

RECYCLE, REUSE, RESOURCE RECOVERY

CE 431

Recycling and Reuse

- Involves recovery of resources from the waste stream in the form of both materials and energy.
 - Primary Recycling
 - Only materials recovery
 - Recycled materials are reused in their same form
 - Most efficient form of recycling involving few processes
 - Secondary Recycling
 - Both materials and energy recovery
 - Recycled materials are used for re-manufacturing or to produce energy
 - More energy intensive than primary recycling

Significance

- Minimizes the use of virgin raw materials directly (raw materials recycled) and indirectly (reuse)
- Saves energy both directly (recyclables used to produce energy) and indirectly (reuse prevents disposal and manufacturing)
- Minimizes overall environmental pollution
- Limits emissions of greenhouse gases by preventing open dumping
- Generates income
- Reduces overall waste management costs

Risks

- Involves health hazards to people working in this sector
- Production costs of reusable products
- Collection of recycled materials involves additional collection vehicles
- Sometimes more energy is required in the recycling processes
- Sometimes emission of certain gases are more in recycling process compared to incineration process

Considerations of Cost components

- Material Costs including transportation
- Production costs – processing and conversion
- Marketing costs
- Costs associated with environmental damage
- Savings from direct sales
- Disposal cost savings
- Opportunity savings – employment
- Savings equivalent to the costs of production of recycled materials
- Savings associated with other environmental benefits

Present Practices

Informal recycling (Developing countries)

- First stage
 - Householders separate refuse of higher market value and sell them
- Second stage
 - Urban scavengers collect refuse
- Third stage
 - Municipal sanitation workers collect and transport SW
- Final stage
 - People salvaging items at final disposal sites

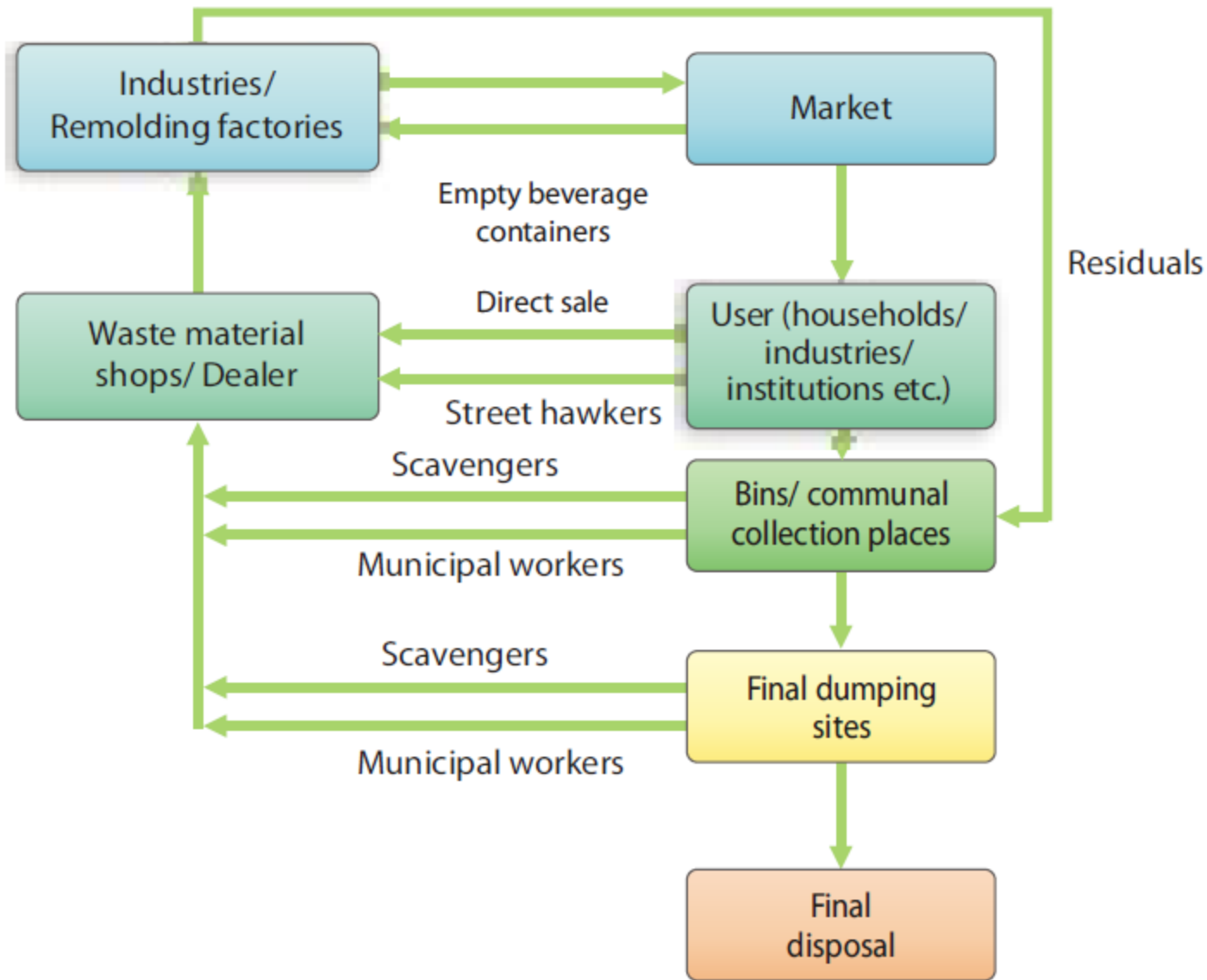


Figure 5.1: Recycling pattern for urban solid waste in Bangladesh

Industrialized countries

- Current recycling practices throughout the world includes a vast majority of materials such as:
 - Papers
 - Glass
 - Metals
 - Plastic
 - Textiles
 - Rubber and leather
 - Construction and demolition wastes
 - Oil
 - Tyres
 - Batteries
 - Chemicals
 - Food waste
 - Garden waste.

**Table 5.1: Recycling of municipal solid waste in selected countries
(as percentage of total waste)**

Country	Recycling including composting	Composting only
United Kingdom	9 ^a (England & Wales)	1 ^b
Italy ^c	10	7
Canada ^c	12	2
France ^c	13	10
Germany ^b	28	5
USA ^d	28	--
Switzerland ^c	29	7
Sweden ^e	32.5	7.5
Austria ^b	38	15
Netherlands ^b	46	18

Source: ^aWarmer (2000a); ^bWarmer (1998b); ^cWarmer (1995); ^dWarmer (1999a); ^eWarmer (1999c).

Effective Recycling

- Legislation
- Recycling Opportunities
- Commitment
- Labour and equipment infrastructures
- Finance

Recycling Processes

- Separation of materials
 - Mechanized sorting
 - Both manual and mechanized sorting
- Conversion of materials
 - Thermal conversion
 - Incineration to recover energy or heat, pyrolysis
 - Biochemical conversion
 - Anaerobic digestion, composting, hydrolysis

Resource Recovery Options from Organic Waste

- Animal feed
- Soil conditioner with or without treatment
- Energy – either biologically or thermally
- Organic compounds

Table 5.2: Worldwide ranking of treatment technologies of the organic fraction of MSW

Technology	Rank
Landfill	First
Incineration	Second
Composting	Third
Anaerobic digestion	Fourth

Planning for Recycling

- Stakeholders
- Public Education campaign
- Commitment of local government
- Building local expertise
- Recycling opportunities
- Assessment of local waste stream

- ETC.....

Recycling Performance Indicators

- Recyclable fraction
- Recycled fraction (realistic)

- Indicators that can be used to measure the performance of recycling scheme (Warmer, 1999) given by UK govt:
 - Municipal recovery rate
 - Household recycling rate
 - Home composting participation rate
 - Recovery effectiveness
 - Capture rate