*. Available: <http://www.ashoka.org/files/Cash%20for%20Trash.pdf>

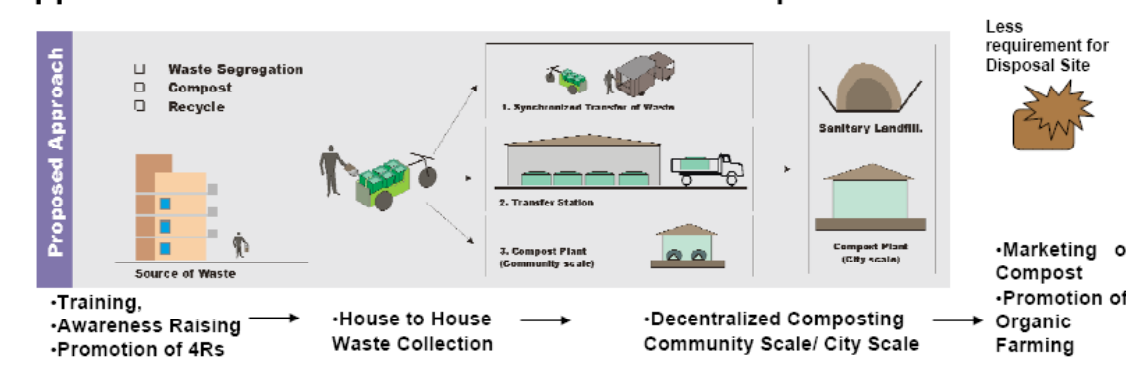
²⁰⁵ 3R Knowledge Hub Secretariat. 2007. *Gap Analysis in Selected Asian Countries*. Bangkok: Asian Institute of Technology.

²⁰⁶ Glawe, U., C. Visvanathan, and M. Alamgir. 2005. Solid Waste Management in Least Developed Asian Countries—A Comparative Analysis. International Conference on Integrated Solid Waste Management in Southeast Asian Cities. Siem Reap, Cambodia. 5–7 July.

Box 6.4: Model of Waste Concern Based on the 3R Principle

Every four to six houses in a slum share a barrel for composting kitchen waste. A group of around 120 former waste pickers employed by Waste Concern collects the organic household waste from local households using small, bicycle-driven collection carts. The waste is then transported to community processing centers and transformed into compost over a period of 55 days. This top quality compost can be sold for up to \$50 for a 50-kilogram bag.

Approach of Waste Concern Based on 3R Principle



Sources: Ashoka. *Cash for Trash: Solving Dhaka's Waste Problems*. Available: <http://www.ashoka.org/files/Cash%20for%20Trash.pdf>; Waste Concern.

income neighborhoods. The program has dignified waste picker activities, raised their earnings, reduced littering, increased refuse collection, and contributed to a cleaner urban environment.²⁰⁷

Local Efforts to Improve Energy Efficiency

Municipalities around the world demonstrate that when cities plan and develop with EE in mind, per capita energy consumption for municipal, residential, and transportation needs can be cut significantly.

While they cannot legislate national carbon taxes or mandate nationwide changes in the fuel mix for electricity, local government decisions can either mitigate or exacerbate unsustainable energy practices that waste money, cause air pollution, and ultimately contribute to climate change.²⁰⁸

First, governments design and manage public assets and operations, such as buildings and facilities (e.g., power plants, water supply and treatment facilities, recreational facilities, street lighting), which directly consume large quantities of fuel and electricity. For instance, they either own or control gas and electricity utilities and district power operations, or they purchase power from private

²⁰⁷ Medina, Martin. 2005. Waste Picker Cooperatives in Developing Countries. Paper prepared for WIEGO/Cornell/SEWA Conference on Membership-based Organizations of the Poor, Ahmedabad, India. January.

²⁰⁸ Yienger, James, Lizbeth Brown, and Nancy Skinner. 2002. Experiences of ICLEI's Cities for Climate Protection Campaign (CCP): A focus on Asia. Proceedings of IGES/APN Mega-City Project. Kitakyushu Japan. 23–25 January.

utilities; thus, they have the opportunity to influence the efficiency of power production and the source of fuel used. Following are some examples from around the region.²⁰⁹

- Puerto Princesa, Philippines, incorporated energy savings features into a socialized housing project called the Green Homes Project. With a goal of 1,000 units, the project will save 1.9 pesos (P) million per year (about \$50,000) and reduce carbon dioxide emissions by 167 tons per year. Puerto Princesa has also implemented EE projects in public buildings, urban greening projects, traffic management, and bicycles for police officers.
- Bhopal, India, reduced energy bills for water pumping by replacing pump sets and installing capacitors at eight major pumping stations and at 400 small pumping units. The city implemented a corresponding maintenance program to reduce leaks and friction. Bhopal also removed redundant fittings in high-mast lighting at intersections, installed daylight sensors to automate streetlight operations, and halved the wattage of street lighting in residential colonies.
- Ahmedabad, India, created a special Energy Cell, with assistance from the Alliance to Save Energy, devoted to preparing proposals for EE. So far, the city has upgraded its water pumping operations by replacing piping, reducing water loss and friction, and improved power quality of motors. These upgrades saved the city 4.4 million rupees (Rs) (over \$90,000) and decreased peak demand for energy by 11%.
- Cebu, Philippines converted 700 mercury vapor lamps to high-pressure sodium resulting in a carbon dioxide reduction of 150 tons per year, an annual cost savings of P1.17 million (about \$28,000), and energy savings of 672 kWh. Cebu also initiated waste minimization strategies, vehicle efficiency and maintenance clinics, partnerships with industries, and EE in city building programs.

Box 6.5: Energy Code in Hong Kong, China

Building energy codes have been upgraded in a number of Asian cities and countries recently. In Hong Kong, China, for instance, lawmakers passed in 2003 a performance-based building energy code using a total energy budget approach. The Government developed a software tool for assessing the environmental impact, energy use, and cost implication of building development and, in doing so, integrated life-cycle analysis and costing into decision making for commercial building development. Because commercial buildings are responsible for a third of the city's total energy end-use, such a program has the potential to save a significant amount of energy.

Source: Asia Pacific Economic Cooperation (APEC). 2005. December. *APEC Energy Overview*. Tokyo: Asia Pacific Energy Research Centre, Institute of Energy Economics..

Local governments also often frequently have regulatory influence or responsibility for building codes, which can include EE standards and recommended technologies (Box 6.5). Such technologies may include cogeneration²¹⁰ and tri-generation²¹¹ for building applications, district heating and cooling systems, ground heat pump systems, energy efficient lighting and windows, energy management controls, and variable speed-drive motor systems for fans and pumps.

Importantly, local governments also control local land-use policies, which determine where buildings and development are located and the mix of uses that are allowed. Zoning, permits, and municipal by-laws affect energy use by affecting residential and commercial density, residential access and proximity to services, transit accessibility, and other factors.

In the transportation sector, local governments make or influence infrastructure decisions and investments, such as roads and transportation or transit systems. In so doing, they influence travel mode choices, a significant determinant of transportation energy use. Local planners should consider the relative resource efficiency of highway versus rail-based transportation systems. For each option, the costs of total urban and rural land

²⁰⁹ Ibid.

²¹⁰ A process in which an industrial facility uses its waste energy to produce heat or electricity.

²¹¹ Includes energy for cooling systems in addition to electricity and heat.

Box 6.6: Integrated Transportation Planning

Creating short-term strategies is useful for increasing the energy efficiency and lowering the greenhouse gas emissions of road vehicles. However, long-term transportation planning requires a holistic approach emphasizing intermodal, rail-based transit systems and not following the errors of western transportation planning. Rail-based transport is far more efficient and cost effective than road transport. Consider the following:

- Efficiency of total resource use per kilometer traveled (for both people, and materials and products) is roughly 7–12 times greater for rail-based systems than for road systems.
- Highway construction costs are almost six times the costs of rail construction, with a similarly greater demand on material and energy resources.
- Highway transport requires approximately three times the land that rail-based systems use. The total land required for the auto and truck infrastructure in cities and towns makes rails even more cost effective in terms of land use.
- Up to one fourth of urban and suburban land in the United States is devoted to vehicle transport. This includes freeways, streets, alleys, home garages, body shops, gas stations, parking garages (lanes, lots), car dealers lots, and wrecking yards.
- The cost of rail vehicles is roughly 15% that of road vehicles to move the same number of people.
- In terms of the energy demand for operation, highway transport uses over five times as much energy as rail systems.

A highly resource-efficient transportation service would, therefore, be rail-based and link other modes of transportation into a seamless system. Information systems would enable travelers to schedule and pay for entire trips, perhaps being picked up at home by a van, transferred to a rail or light-rail station, and at the other end, move to different destinations via a rental car. Travel time could be used effectively and the total budget would be less than half the cost of owning a personal vehicle.

An integrated transportation system would dramatically reduce fuel use, emissions, and resource use. One railway passenger car worth \$2 million lasts 20 years, and replaces the miles traveled by 6,000 automobiles worth \$90 million. Far less urban and rural land would be consumed by the system and existing pavement could be removed in many areas. The technologies are fully available now, including self-propelled passenger cars, power plants using alternative fuels or solar photovoltaics, and distributed information systems for system management and customer travel efficiency.

When a country's leadership decides to follow an integrated transportation planning approach, several basic policies will support success. In urban and rural planning, the emphasis should be on developing around rail hubs (and light transit and subway stops) and place barriers to prevent sprawl development. Land-use plans should make movement by public transit quicker and easier than by highway. New roads should be built primarily to provide intermodal links. Policy makers should end subsidies for road-based transportation and develop and provide research funding needed for the integration of already proven component technologies. They also need to determine the appropriate balance between public and private ownership and management of the different elements of the system.

Singapore offers a useful model for other Asian countries; it has adopted an integrated and comprehensive approach, demonstrating the benefits of a long-term commitment to reducing the need for personal motorized transport. In September 2005, the People's Republic of China State Council Office issued nationwide "suggestions on giving the highest priority to urban public transportation development" that assigns top priority to developing urban public transportation as an important measure to increase energy efficiency in the transport sector and alleviate congestion. These guidelines directly promote the development of multimode intelligent public transportation systems, with priority treatment being given to public transport over private vehicles.

Source: Lowe, E. 2006-7. Interviews with Christopher Swan, CEO of SunTrain, a California transportation planning company. San Francisco.



Source: AFP.

use, projected energy costs, construction and maintenance of infrastructure, and manufacture of the vehicles themselves should be considered. As suggested by the approach advocated in Box 6.6, master planning should integrate the skills and knowledge of urban planners with experts in environmental management, diversified energy systems, economic development, and community development.

Local governments also set parking policies, vehicle registration fees and quotas, and enforce age restrictions on vehicles. For example, Singapore has instituted mechanisms to control the movement of vehicles, thus reducing the need for personal motorized transport, along with energy use. These mechanisms include a high initial registration cost (about 150% of the vehicle's market value); an annual road tax that increases with engine capacity, along with a surcharge for older vehicles; and electronic, automatic road tolls. The city-state also has a vehicle quota system, which uses an open bidding process for certificates of entitlement to own a vehicle.²¹²

Local Approaches to Improve Water Efficiency

While there is certainly a continued need for large-scale, capital-intensive projects where feasible and

²¹² Lowe, Ernest. 2006–7. Interviews with Christopher Swan, CEO of SunTrain, a California transportation planning company. San Francisco.

appropriate, some of the most promising responses to water scarcity are being mounted in households, farmers' fields, villages, and city neighborhoods across the developing world. Such locally-based approaches, whether small or large scale, have been found to be more efficient, more effective, more equitable, and more environmentally sustainable than top-down practices. Local management also elicits local commitment and promotes stronger local institutions, thus contributing to the sustainable management of entire watersheds.²¹³

If local efforts are to expand, local authorities need to operate within a national framework that includes water codes, laws, and regulations, including sound water pricing. Because agriculture is a major consumer of water resources in most countries, much local effort should be focused on developing more sustainable agricultural water management systems. This, of course, links to land-use policy and planning due to the increasing competition between sectors for both resources (page 86). Local strategies also work best when complemented by national and international programs of resource management and conservation, as well as by scientific research and extension programs to develop and popularize ways to increase water efficiency.

Successful projects are determined by a mix of social, economic, and political factors, as well as by choices in technology and science-based analysis.²¹⁴ For instance, skilled management of subsurface water requires not only a detailed understanding of hydrogeology, geochemistry, and similar scientific disciplines, but also institutionalizing ways to prevent overpumping and competitive drilling, and promoting the sharing of the resource. It is also important to consider that investment costs should never outweigh the benefits obtained. For example, reducing leakage is only cost effective up to a certain point.²¹⁵

As discussed in Chapter 4, it is important for national governments to promote planning of water resources at the scale of watersheds. Regional planning

²¹³ Brooks, David. 2002. *Water: Local-level Management*. Ottawa: International Development Research Centre. Available: http://www.idrc.ca/water/ev-9440-201-1-DO_TOPIC.html

²¹⁴ Ibid.

²¹⁵ Global Water Partnership. 2004. *Current Status of National Efforts to Move Toward Sustainable Water Management Using an IWRM Approach*. Project funded by the Norwegian Ministry of Environment. April.

groups organized around watersheds offer a broader scope for integrated water resource planning. In the context of integrated water resources management, there are a number of methods for improving water efficiency on the local or regional levels.

For instance, farmers have long practiced conjunctive water use—the management of surface and groundwater together—but research in the past decade has delivered valuable new knowledge and techniques for improving this old approach. Improvements have been made in areas where canal systems are supported by good quality aquifers. In Uttar Pradesh, for instance, the irrigation agency turned a large unlined irrigation scheme into a massive groundwater recharge scheme. As a result, dangerously declining groundwater levels were reversed. Farmers now have enough water for two cropping seasons and yields and incomes have both increased.²¹⁶ Conjunctive water management can also involve controlling groundwater demand through pricing mechanisms, which some Asian cities have done to control overuse of groundwater by industry.

Other methods are used to improve conveyance efficiency—the proportion of the water delivered into the system that actually reaches end users. This often takes the form of reducing losses as a result of leaks and evaporation, include lining irrigation canals and fixing leaks in urban water supply systems through

regular maintenance programs, thereby decreasing nonrevenue water.

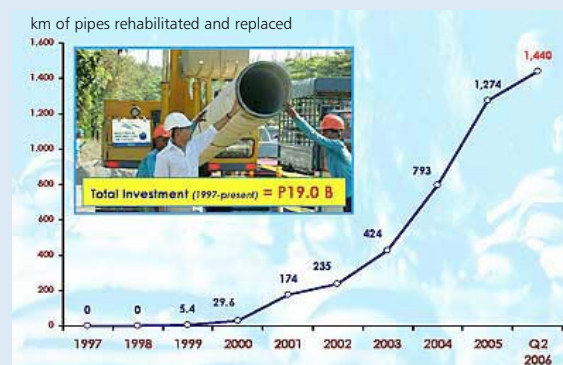
The effective management of nonrevenue water (NRW) is crucial to improving the efficiency of water use in urban areas. Less water losses meant more water supplied to more people. It is often said that there is no point in reducing NRW below about 20% of production, because the costs outweigh the benefits. Some cities in developed countries seem to disprove this idea. Singapore and some cities in Japan have reduced NRW to less than 10% of production.²¹⁷

The case of Manila Water highlights how NRW can be drastically reduced through a concerted effort. When Manila Water took over the operations of the state-owned Metropolitan Waterworks and Sewerage System in Metro Manila's East Zone in 1997, the water network system was poorly managed and very inefficient. The network had deteriorated lines, illegal connections were widespread, and NRW was at a high 63%.²¹⁸ Part of their multipronged NRW reduction strategy involved a massive pipe replacement program. Since 1997, Manila Water has invested a total of P19 billion (about \$450 million) to rehabilitate and replace over 1,440 kilometers of old and leaking pipes (Figure 6.1).²¹⁹ Manila Water also made crucial adjustments in its organization through an innovative NRW reduction program (Box 6.7).

Appropriate irrigation technologies and agronomic practices can also be used to improve application efficiency to ensure that a greater proportion of the water that is diverted from surface sources or pumped from the subsurface is actually used by the crop. In irrigation systems, this often involves giving the user more control over when and how much water is applied to fields, which often leads to huge gains in yield and saves water for other uses.

Some options are possible only through advances in technology, such as highly-responsive surface-irrigation systems, but often simple solutions based on local knowledge are more effective than large-scale and capital-intensive schemes. One practice that

Figure 6.2: Investment of Manila Water in Water Supply Infrastructure



B = billion, km = kilometer, P = Philippine peso, Q2 = second quarter.
Source: Manila Water Supply.

²¹⁶ Ibid.

²¹⁷ McIntosh, Arthur. 2003. *Asian Water Supplies, Reaching the Urban Poor: A Guide and Sourcebook on Urban Water Supplies in Asia for Governments, Utilities, Consultants, Development Agencies, and Nongovernment Organizations*. Manila: ADB and International Water Association.

²¹⁸ <http://www.adb.org/water/actions/phi/Manila-Water-Reducing-NRW.asp>

²¹⁹ Ibid.

Box 6.7: Manila Water's Nonrevenue Water Reduction Strategy

To address nonrevenue water (NRW) and other problems, Manila Water introduced the "Territory Management" concept, which divided the East Zone into 148 demand monitoring zones (DMZs) based on hydraulic boundaries. This approach led to the appointment of territory business managers (TBMs), whose task is to monitor the demand, supply, and variations between the inflow and outflow of water in each DMZ. To facilitate easier management, DMZs were further subdivided into District Metering Areas (DMAs), each handled by a district officer. To date, Manila Water has formed and commissioned 931 DMAs over the East Zone.

Empowered to make important decisions, TBMs and district officers have taken accountability and ownership of their respective DMZs and DMAs. Many underwent intensive trainings and workshops. From being field assistants, customer service support agents, and meter readers, they have now become experts in water supply management and NRW reduction, working closely with communities. Community leaders and representatives count on TBMs and district officers whenever they have water problems. Eventually, customers themselves were policing their own neighborhood, reporting illegal connections or tampered water meters to Manila Water.

In 2004, the concept of "Zero NRW DMAs" was introduced. A zero NRW DMA means that the DMA registers very minimal water losses. Major pipe-laying and pipe-replacement activities were done in priority DMAs. Furthermore, isolation and control valves were installed to make the areas easier to manage and monitor. Manila Water currently has 507 zero NRW DMAs, and the company is doing its best so that its NRW level reaches that of the more efficient cities in Asia.^a

In addition, Manila Water's flagship program for the urban poor, *Tubig Para Sa Barangay* (TPSB) or Water for the Community, has proven to be an effective way of diminishing the high rates of illegal connections in depressed communities and informal settlements. As of June this year, Manila Water has completed over 500 TPSB projects all over the East Zone, serving a total of 900,000 poor people, and further reducing NRW.

As a result of these strategies, Manila Water was able to reduce NRW from 63% in 1997 to 29.9% in 2006. Water recovered from previous leaks and system inefficiencies was translated to water delivered to more customers. The billed volume of water has gone up to 938 million liters per day—more than twice the 1997 figure.

Manila Water has expanded its customer base to 803,000 households from 325,000 in 1997. Of this number, 148,000 households are from the low-income sector. With an average annual budget target of P5 billion (about \$120 million) for major capital programs and NRW reduction, Manila Water will continue to look for new and appropriate technology and approaches to strengthen its operations.

^a www.adb.org/water/actions/phi/Manila-Water-Reducing-NRW.asp

Source: McIntosh, Arthur. 2003. *Asian Water Supplies, Reaching the Urban Poor: A Guide and Sourcebook on Urban Water Supplies in Asia for Governments, Utilities, Consultants, Development Agencies, and Nongovernment Organizations*. Manila: Asian Development Bank and International Water Association.

Box 6.8: Drip Irrigation in Nepal

Low-cost drip irrigation in Nepal has been in place since 1995. Developed and tested by the International Development Enterprises (IDE), an international nongovernment organization, the system was promoted to small and marginal farmers in the hill districts of Nepal where irrigation water is scarce and inadequate for traditional surface irrigation. Before the adoption of drip irrigation, farmers practiced mixed farming (i.e., cereal crops and livestock raising) for subsistence and the yield from food crops was barely enough for family consumption. With the adoption of drip irrigation, most farmers have switched to high-value cash crops and most now produce surplus vegetables and fruits for family consumption and sale in the local markets and beyond. In the past 10 years the system has spread to 32 hill districts.



Source: ADB.

Source: Alipalo, Melissa Howell. 2006. Drip Irrigation Kits are Providing Women and Disadvantaged Farmers in Nepal with New Livelihood Opportunities. *ADB Review*. April-May. Available: http://www.adb.org/Documents/Periodicals/ADB_Review/2006/vol38-1/big-change.asp

Box 6.9: Rainwater Harvesting

Despite numerous challenges in implementing large schemes, projects in the region have confirmed the great potential of rooftop water collection. For instance, in the Philippines and Thailand both government and household-based initiatives have played key roles in expanding the use of rainwater harvesting, especially in water-scarce areas such as Northeast Thailand. The initial per unit cost of rainwater storage tanks in Northeast Thailand is estimated to be about \$1 per liter, and each tank can last for more than 10 years. The reported operation and maintenance costs are negligible.

The technical challenges of rooftop water harvesting involve collecting and storing water in a clean and cost-effective manner, problems experienced even where the practice is an established tradition. The capital cost of harvesting systems varies with the type of catchment, conveyance, and storage tank materials used. The feasibility of rainwater harvesting in a particular locality is highly dependent on the amount and intensity of rainfall. It has been found that water harvesting is most likely to be economical where rainfall averages 100–500 millimeters per year. With less or more rain, costs exceed benefits. It is also a function of the quantity and quality of water available from other sources, household size, per capita water requirements, and budget available.

The decision maker has to balance the total cost of the project against the available budget, including the economic benefit of conserving water supplied from other sources. The cost of physical and environmental degradation associated with the development of available alternative sources should also be calculated and added to the economic analysis.

To address the problem of the cost of storage tanks being beyond the means of most households in developing countries, two policy options are possible. A subsidy or alternative pricing scheme can be offered, or the system can be scaled-up to serve several families or a city block, thereby producing economies of scale and cutting unit costs. This second option requires some system of fair distribution and ongoing maintenance.

Sources: Global Development Research Center. *An Introduction to Rainwater Harvesting*. Available: <http://www.gdrc.org/uem/water/rainwater/introduction.html>. Akash Ganga. Available: http://www.raincentre.org/Brooks, David. 2002. Water: Local-level Management. International Development Research Centre. Available: http://www.idrc.ca/water/ev-9440-201-1-DO_TOPIC.html

holds promise for the region is drip irrigation, a high-frequency low-volume water application procedure (Box 6.8). Available reports record increased water use efficiency estimated at around 90%, compared to 20–30% efficiency under surface (flood) irrigation.²²⁰

While improving the efficiency of irrigation systems gets more attention, making more efficient use of the estimated 16,000 cubic kilometers (km³) of water used in rainfed agriculture (in comparison, some 2,500 km³ of water are diverted annually for irrigation around the world.) can help reduce the need for new irrigation infrastructure in the first place. One method is field water harvesting, which involves diverting and gathering scarce rainwater for household gardens, watering stock, and even for drinking. It has been practiced for thousands of years in semi-arid areas and has tended to work best where there is not enough rain to support

agriculture without intervention but enough rain to produce crops.

However, traditional methods of harvesting field water have fallen into disuse or failed to match new and growing demands. Research funded by the International Development Research Centre has demonstrated that combining old water-harvesting strategies with new methods can be made to work at scales measured in the hundreds of hectares. However, outcomes also indicate that smaller and less complicated approaches are more likely to be adopted and put to lasting use than grand designs of integrated resource management.²²¹

Another method that can be implemented at the local level is rooftop water harvesting. Rainwater harvesting has been practiced for centuries and is most common in arid and semi-arid zones, although it is also practiced in monsoon climates and on islands where freshwater is never plentiful (Box 6.9).

²²⁰ Dr. Shrestha, Rajendra B. 2004, May. *Promoting Effective Water Management Policies and Practices: Gender Equality for Poverty Reduction through Improved Irrigation Management*. Manila: ADB. Available: <http://www.adb.org/Water/PDA/nep/Final-Report-NEP-200302.pdf>

²²¹ Brooks, David. 2002. *Water: Local-level Management*. Ottawa: International Development Research Centre. Available: http://www.idrc.ca/water/ev-9440-201-1-DO_TOPIC.html