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WHO Collaborating Centre

Ueberlandstrasse 133
CH-8600 Duebendorf/SWITZERLAND

Tel.: + 41 - 1 - 823 52 86
Fax: + 41 - 1 - 823 50 28

The "IRCWD News" informs about the activities of the IRCWD team and is published on an irregular basis.

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Dear reader,

The last issue of IRCWD News dates back to 1988 (No. 24/25). On account of financial and time constraints, we were unfortunately not able to publish our Newsletter on a more regular basis. In future, we hope to publish at least one issue per year. Since many of our readers may have moved, we would appreciate receiving their new addresses in order to update our mailing list. **If you wish to continue receiving our IRCWD News, kindly fill in the enclosed orange form.** Readers who do not return the form by 1 July 1992 will be eliminated from our mailing list. On this occasion, we should like to remind the readers of the main purpose of our Newsletter. IRCWD News is chiefly used to inform people interested in the field of low-cost water treatment, sanitation and waste management in "Developing Countries" about our ongoing projects. In the context of our work, the term "Developing Country" is used as a convenient term for low-income (GNP/cap < \$ 545) and middle-income economies (GNP/cap \$ 545-6000). We do not intend to imply that all economies in the group are experiencing similar development or that other economies have reached a preferred or final stage of development. Classification by income does not necessarily reflect development status.

This issue of IRCWD News is devoted to the problems of Solid Waste Management. For the last ten years, the activities of IRCWD concentrated on problems related to water treatment and management of liquid waste in rural and semi-urban areas of so-called "Developing Countries" (DCs). Solid Waste Management (SWM) was given comparatively little attention. This was mainly due to the general feeling that the improvement of water supply and the safe disposal of human excreta are of prime importance for improving the public health situation in these countries. Today, SWM has generally been recognized as one of the most immediate and serious environmental problems confronting urban governments in DCs. In 1990, the IRCWD, with the financial support of the Swiss Development Cooperation (SDC), thus initiated a project on "Solid Waste Management in Developing Countries". Its objective is to identify the main problems and issues related to SWM in economically less developed countries, and to initiate and conduct applied research in this field. The two main articles in this IRCWD News issue are the outcome of the initial phase of this project. The second article was originally prepared for the International Workshop on Solid Waste Management and Resource Mobilisation (IWOSAR) held in Kathmandu, Nepal in 1990.

Roland Schertenleib
Head IRCWD

We should like to draw the attention of our readers especially to the call for collaboration on page 14, and invite them to contact us if they have any information to share and/or if they are interested in collaborating with us in one of the areas described.

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LIBRARY IRC
PO Box 93190, 2509 AD THE HAGUE
Tel.: +31 70 30 689 80
Fax: +31 70 35 899 64

BARCODE: 9755
I.O.: 343 92 MU

343-92 MU-9755

MUNICIPAL SOLID WASTE MANAGEMENT IN DEVELOPING COUNTRIES: PROBLEMS AND ISSUES; NEED FOR FUTURE RESEARCH

by Roland Schertenleib and Werner Meyer

1. INTRODUCTION

During the International Drinking Water and Sanitation Decade, proclaimed by the UN for 1980 - 1990, the main emphasis was placed on the improvement of water supply and the safe disposal of human excreta in developing countries (DCs). Solid Waste Management (SWM) received comparatively little attention.

Today, urban SWM is considered to be one of the most immediate and serious environmental problems confronting urban governments in DCs [1]. This is mainly due to the rapid urbanization taking place on an enormous scale in Asia, Africa and Latin America (s. Fig. 1). An important feature of urbanization in DCs is the rapid growth of large cities and metropolitan areas (s. Fig. 2). In 1980, 5 cities in DCs had a population of more than 10 million and that number is expected to increase to 17 by the year 2000. Of these 17 cities, Mexico and Sao Paulo are expected to have populations in the 20-30 million range [2].

The cities are undoubtedly the major factors contributing to the economic output, employment and income of DCs. Rapid population growth and uncontrolled industrial development, however, severely degrade urban environments, place serious strain on natural resources and consequently also undermine equitable and sustainable development. Inadequate management and disposal of solid waste is an obvious cause for the degradation of the environment in most cities of the developing world. Many cities face serious environmental degradation and health risks due to uncollected domestic refuse on streets and in public areas, clogged urban drainage systems by indiscriminately dumped refuse, and by contamination of water resources near uncontrolled dumping sites.

Inadequate collection and disposal of solid waste is a major factor in the spread of gastrointestinal and parasitic diseases, primarily caused by the proliferation of

insect and rodent vectors. Mostly low-income communities, where uncollected domestic refuse is often mixed with human and animal excreta and piles up on the street, are affected by inadequate SWM systems. However, it should be noted that the introduction of health protection measures for the population (including the workers), such as the elimination of possible transmission routes for communicable diseases, is only one of the objectives of SWM. Other important objectives of a SWM system should be the conservation of natural resources (water, air, soil), minimization of the use of non-renewable resources (energy and raw material) and of imported material (financial resources and products), as well as the achievement of a general improvement of the standard of living by a control of the aesthetic problems like dirt, odour and smoke.

This paper identifies the main problems and issues related to the highly unsatisfactory situation of municipal SWM encountered in most DCs, and suggests some possible approaches for improving the present situation.

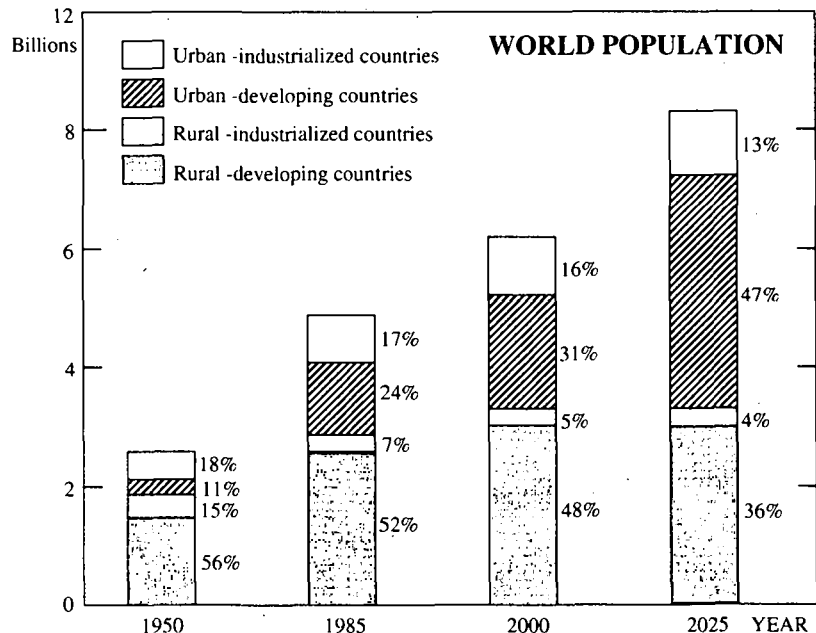


Fig. 1
World population projections for urban and rural areas

2. IDENTIFICATION OF TYPICAL PROBLEM AREAS

Based on extensive literature reviews, observations and discussions in a number of DCs, five typical problem areas have been identified: (a) inadequate coverage of the population to be served; (b) operational inefficiencies of municipal SW services and management; (c) limited utilization of the informal and formal private sector in recycling activities; (d) specific problems related to final disposal of solid waste; and (e) problems concerning the management of (non-industrial) hazardous waste. We shall see that all of these problem areas are related to institutional, financial and technical issues.

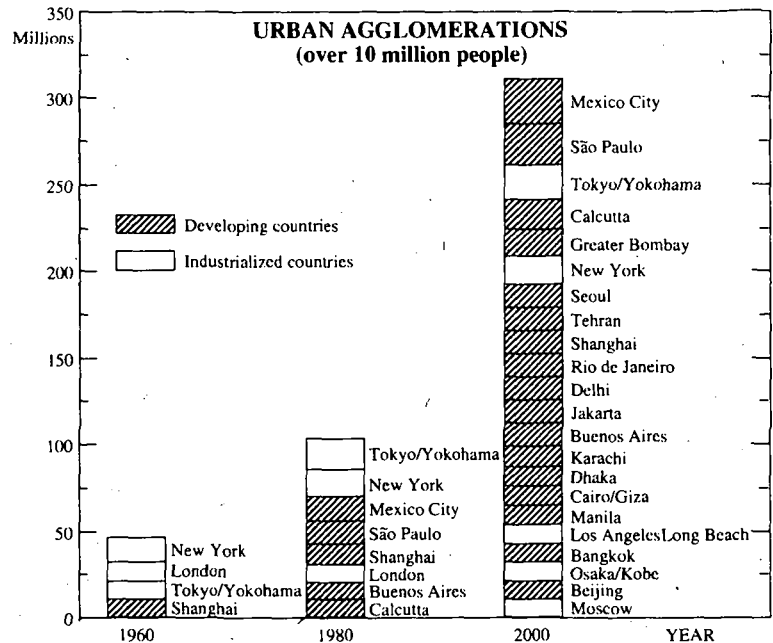


Fig. 2
Population projections for large cities with over 10 million inhabitants.

Inadequate coverage of the population to be served

Existing municipal solid waste management schemes generally serve only part of the urban population. In a "typical" urban area, the municipal service picks up about 50 to 70 percent of the refuse and serves less than 50 percent of the population. The low-income peri-urban areas usually make up the unserved population.



Low-income area suffering from a lack of solid waste collection services. Refuse is indiscriminately dumped on the road and into open drains.

The lack of adequate institutional arrangements and the low financial and technical sustainability of existing collection systems are the main reasons why this kind of situation prevails in urban areas of DCs. The waste generated by the fast growing cities is increasingly beyond the collection capacity and financial limitations of most municipal administrations. Usually, not even the operation costs of the collection services are covered by adequate fees, and the available funds from the central budget are insufficient to finance adequate levels of service to all segments of the population. In a situation where resources are scarce, priority is usually given, mainly for political reasons, to middle and high income areas. In addition, many urban poor live in unplanned and unauthorized areas (often outside the municipal boundaries) and are, therefore, not eligible for municipal services.

Another important reason for poor coverage is the fact that municipal waste management services in DCs usually adopt the "conventional" approach developed and applied in highly industrialized countries of the North (U.S., Europe, Japan); i.e., the use of sophisticated and expensive collection trucks difficult to operate and maintain and generally not suitable for the narrow and unpaved lanes of urban and peri-urban low-income areas of DCs. Sophisticated compactor trucks have for example been given to many municipal services or have even been bought by them although the domestic waste of low and middle income areas has a typical density of 400 to 500 kg/m³ due to its high organic content. Compactor trucks were developed in and for industrialized countries to save transportation costs. The waste in industrialized countries, composed mainly of large amounts of bulky packaging material, has a much lower density (150 - 200 kg/m³) and is more easily compactable. Due to the use of inappropriate equipment, only a small part (typically less than 50%) of the vehicle fleet is in op-

erational condition. It is quite common that governments are still paying back long-term loans for vehicles grounded after two to three years of operation.

Even in places where waste collection is carried out mainly by the informal sector and closely linked to resource recovery (e.g. Cairo), the low-income areas are usually neglected due to lack of incentive caused by the low content of recyclables in the waste of the poor.

Even though low-income areas are grossly neglected by municipal collection services, low-income communities have proved willing to make some investments in cleaning up streets and improving drainage. The question is how much are they willing/able to pay, under what conditions and for what kind of service.

Operational inefficiencies

Although municipalities in DCs expend substantial resources on waste management (often 20 to 30 percent of municipal operating revenues), they tend to do a poor job operationally.

Operational inefficiency is due primarily to the inefficient institutional arrangements common to municipal governments in DCs. In addition, waste management services generally receive little attention from top city officials, and are usually assigned to the lower echelons of municipal government or to health departments. However, the more a city grows, the more the solid waste collection becomes complex and requires top level planning and sophisticated engineering and management skills.

Limited utilization of the capacity of the informal and formal private sector in recycling activities

On the one hand, the informal sector has been playing traditionally an important role in SWM schemes, especially with regard to recycling activities. However, while being basically beneficial to the environment and supporting large numbers of poor workers, these recycling activities by the informal sector can conflict with efficient waste management practices. These activities also pose serious health problems to the worker community. On the other hand, although the materials recovered from the waste stream are marketable, the formal private sector has so far been rather reluctant to participate in recycling activities.

It is sometimes argued that inefficiency is also a major contributor to the typically low coverage mentioned above, and that increased operational efficiency would automatically lead to an expansion of these services. Based on the available information, there is no evidence that this assumption is accurate. The financial constraints which could be alleviated by increased efficiency is only one of the reasons for inadequate coverage. Perhaps more important is the lack of incentives and pressure to extend adequate collection services to low-income areas. Under such circumstances it is more likely that the money saved by efficiency improvements would be used for other municipal activities than for expanding waste collection services to the poor.

Whereas over the past 30 to 40 years informal sector activities have been increasingly disappearing from SWM schemes in the U.S. and Europe, they are still common in most urban areas of the developing world. Some cities, or at least sections of them, rely in fact completely on the informal sector for the collection of solid waste. In this context, informal is referred to that segment of the private sector which operates outside the official legal and institutional framework set up by the agency in charge of solid waste management. One of the important characteristics directly related to this situation is the fact that informal sector businesses escape health and safety regulations. Although the informal sector operates outside the official legal and institutional framework, it is well-structured and operates within strict rules. However, these rules are not set by any legislator or government agency but by the most powerful actors within the same informal sector ("mafia"-type of operation). Probably the best known example of a city with informal scavenging and recycling is Cairo. Approximately 45% of the municipal solid waste generated daily are collected by some 12,000 Zabbaleen living within 7 communities in Cairo. Nearly every Zabbaleen household has its life centred around the daily



Scavengers at a municipal landfill looking for recyclable material

business of collecting, hauling, sorting, classifying, and reusing solid waste. In the Federal District of Mexico City, around 10,000 inhabitants are estimated to be directly involved in informal scavenging operations at the landfill sites. Some 2,500 of them are children. These scavengers recover daily about 600,000 kg of material (paper, cardboard, glass, bones, organic material). Another of the countless examples is Manila where 3,000 to 5,000 scavengers are working at the landfill sites ("smoky mountains") and recovering more than 200 tons of material per day. In Mexico City and Manila, 5-10% of the waste stream are recovered almost exclusively by the informal sector.

The recovery of all kinds of material from municipal solid waste by the informal sector is not only a fact of life which cannot be ignored or even abolished, it also offers opportunities to incorporate resource recovery into solid waste management schemes. Scavenging as a whole not only provides a source of income to one of the poorest segments of the population, but it also reduces the need for highly sophisticated and costly recovery systems. Therefore, these recycling activities should by no means be discouraged, particularly since resource recovery is now becoming a recognized component of municipal solid waste management strategies in industrialized countries. There are undoubtedly also serious problems associated with scavenging. The proper and hygienically safe operation of transfer points and landfills may, for instance, be significantly hampered by the activities of scavengers who are generally also regarded as a serious eyesore to the public. This is why authorities are often trying to outlaw these informal recycling activities instead of officially recognizing them and trying to minimize the problems.

Although material recovery from the waste stream has a great potential for private sector involvement (the outputs are marketable), in industrialized countries as well as in DCs the formal private sector has been playing a minor role in recycling activities. The reasons are manifold and interrelated: (a) the market for recovered material, which is often controlled by cartels, leads to oligopolistic situations; (b) prices for recovered materials are subject to large fluctuations and are not predictable; (c) tipping fees are generally too low to create an economic incentive for private firms to reduce the volume of solid waste by material recovery and recycling of the putrescible components (composting). As long as this situation prevails, the formal private sector will probably only be involved through contractual agreements with municipalities.

Specific problems related to the final disposal of solid waste

The solid waste in DCs is generally disposed of in uncontrolled open dumps. Although the environmental consequences of inadequate disposal are often quite evident, they are seldomly dealt with.

Financial and institutional constraints are the main reasons for such a situation. If financing of solid waste collection services poses a problem, the financing of safe disposal of solid waste poses an even greater problem. Although most people are willing to pay for the removal of the refuse from their immediate environment, they are generally not concerned with its ultimate disposal. In addition, since the important physical components of the environment (air, water, soil) are public goods, their utilization is not controlled by simple market mechanisms. They are often also considered to be free goods in the sense that the supply of clean air, water and soil is thought to be much greater than the demand for them to "absorb" the pollutants. However, this last assumption is certainly no longer true for urban and peri-urban areas with high population densities.

The present situation is expected to deteriorate even more for the following reasons. Due to rapid urbanization, the existing dumping sites, often former quarries originally located at a safe distance outside the municipal boundaries, are increasingly encircled by settlements and housing estates. They are subjected to growing opposition from the public due to odour, dust and other nuisances. On the one hand, the central location of the dumping sites; i.e., close to the collection area, has enabled local governments to dispose the municipal SW at little cost. On the other hand, it is becoming increasingly difficult to find new landfill sites which find the approval of the public, and which are located at a reasonable distance from the collection area. Many of the recently selected landfill sites in larger cities (e.g. Jakarta, Manila) are in fact located at distances between 20 to 40 km from the central collection areas. This results in high transfer and transportation costs as well as in additional investments in the infrastructure of roads. In addition, an increase in service coverage will even aggravate the disposal problem if the amount of waste cannot be reduced by increased recycling [see 2nd article in this IRCWD News].



Open (uncontrolled) dumping is still the most common solid waste disposal method in DCs

Problems related to collection and disposal of (non-industrial) hazardous waste

Although most hospitals officially require the burning of their pathogenic waste, most of the existing incinerators are out of order due to a lack of fuel and/or spare parts. Consequently, pathogenic waste products often enter the MSW stream and cause serious health risks.



Primary health care centres, private clinics and laboratories spread throughout the cities generate hazardous waste products which often enter the MSW stream and cause serious health risks.

Most of the toxic and hazardous wastes are related to industrial activities. The problems associated with the management of these industrial wastes require special attention and are not addressed in this paper. This section of the paper only deals with the hazardous wastes of non-industrial origin which are often found in the municipal waste stream. Pathogenic waste, generated by hospitals and clinics, is the most important waste product of this category. Hospitals and especially the growing number of health institutions such as primary health care centres and dental and veterinary clinics spread throughout the cities and also producing infectious waste generally lack appropriate collection and disposal services. Consequently, pathogenic waste products often enter the MSW stream and pose serious health risks to the public (e.g. children playing with toys recovered from MSW products), to scavengers and collection crews, and to workers at the landfill.

3. POSSIBLE APPROACHES TO SOLVE THE MOST URGENT PROBLEMS AND NEED FOR FUTURE RESEARCH

Increase in coverage

As long as solid waste collection services are not sustainable in the sense that the beneficiaries are not able/willing to pay for the kind of service offered to them, it is obvious that it will be increasingly beyond the resources of the municipal administrations to collect the growing amount of solid waste generated by the rapidly expanding cities in DCs. Even if the efficiencies of the existing systems can be improved significantly, a large portion of the population will realistically not be served by the municipal services, especially in low-income areas where there is insufficient pressure on municipalities to provide the services, and little incentives for scavengers to collect the garbage. This basically means that the people in low-income communities have to assume the responsibility of the municipality with regard to the handling of their garbage, and to set up a system appropriate to their economic situation. This can take different forms; i.e., the community/neighbourhood is either paying private collectors, within or without the community, or the population will have to partly carry out the work themselves. In other words, those who cannot afford to pay in cash will still be provided with SWM services by paying in kind.

Such types of community-based waste management schemes, involving the participation of local communities in the collection, sorting and recycling activities, have been tried out over the past few years in different places in Latin America, Africa and Asia. Since very little has been reported on the experience gained so far, it would, therefore, be urgently necessary to assess these projects in order to determine which approach is the most promising under which kind of condition.

Improving operational efficiency

It is often argued that privatization of SWM activities is the best method to improve the poor efficiency of existing SWM systems. A preliminary study comparing the latest cost data of the urban waste management services in Rio de Janeiro and Sao Paulo revealed that taxpayers in Rio de Janeiro pay for a similar level of service at least twice as much as taxpayers in Sao Paulo [3]. This difference is attributed to the fact that the services in Rio de Janeiro are provided by a government agency in contrast to Sao Paulo, where private firms have been contracted to collect the refuse and operate processing plants and disposal facilities. There is strong evidence that the higher productivity and efficiency of the services delivered by private firms in Sao Paulo can mainly be attributed to the following factors: (a) The labour efficiency of the collection crews of the private contractors is significantly higher than that of the municipal services; this is probably due to the fact that private firms have a much stronger negotiating position with the labour unions than the government

agencies. Management and labour policies of the latter are very much influenced by political considerations. (b) The state enterprise in Rio de Janeiro has an ancient fleet of vehicles that is expensive to maintain and increasingly difficult to replace due to a lack of access to private or government funds.

The fact that SWM in the U.S., Japan and in a number of West European countries has been characterized for many years by private sector involvement, is another indication that increased privatization, especially of collection services, could help alleviate some of the existing problems in DCs (e.g. by improving efficiency and freeing public authorities from day-to-day operations in order for them to devote their attention to policy formulation and regulation as well as support activities). Private sector participation is probably most appropriate in collection activities where the economy of scale is much less important than in the operation of landfills.

However, privatization has also serious limitations. Although in most cities of Francophone West Africa (e.g. Dakar, Abidjan, Lomé, Douala), private firms have been in charge of SW services for many years, there is no indication that the municipal authorities and/or the taxpayers in these cities pay less for their SW services. This is probably because these private firms basically have a monopoly without any competition. In Sao Paulo the situation is quite different. There, the city is divided into several collection areas and three firms compete regularly to obtain the service contracts for these different parts of the city.

In this context, it is important to note that the organizational structure and management of the refuse collection agency are the most important factors affecting the efficiency of the system. Organizational structure does not refer in this context to municipal or contract collection arrangement, but to how an organisation, be it a public agency or a private firm, structures itself internally to provide the collection services and, especially, the way in which staff responsibilities are distributed and what kind of incentives exist. Therefore, future research should not only address the question of what should be the role of the private sector in SWM, but also of how the performance of public enterprises can be improved and what should be the role of the public (government) sector vis-à-vis the private sector [4].

Better utilization of the capacity of the informal and formal private sector in resource recovery from MSW

The crucial question with regard to informal sector involvement in SWM systems is how can the above mentioned problems associated with scavenging be reduced or even eliminated without jeopardizing the benefits of these activities. A possible approach is to regard improved scavenging as an integral component of solid waste management planning and implementation.

The existing situation with regard to scavenging activ-

ities at dump sites and/or transfer stations/points could be improved significantly for example by (a) physically separating the area where scavenging is taking place from the actual disposal site (same location but physically separated). This would prevent interference with the sanitary operation of the landfill (e.g. regular covering); (b) providing manual or very simple mechanical sorting equipment and operational training to the scavengers. This would lead to more efficient material recovery but still require the work force of scavengers; (c) incorporating processing activities to add market value to the recyclables; (d) providing washing and sanitary facilities in the areas where controlled scavenging is taking place; and (e) providing education, housing and health facilities to the scavenger community. These measures should perhaps be combined with the attempt to organize scavengers into a recognized group (e.g. a recycling cooperative). In cases where collection and recovery are closely linked; i.e., where scavengers are actually given the task to collect the solid waste, it is essential to have formal agreements between the authority in charge of SWM, the households and the scavengers, and to put in place appropriate payment mechanisms. This is important as it would solve the problem of having scavengers only collect the waste from high and middle income areas because of its high content of recyclable material. This again requires scavengers to be organized in formally acknowledged groups.

However, it is important to note that it might be very difficult to introduce any changes in the existing set up of informal recycling activities, especially since these activities are generally very tightly controlled by informal groups. It should also be emphasized that the very complex set up of an existing informal recycling system should be thoroughly studied before introducing specific changes.

Since the formal private sector has so far been rather reluctant to enter the recycling market, investigations on market and price mechanisms of secondary raw materials are urgently needed. In this context, the question of prime interest is how do direct and indirect (e.g. through overvalued local currency) subsidies of virgin and/or imported raw material influence the prices of recyclables.

Improving the situation with regard to the final disposal of MSW

The following three basic measures are suggested to improve the present situation with regard to the final disposal of MSW in landfills: (a) Institutional and financial models for waste disposal activities as an integral part of SWM have to be found and applied. Landfill operation costs have to be covered by the collection fees. (b) Appropriate guidelines for the operation of landfills in DCs have to be developed. These guidelines should not be based primarily on the existing requirements of sanitary landfills in industrialized countries but mainly take into account the basically different physical and economic situa-

tion prevailing in DCs. (c) Increased recycling of the organic putrescible component, which accounts for the largest fraction of the MSW produced in DCs, will reduce the amount of waste to be disposed of, lower landfill operation costs and prolong their lifespan.

Improving the management of pathogenic hospital waste

Most of the wastes generated by hospitals and clinics are similar to the domestic and commercial wastes produced by other institutions; i.e., they are not hazardous and do not require special attention. In order to minimize the amount of waste to be handled in a special way, the small portion of infectious and hazardous waste should always be kept separate from the other waste stream (e.g. separation at the source). Nevertheless, appropriate guidelines have to be developed for the special handling and safe disposal of the relatively small portion of hazardous pathogenic waste from hospitals and clinics.

4. CONCLUSIONS

Urban SWM is one of the most serious environmental problems confronting the governments in DCs. Inadequate collection and disposal of solid waste are major reasons for the environmental degradation and health risks in the fast growing urban areas of DCs. The five typical problem areas: (a) inadequate coverage of the population to be served; (b) operational inefficiencies of existing municipal SW services and management; (c) limited utilization of the capacity of the informal and formal private sector in recycling activities; (d) inadequate final disposal of municipal solid waste; and (e) inadequate collection and final disposal of (non-industrial) hazardous waste. All these problem areas are related to institutional, financial and technical issues.

The most promising approach to **improve the collection coverage** is the introduction of community-based waste management schemes which involve the local communities in the collection, sorting and recycling activities. Research is needed to determine how such schemes can be implemented under different kinds of condition.

Operational efficiency of SW services can be improved by increasing the participation of the private sector. However, future research should not only address the question of what should be the role of the private sector in SWM, but also how the performance of public enterprises can be improved and what should be the role of the public (government) sector vis-à-vis the private sector.

The benefits of the **recycling activities** by the informal sector should be officially recognized. Instead of being outlawed, these activities should be improved and encouraged. However, informal recycling systems have to be thoroughly studied before changes are introduced. Investigation on market and price mechanisms of sec-

ondary raw materials are also necessary to determine how the capacity of the informal and formal private sector in resource recovery from municipal solid waste can be improved.

In order to improve the present situation of **final disposal**, three basic measures are suggested: (a) institutional and financial models for waste disposal activities as an integral part of SWM have to be found and applied; (b) appropriate guidelines for the operation of landfills in DCs have to be developed; and (c) recycling of the large organic putrescible MSW fraction needs to be increased.

There is a need for appropriate guidelines for the handling and safe disposal of **hazardous pathogenic waste** from hospitals and clinics in DCs.

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***"Some for All
Rather Than
More for Some"***

New Delhi Statement