Urban Waste and Rural Soil Management

Making the Connection

As urban communities face increasing congestion, more and more fresh water and a range of solid materials are required to satisfy the daily needs of people and industry.

This trend is especially true in developing countries, where urban populations are expected to triple by 2025. Management of municipal wastes poses many problems in these growing urban centers. Waste management is a labor- and capital-intensive function that often consumes 20 to 50 percent of a municipal operating budget. Financing waste management is a major problem for municipalities that are faced with chronic resource shortages and competing demands. As a consequence, waste management in many cities fails to meet minimum acceptable standards, with grave adverse effects on the urban environment, public health, and the quality of life for large numbers of city dwellers, especially poorer people living in these highly congested areas. (see graph below)

Indiscriminate dumping of liquid and solid wastes pollutes soil and water and damages the economy and public health.

Using Urban Waste

Expanding populations require more food. Until recently, use of higher yielding crops and livestock and expanded agricultural areas provided most of the necessary increases, but now most productive land is already in use. Higher yielding crop varieties require good soils, but many farmers are forced to use mediocre land without the means to purchase inputs to maintain soil fertility. In many areas livestock make the major contribution to soil fertility, but some areas are not able to sustain livestock in numbers that would significantly benefit soil fertility.

Linking waste to soil. One solution is to use urban waste to improve rural soils, especially in peri-urban areas. The benefits of such programs can be demonstrated, either as a free-standing intervention, or in conjunction with other soil improving efforts such as the use of fertilizer and various land conservation techniques.

A well designed and cost-effective waste management system, based on resource recovery and recycling technologies as well as reuse of wastewater, can produce substantial social and economic benefits. Processors of raw materials are reusing discarded products made from metals, glass, plastics, and paper, an approach that needs to be expanded. In addition, large quantities of organic materials can be composted instead of polluting rivers and lakes or ending up in landfills. The same principle applies to wastewater. Rather than paying for secondary or tertiary treatment, the water can be used for irrigation or aquaculture. The economics of these alternative approaches is a necessary part of the decisionmaking process, but when total costs are considered — health, pollution, landfill, and incinerator costs — these options begin to make sense (see graph above).
Managing waste. Liquid wastes from a city sewer system that are destined for reuse are usually processed in a wastewater plant, while solids are composted. These processes produce water, sludge (which can be dried or composted), and compost. As concerns about water quality increase, more sewage waste products are applied to agricultural lands (see large box, page 3).

Composting is the controlled, biological decomposition of organic materials into a stable humus-like product that can be handled, stored, and applied to land without adversely affecting the environment. Compost is an excellent organic soil amendment that improves soil moisture retention and increases biological activity, thereby improving soil productivity.

Recycling experience. Recycling waste for agriculture is by no means new. Well-known examples include use of city waste in peanut growing systems on the Kano plains of Nigeria, use of nightsoil in China, and ‘sewage farms’ around European cities during the 19th century. More recently, city waste improves soil in the Netherlands (see box, right); urban wastewater is used in many parts of the U.S., Israel, and Jordan; and abattoir waste produces methane and compost in Senegal (see small box, page 3). The Calcutta sewage fisheries system is the largest single wastewater system involving aquaculture, with 4,600 hectares of sewage-fed fish ponds employing 4,000 families (Pescod 1992).

Issues and Policies

Widespread adoption of recycling technologies has been hindered by undeveloped markets, transportation costs, health and cultural issues, and inadequate regulations. But the primary barrier is that the potential benefits are not adequately taken into account by urban planners, sanitary engineers and farmers. Waste handling has focused on landfills and incinerators, while inorganic fertilizer and fresh water are the primary inputs used to meet the needs for soil nutrients and irrigation water. Both sides could benefit from closer cooperation, and urban and agricultural policies can significantly affect the acceptance of urban waste in agriculture (see large box, page 3).

The Dutch VAM example

In the 19th century, the Dutch dried their swamps and harvested the peat for fuel, leaving sandy bottom land. They then developed a scheme to improve these sandy areas, dalgronden, by mixing in urban waste that was transported by train from western Holland 100 miles away. This system worked well in the early 20th century when city waste was mainly organic, but more complex handling became necessary in the second part of the century as more and more inorganic waste and plastics were mixed in. The parastatal company VAM now has a sophisticated waste handling, sorting, and composting facility, and sells its products (such as high quality compost) on the open market.

Technology. The current, limited use of waste in agriculture has been mostly beneficial, but there are some potential detrimental effects, usually closely related to either the quality of the raw material, its processing, or both. The level and type of treatment varies, as does cost (see box, page 4, left). Composting technologies have improved greatly in recent years and provide better quality compost with increased acceptability. In California, growers add compost to build up soil organic matter — high quality compost is widely used in horticulture, seedling production, and general agriculture, while lower quality material is used in city parks and to stabilize land. Sludge and compost add nutrients and organic matter to the soil, improve water retention and transmission, and improve soil structure.

Public health concerns. Disposal of municipal waste by land application has been a popular option for centuries from northern Nigeria to China and beyond. While generally successful, there is evidence that irrigation with untreated municipal and industrial waste can harm crops as well as humans, either those living in the area or those who consume the products. These risks can be resolved by preventing pollutants from accumulating in the soil, taking advantage of the soil’s capacity to assimilate and detoxify pollutants, and determining optimal levels of safe application. Specific attention needs to be given to the risks associated with transfer of human pathogens.

Standards. A mature waste management industry will develop overall quality standards for both processes and products. Process standards often relate to odor control and prevention of air and groundwater contamination, while quality standards are necessary to control pathogens and toxic materials and produce a homogeneous product that maintains its value. To realize the full benefits of compost in the soil, it is crucial to use a proven method. As with commercial fertilizers, the compost must be of high quality to be effective. Methodologies for quality indicators for
**New income stream for Senegal abattoirs**

Since 1990, a project in Thiès supported by French and Senegalese government agencies has demonstrated significant economic and environmental benefits from channeling slaughterhouse wastes into continuous methane- and compost-generation. Despite the project's nearly 25% annual return on a $250,000 investment, creating the public/private partnership necessary to operate on a commercial basis faces institutional and management constraints. The key challenge is coordination of the slaughterhouse production of compost with companies skilled in growing high-value crops such as tomatoes and melons from compost ball seedlings. Another current challenge is to apply the lessons learned in the pilot project in Thiès to larger abattoirs.

Compost are now being developed (Bidingmaier and Maile 1996).

**Marketing.** A key step in the development of sustainable waste management is marketing the final product. Products can be compost, treated sludge, or more advanced products such as alkaline-stabilized sludge in the U.K., compost enriched with fertilizer in Haiti, and seedlings grown on compost in Senegal. There are a number of companies specializing in treatment and sale of (urban) waste for agricultural uses such as N-viro and Ecosci (U.K.) or Milorganite (U.S.). In some other countries, waste is directly marketed by municipal waste management facilities. (see box, page 4, right).

**Implementation in Bank Projects**

At the policy level, Bank staff and counterparts should evaluate whether agricultural, environmental, and urban policies are conducive to recycling in general, as well as to recycling waste for agriculture. This approach will likely require building bridges between sectors and fostering complementarity. Modern agriculture is still associated with extensive fertilizer use rather than with a mix of commercial fertilizer and organics, and there is little appreciation for the benefits of using such a combination.

**Policies that may influence the use of waste in agriculture**

**Multisector policies**
- Integrated, multisectoral policies and framework for waste and water management
- Well defined reuse priorities and strategies recognizing the need to protect human health
- Link urban waste management to agriculture, especially to fertilizer and other input suppliers

**Urban policies — limiting**
- Subsidized landfills and incineration
- Lack of or below-cost water charges
- Lack of (clean) water laws and regulation of sewage treatment and disposal

**Urban policies — stimulating**
- Promotional and support activities — public education, voluntary or mandatory recycling targets, liaison with private sector
- Incentives for engaging in resource recovery technical assistance, tax credits, surcharges on land fills, sound environmental regulations
- Incentives to stimulate marketing of recovered material — information, tax credits

Success in fostering such appreciation can lead to project level initiatives that recognize the environmental and economic benefits of using urban waste in agriculture. Greater collaboration among Bank staff in different sectors is necessary to identify these projects — urban waste project planners may need to consult agricultural technical staff, while agricultural planners may benefit from the expertise of urban waste managers. Essential in this effort is the integration of the private sector in the collection and recycling of waste, and marketing the final product.

Most experience in the Bank involves use of wastewater based on long-term experience of the UNDP/World Bank Water and Sanitation Group. Innovative, smaller-scale interventions (such as the Senegal example) could be suggested for agricultural as well as urban projects, either as pilots or as an integral project component. Based on experience in both developed and developing countries, the best opportunities to use compost exist in peri-urban areas where higher value vegetable and horticulture crops are grown — transportation costs are lower and enhanced productivity has been demonstrated. The time is right to make these practices universal.
### Nutrient content and value of sludge and compost

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<thead>
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<th></th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potash</th>
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<tbody>
<tr>
<td><strong>Sludge</strong></td>
<td></td>
<td></td>
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<tr>
<td>Nutrient content (%)</td>
<td>1.0-6.0</td>
<td>0.8-6.1</td>
<td>0.5-5.0</td>
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<tr>
<td><strong>Compost</strong></td>
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<tr>
<td>Nutrient content (%)</td>
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<td>1.0-2.0</td>
<td>2.0-4.0</td>
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<tr>
<td>Approx. nutrient content (kg/ton)</td>
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<td>25.0</td>
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<tr>
<td>Approx. value of nutrient (US$/ton)</td>
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<td>6.50</td>
<td>7.50</td>
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</tbody>
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### Keys to market development

- Product must be clean (no pathogens, glass, plastics, heavy metals, etc.)
- Strict quality control to ensure product consistency
- Properties and quality of the product must be understood by producer and user, and where possible, should be tailored to the users
- Regular supply of raw product

### Cultural considerations and environmental impact

- Cultural considerations are shifting from a ‘throw away’ to a ‘recycling’ approach;
- Land for conventional waste disposal is becoming scarce;
- Conventional disposal methods are expensive and/or socially or environmentally unacceptable;
- Use of organics to sustain soil productivity is experiencing a resurgence; and
- Planners and politicians are being pressured to make better use of fresh water.

A shift in policies and technologies to make better use of urban waste will benefit the environment, economy, agriculture, and rural and social development. New partnerships must be forged among local governments, private industry, farmers, and development institutions to champion this effort.

### References and Readings