fluid layer on top of the heavier lead layer in the furnace.

- Lead bullion is tapped from the furnace when the metal level builds up to a height that only small amounts of lead appear in the slag.
- Lead is recovered from the slag by charging it in blast furnace along with other lead containing materials and fluxing agents like iron and limestone.
- Hard lead is recovered from the blast furnace.
- Flue gas emissions from reverberatory furnace are collected by bag house and feedback into the furnace to recover lead. Slag from blast furnace is disposed of in hazardous waste landfill sites.

Precious Metals Recovery

It involves the steps shown in the flow chart. The anode slime recovered from copper electrolytic process shown in figure is used for precious metal recovery. Refer *Figure 20*. The process involves the following steps.

- Anode slime is leached by pressure.
- The leached residue is then dried and, after the addition of fluxes, smelted in a precious metals furnace. Selenium is recovered during smelting.
- The remaining material from smelter is caste into anode and undergoes electrolysis to form high-purity silver cathode and anode gold slime.
- The anode gold slime is further leached and high purity gold, palladium and platinum sludge are recovered.

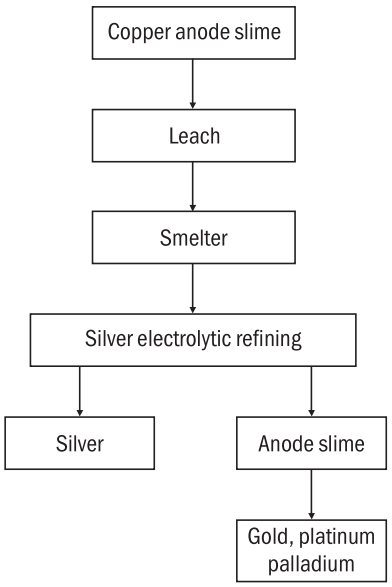


Figure 20: Precious metals recovery process

Integrated Solid Waste Management

Integrated solid waste management (ISWM) refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects such as generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency. An effective ISWM system considers how to prevent, recycle and manage solid waste in ways that most effectively protect human health and the environment. ISWM involves evaluating local needs and conditions, and then selecting and combining the most appropriate waste management activities for those conditions. The major ISWM activities are waste prevention, recycling and composting, and combustion and disposal in properly designed, constructed, and managed landfills.

The selection of the most appropriate waste management systems and sustainable technologies is also needed to deliver an optimum and sustainable ISWM system. In combination with economic and social considerations, this approach would help waste managers to design more sustainable solid waste management systems.

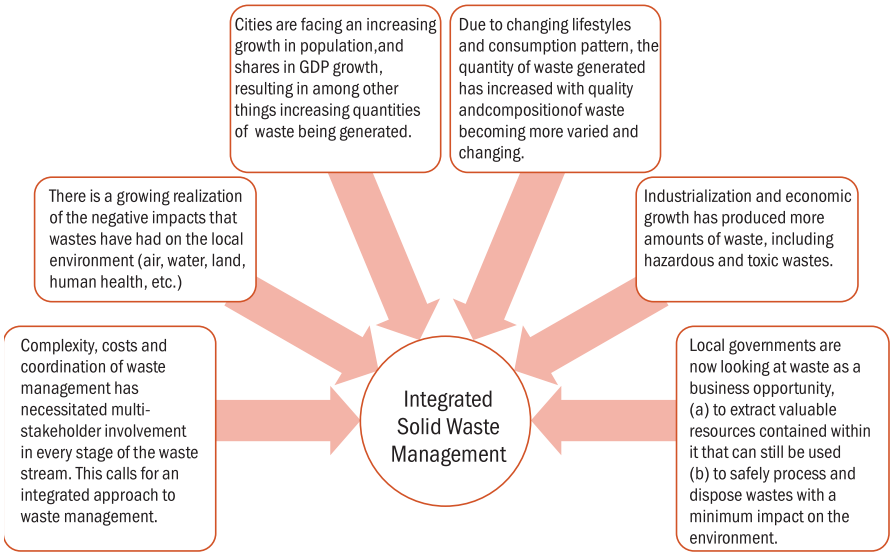
Thus, for the management of solid waste, the following is the preferred hierarchy of approaches

- Reduction at source: meaning incorporation of the tenets of waste management at every stage of consumption from design, manufacture, purchase, or use of materials to reduce the amount or toxicity of waste generated.
- Environmentally suitable reuse and recycling: to conserve natural resources and energy through systematic segregation, collection and reprocessing.

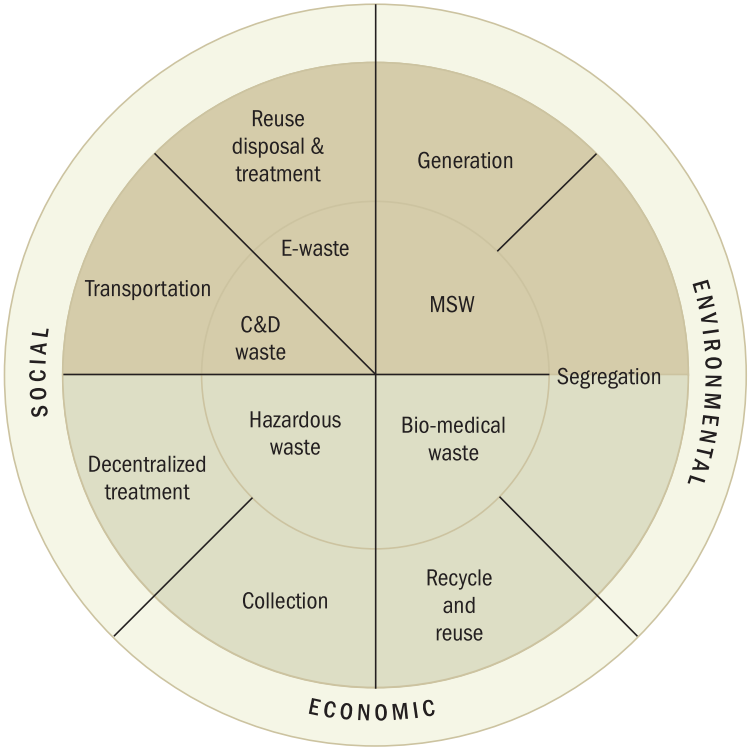
ISWM concept has to be adapted with a view that effective management schemes need the flexibility

of design, adaptation and systems which can best meet current social, economic and environmental conditions. These are likely to change over time and vary by location.

ISWM with respect to three perspectives are lifecycle, waste generation and waste management.



Need for Integrated Solid Waste Management



Concept of Integrated Solid Waste Management

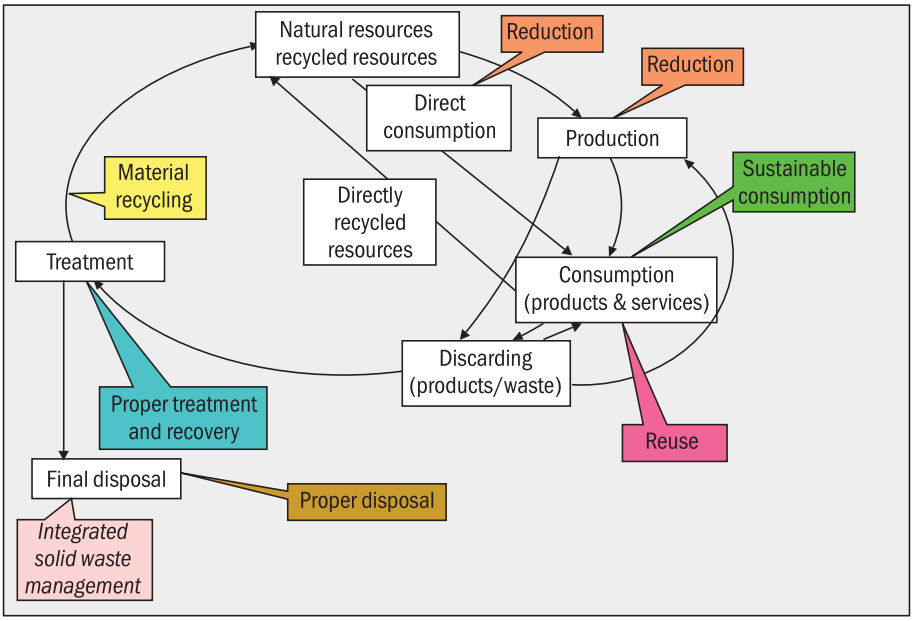


Figure 21: Lifecycle-based Integrated Solid Waste Management

Life-cycle Based Integrated Solid Waste Management

The first concept of ISWM is based on lifecycle assessment of a product from its production and consumption point of view. The reduction in consumption, and utilization of discarded products within the production system as a substitute for new resources, can lead to reduced end-of-cycle waste generation; thus, less efforts and resources would be required for the final disposal of the waste.

Generation-based Integrated Solid Waste Management

The second concept of ISWM is based on its generation from different sources including domestic, commercial, industrial and agriculture. This waste could be further classified as hazardous and non-hazardous waste. The former has to be segregated at source and treated for disposal in accordance with the strict regulations. 3R approach (reduce, reuse and recycle) is applicable both at source as well as at the different levels of solid waste management chain including collection, transportation, treatment and disposal.

Management-based Integrated Solid Waste Management

The third concept of ISWM is based on its management which includes regulations and laws, institutions, financial mechanisms, technology and infrastructure, and role of various stakeholders in the solid waste management chain.

Benefits of Integrated Solid Waste Management

- Cleaner and safe neighbourhoods
- Savings in waste management costs due to reduced levels of final waste for disposal.
- Holistic approach to all waste streams thus maximizing synergetic benefits in collection, recycling, treatment & disposal
- Maximize the opportunities for resource recovery at all stages—from generation to final disposal
- Accommodate aspirations of all stakeholders—from waste generators to waste management and service providers
- Facilitate life-cycle view of products and materials; thus, promoting greater resource use efficiency
- Integrate different response functions such as technical, managerial, financial, policy, etc.

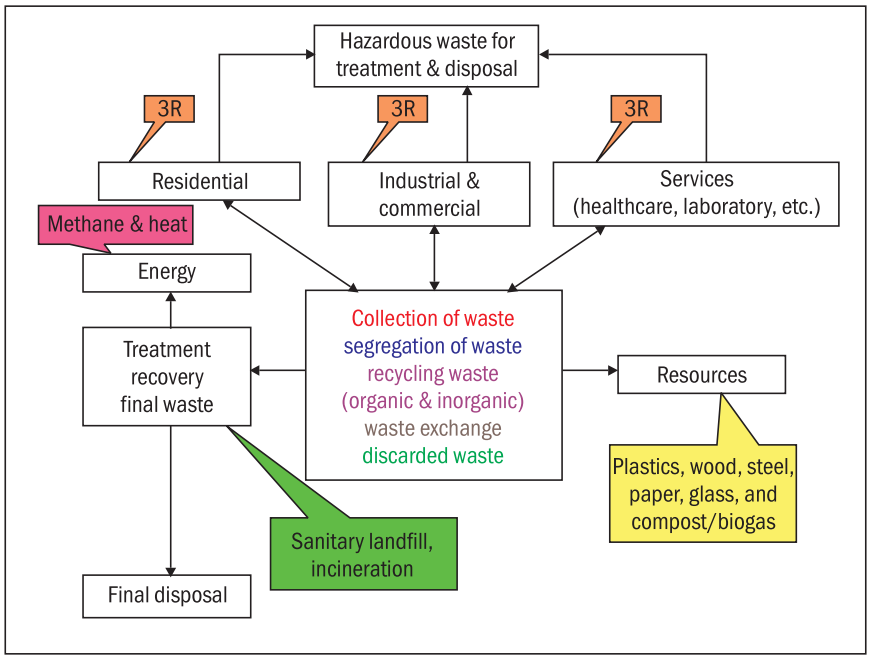


Figure 22: Generation-based Integrated Solid Waste Management

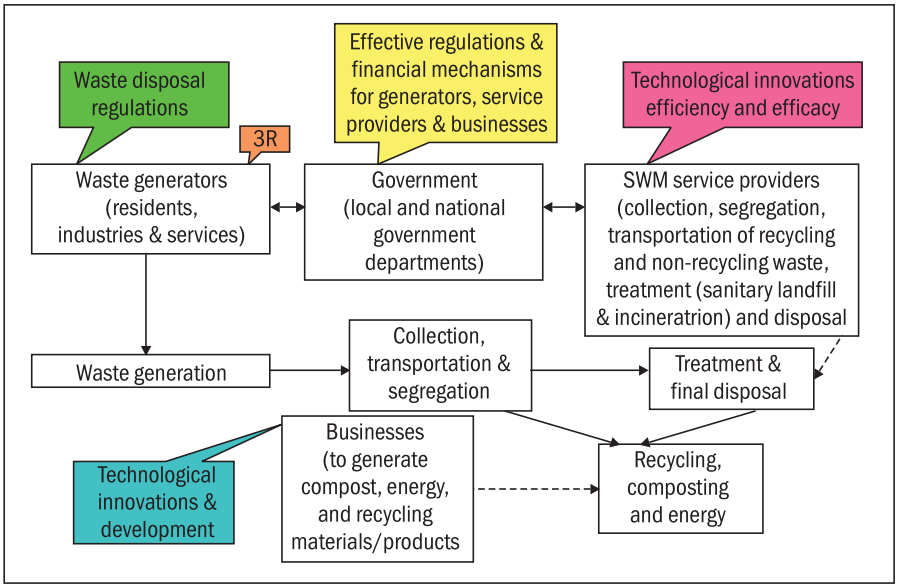


Figure 23: Management-based Integrated Solid Waste Management

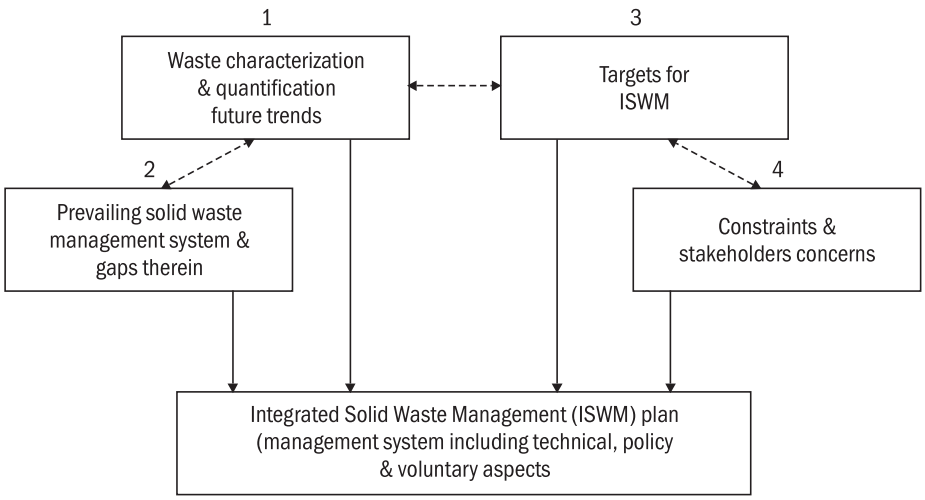
- Greater local ownership & responsibilities/ participation through a consultative approach

ISWM Plan

The objective of the ISWM plan is to develop waste management approach covering MSW, Biomedical, Industrial hazardous, Construction & Demolition (C&D) and Electronic-waste. The plans would cover all the aspects of ISWM chain including collection, segregation, transportation, recycling, treatment and disposal.

An ISWM Plan per se is a package consisting of a Management System including:

- Policies (regulatory, fiscal, etc.)
- Technologies (basic equipment and operational aspects)



Outline of ISWM Plan

- Voluntary measures (awareness raising, self-regulations)

Management System covers all aspects of waste management from waste generation through collection, transfer, transportation, sorting, treatment and disposal. Data and information on waste characterization and quantification (including future trends), and assessment of current solid waste management system for operational stages provide the basis for developing a concrete and locality-specific management system.

Elements of ISWM Plan

- Baseline data on waste characterization and quantification with future trends and baseline data on prevailing waste management systems and gaps therein.
- A list of targets to be achieved through the ISWM System.
- A Plan with details of the Management System covering policies, technologies (and voluntary measures
- Implementation Aspects such as time schedules, costs, institutional requirements, etc.
- Monitoring and feedback mechanism.

Steps for ISWM Plan

- Targets are set for each operational level (generation, collection and transportation, sorting and material recovery, treatment and resource generation, and final disposal) and for coverage and efficiency of services, as well as for efficiency of efforts and management system.
- Identification of technical, socioeconomic and policy constraints—which should be kept in mind when designing the elements of an ISWM System.
- Identifying the issues of concerns of the stakeholders: financial, social, technical and environmental—which are consider as very important to be addressed while designing the ISWM system.
- Designing the elements of the ISWM System—policies (regulatory, fiscal, etc.), technologies (basic equipment and operational strategies) and voluntary measures (awareness raising, self-regulation, etc.)—and their technical feasibility, economic viability and implementability.
- Developing an implementation strategy including financing strategy, human resources, institutional aspects and timeline (schedule of implementation).
- Developing a monitoring and feedback system for periodic feedback to improve the ISWM system and its implementation or to modify the targets.
- Developing detailed schemes based on strategic action plan.

Source: UNEP

Dr. Kaizar