Integrated Sustainable Waste Management: the selection of appropriate technologies and the design of sustainable systems is not (only) a technical issue

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ABSTRACT:

This paper presents the concept of Integrated Sustainable Waste Management (ISWM)[1], in the context of the selection of technologies and the design of systems for waste management. ISWM differs from the conventional approach towards waste management by seeking stakeholder participation, covering waste prevention and resource recovery, including interactions with other systems and promoting an integration of different habitat scales (city, neighbourhood, household). The principles and mechanisms of ISWM are explained and their relevance for the technology selection and system design are outlined. It is emphasised that waste management is not a purely technical issue, but that other aspects need to be taken into account, while selecting a technology or designing a system, the political factor being the most important. Needs for future research to further develop the concept of ISWM are indicated, including identifying criteria for sustainability and defining weighting procedures.

[1] The concept of ISWM has been developed by WASTE, Advisers on Urban Environment and Development, and has first been presented in 1995 during the UMP Workshop on Municipal Solid Waste Management in Ittingen, Switzerland. The concept presented is not a final product; it builds continuously on new insights and experiences.

CHAPTER 1 INTRODUCTION

As the CEDARE/IETC Workshop focuses on 'technologies for sustainable waste management' it seems relevant to spend some thoughts on the concept of technology itself. What is technology? Technology, as the International Environmental Technology Centre (IETC) of the United Nations Environmental Protection agency (UNEP) puts it, includes both 'hardware' and software' components. It refers not only to equipment, goods, services and related know-how but also to organisational and managerial procedures (from Chapter 34 of Agenda 21, UNCED Conference in Rio de Janeiro, Brazil, 1992, quoted in IETC, 1999). The concept of technology thus already includes more than just technical aspects, incorporating also institutional and capacity-building aspects.

What is sustainable technology for waste management?
That depends on how the word 'sustainable' is interpreted. Waste management technology choices can be restricted to technical requirements like waste quantities and composition, area characteristics, haul distances to the disposal site and operational cost. It may be interpreted broader, including economic conditions, the cost of labour and capital (interest rates, etc.), maintenance and repair capacity, and skill levels of existing staff.
Still a wider perspective can be taken looking at the whole waste management system, including waste prevention and resource recovery and searching for a system that best suits the society, economy and environment in question. Such is the ISWM framework, as will be pointed out in section 3.

CHAPTER 2 REASONS WHY WASTE MANAGEMENT IS NOT (ONLY) A TECHNICAL ISSUE

As was demonstrated by the narrow approach above, waste management is often considered to be mainly a technical issue. However, numerous cases are known nowadays of technologies that appeared to be unsustainable in the given society, economy and environment, because the approach taken was too much focused on the technical aspects.

A few examples will underline this point. They draw upon extensive experiences with solid waste management in developing countries.

- It used to be quite common for city councils in some developing countries to finance the purchase of new refuse collection equipment with medium- to long-term loans (up to 30 years) from foreign donor countries. Taking into account the fact that the average life of waste collection equipment is usually limited to 5 to 7 years and combined with a poor revenue generating capacity of the municipality (to service debts, cover operation and management costs and to replace assets), this frequently led to crippling debts for the municipality, which continued long after the equipment had become obsolete and was not used any more.
- In some countries there has been a policy of standardisation of waste collection fleets, with the obvious objective to reduce the costs of maintenance and supervision. The result has been that whole areas have been left out, because the streets were too narrow, unpaved, or sloping. These areas often happened to be low-income neighbourhoods, located at the urban fringe or in densely populated old city centres. Leaving these areas unserved (or underserved) subsequently affected environmental and public health conditions in the whole city.
- In one country a sophisticated system was introduced, using a truck with an automatic loading system to empty plastic bins, which had been placed outside by households. Unfortunately the distributed plastic bins were far too valuable for the local population and were frequently used for other purposes, such as washing clothes, bathing children, brewing beer, etc. Thus the whole system collapsed and the expensive truck had to remain in the garage, because it could not be used for manual loading.
- Political motives have often coloured technology choices. Equipment has been provided by foreign donor countries under 'tied aid' structures, usually favouring capital-intensive equipment that is not the most appropriate for waste management in many developing countries. For example this can result in the introduction of compactor trucks in developing countries, while the density (compactness) of waste there is usually already very high due to its high organic and dust content. According to some sources, capital-intensive technology is favoured by many governmental employees, because it provides more opportunities for rent seeking (Frisch, 1994, in Transparency International, 1996).

The above examples show that focusing on the technical part only is not enough for proper technology choices or the design of waste management systems: other (e.g. social, political, financial) aspects should be integrated in the analysis or decision-making process to arrive at an integrated and sustainable system. In the following paragraph we will look in more detail at the concept of Integrated Sustainable Waste Management (ISWM).

CHAPTER 3 THE CONCEPT OF INTEGRATED SUSTAINABLE WASTE MANAGEMENT (ISWM)

Before elaborating upon the concept of ISWM, it is necessary to explain the terms ‘sustainable’ and ‘integrated’.

Sustainable = a system that is:

- appropriate to the local conditions in which it operates, from a technical, social, economic, financial, institutional, and environmental perspective, and;
- capable to maintain itself over time without reducing the resources it needs

Integrated = a system that:

- uses a range of inter-related collection and treatment options, at different habitat scales (household, neighbourhood, city)
- involves all stakeholders, be they governmental or non-governmental, formal or informal, profit- or non-profit oriented
- takes into account interactions between the waste management system and other urban systems

The different habitat scales that need to be integrated are the premise, neighbourhood and city level. Table 1 below shows the solid waste management activities that can be carried out at each of these levels.

Table 1 Habitat scales and activities in an Integrated Sustainable Waste Management system

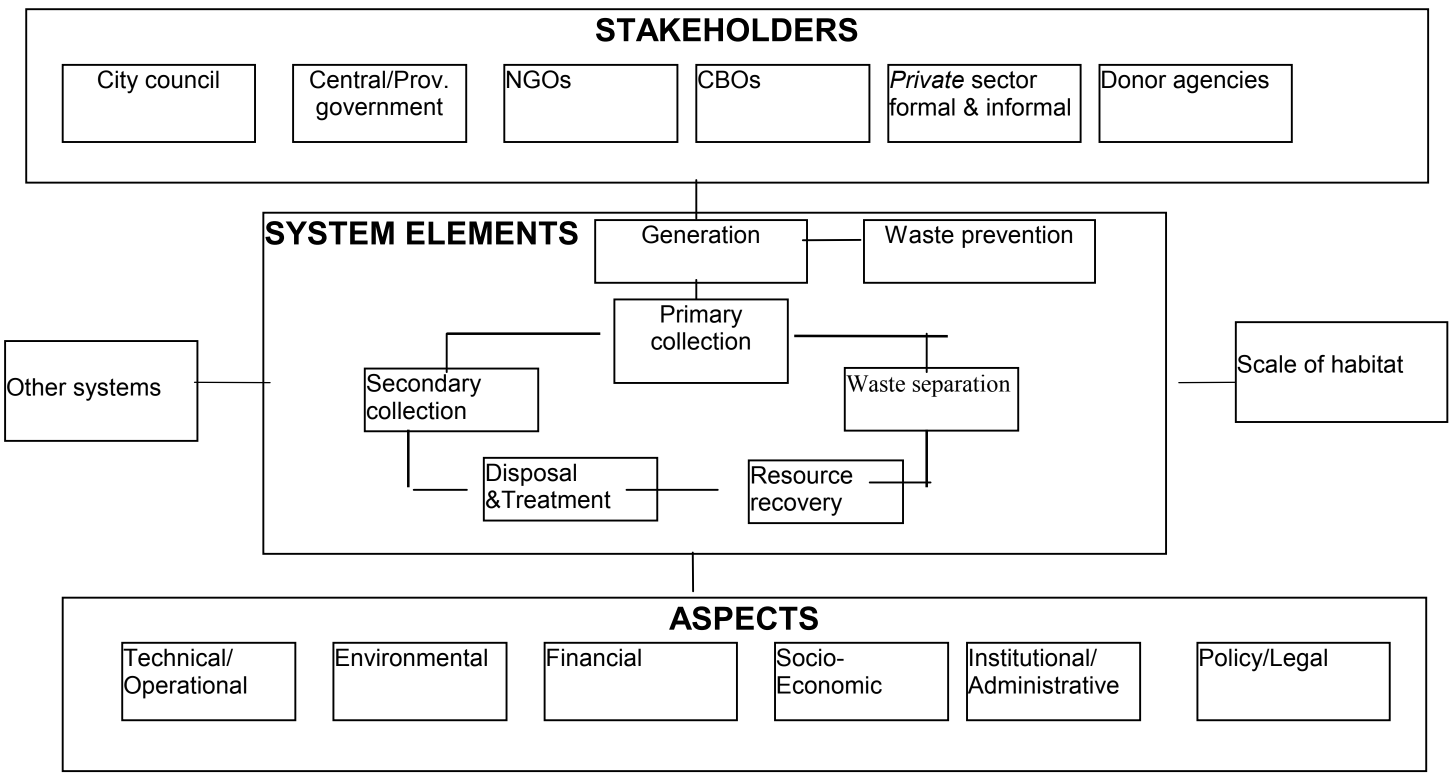
Habitat scale	Collection and disposal system	Resource recovery system
Premise level	Storage at source	Prevention Separation at source Reuse at source
Neighbourhood level	Primary collection Temporary storage	Primary collection Sorting and pre-treatment Reuse Recycling Composting
City level	Secondary collection Transfer storage Tertiary collection Final disposal and treatment	Sorting and pre-treatment Secondary collection Reuse Recycling Composting

Any ISWM system should distinguish between the habitat scales and integrate them as much as possible.

Sustainable and integrated are, in a sense, two sides of the same coin. For example using different collection and treatment options, at different habitat scales, can form the basis of a system that is adapted to local (physical, social, economic, etc.) conditions. Involvement of stakeholders is one of the pillars of sustainability of a system, leading to a feeling of responsibility for the success of the system, at least if their political and economic interests are served with the system, and a willingness to keep it going on the part of stakeholders. If waste management systems are integrated with other systems, this could enhance sustainability as well. For instance compost made from urban organic waste and applied in urban agriculture, parks etc. can lead to a closed-cycle system within the city, thereby reducing import of raw materials and goods from outside and concurrent burdens on the environment from transportation, manufacturing of chemical fertilisers, etc.

The concept of ISWM is visualised in a diagram (Figure 1) below. It shows in a highly schematic way all dimensions of ISWM: a range of stakeholders, different system elements and their interactions with other systems and habitat scales, and six different aspects of integrated sustainable waste management.

Figure 1 Dimensions of Integrated Sustainable Waste Management



ISWM is not supposed to be used as a blueprint. However, it can provide a framework for the selection of appropriate technologies for waste management and for the development of sustainable waste management systems in general, for both liquid (human) and solid waste. It can induce policy and institutional reform to promote sustainability in waste management. In addition, it can provide the basis for analysis of existing waste management systems to assess their sustainability. The concept has already been used as a guideline for the analysis of the solid waste management system in Bangalore, India (van Beukering et al., 1999). The financial aspects are expected to be adopted by the national planning authority in Indonesia and will be tested in a number of pilot projects (Hemelaar, 1999).

The aspects of ISWM will be approached below from two different sides, one aimed at basic principles, and the other aimed at means and mechanisms:

1. PRINCIPLES: What principles is a ISWM system built on? What strategic objectives should be the guideline to achieve a integrated sustainable waste management system?

2. MEANS/MECHANISMS: How can a waste management system be made sustainable and integrated? What measures need to be taken or what mechanisms need to be established to achieve this goal?

For each aspect these will be dealt with in detail.

CHAPTER 4 PRINCIPLES OF ISWM

The following principles for Integrated Sustainable Waste Management have been developed by WASTE, based on project experience and studies by different authors (Lardinois & van de Klundert, 1995, Hemelaar & Maksum, 1996, Moreno *et al*., 1999, Coffey, 1996, Schuebeler *et al*., 1996, van Beukering *et al*., 1999).

Technical/Operational principles:

Technologies and systems should be:

- adapted to the physical environment, topography and other physical requirements
- preferably locally manufactured and based on indigenous technology
- geared towards efficiency and optimum utilisation of equipment
- adapted to the local availability of spare parts
- durable and of good quality; the equipment used should have a long expected

Environmental principles:

Technologies and systems should:

- be clean, i.e. minimise the negative impact on soil, air and water at local, regional and global level
- promote closed cycle systems and avoid loss of raw materials, energy and nutrients
- follow the 'waste management hierarchy', preferring options that promote waste prevention, source separation, re-use and recycling, above those merely aimed at collection and disposal
- encourage treatment and resource recovery as close to the source as possible

Regarding the 'waste management hierarchy' it needs to be added that in developing countries a large quantity of the waste is dumped in an uncontrolled manner, or, worse, burned in the open air. These practices obviously form the lowest level of the hierarchy and they are not laudable principles to strive for (van Beukering *et al*., 1999).

Financial principles:

Financial management of technologies and systems should:

- be based on the 'all beneficiaries contribute principle', i.e. besides the waste generators paying user charges, the resource recovery sector and the local government should also contribute by respectively paying a profit tax and allocating municipal revenues to waste management
- be geared towards the most efficient overall system, leading to the lowest cost per ton to operate, taking into account the cost of other affected urban systems
- ensure highest productivity of labour and capital in the local situation
- lead to full cost analysis and full cost recovery, including all costs and benefits involved

In many developing countries it makes financial and economic sense to opt for labour-intensive rather than capital-intensive systems.

The ‘all beneficiaries contribute’ principle is a concept developed by WASTE (Hemelaar & Maksum, 1996, Hemelaar, 1999). It is used here instead of the ‘polluter pays’ principle, because in many cases cost-based tariff levels are not affordable for low-income groups. It is argued instead that all groups that benefit from the waste management system, should financially contribute to its operation and maintenance. Citizens are usually the direct users of a waste management service and benefit, because their living environment improves. The private sector involved in resource recovery and recycling benefits, because it has access to the valuable waste materials and makes profits out of these. Last but not least, the local government benefits because of reduced health care related costs and reduced costs of urban management, especially the cost of drinking water supply and treatment and of drainage (Hemelaar, 1999).

Socio-economic principles:

Technologies and systems should:

- be provided to all strata of the population regardless of ethnic, cultural, religious or social background
- minimise risks to public health
- be adapted to user demands and priorities
- be adapted to local willingness and ability to pay, leading to affordable systems
- incorporate management models which are acceptable to people and institutions involved
- be geared towards improvement of working conditions of system operators
- be geared towards income and employment generation

Note that according to these socio-economic principles any user charges introduced should be adapted to ‘ability to pay’, including for example higher charges for industrial and commercial companies, thus ensuring cross-subsidisation between high- and low-income users. Communities that are not able or willing to pay for expensive services, should be given the option of receiving a cheaper yet still effective service, e.g. block collection instead of door-to-door collection.

Institutional/Administrative principles:

Technologies and systems should be:

- geared towards capacity-building of operators and managers, especially of local authorities
- creating room for involvement of all stakeholders in planning and implementation, especially weaker and underprivileged groups
- encouraging ‘social privatisation’
- promoting organisational cultures that foster professionalism, transparency and accountability
- based on decentralised management, giving sufficient regulatory and financial autonomy to local governments to improve waste management sustainably
- ensuring competitive bidding for waste service provision by private sector
- encouraging incentives, recruitment and promotion based on merit and performance
- promote inter-sectoral co-operation (with other urban systems)

Who are stakeholders and why is stakeholder involvement in planning and implementation important? Stakeholders are all groups and individuals who have a stake, an interest, in the waste

management system in a certain area. The interests and roles stakeholders have in waste management may differ significantly from each other.
A stakeholder analysis, defining these roles and interests, is therefore a prerequisite for setting up a new solid waste management system or for improving an existing one. Three groups are usually defined as having a stake in waste management:

1. the local community and its representatives (the community sector),
2. the local government and agencies responsible for cleanliness and public hygiene (the public sector), and
3. private companies involved in waste management (the private sector), which can be divided into a formal, usually large-scale and institutionalised group and an informal, usually small-scale and unregistered group.

Involvement of stakeholders can take several forms. For example the involvement of local communities in planning and implementation does not mean that residents are used as cheap labour. They can play a range of roles, such as those of (Moreno *et al*., 1999, Anschutz, 1996):

- residents - placing waste outside for collection, separating it at source
- community managers - participating in the design of a waste service, recruitment of workers, setting rates for user charges
- citizens - pressuring municipal authorities so that services are being offered
- community members - participating in clean-ups
- clients - paying for waste management services
- watchdogs - monitoring and supervising the operation of services

Stakeholder involvement is important, because it can lead to more responsible behaviour, increased environmental awareness, and a higher willingness to pay among users of a waste management system. It can also lead to empowerment of groups of stakeholders that have had limited access to decision-making power and resources, for example local residents or informal micro-enterprises involved in collection and recycling of waste. Indeed it needs to be kept in mind that stakeholders do not have an equal starting position. Thus the idea of stakeholder involvement aims at supporting the weaker, underprivileged groups to have a say in planning and implementation of a waste management system. Actors like community-based organisations (CBOs), non-governmental organisations (NGOs), research institutes, universities, etc. should be strengthened for this purpose to enable them to play a role in supporting communities and the informal sector, for example through organising them, providing them with training, promote them (advocacy), or support them with research, technical or financial assistance. Local governments can create room for local communities and the informal sector by changing legislation and recognising them as candidates for service contracts (see Policy/legal aspects below).

Internationally the idea has gained ground that communities, the private sector and the local government can complement each other resulting in a more effective and efficient waste management system. Besides this, the participation of communities and micro- and small-scale enterprises can generate income and employment in low-income urban areas and thus contribute to the alleviation of urban poverty (Lardinois, 1996). In some countries, especially in Latin America, this has led to the development of the concept of 'social privatisation', in which micro-and small-scale enterprises, co-operatives and community-based organisations undertake the management and operation of waste management services in specific, especially low-income, areas. Motivated by social concerns as well as profit motives, they take over the role of the government, because public services are absent in these areas or do not function properly. In other cases they undertake activities that are traditionally not pursued by the local government such as recycling (Moreno *et al.*, 1999).

Social privatisation thus broadens the concept of privatisation from merely selling public enterprises to the private, often large-scale, business sector to a concept where all non-governmental actors, whether small- or large-scale, profit- or non-profit-oriented, working in high- or low income areas, are considered partners in the city-wide waste management system, worthy of recognition and support.
To involve all these groups and to address the constraints they face requires a change in the attitudes of governments and politicians. The necessary changes are mentioned below under the policy and legal principles. That this is not an impossible task has been proven by many examples from Latin America (Moreno *et al.*, 1999).

Policy/Legal principles:

Technologies and systems should be supported by:

A legal framework that:
- encourages involvement of non-governmental actors and the private sector
- supports decentralisation of tasks, authority and finance
- contains rules and regulations that are transparent and unambiguous
- enables impartial enforcement of rules and regulations

A policy framework at national and local level that:
- encourages decision-making at the lowest level of authority, usually the municipality, regarding financial matters and selection of technologies
- gives waste management high priority both in policies and budgets
- recognises waste management as an environmental health issue, that necessitates equity in service provision
- recognises the role of non-governmental actors and the private sector in waste management
- fosters accountability of decision-makers to ensure efficient use of public funds
- supports the ‘waste management hierarchy’, giving preference to waste prevention, source separation, re-use and recycling, above mere collection and disposal

Policy measures that can be taken to put these principles into practice, are listed in section 6. But first we will elaborate to some extent on the use of these principles of ISWM in analysis and assessment.

CHAPTER 5 USING THE PRINCIPLES OF ISWM IN ANALYSIS AND ASSESSMENT

Not all the objectives and principles mentioned above will point in the same direction or go together harmoniously. Some may even be conflicting or contradicting (Hemelaar, 1999, Lardinois, 1996).
Examples are:

- The classical contradiction between the socio-economic principle of 'equity' and the financial principle of 'efficiency'. Can social concerns go together with a commercial and professional approach to waste management? Can CBOs carry out waste management services as efficiently as private enterprises? Experiences are mixed in this respect, and appropriate training in financial and technical management could be crucial factors to ensure a good combination of both.
- Recycling could be the environmentally most preferred option, but actual recycling takes place under degrading working conditions and it pollutes the air more than the use of raw materials. The solution here would be to take into account all emissions and impacts on the environment of the different options and to upgrade working conditions of the operators involved whenever possible.
- Locally manufactured equipment is not always of the best quality. The solution here would be to build the capacity of the local manufacturing industry.
- The environmentally best solution could turn out to be the most expensive, especially when not all costs are internalised in (market) prices. Here it is of vital importance to use shadow prices and opportunity costs to make sure that all cost and benefits are put into the equation, including the cost and consequences of 'doing nothing'.

The optimal solution seems to be the one that considers the highest number of aspects of sustainability. This confirms our earlier statement that a technology that is sustainable only from a technical point of view is less preferred than one that is also socially, environmentally and financially sustainable. The final choice remains a trade-off between different aspects that can only be dealt with in each specific situation. This trade-off can be a rather complex exercise (van Beukering, 1999).

Assessment of the degree of 'integrated sustainability' needs an analysis that uses a range of criteria, both quantitative and qualitative indicators, as well as a mechanism to weigh these different indicators against each other. Some examples of indicators of 'integrated sustainability' are given below (see also PAHO, 1995):

Technical:	- amount of waste collected by area of the city and per source
	- durability of equipment
	- existence of a separate hazardous waste management system
	- existence of preventive maintenance procedures
Environmental:	- amount and % of waste recycled
	- extent of pollution of air, soil and water (emissions, etc.)
	- amount of energy and of natural resources saved through recycling

Financial:	- degree of cost recovery - overall cost of waste management services provided - labour productivity (amount of waste collected per worker)
Socio-economic:	- service coverage (% of citizens receiving minimum required waste collection service, e.g. twice a week) - working conditions (number and duration of sick leaves, health complaints) - user satisfaction with the service by area of the city
Institutional:	- degree of formalisation of informal sectors (number of licensed CBOs, co-operatives, micro-and small-scale enterprises) - existence of feedback mechanisms for citizens (complaint desks, etc.)
Policy/Legal:	- degree of decentralisation of authority and funds - height of budget earmarked for waste management

By clustering these indicators, the different options available for the design (or improvement) of a waste management system could be given a rating on each aspect of ‘integrated sustainability’. These ratings could be summed up and the total would thus indicate the overall ‘degree of integrated sustainability’ of the options available. However, the question remains whether some aspects are more important than others, some might be ‘necessary’, others just ‘sufficient’ conditions for ‘integrated sustainability’. Also the question which criteria are most suitable and which weights appropriate needs to be answered (Gerlagh *et al.*, 1999). Besides there is the problem of comparing quantitative indicators, which can be expressed in absolute or relative figures, with more qualitative indicators, which can only be given a ranking (e.g. user satisfaction) or a descriptive value.

One of the first attempts to design a model to evaluate different waste management alternatives from an ISWM perspective has been carried out by Indian and Dutch economic researchers (Gerlagh *et al.*, 1999). It uses a combination of a linear programming model and a multi-criteria analysis. Its goal is to minimise overall system costs and to identify low cost solutions. So their main indicators of sustainability are financial. Nevertheless, social and environmental parameters can be put into the model.

There seems still a considerable amount of work to be done in this field. Different tools for analysis exist that should be evaluated for operationalising ISWM into indicators. In the conclusion we will list some future needs for research.

CHAPTER 6 MEASURES TO TAKE TO MAKE WASTE MANAGEMENT SYSTEMS MORE SUSTAINABLE AND INTEGRATED

Based on the principles outlined above, several measures can be defined that should be taken to make waste management more sustainable and integrated. A selection of measures will be presented for each aspect of sustainability. The list is by no means exhaustive. Again these measures are based on WASTE's own experiences and several studies carried out by others (Lardinois & van de Klundert, 1995, Hemelaar & Maksum, 1996, Coffey, 1996, Schuebeler *et al.*, 1996, Dakahleya Governorate, 1998, Awed, 1998). Regarding the institutional and political measures we also would like to direct the reader to the excellent contribution of Dr. Ossama Salem in this monograph.

1. Technical and operational measures

Waste reduction and prevention:
- gather data regarding quantities, types and sources of waste
- disseminate technical guidelines for waste reduction and prevention

Waste collection:
- gather data on waste generation and composition, area characteristics, haul distances, availability of spare parts and service facilities, etc.
- integrate storage, collection and transportation systems
- adapt collection frequency to waste generation and overall efficiency of the system
- improve maintenance capacity and establish a preventive maintenance programme
- establish a record-keeping and monitoring system to support continuous improvement of the system

Resource recovery:
- encourage waste separation at source through education and economic incentives
- gather data on types and quantities of recyclables generated, collected and recycled
- encourage resource recovery through tax and duty exemptions, land, credit, training, etc.

Disposal and treatment:
- gather data on types and quantities of waste arriving at landfills
- assess life expectancy landfill
- investigate tipping practices (systematic disposal or not, covering, spraying, waste set on fire, existence of leachate and gases, etc.)
- assess technical performance of treatment facilities (energy recovery, incineration), if any

Handling of special and hazardous wastes:
- gather data on types, quantities and sources of hazardous waste

- explore existing practices regarding hazardous waste
- disseminate technical guidelines for sound hazardous waste handling
- identify possibilities for source reduction and replacement
- identify possibilities for separation at source and for separate treatment and disposal

2. Environmental measures

Rules and regulations:

- develop and enforce environmental legislation governing collection, disposal, treatment of all types of waste, but especially hazardous wastes
- make establishment of a sound waste management system a prerequisite of new developments, such as industrial estates, residential areas, tourist resorts.
- make an EIA obligatory before site selection of a landfill or a waste treatment facility

Environmentally sound practices:

- monitor amount of waste left in streets, empty lots, burnt in the open air, left in water courses, etc.
- monitor coverage of waste collection services and their frequencies
- cover all trucks during transportation
- monitor amounts of recyclables recovered and energy saved through recycling
- monitor amount of energy recovered through treatment plants, if any
- monitor environmental effects of landfills and waste treatment facilities
- control leachate and gases at landfills
- encourage resource recovery through awareness-raising, incentives, training, access to credit, etc.
- introduce waste exchange systems , e.g. for industrial wastes

Education and awareness-raising:

- initiate awareness-raising programmes about waste reduction and prevention, resource recovery and hazardous waste handling
- prepare guidelines for environmentally sound waste collection, disposal and treatment

3. Financial measures

Budgeting and cost accounting:

- assess real costs of waste management systems, including the 'costs of doing nothing' (increased cost of water treatment due to waste pollution, drainage problems, increased public health costs)
- increase transparency, accountability and fiscal discipline of local governments through training, incentives, codes of conduct, etc.
- earmark local and national revenues for waste management

Revenue generating mechanisms:

- introduce user charges adapted to ability to pay and based on actual costs. These charges could be based on volume and/or type of service
- introduce gate fees for landfills, treatment plants and hazardous waste disposal
- introduce fines and penalties for persistent polluters
- improve revenue collection through simplified billing, better incentives for fee and tax collectors, etc.
- increase revenues from resource recovery (composting, energy recovery)
- increase access of local governments to capital (loans, etc.)
- lobby central government
- harness customer willingness to pay

Cost reduction and control:

- encourage waste minimisation at source
- encourage (social) privatisation and community participation, expectedly resulting in efficiency gains and cost savings
- introduce performance related pay-schemes in local governments, preferably linked to efficiency improvements
- close monitoring and evaluation of performance, increasing efficiency whenever possible
- cost savings from improved maintenance, from improved financial management and planning and from waste exchange systems

4. Socio-economic measures

Monitoring public health

- monitor morbidity and mortality caused waste-related diseases in different localities

Design of systems:

- prepare a plan to cover unserved areas with waste management services
- identify stakeholders and their interests in waste management (stakeholder analysis)
- prepare a social profile of areas to be served (household size, occupation, income, consumption patterns, attitudes towards waste handling, willingness to separate at source, willingness to pay, etc.) through social surveys, focus group discussions, key informant interviews, and other techniques
- assess demands and needs of users (level and quality of services, etc.) through community meetings, social surveys and other social research methods

User participation:

- involve users in monitoring and implementation of waste management services through neighbourhood committees, citizen panels, local councils, etc.
- establish communication channels between local government and users through complaint desks, information sharing, etc.

- raise awareness and mobilise communities to build a basis for collective participation, using clear and simple messages and popular channels of communication (such as television, radio, theatre, puppet shows, religious leaders, festivals and competitions, etc.)
- build capacities of low income groups to enable them to participate through training of leaders, involving them in neighbourhood committees, involving them as enumerators in social surveys, etc.
- develop linkages and trust between different groups of actors involved in waste management (local government, formal and informal private sector, NGOs, CBOs) through joint management committees, co-ordinating platforms, etc.

Social conditions:
- improve status of waste collectors by providing them with uniforms, ID cards, training, etc.
- improve working conditions of waste collectors by adapting the height of trucks, providing them with protective wear (gloves, boots), give them better tools, etc.
- identify number and type of waste-pickers in streets and at disposal sites and their working conditions
- introduce measures to improve their working conditions and to raise their awareness of health and hygiene conditions (e.g. introduce special sorting area on landfill, provide them with protective wear, water and sanitary facilities)
- improve income earning potential of informal sector through tax exemptions, import duties on raw and waste materials, training, access to credit, help them form co-operatives, etc.

5. Institutional and administrative measures

Institution building:
- consolidate waste management functions under jurisdiction of one single department
- make a clear division of roles and responsibilities in waste management
- establish transparent procedures for competitive bidding and contracting out of waste management services
- improve organisation of the informal sector and increase its integration into the formal waste management system by recognising it, allowing it to participate in tenders and contracting

Organisational development:
- adjust pay-scales and incentive systems and make them dependent on performance
- develop recruitment and promotion procedures based on merit and performance
- install a transparent system of rewards and penalties

Human resource development:
- assess skills and educational levels of waste management staff within the local government and define training needs
- prepare a training programme to promote the concepts of ISWM

6. Policy and legal measures

Planning and policy:

- decentralise responsibility for waste management decisions to the local level, including decisions on finances and discretion over earmarking of budgets
- develop a waste management strategic plan for cities and neighbourhoods (including problem analysis, goals, measures to be taken, organisation, private sector involvement, etc.)
- make equity an explicit goal of waste management strategies
- make waste management a high priority in policy and funding decisions
- give policies a long-term orientation and make them predictable and not subject to sudden changes

Regulatory framework:

- establish unambiguous and effective bye laws and ordinances for waste management
- replace legislation that is contrary to ISWM principles (e.g. laws that inhibit private sector participation or that are hostile to the informal sector)
- establish unambiguous and effective regulations and procedures for private sector participation and clear standards for evaluating tenders
- strengthen the legal enforcement and inspection structures
- allow civil society and media to play their role of watchdogs

The measures described above give some ideas on how to make waste management system more sustainable. Their relevance depends largely on the local context. A thorough problem analysis is needed to determine first what are the main problems inhibiting sustainable waste management systems and what are the resources available. Then it can be determined what should be done to change these conditions, possibly using some of the measures mentioned above.

Generally speaking, decisions about waste management options should also take local resource constraints and concentrate on what is possible in the given context, rather than on what should be. These resource constraints can be financial, but can also include expertise, authority, political clout, historical character, civic spirit, etc. (IETC, 1996).

This section gives an overview of the policies and mechanisms which can be applied to advance the principles of ISWM in practice, based on planning and project experience from all over the world. The challenge is how to combine them in a consistent manner in a waste management plan so that they have the desired effects on sustainability and integration of waste management. Another challenge is to address the political issues related to waste management. Which stakeholders have an interest in promoting certain policies and measures, and what means does each stakeholder have to influence decision-making and co-operation with other stakeholders? Such issues refer to the ‘politics of waste management’ and to empowerment of local communities and small-scale informal enterprises in the public arena.

CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

The policy and legal aspects seem to be the most important aspects of ISWM, because they provide the overall background that determines whether ISWM objectives will be integrated into policies or not. Decentralisation and autonomy of local governments in administrative and financial issues, together with improvement of their accountability, are for example of utmost importance. But without explicit political choices for these objectives, it will be hard to achieve sustainable and integrated solutions or even to introduce some of the measures mentioned in Section 6.

The above analysis shows a need for future research and development in:

- definition of suitable criteria/indicators for 'integrated sustainability' for all aspects (either quantitative or qualitative)
- design and evaluation of appropriate weighting mechanisms to guide the analysis

The ISWM framework seems a multi-faceted approach, which will make technology choices not necessarily easier but more sustainable and will thus save resources in the end. As IETC describes it in its International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management (IETC, 1996): 'Spending money on an ineffective technology shifts the burden of cleanup efforts to future generations.'

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