



Small-scale urban organic waste recovery

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ON REQUEST OF the Undugu Society of Kenya (USK) a comprehensive research was carried out (1991-1993) addressing both problems of unemployment and uncollected waste in low-income areas. Focussing on resource recovery, the research covered the great variety of products made, markets covered and technologies used by small-scale enterprises in six cities in the South. WASTE Consultants has coordinated this research project, whereas the research itself was carried out by consultants¹ in the following six cities: Manila, Calcutta, Cairo, Nairobi, Bamako and Accra.

This paper is based on their findings, on field visits and additional literature and deals specifically with the recovery of organic waste, which was one of the ten materials researched². The paper will focus on small-scale recovery methods of urban organic waste and describes three examples from Bamako, Cairo and Manila. It will also deal with economic feasibility, environmental and health aspects, possible measures for improvement and the role of government authorities.

Background

In many cities in low- and middle-income countries, the municipal refuse collection and disposal services are woefully inadequate and thus, waste accumulates in the streets and at transfer stations. A large proportion of urban waste consists of organic material, which therefore forms an interesting source for recovery. It may offer ample opportunities not only for the improvement of environmental and health conditions but also for employment generation.

All over the world, municipal authorities have started initiatives in this area, the most important being composting. However, large-scale installations have been purchased that were often too expensive, too complicated, and not tailored to local conditions. The construction and operating costs of these highly mechanized facilities were often higher than the revenue received from the sale of compost. Consequently, some facilities have been closed down, others have been scaled down, and many operate well below their planned capacities. A tentative conclusion is that in the urban areas of economically less developed countries, large-scale reprocessing of organic waste is undergoing a crisis. Already existing and new small-scale recovery opportunities could therefore provide valuable ingredients for an alternative strategy.

Organic waste can be the basis for many diverse activities. Basically, organic material can be reused in three

ways: to improve the soil (compost), to feed animals (fodder) and to produce energy (briquettes, biogas). The direct reuse of organic waste as fuel for cooking in the home is quite common. Woody residues such as coconut shells are frequently used when conventional fuels are either too expensive or difficult to get hold of. To achieve a more efficient use of existing organic waste resources, experiments are carried out with briquetting, which involves the compressing of combustible materials into a solid fuel product that can be burned like wood or charcoal. Another way of converting waste into energy is anaerobic digestion whereby not only energy in the form of biogas is produced, but also compost. Experiments are currently under way to study the anaerobic digestion of municipal organic waste in reactor systems. However, at the moment these are not profitable activities. In terms of providing a source of income for small and micro-entrepreneurs, the first two opportunities (the use of organic waste as compost and as fodder) are already practised to a certain extent.

Economic feasibility

The recovery of organic waste differs from the reprocessing of other waste materials such as plastics and rubber in that the latter have proven their economic profitability in small-scale enterprises: in Asian cities hundreds of such micro-enterprises exist. In general, organic waste reprocessing does not take place at such an extended scale; only animal raising as income-generating activity is carried out by many entrepreneurs, although on a part-time basis. We will now give a few examples of feasible small-scale enterprises reprocessing organic waste:

Bamako: compost making

In Bamako, Mali, municipal solid waste is decomposing via natural processes. Micro-entrepreneurs exploit this free source of raw organic material. When the garbage is delivered to the dump, it is stacked into piles which are left to decompose. The process is not controlled, and the piles remain undisturbed for an indefinite period. Using relatively simple tools (sieves, spades, brooms, pushcarts) the entrepreneurs manage to produce fine compost by sieving out the impurities and non-organic materials. They earn about three times the minimum wage, also due to the absence of transportation costs. The resulting compost has a good appearance and is almost free of visible foreign matter. The regular supply, the low price and the proven quality of this soil conditioner have created a high

demand, particularly from vegetable farmers in the peri-urban areas.

Manila: pig raising

One of the simplest ways to recover the value of organic waste material, is to feed it to animals. In the outskirts of Manila, the Philippines, pig raising is a popular backyard operation. Commercial animal feed is substituted with organic waste, which costs less than 50% of commercial feed. Pig raisers collect the organic waste on a daily basis from restaurants in the city centre. The use of organic waste as pig feed reduces production costs considerably: it doubles the net profit per production cycle of 3.5 months. Given that pig raising is a part-time activity, the earnings per day are reasonable compared to the minimum wage level.

Cairo: pig raising and co-composting

The Zabbaleen, a marginalized group of Coptic Christians in the predominantly Islamic society of Cairo, survive through the resource recovery of various waste fractions. They earn their daily income by collecting relatively high-value waste from middle- and high-income areas of the city. Valuable materials, such as plastic and paper are sorted and reprocessed in a large number of micro-enterprises. The Zabbaleen also raise pigs on the organic material they find in the refuse in so-called *zeribas*, or enclosed courtyards. Once or twice a year the *zeribas* are cleaned and the mixture of leftovers and pig manure is carried on donkey carts to the composting plant. Normally, the plant processes 30 tonnes of compost per shift per day. During the season when land is prepared for cultivation (November to February) output is doubled by working two shifts per day. The compost is sold mostly to farmers within a radius of 100 150 km around Cairo, who also pay the transport costs. The operating costs and also part of some welfare projects are paid for from the sale of the compost.

However, not all organic waste reprocessing activities are cost-effective. One of the bottle-necks in organic waste processing is the marketing of end products, among others the marketing of compost. High transportation costs limit the use of compost to the surrounding areas of the city. Urban agriculture could be an option for the application of large amounts of organic waste. Links could be sought with the many urban women who grow and market vegetables. Urban 'greening', that is, supplying green areas (e.g. parks) for the improvement of living conditions, also offers possibilities for the application of compost. So far, these issues have not yet received the attention they deserve and their potential is hardly utilized, also because of the negative image of urban waste.

There is a conflict between the financial constraints and the ecological advantages of resource recovery of organic waste material. Large-scale composting activities, also in industrialized countries, have shown that environmental benefits are more realistic targets than economic feasibility.

The question is whether compost production and organic waste recovery in general should be seen as a way to secure profits or rather as a contribution to social and ecological improvements. Organic waste recovery reduces the overall volume of solid waste that needs to be disposed of in sanitary landfills, thus reducing transportation and disposal costs. These so-called opportunity savings could be used to subsidize recovery initiatives to a certain extent.

The improvement of working conditions and the environment

Although the recovery of organic waste has many beneficial aspects, including ecological ones, the reprocessing methods themselves are not always environmentally sound and may pose health hazards to the workers and to the inhabitants, since small-scale, informal activities are often carried out within crowded residential areas.

In urban areas, livestock rearing presents a number of health risks, not only because human diseases can be spread through the waste, but also because of the unsanitary conditions created within residential areas. For these reasons, and because of the foul odours that are often generated, the practice of animal raising is sometimes forbidden in city centres. These considerations pose a dilemma as to whether livestock rearing should be encouraged or not. However, environmental risks should also be seen in relation to the local circumstances. It is of little use to improve living conditions considerably or thus to forbid certain activities, when citizens struggle for their survival and lack access to basic services, such as adequate water and sanitation supplies.

In the centre of Manila, for example, backyard pig raising was once widespread, but as the population grew and space became scarcer, the practice was prohibited. The activity has now been displaced from the centre to the surrounding neighbourhoods, and the number of backyard pig breeders increases with the distance from the centre of Manila. Another option is to attempt to prevent or reduce the risk of environmental and health problems, for example by immediately recycling animal waste into agricultural production, but this again, depends on local circumstances.

Animal raising as carried out in urban areas such as Manila also generates new waste, since the untreated manure is usually allowed to drain into the environment. In Cairo, however, the Zabbaleen take solid pig manure to the nearby composting plant where the mixture of manure and organic waste is sold as compost. The health of the animals is checked at the neighbouring veterinary clinic of GAMEYA (the Association of Garbage Collectors).

Another example of a possible negative side-effect constitutes the quality of the compost. In 1991, a chemical analysis of the compost produced at the plant in Cairo showed that it fell well below European safety standards;

it contained high levels of zinc and lead, and even dangerous levels of cadmium. It was assumed that the organic waste was being contaminated by mixing with non-organic, sometimes hazardous waste (such as household batteries) during storage and collection. Efforts are now being made to avoid this contamination. In an experimental project, 600 households are separating their organic and non-organic refuse before it is collected by the Zabbaleen. The resulting health and efficiency effects on the participating Zabbaleen community, the men who collect the waste and the women who sort the waste in their backyards, as well as the quality of the compost are being monitored. The refuse segregation into dry (non-organic) and wet (organic) fractions could make the Zabbaleens' job easier and less dirty, while they may fetch higher prices for the cleaner 'raw materials'. Improvements, such as separation at source but also precautionary measures for the workers, like the need for protective clothing and face masks, should be taken into consideration as much as possible.

Towards integrated waste management systems

The reuse of organic material as animal or fish feed, compost or fuel can contribute to the solution of urban problems such as the need for income-generating employment opportunities, food production, the lack of adequate waste disposal sites, energy supplies, and maintaining environmental quality. In managing waste collection and disposal systems, these benefits should be taken into account and the various recycling possibilities should be incorporated on both the implementation and policy level.

Resource recovery and utilization are essential elements in any effort to achieve a sustainable level of waste management. Enhancing the recovery of organic waste can restore various natural cycles, thus preventing the loss of raw materials, energy and nutrients. An example of an integrated system of urban waste recovery is the multiple use made of waste at a dumpsite in Calcutta. Figure 1 indicates the various cycles of nutrients and the optimal use that is made of the various waste resources. Organic waste is used both for animal fodder and for growing vegetables. Sewage water flows into fish ponds and the effluent is used as irrigation water.

The waste recovery system as it is operated by the Zabbaleen in Cairo, including pig raising on organic waste, co-composting of pig manure and garbage and reprocessing of other waste materials such as paper and plastics, is another example of the integrated reuse of organic waste. Both systems, however, could be improved in terms of product quality and working and living conditions.

Waste treatment near the source of generation and separation at source could be other elements of an integrated approach and an important means of preventing the shift of environmental problems to adjacent urban areas, to urban fringes, to more remote places or to future generations. Composting, at household as well as at neighbourhood level, could be part of such a strategy.

Appropriate technology

Until now, transfer of technology has mainly taken place from the industrialized countries to the economically less developed ones, although most of the time these technologies were not directly applicable. The type and com-



Figure 1. Ecological system of urban waste recovery in Eastern Wetlands of Calcutta.

Source: Furedy and Ghose³.

position of waste, the lack of capital and specific technical know-how, the need for employment generation, the existence of a large informal waste collection sector and cultural attitudes are far from all the aspects that should be considered when developing a sustainable solid waste recovery system in low- and middle-income countries.

Efforts to simply transfer reprocessing techniques based on high-cost equipment should therefore be discouraged. At the same time, one should remain alert to valuable know-how and technologies that could be of use to economically less developed countries. Reprocessing techniques and methodologies, such as forced aeration systems or separation at source that are applied in industrialized countries may provide an option if the aforementioned aspects have been taken into account in the feasibility studies that precede the choice of technology. Transfer of technology consists of more than just technical solutions; a number of financial and social problems should also be solved.

Rather than copying waste management systems that work in the affluent societies of Europe and North-America, countries in Africa and Asia could also look for successful approaches in their own countries. The exchange of ideas, adapted technologies and approaches through a so-called South-South exchange (for example, between Asian and African countries) probably offers more opportunities, and has as yet, not received the attention it deserves.

Many initiatives have been undertaken and many experiments have been carried out in the field of organic waste recovery.

Some activities can indeed serve as examples for other non-governmental initiatives and local government bodies who would like to establish a more appropriate solid waste management system while improving the livelihood of a large number of entrepreneurs involved in waste recovery activities, and are indeed worth being adapted to local circumstances and conditions.

Private initiatives and the role of public authorities

The viability of resource recovery systems depends upon a number of important technical, socio-economic and political relationships. Macro-economic influences such as prices on the international market and trading policies, government policies such as import regulations, and municipal policies also affect the level of resource recovery that will be feasible. For example, the reuse of organic material as an organic fertilizer can reduce the country's dependence on imported fertilizers. However, if chemical fertilizers are cheaper because of government subsidies, farmers are likely to be less interested in using locally produced organic waste as a soil conditioner.

In the past, many municipalities opted for capital-intensive solutions to the waste problem, such as buying large-scale mechanical composting plants rather than

developing small-scale, low-tech and low-cost approaches. This is not surprising, since the installation of a plant is an easy decision for a city council, especially if it is offered as a gift or on low-interest financing under a bilateral aid agreement. Also, a people-centred approach requires much more elaborate and decentralized decision-making and coordination. Donor agencies may also play an important role in this process in that they often push certain technologies developed in their own countries, for example compactor trucks or mechanical composting systems.

For various reasons, informal resource recovery, either by micro-entrepreneurs or by communities, has not received the support it deserves. In low-income countries in particular, where unregulated dumping is usually the cheapest means of waste disposing, activities in this field are poorly stimulated and supported by local and national governments. Sometimes municipal policies (deliberately or accidentally) undermine small-scale recovery activities. Different methods of waste treatment and disposal have to be compared, not only in terms of their ecological benefits and economic output, but also of their impact on the less privileged.

A prerequisite for well-functioning organic waste recovery activities is the cooperation between government and private initiator. The wave of democratization processes all over the world facilitates the cooperation between public authorities and private initiatives. This is clearly shown by the Bamako case. Micro-entrepreneurs not only make and sell compost at the dump sites, but several private enterprises and non-governmental organizations have also started waste collection and treatment services. However, to maintain public health and environmental standards the final responsibility (e.g. legislation, coordination and control of private services) for waste collection, treatment and disposal should rest with the government.

Some issues that governments could address, depending on their resources and responsibilities, include:

- facilitating the composting of organic waste and other resource recovery processes;
- stimulating the development and implementation of appropriate technologies for organic waste treatment;
- recognizing and integrating the existing informal recycling networks within municipal solid waste management systems;
- formulating policies to protect and encourage the horizontal growth of small-scale resource recovery initiatives;
- creating legal frameworks and controlling mechanisms that will enhance safety in the working place as well as protect the environment;
- stimulating urban agriculture and the 'greening' of cities;
- encouraging the separation of waste fractions at source;
- developing educational material for public information and awareness raising campaigns.

The problem in introducing small-scale resource recovery modules that can contribute to sustainable waste management systems is more a matter of perception than of technology. It requires interdisciplinary cooperation at several levels among various actors, such as municipal and national governments, non-governmental initiators (varying from welfare to women and environmental organizations), research institutes, scholars, community representatives and so on.

Many questions are still to be answered, such as how small-scale resource recovery activities can be optimized under local circumstances and best fit in a broader perspective on waste management. But from the practical experiences gained all over the world, important lessons can be learnt and decisive steps in the adequate direction can be taken.

Linking the insufficient municipal cleansing services to the informal sector services, especially in the field of organic waste reprocessing, could provide a considerable contribution towards urban solid waste removal. The informal sector definitely makes a contribution to a healthy living environment in cities by reutilizing waste materials, since the reuse of organic waste helps to prevent environmental degradation and pollution. Many people

depend for their survival on the jobs provided in this sector. Also, organic waste recovery may save foreign currency and natural resources, particularly in the form of raw materials and energy. So, by integrating small-scale organic waste recovery activities in the municipal waste management system, savings can be realized, more employment can be generated and environmental and health conditions can be improved.

1. These consultants are: EQI/Cairo, AUC/Cairo, Undugu Society/Nairobi, Ptr/Calcutta, CAPS/Manila, ABP/Ghana and GERAD/Bamako.
2. A complete overview of the results can be found in 'Organic Waste; options for small-scale resource recovery', which is the first publication in the Urban Solid Waste Series. The book can be ordered from TOOL, Sarphatistraat 650, 1018 AV Amsterdam, The Netherlands. Forthcoming publications are: 'Plastics Waste', 'Rubber Waste' and 'Hazardous Waste'.
3. Furedy, C. and D. Ghose. Resource conserving traditions and the creative use of urban wastes: the sewage-fed fisheries and garbage farms of Calcutta. *Conservation and Recycling*, Vol. 7 (2 4), 1984.