



17th WEDC Conference  
Infrastructure, environment,  
water and people  
Nairobi, Kenya 1991

## The role of waste recycling and reuse in managing urban solid wastes

Dr Gehan S. Sinnatamby and  
Mr Andre Dzikus

The views expressed in this paper are those of the authors and do not necessarily reflect that of the organization, the United Nations Centre for Human Settlements (Habitat).

### INTRODUCTION

One of the most important environmental consequences of the process of urbanization that is currently transforming cities in developing countries is the immense and ever-growing amounts of solid wastes generated within them. These wastes have long outstripped the capacity of nature to assimilate them and city authorities to collect and dispose of them safely and efficiently. The results are increasing water, land and air pollution, translating into direct negative impacts on human health and the quality of urban life, as well as the rapid depletion of environmental resources essential for long-term sustainable development.

As cities grow, they exhaust the capacity of traditional disposal sites and require that the waste be transported greater distances to sites outside the city. The explosion of satellite informal communities around most cities in developing countries has made this problem reach crisis proportions. City managers are, therefore, struggling with a common problem: how to dispose of ever-growing amounts of wastes in an environment of dwindling available landfill space. The inevitable consequence of this trend is the increasing cost of waste disposal.

The recycling of waste materials is a clear strategy in managing solid wastes. This paper reviews the role of waste recycling and reuse in improving solid-waste management services; conserving natural and foreign-exchange resources; reducing pollution; and increasing employment among deprived sectors of urban societies. The paper draws from an analysis of informal waste-recycling and -reuse practices in Asian cities and focuses on the role of small-scale cottage-based waste-recycling industries (SCWRIs) in reprocessing waste materials. Strategies for supporting and promoting waste recycling are included.

While it is possible that municipal solid wastes will contain some industrial waste materials, this paper assumes that hazardous wastes and toxic chemicals, which must be kept out of municipal landfills, will not form part of municipal solid wastes. Although this is not always a valid assumption it is, nonetheless, a precondition to gaining effective control over this traditional form of environmental pollution.

### SOLID WASTE TRENDS

The quantities of solid wastes generated in developing countries are increasing rapidly and may double by the end of the decade.<sup>1</sup> There are two reasons for this. First, demographic changes, especially in urban areas, where average annual growth is about 3-6 per cent, will lead to the generation of greater quantities of wastes. Secondly, industrialization and economic growth change consumption patterns that will increase per capita quantities and change the composition of the solid wastes. Despite consolidated urbanization, most European countries saw a tripling of their per capita waste quantity generation over the last two decades. By the year 2025, when over 60 per cent of the world's population, some 5 billion people, will live in urban areas, a five-fold increase over present-day quantities of waste generation could result. Accompanying the increase in waste generation will be an inevitable decrease in the biodegradability of the wastes as more and more non-organic materials and industrial wastes are discharged together into municipal solid waste facilities.

At best, cities in developing countries collect 70 per cent of solid wastes generated each day while, at the other extreme, in low-income countries as little as 30 per cent of the solid wastes generated each day are currently collected. Landfill remains the most common form of disposing of solid wastes and most, if not all, such landfills are run as open dumps with sanitary landfilling being the exception rather than the rule. The exhaustion of traditional disposal sites, stricter environmental controls governing waste disposal, and increasing quantities of more persistent wastes have all contributed to a rapid increase in the cost of solid-waste disposal services, especially, in developed countries. Some of these countries have experienced a six-fold increase in solid-waste disposal costs over the last decade. Many developed countries are today investing in waste recycling as a recourse action in response to the ever-increasing cost of disposal and lack of landfill space. Some dramatic measures have recently been introduced in these countries to ensure that waste is, in fact, recycled. In Newark, New Jersey, United States, for example, local authorities pay \$US30 per ton of waste that is recycled through buy-back centres and thereby avoid paying this \$US150 it would otherwise cost for its collection and disposal.

Although the cost per ton of waste collection and disposal services in developing countries is typically only a third that in industrialized countries, similar causes could double or triple solid-waste-disposal costs in those countries by the end of the present century. As the economics of solid-

waste-disposal services change, landfill will no longer be the most economic form of waste disposal and waste recycling and resource recovery will become increasingly cost-effective. Resource-efficient approaches to solid-waste management will, therefore, increasingly prove to be the most economic form of waste disposal and one on which future solid-waste-management programmes will need to be founded in developing countries. Another factor which will reinforce this trend is the shift away from direct cost/benefit analysis to environmental accounting as the basis for decision-making. Environmental accounting, which assesses the long-term impact on the national resource base and economy of alternative practices, when applied to waste management, will increasingly find current practices detrimental to national wealth and productivity.

Solid-waste-disposal operations absorb between 30 and 50 per cent of municipal operating budgets. Even so, service is frequently inadequate and poor solid-waste-disposal is increasingly emerging as the most significant cause of urban environmental pollution.<sup>2</sup> A recent environmental improvement study of Metropolitan Manila, for example, found inadequate solid-waste management to be the single, most important, urban environmental problem. Besides the direct impact on water, soil and air, inadequate solid-waste management was also found to be responsible for increased flooding in the metropolitan area. In view of the fact that increasing waste generation and waste disposal cost trends are destined to continue, a radical change in the approach to managing developing-country solid-wastes is called for in order to address the potential urban environmental problems these trends can precipitate.

---

## FRAMEWORK FOR IMPROVED SOLID-WASTE MANAGEMENT

---

A comprehensive framework for the improved management of solid wastes should be founded on a hierarchy of objectives: first, minimize waste generation; secondly, recycle, to the extent possible, the wastes that cannot be avoided; and thirdly, dispose, in an environmentally-safe way, the non-recyclable fraction of unavoidable solid wastes. Clearly, the emphasis to be placed on each of the above objectives will vary from country to country. Efforts at minimizing wastes through changes in production and consumption patterns should, for example, characterize the thrust of efforts to improve solid-waste management in industrialized countries. Current consumption levels in developing countries are low and substantial increases will be inevitable as these countries attain basic standards of economic welfare. Emphasis, in these countries should, therefore, be focused on waste recycling and safe disposal. The instilling of sound waste-management policies and approaches founded on increased waste recycling and reuse, in particular, could reduce demands for safe disposal and ensure that development is made compatible with environmental protection.

---

## BENEFITS OF WASTE RECYCLING

---

While the inadequate disposal of wastes gives rise to a number of environmental problems, the reclamation and reutilization of materials contained in them can actively

prevent environmental degradation and support development. Recycling reduces the quantity of solid wastes that must be disposed of and, thereby, reduces its direct polluting impact on the environment and extends the life of available landfills. Recycling metals, paper, glass, plastics and organic wastes conserves resources: by reducing the demand for energy, raw materials, fertilizers, foreign exchange and product-manufacturing-process water. Producing aluminium from scrap instead of bauxite cuts energy use and related air pollution by 95 per cent. Making paper from discards instead of virgin timber not only saves valuable forests, it reduces the energy used per ton by up to three quarters and requires less than half as much process water. Recycling of certain materials can lead to import substitution and thereby conserve valuable foreign exchange. Waste recycling can create employment: when fully developed, the waste-recycling and -reprocessing industries could employ as much as between 2 and 3 per cent of the national work force. By taking action now to set in place and support waste recycling, developing countries can ensure that as the quantity and recyclable proportion of solid wastes increase, their disposal will not be to the detriment of the environment but enhance its conservation. In addition to these benefits, the avoided cost of collecting, transporting and disposing of wastes and deferred investments in new facilities can be considerable.

---

## WASTE RECYCLING AND REUSE IN DEVELOPING COUNTRIES

---

The problem of solid-waste management in developing countries will indeed be much greater than at present if it were not for the fact that much of the waste is recycled. Various social groups are involved in the waste-recycling trade. Waste materials are separated at source and removed from communal storage facilities and tip sites. The source-separated materials are purchased by door-to-door used-materials merchants and recovery after disposal is often conducted by scavengers. Unfortunately, waste scavenging rather than source separation is the predominant mode of waste recycling. In some developing countries, as much as 1 to 2 per cent of the population derive their subsistence either directly or indirectly from the occupation of recovering and selling various materials discarded in refuse. No formal recognition is afforded to those involved and their activities besides presenting a threat to health also obstruct municipal operations since wastes are often scattered to recover valuable materials. In order that waste recycling and existing waste-collection systems can be made compatible and their respective productivities improved, ways by which materials to be reused are retrieved through separation at source, instead of post-disposal scavenging, need to be found and supported. Once the material is recovered, it is often sold directly or through intermediaries to larger waste-material deposits which in turn sell the materials to reprocessing industries.

Since many of those engaged in the waste-reuse trade often belong to special, deprived social groups which, today, have little access to governmental channels or formal financing and markets, they are obliged to sell the recovered materials to intermediaries (middlemen) who, in turn, often sell the materials to large reprocessing factories.

Unfortunately, it is the intermediaries that derive the greatest economic benefit from this activity: some intermediaries sell recovered materials at prices five times greater than what they pay scavengers for collecting them. Social stigmata are often associated with those who scavenge waste dumps for reusable materials. Such stigmata are primarily founded on the nature of the work undertaken by the concerned social group.

An increasing amount of the waste in developing countries is being reprocessed by a heterogeneous group of poor, small producers of goods who exist outside the formal sector. Their diversity defies precise definition, but, in general, they run one- to five-person establishments - mostly family operations, based in their homes. These small-scale, cottage-based waste recycling industries (SCWRIs) purchase various discarded materials for reprocessing them into a variety of commercial products. Products made of recycled materials, despite having their own individual market that satisfies the demand for cheap products, are invariably also able to compete favourably with the more formal markets. Many of the SCWRIs are established in low-income, informal settlements and provide valuable employment to their residents many of whom are also engaged in collecting the waste materials that feed these industries. On average, between 30 and 50 per cent of developing-country refuse might potentially be reprocessed through SCWRIs although no more than 3 to 5 per cent is currently reprocessed. The remaining fraction is primarily composed of organic materials and can be composted. Most efforts to produce compost have proved to be 2 to 4 times as expensive as landfill and have rarely been financially compensating. Past efforts at producing compost have been based on centralized plants and, lacking demand from the agricultural sector, have generated large amounts of unsold compost. While the ratio of the waste that might be reprocessed through SCWRIs and that which might be composted at present amounts to 35/65, it will, with development, increase steadily until it reaches some 80/20 as is the present case with developed countries.

SCWRIs form part of an ever-expanding urban informal sector that has existed in many countries for several centuries. The fact that they operate without formal permits and get no social security has led them to be designated as "illegal" and they have, therefore, been deprived access to both credit and markets. Government views of the informal sector have, however, changed over a period of time from one of ignoring their existence to actively encouraging and supporting micro-industries. Unable to arrest and stem their growth and acknowledging the increasing contribution that the informal sector makes to the urban economy, governments and non-governmental organizations are seeking ways in which to integrate those involved into the mainstream of the urban economy. For example, while the modern, formal sector in Latin America grew by only 2 per cent from 1980 to 1985, the urban informal sector is thought to have grown by close to 7 per cent. In Africa, it is estimated that about 20 per cent of total output is produced through the informal sector which in turn absorbs over 20 per cent of the total labour force. Both proportions of labour and outputs in Africa are projected to rise over time. As natural population increase and pressure on land continue to fuel urbanization and spawn a surplus labour force, more and

more people will seek employment in the informal sector as a means of surviving. The development of future waste management programmes based on waste recycling could serve to absorb an increasing proportion of this surplus labour force.

---

## A FRAMEWORK FOR ENHANCED WASTE RECYCLING

---

Waste recycling must be founded on the collection and reprocessing of source-separated materials. Unlike industrialized countries, where waste recycling is motivated by environmental consciousness and is, therefore, to a large extent voluntary, in developing countries, socioeconomic conditions are such that for waste recycling to be widely adopted it must be financially compensating and all those involved in the waste recycling chain must receive some return for their effort. Where returns are insufficient to interest one group, it must be targeted at an alternative group. For example, if the householder has little interest in segregating wastes for sale, it might interest school children or even domestic staff to do so. Waste-recycling programmes will, therefore, need to be targeted at the group that is most likely to cooperate.

Based on the premise of financially-motivated waste recycling, a comprehensive resource-efficient approach to solid waste management will need to separate the organic fraction (primarily food wastes) from the inorganic fraction into two mutually exclusive recycling channels. While most, if not all, of the inorganic fraction could be purchased by used-material merchants and reprocessed through SCWRIs, the organic fraction would need to be converted in-situ into compost. Except in multi-storey housing estates, such in-situ composting could help reduce the waste stream by half. Today, city authorities are obliged to return to collect the wastes from each house once every two or three days by virtue of the fact that in warm climates the organic fraction of the refuse undergoes rapid decomposition. If a suitable on-site composter could be developed which is capable of accumulating and converting the organic wastes generated over a period of 1 month, then the city authorities would only need to visit each house once every one or two months. Such a composter should be capable of ensuring aerobic decomposition of the wastes and will be similar to ones now commercially available for garden wastes. UNCHS (Habitat) is currently developing such an insect-proof, aerobic composter.

Consistent with the financially-motivated waste-recycling principle, city authorities could, with the avoided expenses of a less frequent collection interval, purchase the compost from the householders. The compost thus produced could either be sold or applied on green areas and in open-urban agriculture. The quality of the purchased compost could be controlled through further reprocessing and blending with nutrients at a central plant prior to application. Much of the purchasing and reprocessing of the compost could be privatized in much the same way as the inorganic fraction is purchased and reprocessed through SCWRIs.

## STRATEGIES FOR PROMOTING WASTE RECYCLING

A variety of strategies could be adopted to promote waste recycling and reuse in developing countries. Some of these are discussed in detail elsewhere.<sup>4</sup> The extent to which these other strategies could be applied to enhance waste recycling within the framework set out in this paper is given below and is by no means exhaustive.

(a) Application of user charges: Foremost among the strategies to encourage waste recycling is the application of user charges for waste services that reflect the marginal cost of providing the service. One of the problems in the past has been the inability to levy such charges based on volumes generated which has, in the main, been confined to a flat-rate user fee or municipal tax. Those using the service have, therefore, had little incentive to reduce the quantity of waste they generate. Recently, however, some advances have been made in levying volumetric charges for waste services and where these have been applied, reductions in waste generation by between 25 and 50 per cent have been achieved. Various volumetric user-charge mechanisms such as the pay-per-bag, or charge-per-can have proved successful in various cities in the United States. A sticker purchased from city authorities is attached to any standard domestic waste-storage container or bag intended for municipal collection at the curbside. Most of the reductions achieved by these tariff systems were attributed to the separation and recycling of glass, paper and cans.

(b) Supporting resource segregation and recovery: Much can be done by municipal authorities to enable used-materials merchants to service given areas of the city. Some form of subsidy might even be provided from the avoided cost of collecting and disposing of that proportion of the total waste the merchants handle. The operation might also be privatized and waste-collection zones allocated to individual companies on competitive bidding. Alternatively, local authorities could support and upgrade scavengers to used-material merchants by providing them with uniforms and identity-cards to service given areas within the city and even create buy-back centres to purchase the materials they collect from households. Ideally, however, the whole operation should be run with the least involvement of municipal authorities on a self-financing basis. The use of deposit-refund systems when pegged at appropriate levels continues to lead to over 80 per cent return rates in most countries. This system is most appropriate for beverage containers. In addition, public education campaigns, voluntary or mandatory recycling targets and the allocation of central-government transfers to local authorities based on recycling targets can all serve to encourage both local authorities and individuals to recycle wastes.

(c) Supporting resource reprocessing: Much can be done to support the creation and expansion of SCWRIs. The provision of investment grants, soft loans and even tax reliefs to create SCWRIs could expand the number of industries able to absorb and reprocess the wastes. Where demand for used materials is increased, those engaged in

recovering wastes will be able to demand higher prices which, in turn, will increase the economic viability of waste recycling and reinforce the process of resource conservation. Much can also be done to create waste reprocessing cooperatives and community groups within low-income settlements. The extension of financial and technical assistance could further strengthen reprocessing. National governments could also require manufacturers and importers to use recovered materials to conserve resources, alleviate shortages and reduce adverse impacts on the environment. In the Republic of Korea, the Waste Plastics Recovery Law requires recycling of waste plastics by the appropriate corporation. Much could also be done to modify prohibitory regulations to permit the use of salvaged materials in production.

## CONCLUSIONS

Current trends in municipal waste generation in developing countries indicate that solid-waste-service coverage and quality are both destined to decrease and lead to increasing adverse impacts on both the environment and human health. Developing countries are also increasingly destined to become a consumer society which, in turn, could undermine sustainable development. Resource-efficient waste management presents an eminent approach to reversing these trends and reconciling development with environmental protection. Financially-motivated waste recycling through in-situ compost production and the channelling and reprocessing of wastes through small-scale cottage-based recycling industries are two ways in which this might be achieved.

## REFERENCES

1. United Nations Conference on Environment and Development (UNCED), *"Environmentally sound management of solid wastes" and sewage related issues: Background, document*. (A/Conf.151/PC/76), (Geneva, August 1991).
2. Asian Development Bank, *Manila Metropolitan Region Environmental Improvement Study*, Report T.A. No. 1057-PHI (Manila, April 1990).
3. Pollock, C., *Mining Urban Wastes: The Potential for Recycling*, World Watch Report No. 76, (Washington, D.C., 1987).
4. Bartone, C.R., *Economic and Policy Issues in Resource Recovery from Municipal Solid Wastes*, Resources, Conservation and Recycling, No.4, (Pergamon Press, 1990).
5. Bernstein, J.D., *Alternative Approaches to Pollution Control and Waste Management: Regulatory and Economic Instruments*, UNDP/World Bank/UNCHS (Habitat), Urban Management Programme, (Washington, D.C., 1991).