# LESSONS FROM INDIA

# IN

# SOLID WASTE MANAGEMENT

Edited by Adrian Coad

Based on material collected and developed by study-fellows and tutors
on courses conducted by
The Water, Engineering and Development Centre (WEDC),
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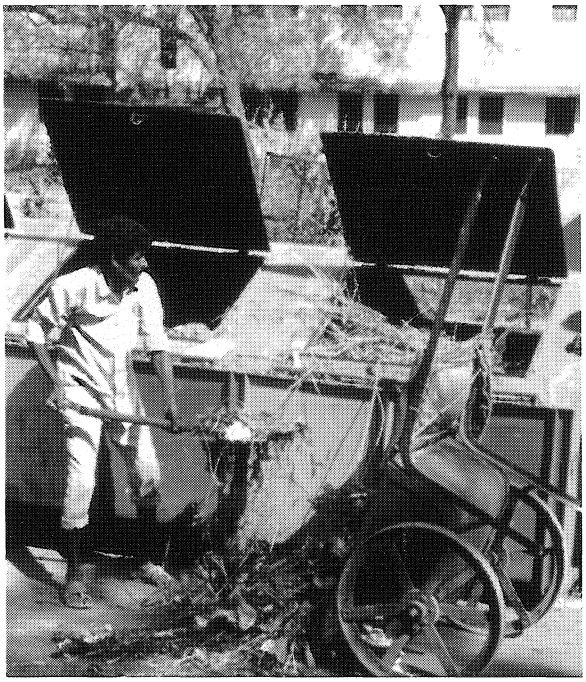

Photo Manfred Scheu

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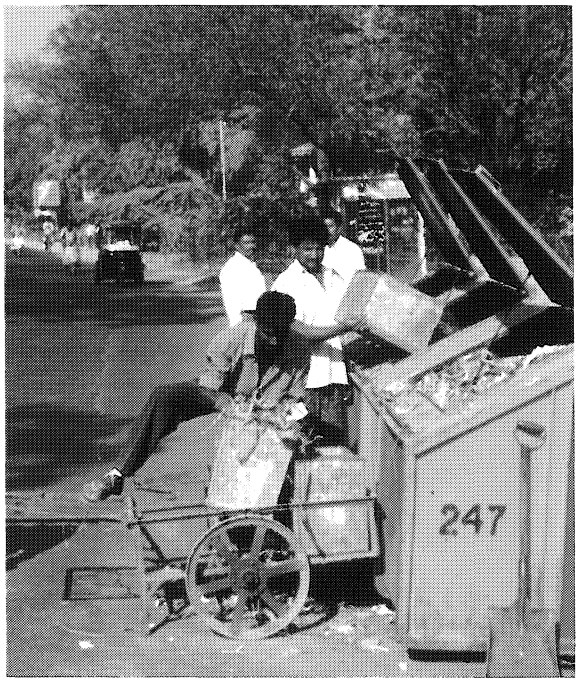


Photo Manfred Scheu

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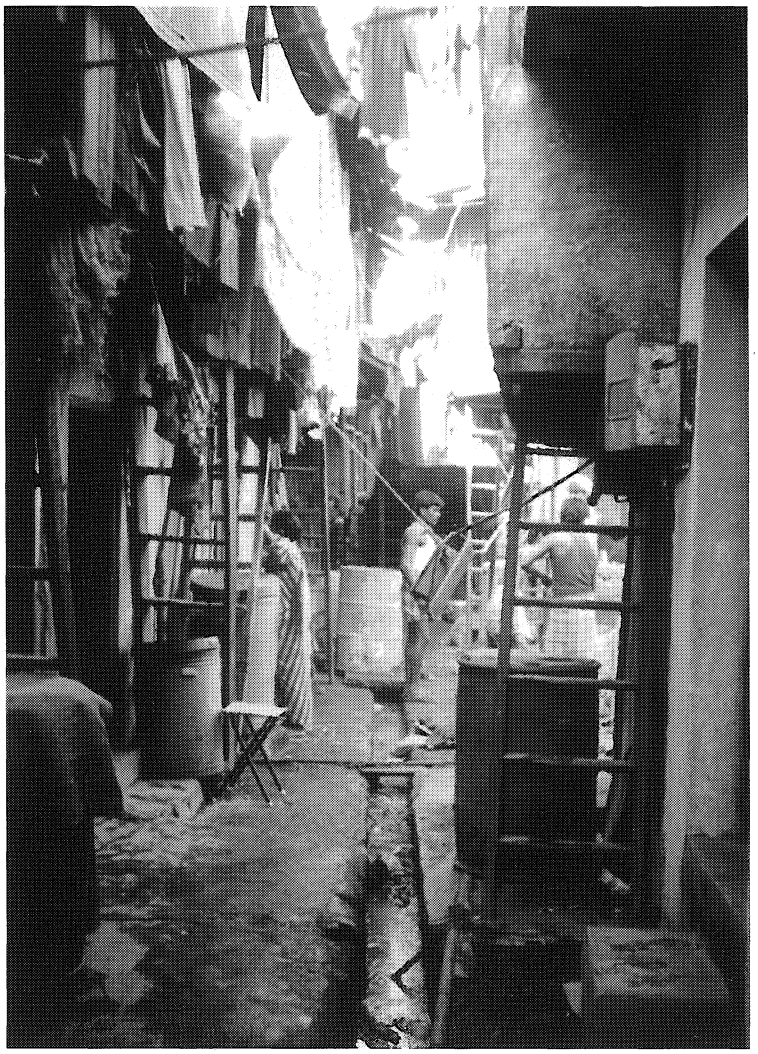


***Photograph 6 A Multipack compactor truck, similar to those widely used for collecting solid waste in Mumbai. Chapter B-2 discusses the operation of these trucks and Chapter D gives some information about their maintenance***

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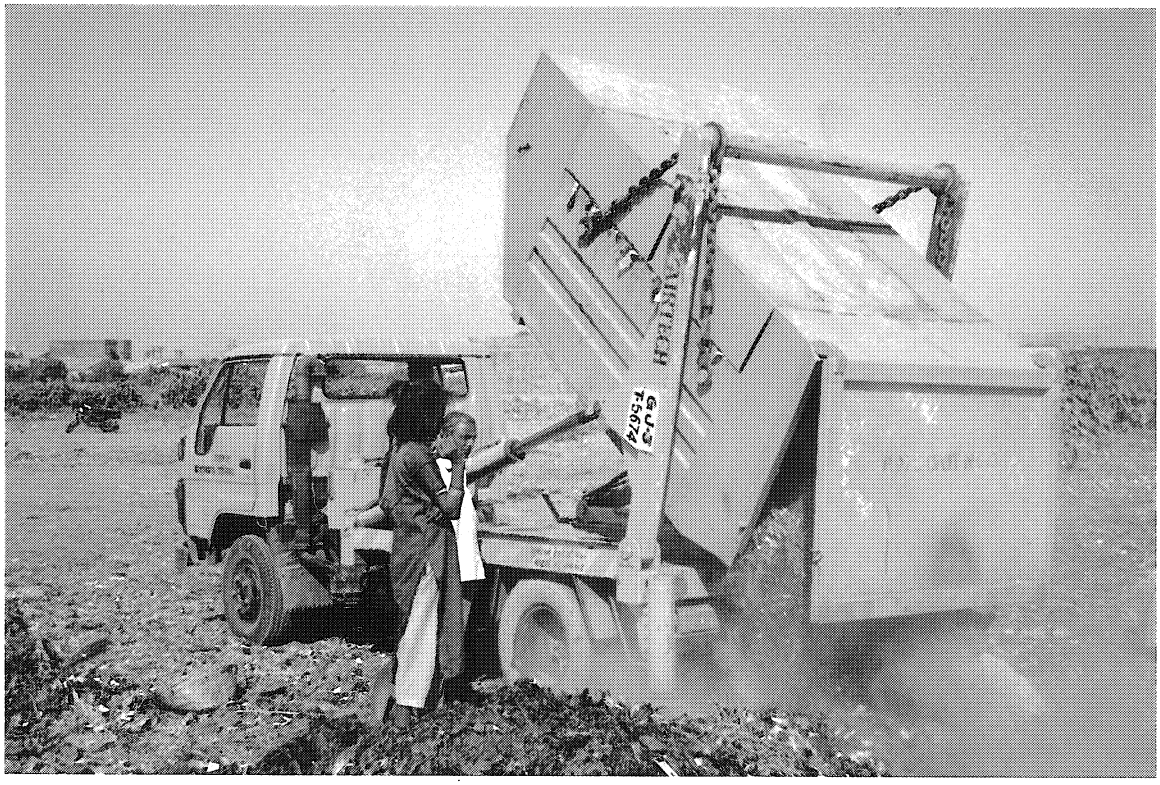

*Photograph 8 Municipal dumper-placer vehicle unloading at Rajkot (Chapter B-3)*

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# Editorial

## Lessons from India...

There are many reasons why the title of this book must be "Lessons from India".

To start with, the material in this book is derived from three training courses, held over a period of three years. The courses each began in UK, where there were lectures, exercises and site visits, and continued in India, where most of the time was spent on site visits and in collecting information in small teams. In this way, India provided the lessons for the second part of the course, and it is the material collected by the course participants and tutors which forms the substance of this book. The participants on the courses were mostly engineers and administrators with some previous contact with solid waste management. The wide range of disciplines and geographical origins (within India) of the participants gave each person on the courses the opportunity to learn from the other. The courses benefited from the lessons that India passed on, and is hoped that some of this benefit can be passed on to a wider readership.

A shorter report was written after the first such training course operated by Loughborough University; that report was entitled "Observations of Solid Waste Management in Bombay, 1992", and it is available from the All India Institute of Local Self Government in Mumbai and from WEDC, Loughborough University, UK.

This report contains a number of snapshots from the past. It should not be seen as a current review of the status of solid waste management in the locations mentioned. Some of the problems mentioned in the chapters may already have been solved. Since much of the information was collected over a short space of time, it also cannot claim to be comprehensive or complete. So if the material in this book is neither current nor comprehensive, what is its value?

- ◊ Firstly, the chapters present information gathered by impartial outsiders, and will provide useful introductions to a wide range of subjects.
- ◊ Secondly, since different towns and cities are at different stages, experiences that may belong to the past in some cities, may soon happen in others. One city can learn from the mistakes and successes of another. It is hoped that this book will stimulate exchanges of information between municipal officials and engineers in different towns and cities throughout India.
- ◊ Thirdly, the examples that are described in this book can serve as case studies, valuable in their own right, not tied to any time or place, and as such useful for instruction and discussion. Examples and information are drawn from actual field observations and operations records. It is hoped that this book will be used in solid waste management courses, both for conventional teaching and also for discussion and case study exercises. Some chapters contain suggested exercises for assignments and discussions.
- ◊ Fourthly, it is often instructive to follow the methodology of the investigations, even if the collection of data has not been as exhaustive as one would wish. The chapters in this book will suggest how to approach particular problems, how to calculate important indicators and compare the results, what questions to ask, and what other factors to keep in mind.
- ◊ Fifthly, some of the authors have considerable experience in the subjects they are writing about, This book is an opportunity to learn from them and to see how they apply their knowledge in a concrete situation.

India is a huge country, a place of immense variety, energy and talent. India has much to teach the rest of the world. There is ample scope for south-south technology transfer. India's initiative and intellectual energy have resulted in many innovative schemes - on both technological and sociological levels, and others can learn from the successes and failures. I have learned much from Indian colleagues and admired many for their dedication and spirit of service, working long hours, seeking to improve their outputs, often with little thanks or financial reward.

The variety within India is illustrated by statistics found within this report. In only three cities, examples were found of the cost of collection of domestic solid waste varying from Rs 95/- per ton to Rs 895/- per ton, and densities as low as 190 kg/m$^3$ and as high as 985 kg/m$^3$ were measured.

This is an interesting time to be considering solid waste management in India. There has been the relaxation of restrictions on imports. The plague epidemic in 1994 focused the attention of many on the state of solid waste collection and disposal services. In 1995 there were some government statements that expressed a concern to see the private sector more involved in services that were being carried out by municipal corporations. The following year, 1996, saw a number of unequivocal orders from Supreme Court concerning the performance of solid waste management functions. This growing concern about accumulations of waste and the risks of toxic materials is found elsewhere in the world, in that there seems to be a growing awareness amongst governments, development agencies and public, that comprehensive solid waste management needs supporting - *comprehensive* meaning here not only the provision of refuse collection trucks, but also the development of systems including public awareness, institutional development and financial management.

The tradition of keeping good records appears to be very strong in India. During the investigations described in this book there were opportunities to compare records with field observations, and the records that were being kept on a routine basis were found to be reliable and useful. Such records are very valuable to the manager who wants to use his or her resources in the most effective way. Examples are shown of how the records were being kept, how records can be used, and how the method of keeping records might be improved.

Many developing economies suffer from dependence on industrialised countries, in terms of their technology, their training and their financing. As a result of government policy, India has developed a high degree of self-sufficiency, and there are many examples of the effects and benefits of such independence. Now there is more freedom to import machinery and ideas, and so there may be interesting opportunities to compare the indigenous with the imported.

A major feature of the way India manages her solid waste is the massive recycling industry, highly organised and interdependent, yet informal and without bureaucracy, apparently efficient and thorough, and providing a livelihood for hundreds of thousands. Unfortunately standards of hygiene and safety are usually very poor, and there are examples of local pollution - from the fires at disposal sites and from the many small and primitive reprocessing industries. Similar systems exist in other Asian countries and in Egypt, where very small incomes (typically one US dollar a day) can sustain an individual or even a family. The system has many opponents, who are concerned for the environment and appalled at the working conditions of so many. It is not easy to determine what government *should* do. It is easier to see what government *can* do - very little - because of the large numbers of poor people with no alternative source of support, people who have considerable power because of the desperateness of their position and their influence at the ballot box.

Much of the material is based on observations in Mumbai (or Bombay as it was called by the British and known until recently). Mumbai is one of the three biggest cities in India, and suffers from shortage of space, difficult transport conditions, a large influx from rural areas putting pressure on urban land and building large slum or squatter settlements, and a huge population. These are problems facing many large cities in the developing world, and municipal officials from mega-cities in other countries can learn from what Mumbai is doing. Other studies were carried out in Ahmedabad, where there has been some very dynamic and innovative leadership in solid waste management, and from Rajkot, also in Gujarat state, which has attracted considerable interest because of the experiments with the use of contractors to undertake municipal services.

This book seeks to address some of the burning issues in solid waste management - how to gain a higher degree of public participation, what type of refuse collection vehicle is most suitable and how it can be kept in good working order, how the productivity of man and machine can be improved, and how solid waste should be disposed of - what method is affordable, reliable and sustainable. This single volume does not pretend to give a complete treatment of solid waste management, but it does aim to be practical and realistic, to show the interdisciplinary nature of the subject and to tackle selected subjects with a useful degree of detail.

Lessons *from* India, but also lessons *for* India. The country is so large that the lessons included here will surely be useful elsewhere in India, as well as elsewhere in the world.

## ...in solid waste management

As already mentioned, there is a growing international concern to improve standards of solid waste management. As cities grow larger, the problems of removing and disposing of accumulating waste become much more difficult, and threaten to overwhelm many administrations.

Many administrators, and even engineers and consultants, fail to understand the extent to which local conditions affect the choice of techniques, equipment and approaches. They recommend containers, vehicles or other equipment which they have seen working successfully under certain conditions, and they want to apply them in a completely different situation. This approach has led to countless failures and the wasting of millions of dollars. It is necessary to go back to first principles and *question* each step and decision in the selection process. There are countless examples of such mistaken transplantation, but the most common types are:

- ◊ the specification of containers that are designed for a waste of a much lower density, so that they (or the lifting mechanisms designed to empty them) are quickly broken when they are filled with waste which is six times as heavy as the waste they were designed to contain;
- ◊ the use of compactor trucks for dense, wet waste, with the result that they are overloaded [especially on the back axle], and they are rapidly damaged by corrosive and abrasive wastes;
- ◊ the attempt to use incinerators to burn wastes that are too wet or too inert to burn satisfactorily.

Unfortunately there are very few books, currently in print in English, that address the issues of solid waste management in low- and middle-income countries. Most waste management books and journals concentrate on technologically advanced treatment and disposal of waste [subjects which are more suited to laboratory research and the objectives of universities] and they neglect the subjects of collection and transport. Research is often based on the interests or background of academics and the available research or laboratory facilities rather than the needs of the community. More recently there have been books and articles published on recycling of solid wastes in developing economies, but these are largely written from a sociological standpoint, and sometimes give the impression that the author is unaware that there is a large municipal organisation which is trying to solve the solid waste problems in the city in question. There is very little literature in print that can lead a municipal engineer from his present open dump to an intermediate landfill that can significantly reduce the pollution and nuisance from disposal at a cost that can be afforded and sustained. It is hoped that this book will go some way to filling the gap in the literature by discussing some of the issues that concern the formal municipal or private sector operations in large cities.

Solid waste management is not just technology, nor simply the organisation of a workforce. It touches on many disciplines, among them

- ◊ sociology - to know how to motivate the public to play their part in the solid waste chain and to develop appropriate recycling systems;
- ◊ management science - to create an organisation that works harmoniously and efficiently and that motivates the staff to do their best for the community they serve;
- ◊ town planning - to make provision for waste management within urban areas and to locate transfer stations and waste processing and disposal facilities in a socially acceptable and environmentally sensitive way;
- ◊ mechanical engineering - to specify, design, operate and maintain the appropriate machinery and equipment;
- ◊ accountancy and financial management - to generate the necessary funds, to use them effectively and to plan and provide for future needs;
- ◊ architecture - to design attractive and functional buildings and structures for waste storage and management;
- ◊ geology - to site disposal facilities in places where they will cause the minimum pollution;
- ◊ civil and environmental engineering - to design, operate and complete environmentally sound and economical sanitary landfills;
- ◊ chemistry - to define ways of managing difficult and toxic industrial wastes;
- ◊ environmental science - for environmental impact studies, monitoring pollution from industries and waste management facilities, and research;
- ◊ public relations - handling complaints, dealing with the press, presenting a positive image.

## Personal views on key issues

While compiling this book I have been made aware of some ways of thinking that I believe are responsible for many of our problems in dealing with solid wastes. I will mention them in general terms here, and some of them will reappear later in the book as they apply to a particular issue. Some points are very controversial, but even these should be discussed and reconsidered from time to time. There is no significance in the order in which these points are raised.

*Why should anyone want to work in waste management*? This is an important question, because clearly there are important benefits when the managers are interested in their work, have been trained by courses and experience over a number of years, and are committed to working in this sphere for many years to come. There are engineers and managers in India who are motivated, talented, committed and dedicated, and it has been very valuable for the course participants to meet such people, to benefit from their knowledge and to learn from observing their example and attitude. Unfortunately there are others who did not wish to be transferred into solid waste management, and who are not interested in the subject, but are concerned to do the minimum necessary until they can find a way to be transferred out. How can the solid waste industry be made more attractive?

*The engineer or middle manager - between a rock and a hard place*. Perhaps because they are relatively few in municipal organisations, perhaps because they have a strong sense of duty, or perhaps because of their understanding of the importance of their work, engineers have not demanded improved pay and conditions in the same way that unskilled workers have done, with result that their pay and conditions are not attractive. Some engineers in the solid waste management sector work long hours, suffer from the pressures of large, powerful workforces, and receive complaints and blame from the press, the public, elected representatives, and perhaps their superiors The main benefit they have in municipal service is job security, but this does not motivate them to do their best and develop their skills. India has some dynamic management training institutes - it might be very worthwhile for a large municipality to commission one of these institutes to investigate its management climate with the aim of finding ways of improving the situation of engineers and middle managers - but would the corporation be willing to implement change?

*Attending a course is not always training, and the need is often motivation rather than training.* There is sometimes a tendency to think that attending courses, training and motivation are all the same thing. The training sections of municipalities may not be resourced as they should be. Attitudes to training are often negative or apathetic. Training courses may not be seen as relevant. After a course there may not be the opportunity of putting into practice what has been taught during the course, leading to frustration. The primary need may be motivation - to answer the question "Why should I do it?" rather than "What should I do?" Often training is seen in terms of travel, allowances and a rest, rather than as a step on a ladder.

*Should or will?* I have learned to react whenever I hear people use the word "should' when discussing solid waste management issues.

"The residents *should* replace the lid on the container when they have deposited their waste."

"People in the street *should* put their waste in the nearest waste container."

"Shopkeepers *should* not put their waste in the containers for domestic waste."

"Rag-pickers *should* not set fire to the waste."

And so on. Sometimes we feel we have done our job when we have declared what people should do. My reaction, when I hear the word "should" is usually to ask:

"Yes, but what *will* they do?"

The public often do not do what they should. This may be because they do not know what they should do, or they do not know why or how. Sometimes what they should do is very difficult to do, for reasons that the engineer or manager may have overlooked. Let us use the word "should" with caution. Let us be prepared to invest in surveys of attitudes and knowledge, and in public awareness campaigns to explain and motivate.

*The most expensive solution is not always the best.* A solution should be appropriate to the local conditions and situation. A man lost in the desert and dying of thirst would be much happier to find a bottle of mineral water costing ten rupees than a bottle of whiskey costing a thousand rupees, whereas a businessman about to entertain two prospective clients from Scotland would prefer to

have the whiskey. Sometimes the most expensive is the best, but this is not always the case. We should not reject or despise low-cost options simply because they are not expensive. Spending money does not guarantee success. There have been many examples of large sums spent on treatment or disposal technologies that have produced little or no benefit, when often a less expensive option, given sufficient support, would have been successful.

*Privatisation - the pill to cure all ills?* Some politicians and decision-makers talk as if engaging contractors will solve all problems. They forget the pitfalls associated with contractors:-

- ♦ The danger that monopolies or lack of competition will result in excessive costs;
- ♦ The failure of inexperienced and under-resourced contractors;
- ♦ The unwillingness of contractors to invest in the most appropriate equipment, so that, for example, they use open trucks from which the waste may be scattered;
- ♦ Exploitation of the workforce in terms of inferior pay and conditions;
- ♦ Opportunities for corruption in the awarding of contracts.

There are also advantages associated with engaging contractors to provide municipal services:-

- ◊ Freedom from restrictive labour agreements that result in less work being done for higher wages - some municipal workforces are very large, and new systems that require fewer labourers must be manned at the old levels if operated by the municipality, because of agreements with labour unions and pressure from politicians;
- ◊ More effective supervision and performance if the contract has satisfactory penalty clauses;
- ◊ Lower costs because of competition and better financial management;
- ◊ Easier financial planning for the corporation since annual costs are known in advance and capital expenditures are reduced or eliminated.

A compromise, or middle option, that is sometimes ignored, is the creation of a separate publicly owned unit which has financial autonomy and a degree of independence. Sometimes the key to success is to build small administrative units, where the beneficiaries are close to those in charge, and where there is a sense of ownership and responsibility on the part of the public.

*Who wants to save money?* This book suggests several ways in which the work of waste collection could be done more effectively and at lower cost, but it is not clear whether anyone in India's largest cities is interested in saving money, because of the influence of the labour unions. The wages and other benefits of unskilled municipal workers are much more than would be paid in the private sector. It is clearly in the interests of municipal workers to resist any change that would erode their living conditions. Manning levels are generally high, and wage costs are the main part of the expenditure on solid waste collection services, so the most effective way to cut costs is to find ways to reduce the number of labourers. Strong opposition to this can be expected from the unions and the politicians who seek support from the community from which the labourers are drawn. Unless the decision is made at a high level to resist these pressures and force a cut in costs in spite of strikes and violence, it is unlikely that the power of the unions can be overcome. Faced with these prospects, it is not surprising that officials choose to continue paying excessive wage bills in order to maintain a regular service. Saving money may be down the list of priorities in big cities.

*A social service or a cleansing service?* Many see municipal services that employ unskilled labour as a social service, like an unemployment benefit, providing a livelihood for people who otherwise would have no work. For this reason they are concerned to maintain existing workforces, and not to find ways to increase efficiency. There are, of course, large numbers of very poor citizens who fall outside this safety net, and if it is a concern for the poor that determines recruitment, it would be better to pay a larger number of people a smaller wage, given the existing wages allocation. It is good for the municipal managers that this does not happen, because it appears to be true that increasing the size of a workforce can result in less work in total being done, because of difficulties of organisation and supervision.

*The value put on technical advice* It sometimes appears that decisions on the selection of equipment and systems are made by executives and politicians without seeking technical advice from engineers in the relevant fields. In some cases too much attention may have been given to the claims of manufacturers and salesmen. In other cases too much emphasis may be placed on the financial details of a tender, and not enough on the technical content. The selection of the option with the lowest capital cost does not always give the best value in the long term..

*Start small* There are times when there is not sufficient information about a product, a process or a system. In such cases it is advisable to start in a small way [for example, buying only one truck and observing how it operates, or setting up a process on a pilot scale and operating it for a year or more], and only after trials have proved successful, committing the organisation to a larger investment. Examples are given in which money was wasted because of impatience to implement a project on a large scale without first learning from a pilot trial. There are times when enthusiasm and boldness should be tempered with caution.

## About this book

**Numbering of chapters and pages**. As shown in the list of contents, the book is divided into parts - A, B, C, etc. - each covering a general theme, and within each part there are one or more chapters - A.1, A.2, A-3 etc. The pages are numbered according to the chapters. If there is an appendix for a particular chapter, it follows directly after the chapter, and is denoted by a double letter. [For example, page BB-2.3 is the third page of the appendix that is linked with chapter B-2.] It is hoped that the reader will appreciate the benefits of this system.

**Cover photographs** The top photograph shows a sweeper using a small handbroom, with her six-bin handcart, in Rajkot, and is linked with chapter A-1. The lower photograph shows the sieving of decomposed wastes at Mumbai's Deonar disposal site; the fine material is mixed with certain additives and sold as a soil conditioner. This practice is discussed in chapter E-1.

## Miscellaneous notes

The exchange rate for the Indian Rupee during the time of the investigations was in the region of Rupees 30 to one US dollar.

Usually the Indian numbering system will be used:
one lakh = 100 000, one crore = 10 000 000

A list of abbreviations and technical or Indian words used in this report can be found in appendix 1.

A list of the contributors and others who helped with this work is given in appendix 2

Bombay officially reverted to its original name of *Mumbai* since the investigations were carried out. In general the current official name will be used in this report. Until recently, the municipal government was known as the *Municipal Corporation of Greater Bombay [MCGB].* Earlier, before the suburban area was joined with the city, there was the *Bombay Municipal Corporation [BMC].* Since the name of the City was changed to *Mumbai* the Corporation has been officially known as *Brihan Mumbai Mahanagarpalika*, but in this report the initials *MCGM* will be used for the English translation of this name - *Municipal Corporation of Greater Mumbai.*

I hope that you, the reader, will find this book easy to use, interesting and stimulating.

Adrian Coad
July 1997