



WHO

REGIONAL OFFICE FOR EUROPE

SCHERFIGSVEJ 8
DK-2100 COPENHAGEN Ø
DENMARK
TEL.: +45 39 17 17 17
TELEFAX: +45 39 17 18 18
TELEX: 12000
E-MAIL: POSTMASTER@WHO.DK
WEB SITE: [HTTP://WWW.WHO.DK](http://WWW.WHO.DK)

2 60655
EUR/ICP/ENHA 01 01 01
ENGLISH ONLY
UNEDITED
E60655

FINANCIAL AND OPERATIONAL FACTORS INFLUENCE THE PROVISION OF MUNICIPAL SOLID WASTE SERVICES IN LARGE CITIES

Report prepared by Colin Macfarlane,
WHO Consultant, and coordinated by
Philip Rushbrook, Waste
Management, WHO Nancy Project
Office, Nancy, France

TARGET 23

WASTE MANAGEMENT AND SOIL POLLUTION

By the year 2000, public health risks caused by solid and hazardous wastes and soil pollution should be effectively controlled in all Member States.

ABSTRACT

The management of urban solid waste is one of a number of essential public services provided directly or on behalf of local government. The allocated funding reflects both the need and the relative importance perceived by the public to be attached to each service. In low-income countries, the urban public is often apathetic about waste service, though, by its nature, it typically consumes a substantial proportion of urban revenues to provide even a bare minimum level of services. Local governments are loath to augment taxes to improve services for which there is little public enthusiasm. Reform can be expected to be gradual.

Comparable attitudes and conditions prevailed in the rapidly growing cities of western Europe and North America until the second half of the 19th century. A strong growth of social reform together with respected and influential leaders eventually led to political changes and the assured public support needed to pay for service improvements. However, the process was lengthy. Several decades were required to achieve a reasonably uniform, good standard of waste collection and transportation, while substantial reform of disposal languished a further 80 years. In contrast to low-income countries, the proportion of urban revenues presently consumed by waste service in high-income countries is typically relatively modest.

It seems reasonable that urban waste service expenditure is constrained by the state of prosperity. With exceptions the data suggest that large cities across a wide range of incomes are willing to spend up to 0.5% of the prevailing annual gross national product per capita. Greater expenditure is likely to meet increasing reluctance because the perceived social benefits do not warrant additional cost.

The most effective and least costly means of improving urban waste services, especially in lower-income countries, is by the appointment of trained and motivated managers employing strict cost control, and accompanied by supportive elected representatives. Substantial improvements in urban cleanliness can often be identified by the selection of more appropriate waste collection methods and transportation vehicles, a better deployment of existing cleansing staff, and better designed collection routes to save time and money.

Keywords

WASTE MANAGEMENT
REFUSE DISPOSAL
FINANCING, GOVERNMENT
CITIES
ENVIRONMENTAL HEALTH

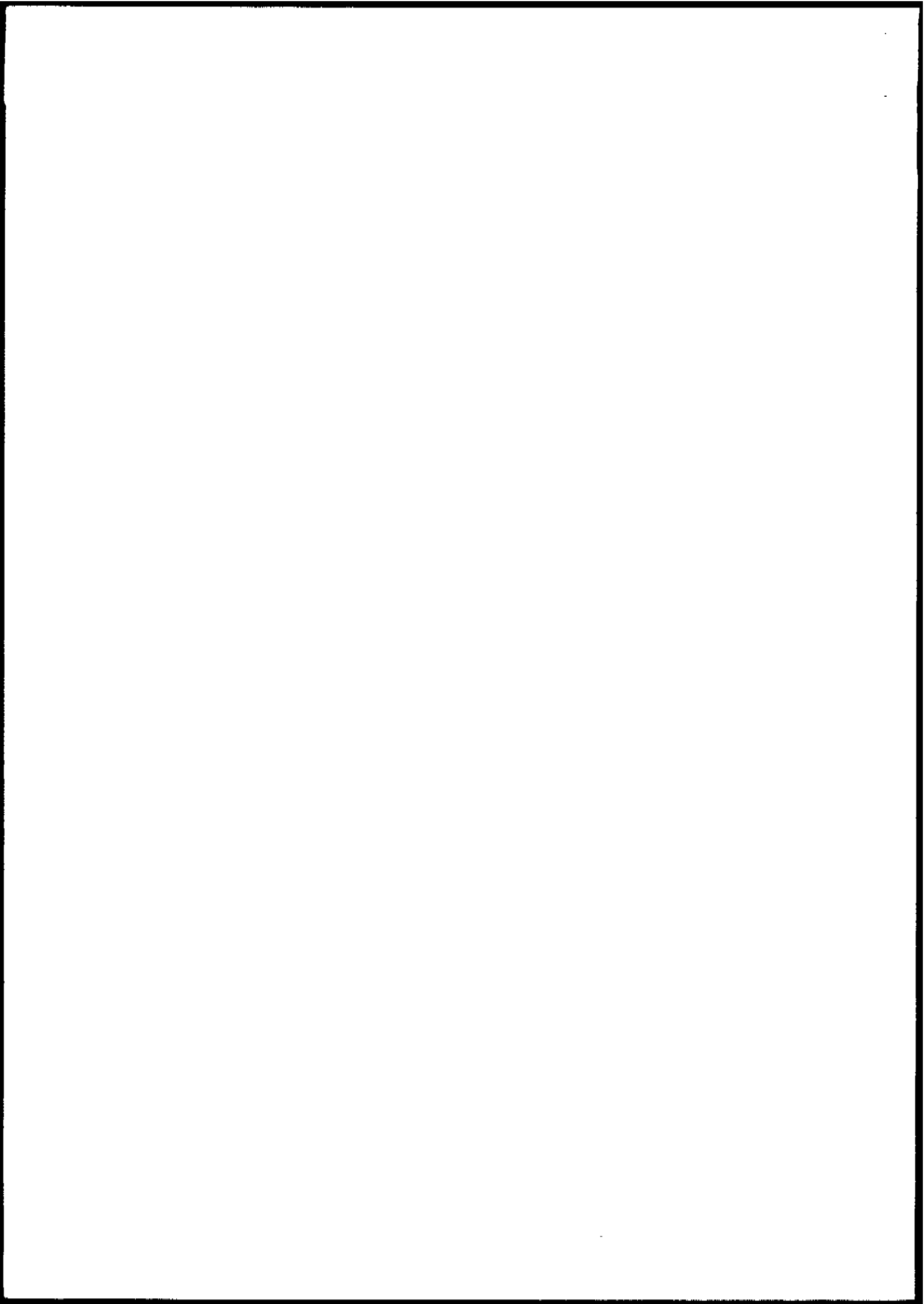
© World Health Organization

All rights in this document are reserved by the WHO Regional Office for Europe. The document may nevertheless be freely reviewed, abstracted, reproduced or translated into any other language (but not for sale or for use in conjunction with commercial purposes) provided that full acknowledgement is given to the source. For the use of the WHO emblem, permission must be sought from the WHO Regional Office. Any translation should include the words: *The translator of this document is responsible for the accuracy of the translation.* The Regional Office would appreciate receiving three copies of any translation. Any views expressed by named authors are solely the responsibility of those authors.



CONTENTS

	<i>Page</i>
Local government and public interest	1
Urban services, revenue and management	1
Historical precedents	2
Affordability and allocation of public funds	4
Management and cost control.....	7
Conclusions	9



Local government and public interest

Urban services, revenue and management

Solid waste management is one of the many essential urban services needed to sustain an orderly and healthy city life. The amount of attention and funding it receives, relative to water, roads, drainage and other basic services, depends on the judgement of each city's elected representatives and their management committees. Priorities depend on their assessment of public opinion. Local culture, history, social conditions and the state of prosperity affect the level of support provided to each service. Civic leaders can be expected to be cautious in following swings in public opinion. Because funding for urban services is characteristically scarce and fully committed in any well run city, improvements can only be made gradually to correspond with growing prosperity and resulting increased affordability.

The allocation of substantial urban resources to waste services is reasonably assured in high-income communities due both to long-established procedures and to continued public interest and willingness to pay.

In low-income countries urban waste and other services are often poor, partly due to a lack of public interest and partly to an inability to pay for high quality service. However, although the deficiencies and social consequences are serious, their effects, so far, have not been so fundamentally disruptive as to result in the collapse of orderly city life.

A glimpse of the wide disparities in financial resources between cities in high- and lower-income countries is provided in Table 1. Comparisons can be made between the prosperity of several countries (measured as the annual gross national product (GNP) per capita for selected years) and the relevant local government expenditure per capita, together with the national populations. For example, Brazil, Kenya and the USA, representing upper-middle, low- and high-income countries, respectively, have wide variations in GNP per capita. Differences in prosperity would seem likely to lead to corresponding differences in the national capability to provide local government revenue. These, in turn, affect possible expenditure and the affordability of essential urban services. Furthermore, they hint at the great difficulties facing city governments in lower-income countries in providing even basic essential services and in making any meaningful allocation of funds for each service. Clearly, the American municipal council spending, on average, US \$2054 per capita is much more likely to provide a broad range of high-quality services than its counterpart in Brazil (US \$153 per capita) or Kenya (US \$5 per capita).

Despite these disparities, the goal of urban waste management in all communities is to protect neighbourhood public health, minimize environmental damage and enhance the quality of life. In large cities in low-income countries in Asia, for example, this goal is far from achieved. Commonly it is observed that the general population is often apathetic, and there is little incentive for a municipal council to give greater priority to allocating funds to improve the waste service. The portion of the population that wants a better service is usually from wealthier neighbourhoods, where the local remedy is often a privately-funded service to supplement that provided by the general public.

Table 1. Local government expenditure, selected countries and years

Country	Year	Population (millions)	GNP per capita 1991, US \$	Local government expenditure per capita, US \$
Brazil	1991	153.3	2 940	153
Chile	1988	12.8	2 160	47
Colombia	1986	29.2	1 260	14
Iran	1989	54.2	2 170	7
Israel	1990	4.7	11 950	78
Kenya	1990	24.9	340	5
Malawi	1984	6.8	230	3
Paraguay	1989	4.2	1 270	4
South Africa	1990	35.3	2 560	120
Thailand	1992	57.8	1 570	24
USA	1991	252.7	22 240	2 054
Zimbabwe	1986	8.4	650	64

Source: Bird 1995.

Note. Data from many lower-income countries should be treated with caution due to difficulties in estimating municipal populations and to a lack of uniformity in keeping accounts.

Unfortunately, matters are usually made considerably worse by a lack of experienced waste managers and the close cost control necessary to maximize the use of the limited funds available. Problems tend to be made even more acute by inappropriate legislation, by which waste management in impoverished cities is governed by regulations devised for high-income countries. These are often applied at senior levels of national government where there is little understanding of municipal affairs.

Historical precedents

There are interesting and instructive parallels between the problems faced by the rapidly burgeoning cities of today's low-income economies and those of 19th century north America and western Europe. In both cases the pace of population growth outstripped the capacity to manage urban services. For example, in the last century, the British public was for many decades apathetic about sanitation, except briefly during occasional outbreaks of cholera or typhoid, and reluctant to pay for enhanced services. By the 1840s, conditions in Manchester had deteriorated to the point where the lifespan of members of labourers' families averaged 17 years; the corresponding lifespan in a rural area was 38 years (*Briggs, 1968*). An attempt to improve matters by the Public Health Act 1848 proved ineffective, due partly to resistance to any intrusion by central government into municipal affairs, and partly to a reluctance to increase local taxes. A more assertive Public Health Act in 1875 was required to enforce better municipal sanitation. This came at a time when public opinion was more favourably inclined towards reform, following the well publicized and widely influential social commentaries of Charles Dickens and Charles Kingsley and the work, starting in the Crimean war, of Florence Nightingale. Politically significant events like the illness due to typhoid of the Prince of Wales, the heir apparent to Queen Victoria, seem to have been more persuasive for politicians to provide public health reform than the more readily forgotten outbreaks of cholera. Even after the Public Health Act of 1875 it took a further 30 years before local authorities attained a moderately good, uniform level of sanitation in major British cities.

Briggs notes that street cleaning in Manchester in 1842 followed a pattern whereby only the more opulent parts of the city received attention and the poorest areas in greatest need were left untouched. There are similar examples of this practice in some south Asian cities today.

Wohl (1983) notes that in the Victorian Britain of the 1860s, Sir John Simon (an eminent public health reformer and physician) attributed as much as one quarter of national deaths to defective or inadequate sanitation and a failure "to make due removal of refuse matters, solid and liquid, from inhabited places". The Government of Pakistan noted in 1987 that "The statistics of Planning Committee show that 30% of the reported illnesses and 40% of deaths in the countries are attributable to waterborne diseases". It is thought that these latter data were meant to include the results of a general lack of sanitation. The report also notes that in Karachi only 33% of municipal waste was transported to disposal sites. Much of the waste in mid-Victorian British cities also languished uncollected in middens adjacent to or even under dwellings.

The history of sanitation in American cities follows a similar pattern. Public interest, particularly among women, in community cleanliness accelerated only after the Civil War (1861-1865) in which diseases of "filth" had claimed 400 000 of the 600 000 deaths amongst the combatants. This provided the necessary spark to ignite political interest, while the influence of Florence Nightingale's teachings about cleanliness did much to persuade the American public of the benefits of good sanitation.

Hoy (1995) also notes that the leadership for the cleansing of American cities was provided by respected and well known public figures, supported by influential women's groups. George Waring in New York City and Ada Sweet in Chicago transformed public interest in urban waste service in the 1890s. In both cases, this was accomplished with some flamboyance, by clothing and parading the street-sweepers in white uniforms to provide public recognition and give the workers a sense of pride. In New York City, the Metropolitan Health Bill of 1866, which was intended to provide for improved urban waste service, had clearly not been strongly enforced. Corrupt practices in private waste contracts in New York City and Chicago beset urban service until the reforms of Waring and Sweet. Noticeable in both cases is a lapse of about 30 years from the time when public attention was first aroused until the introduction in practice of reforms in waste collection and transportation.

In part, the time lag between the enactment of legislation by senior government and full compliance by municipalities is due to a reluctance to invest in new and expensive programmes until it is clear to locally elected representatives that there is sufficient popular willingness to sustain the required additional expenditure. It is also partly due to the preparation and discussion of the necessary technical and financial studies. Even in present-day cities in high-income countries, these processes can consume decades rather than years when public opinion is deeply divided and the expense is great.

Public interest in waste disposal in high-income countries has lagged more than 80 years behind reforms in waste collection and transportation. The present issues about location and technologies of disposal suggest that the subject is far from settled in both high- and lower-income economies. Long debates over the identification of new disposal sites in cities in a wide range of national economies indicate that a fully integrated urban waste management system is not always assured.

The total lapse of more than a century from the first clear stirrings of public interest in urban waste services to the present time in high-income countries suggests that a comparable change in

low-income countries, where public interest is not yet fully aroused, is not likely to be swift. Until public interest is aroused, additional public funding for improved waste service is unlikely unless accompanied by increased prosperity.

Affordability and allocation of public funds

All major cities carry out some level of waste service. A fundamental question for local governments is the allocation of expenditure that the general public feels is appropriate and in balance with other essential urban services.

The aim of a waste service is to provide enhanced neighbourhood public health and personal wellbeing, including the protection of public health. While this may have a strong appeal to citizens with an expectation of permanent residence, it is much weaker in large squatter settlements where residence is customarily temporary, squalid, unplanned and often legally unrecognized. Waste service in these latter areas can often be observed to be less than in areas of more prosperous and permanent dwellings. This has the effect of worsening an already bad situation. It tends to make squatter residents more apathetic and less likely to try a self-help service. However, the squatters are often a significant proportion of the urban population, and local governments are in a dilemma between trying to prevent serious social and health problems on the one hand, and discouraging squatting by providing minimal urban services on the other. In addition, collection crews favour affluent areas where they can expect a tip for the service. This results in noticeably greater accumulations of uncollected waste in poorer areas of many Asian cities.

Irrespective of the complexity of its problems, local government is usually obliged to provide some form of waste service and to place affordable limits on service expenditure.

In higher-income countries with an interested public, the allocation of adequate waste service funding is rarely a major political issue. This is mainly because it typically commands only a modest fraction of total urban expenditure, and its management is likely to be conducted by experienced and accountable staff. It would also be unthinkable for elected members to avoid financing an efficient and reliable service. The local electorate expects it. The major difficulty now lies in the increasingly lengthy political process of acquiring and developing new waste treatment and disposal sites. This often arouses strong emotions in communities at all levels of national income.

Many lower-income countries have sizeable numbers of citizens who are largely apathetic about the cleanliness of their urban neighbourhoods, in some cases because they are disenfranchised from the electoral process. Consequently, the sum allocated for expenditure is typically small but of critical importance because it usually consumes a substantial fraction of urban revenues.

Table 2 provides an overview and comparison of the nature of the allocation of expenditure by the public on waste services in a range of cities. The cost of a waste service is compared to the state of national prosperity (measured as GNP per capita). Where total urban expenditure per capita is available, it has been added. From this it is possible to portray the proportion of waste costs to total urban expenditure. The data should be taken as indicative only, because no two cities provide fully comparable services, and no uniform urban accountancy system has been adopted to permit reliable comparisons. However, the data permit some assessment of relative cost burdens in cities.

Table 2. Urban expenditure, total and on waste, selected cities and years

City	Year	Annual expenditure		GNP US \$ per capita	% GNP spent on waste
		Total urban expenditure US \$ per capita	Solid waste US \$ per capita		
Accra ¹	1994	2.76	0.66	390	0.17
Ahmedabad ²	1995	24.27	1.61	350	0.46
Bogota ³	1994		7.75	1 620	0.48
Bombay ²	1995	63.65	3.92	350	1.12
Bucharest ⁴	1995	94.75	2.37	1 450	0.16
Budapest ⁵	1995	310	13.80	4 130	0.33
Buenos Aires ⁶	1989		10.15	2 160	0.47
Caracas ⁶	1989		6.67	2 450	0.27
Dhaka ⁷	1995	8.31	1.46	270	0.54
Hanoi ⁸	1994		2.00	250	0.80
Jakarta ⁹	1993	82.75	2.50	740	0.34
Kuala Lumpur ¹⁰	1994		15.25	4 000	0.38
Lahore ¹¹	1985	9.70	1.77	390	0.45
London ¹²	1991		46	16 550	0.28
Madras ¹³	1995	14.75	1.77	350	0.51
Moroccan cities ¹⁴	1990		1.12-2.03	950	0.12-0.21
New York ¹⁵	1992	5804	97	23 240	0.42
Riga ⁵	1995	153	6.00	2 420	0.25
São Paulo ⁶	1989		13.32	2 540	0.52
Strasbourg ¹⁶	1995	1600	63	24 990	0.25
Surabaya ¹⁷	1993		3.90	740	0.53
Sydney ¹⁸	1995		38	18 720	0.20
Tallinn ⁵	1995		8.11	3 080	0.26
Tokyo ¹⁹	1987	3010	100	15 840	0.63
Toronto ²⁰	1994	2043	48	19 510	0.25

Sources:

- ¹ World Bank, Washington, D.C., 1997.
- ² Mazumdar, N.B. Municipal waste management: the Indian perspective. *Energy environment monitor*, 12(2): 57-69 (1996).
- ³ Canrede Inc., Resource Development Engineers and Planners, Whitby, Canada, 1996.
- ⁴ EX Corporation and Yachiyo Engineering Co. Ltd., for Japan International Cooperation Agency (JICA). *The study on the solid waste management system for Bucharest Municipality in Romania - Final report*. Bucharest, Ministry of Public Works and Regional Planning, 1995.
- ⁵ Canadian Urban Institute, Toronto, 1999.
- ⁶ Bartone, C.R. et al. Private sector participation in municipal solid waste service: experience in Latin America. *Waste management and research*, 9(6) (1991).
- ⁷ Preliminary data provided by World Bank, Washington, D.C., 1998.
- ⁸ Solid waste management in Hanoi, Vietnam. *Warner bulletin*, 44 (1995).
- ⁹ Compiled from: (i) Porter, R.C. *The economics of water and waste: a case study of Jakarta, Indonesia*. Aldershot, Avebury, 1996; (ii) World Bank. *Private sector participation in solid waste management, Indonesia, 1995*; and (iii) PT Kartika Pradiptaprisma. *Promotion of waste recycling and reuse in developing countries, Jakarta Metropolitan City, Final report, April 1992*. Bandung, 1992.
- ¹⁰ Hassan, M.N. & Rahman, R.A. Solid waste management in Malaysia: existing situation, issues and problems. *Waste management and research* (accepted for publication), 1998.
- ¹¹ Lahore Municipal Corporation, Lahore, Pakistan, 1988.
- ¹² Greater London Council, London, United Kingdom, 1993.
- ¹³ World Bank, Washington, D.C., 1997.
- ¹⁴ Said, N. *Management of solid waste in Morocco*. University of Mohammed V, Ecole Supérieure de Technologie, Sale, Morocco, 1993.
- ¹⁵ U.S. Department of Commerce, U.S. Bureau of the Census. *City government finances, 1991-1992*. Washington, D.C., 1994.
- ¹⁶ WHO European Centre for Environment and Health, Nancy, 1997.
- ¹⁷ World Bank. *Private sector participation in solid waste management, Indonesia, 1995*.
- ¹⁸ Beverage Industry Environment Council. *Domestic waste management in Sydney: costs and efficiencies*. Sydney, 1997 (research project).
- ¹⁹ Tokyo Municipal Corporation. *The fiscal outlook for the Metropolis of Tokyo, 1989*. Tokyo, 1990.
- ²⁰ Ontario Ministry of Municipal Affairs. *Municipal financial information, 1994*. Toronto, Queen's Printer for Ontario, 1996.

To illustrate the contrasts, consider the examples of New York City and Madras. In 1992, New York City with an estimated population of 7.32 million had total local government expenditure of US \$5804 per capita, and a waste management expenditure of US \$97 per capita (or about 1.7% of the city's total expenditure). Related to the prevailing scale of national prosperity, the city's public expenditure on waste was 0.42% of GNP per capita.

In 1995, Madras, with an estimated population of about 4.1 million, had a total local government expenditure of US \$14.75 per capita, and a waste management expenditure of US \$1.77 per capita (or 12% of the city's total expenditure). Related to the prevailing state of national prosperity, the city's public expenditure on waste was 0.51% of GNP per capita.

Most striking are the large differences between the expenditure, both total and on waste services, by the two cities. This can only result in large differences in the range of services available and in the scale of each service provided. The contrast becomes even more significant when it is observed that a major cost of urban waste management in lower-income countries stems from motorized collection and disposal vehicles and equipment, whose capital, spare parts and fuel costs are more or less uniform throughout the world. The wide disparity in available service funding strongly emphasizes the need for good management and strict cost control of every step in urban waste management systems in lower-income countries. Unfortunately, in many larger cities, at least in Asia, the necessary quality of management and cost control required to mitigate the effect of inadequate funding are not evident.

Another feature of the data presented in Table 2 is the relationship between public expenditure on waste services in large cities and the state of national prosperity. With a few exceptions, it can be observed that public expenditure does not exceed 0.5% of the prevailing annual GNP per capita. In the more opulent cities, it is often considerably less.

The most glaring exception is Bombay, where waste service expenditure in 1995 was 1.12% of GNP per capita. The anomaly becomes more striking when it is compared with other Indian cities such as Madras (0.51% of GNP per capita in 1995) and Ahmedabad (0.46% of GNP per capita in 1995). Part of the explanation may stem from the unusual relative wealth of Bombay, as evidenced in the high total urban expenditure per capita. The other two exceptions, Tokyo (0.63% of GNP per capita) and Hanoi (0.80% of GNP per capita) are believed to include the collection of human body waste (night soil) from privies in the reported service expenditure on municipal waste. Furthermore, several cities in Asia (e.g. Dhaka) collect all wastes deposited in community receptacles including wastes from commercial establishments such as markets. The cost of this service and this type of waste is not accounted for within the normal definition of municipal waste. In most high-income countries, commerce and industry are now expected to arrange and pay for their own waste service to avoid burdening the funds available for municipal cleansing.

While there are clearly exceptions arising from local practices, the data in Table 2 suggest that most large cities do not spend more than 0.5% of the prevailing annual GNP per capita on municipal waste services. Expenditure beyond this level would appear to encounter increasing reluctance on the part of local government, due to an apprehension that greater allocation of funds may not be matched by commensurately greater public satisfaction.

Therefore, for planning and budgetary purposes, it would appear reasonable to use the value of 0.5% of prevailing annual GNP per capita as a guide to affordable expenditure on large city waste services. It can then provide a base for selection of the equipment, management and

human resources required to collect, transport and dispose of municipal waste. Proper selection and management of the most cost-effective waste service system that can be afforded appears to be the most prudent and satisfying course of action open to any local government.

In practice, this means that larger cities in lower-income countries where the GNP per capita is, for example, US \$500 should be reasonably expected to spend as much as US \$2.50 per capita of public funds on a municipal waste service. In a high-income country with a GNP per capita of, say, US \$20 000, a large city may spend as much as US \$100 per capita before the citizens and the local government are likely to question the benefit of greater expenditure. Reluctance is most probable if higher service costs require increased taxes or the curbing of other essential urban services, unless improvements can be introduced gradually and reflect a general growth of prosperity in a city.

Management and cost control

In low-income countries, when the GNP per capita is less than about US \$1000, municipal waste services, as well as other essential services, are likely to suffer substantial inadequacies. The issue for local governments is to strive for the best balance of public satisfaction that an affordable level of service expenditure can achieve. The cheapest means of progressing towards this goal is by applying good management of human, physical and financial resources. Experience continues to show that advanced mechanical equipment is no substitute for leadership and management.

Middle-income countries acquire some of the good practices of waste collection, but most lag behind in the disposal of wastes. However, this order of priorities is correct, because the squalor and health hazards caused by uncollected municipal wastes almost always outweigh those posed by disposal sites. Exceptions may occur where disposal sites endanger nearby homes due to catastrophic slope-stability failure, fire or explosion, but the hazards of any resulting water contamination are usually modest compared with those caused by a lack of adequate urban sewage management that prevails in most middle- and low-income countries.

For lower-income countries the greatest priority in waste management should be placed on waste collection and transportation where the major part of waste service expenditure is normally allocated. This is sometimes difficult. There are many cities in which the waste service labour force is heavily protected by hereditary right, strong unions, prescriptive laws or political appointments. Attempts to introduce change are likely to be strongly resisted unless there are offsetting benefits. The number of employees is often substantial. For example, Dhaka in Bangladesh, with an estimated population of 4.7 million in 1995, has 3000 permanent and 2000 temporary sweepers and cleaners. Salaries, benefits and administrative costs are approximately US \$25 per worker per month. Meanwhile, Bombay, India, with an estimated population of 9.9 million in 1991, is believed to have 33 000 municipal waste service workers, and salaries, benefits and administrative costs exceed US \$100 per worker per month (*Coad, 1997*). Despite the disparities in relative sizes in workforces and expenditure, both cities have substantial problems of squalor caused by uncollected waste. However, while it is often unclear what measurable public benefit derives from tasks such as street-sweeping without adequate waste transportation, the re-allocation of staff to more productive waste service tasks is likely to be strenuously resisted unless security of employment is assured. Faster improvements in cost-effectiveness are better sought in the employment of motorized vehicles and equipment.

Cointreau (1982) and Scheu and Coad (1992) have illustrated the substantial differences in cost-efficiency available through the selection of waste collection vehicles and systems. The relatively slow progress of expensive motorized vehicles and crews collecting waste from house to house in cities of high-income countries is a luxury of convenience that only affluence permits. It has no place in primary waste collection in low-income countries.

Carts drawn by hand or bicycle are more likely to be cost-effective. When coupled with well designed local transfer stations equipped with motorized or animal-drawn vehicles selected to transport wastes to disposal sites with minimal delay and cost, the use of simple carts in primary collection is likely to be both cost-effective and socially beneficial.

While it is impossible to identify the most cost-effective and socially beneficial waste service system for a city without lengthy analysis, some of the important underlying principles can be illustrated by a simple example.

Example: A city of four million inhabitants in a country with a GNP of US \$400 per capita has a total annual local government expenditure of US \$10 per capita. It employs 5000 sweepers and cleaners in its waste service with an annual average cost of US \$450 per capita for wages, benefits and administration. Municipal waste generation rate is 0.5 kg per person per day. Waste is disposed of in sites averaging 20 km from collection areas. About 10% of discarded waste is recuperated. Disposal costs are estimated to be about US \$2.25 per tonne.

As a first step towards improving the municipal waste service, the mayor wants to improve city cleansing after a period of public education by the enhanced removal of waste to existing disposal sites at an affordable cost. He wants to compare the cleansing efficiency of roll-on collection trucks, each servicing four skips placed in neighbourhoods, with the present system of six-cubic-metre pick-up trucks that stop at fixed community bins while the contents are shovelled by hand into containers on the trucks. Transport costs per tonne of waste are shown in Table 3.

- a) Affordable annual expenditure on waste service = 0.5% of GNP per capita
 = US \$0.005 x 400 per capita
 = US \$2.00 per capita
- b) Expenditure on waste service = Fixed labour cost + transportation cost + disposal cost
- c) Fixed annual labour cost, per capita = $\frac{\text{US } \$5\,000 \times 450}{4\,000\,000}$
 = US \$0.56
- d) Average annual waste production, per capita = 0.5×365 kg
 = 0.183 tonne/year

- e) Cleansing efficiency of affordable service level, existing system.

See Column 2, Table 3 at 20 km to disposal site, 6 m³ trucks

$$\text{US } \$2.00 = \text{US } \$\{0.56 + \text{efficiency} \times 0.183 [21.41 + 0.9 \times 2.25]\}$$

Present cleansing efficiency = 0.34. That is, under present waste management, it is likely that the city can afford to remove only 34% of its waste to disposal sites.

- f) Cleansing efficiency of affordable service level using an alternative roll-on system of vehicles and demountable skips.

See Column 3, Table 3 at 20 km to disposal site, truck and 4 skips

$$\text{US } \$2.00 = \text{US } \$\{0.56 + \text{efficiency} \times 0.183 [8.36 + 0.9 \times 2.25]\}$$

Alternative cleansing efficiency = 0.76. That is, under an alternative waste management system employing roll-on skips, it is likely that the city can afford to remove 76% of its waste to disposal sites.

Table 3. Representative costs of transportation of municipal wastes, low-income countries

Col. 1	Col. 2	Col. 3
Distance to disposal site, km	Cost per tonne of municipal waste transported to disposal sites (discounted at 5%), US \$	
	Pick-up truck, 6 m ³ capacity Capital cost = US \$39 000	Roll-on truck and four 20 m ³ skips Capital cost = US \$182 000
0	19.08	3.12
5	19.66	4.43
10	20.24	5.74
15	20.83	6.22
20	21.41	8.36
25	22.00	8.34
30	22.58	9.83
	Collect and transport mode	Collect and transport mode
	Waste manually shovelled from stationary community receptacles. 2 shifts, 1 load per shift	Waste discarded into community skips, which are rolled on to truck. 2 shifts, 2 skips per shift

Source: PLANCO Consulting GmbH, 1995 (average incremental cost analyses presented in Annex 2.2.3, Table 2).
Note. The analyses were conducted for conditions prevailing in cities in low-income countries.

The foregoing example illustrates the substantial difference that can be made in improving the cleanliness of cities by a better choice of waste transportation. It is likely that improvements can be further enhanced by refinements in vehicle selection, better deployment of labour in primary waste collection, and close control of vehicle movement and labour productivity. However, none of these will happen until both a good cost control system is available to waste managers, and waste managers are given the public and professional esteem that their substantial budgets warrant. Unfortunately, the growth of professionalism and managerial quality that has been evident in Europe and north America since the end of the Second World War is usually far from evident in low-income countries where the need is greatest. However, there are encouraging signs of improvements in middle-income countries, such as some of the European Union accession countries (e.g. Czech Republic, Hungary, Poland), Malaysia and Turkey, although much remains to be done.

Conclusions

Reform of waste services in large cities has typically resulted from events that have sufficiently and fundamentally stirred the public conscience, and aroused the political will to pay for remedial action.

In many lower-income countries interest in urban waste service reforms remains modest. It is, therefore, unlikely that local government will either quickly improve services or allocate additional resources. The rate of improvement is constrained by small urban revenues and judgements as to its most satisfying allocation to essential services, each competing for the best portion obtainable. For many cities, growth in a waste service will mainly depend on increasing prosperity coupled with the quality of service managers.

With some exceptions, large cities in a wide range of countries and conditions of prosperity seem reluctant to spend more than 0.5% of prevailing GNP per capita on a solid municipal waste

service. If this value is adopted as a budgetary guideline for most large cities in lower-income countries, it can serve as a useful design tool that ties affordable service improvements to growth of national prosperity. It also directs attention to the judicious selection of affordable wheeled equipment, the productivity of the labour force and, not least, to the organization and cost control required to manage a waste service to best effect.

References

- Bird, R.M. *Financing local services: patterns, problems and possibilities: Major report 31*. University of Toronto, Centre for Urban and Community Studies, 1995.
- Briggs, A. *Victorian cities*. Harmondsworth, Pelican Books, 1971.
- Coad, A., ed. *Lessons from India in solid waste management*. Loughborough University of Technology, and Bombay, All India Institute of Local Self Government, 1997.
- Cointreau, S.J. *Environmental management of urban solid wastes in developing countries*. Washington, World Bank, 1982.
- Environmental profile of Pakistan*. Islamabad, Government of Pakistan, Environment and Urban Affairs Division, 1987.
- Hoy, S. *Chasing dirt: the American pursuit of cleanliness*. New York, Oxford University Press, 1995.
- Planco Consulting GmbH. *Information and management tools in municipal solid waste management: Decision makers' guide, Financial and economic planning, Part 2, Background paper*. Hamburg, 1995.
- Scheu, M. & Coad, A. *Observations of solid waste management in Bombay, 1992*. Loughborough University of Technology, and Bombay, All India Institute of Local Self Government, 1992.
- Wohl, A.S. *Endangered lives: public health in Victorian Britain*. London, J.M. Dent & Sons Ltd., 1983.