ES 200-S2

Module B : Solid Waste Management and Other Aspects of Environmental Management

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Course Outline

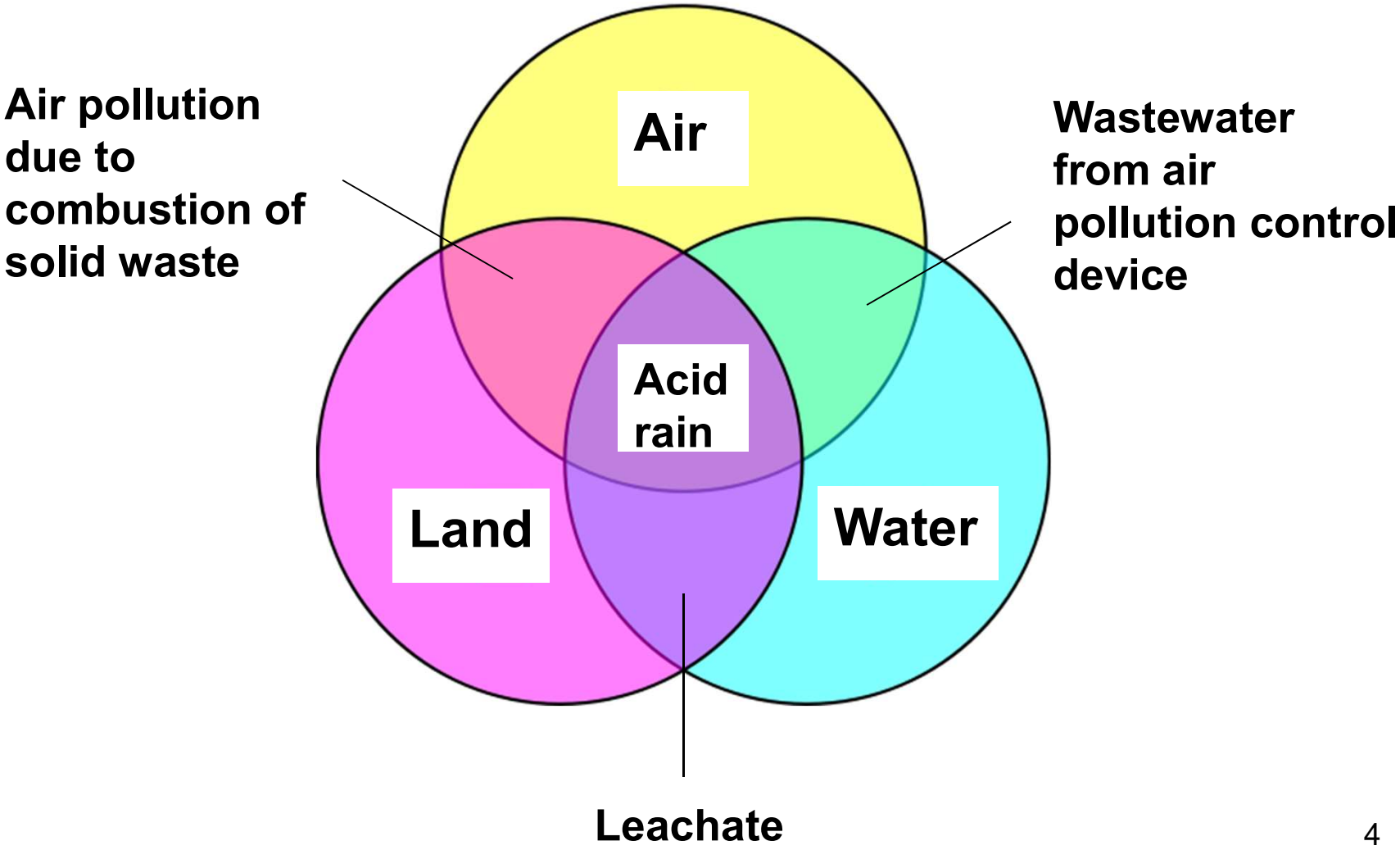
- Solid waste management
  - ✓ Municipal solid waste
  - ✓ E-waste
- Environmental law and policy
- Environmental management tools

Total Weightage: 33 marks (Assignment and/or quiz = 13 marks and End sem exam = 20 marks)

Key References

- **Masters, G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi.**
- **Nathanson, J. A., Basic Environmental Technology – Water supply, Waste Management and Pollution Control. Prentice Hall, New Delhi.**
- **Additional reading material will be suggested as needed.**

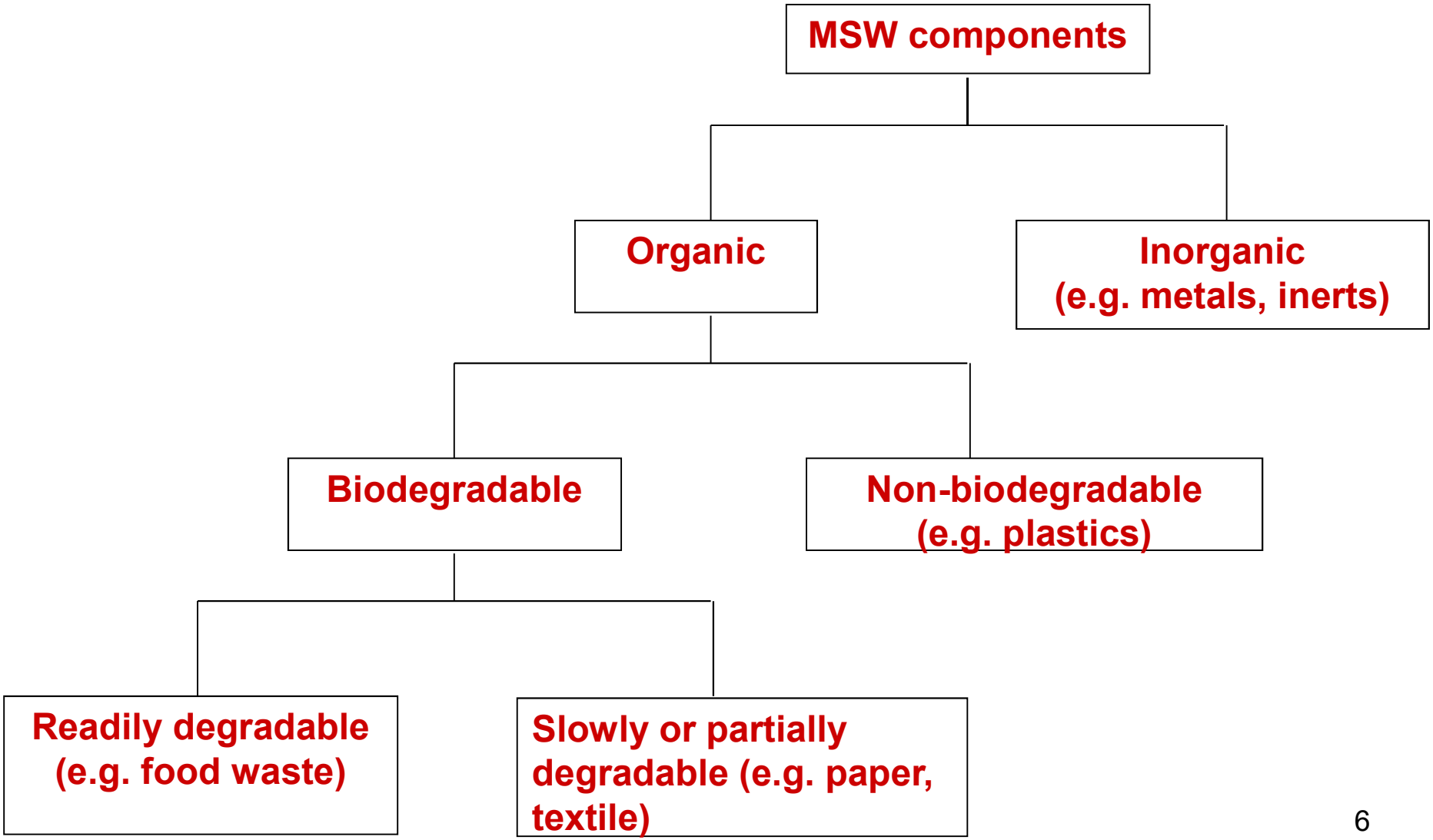
Environment Interrelationships



What is MSW?

- **Solid Waste:** Solid or semi-solid domestic waste, sanitary, commercial, institutional, catering and market waste and other non residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active

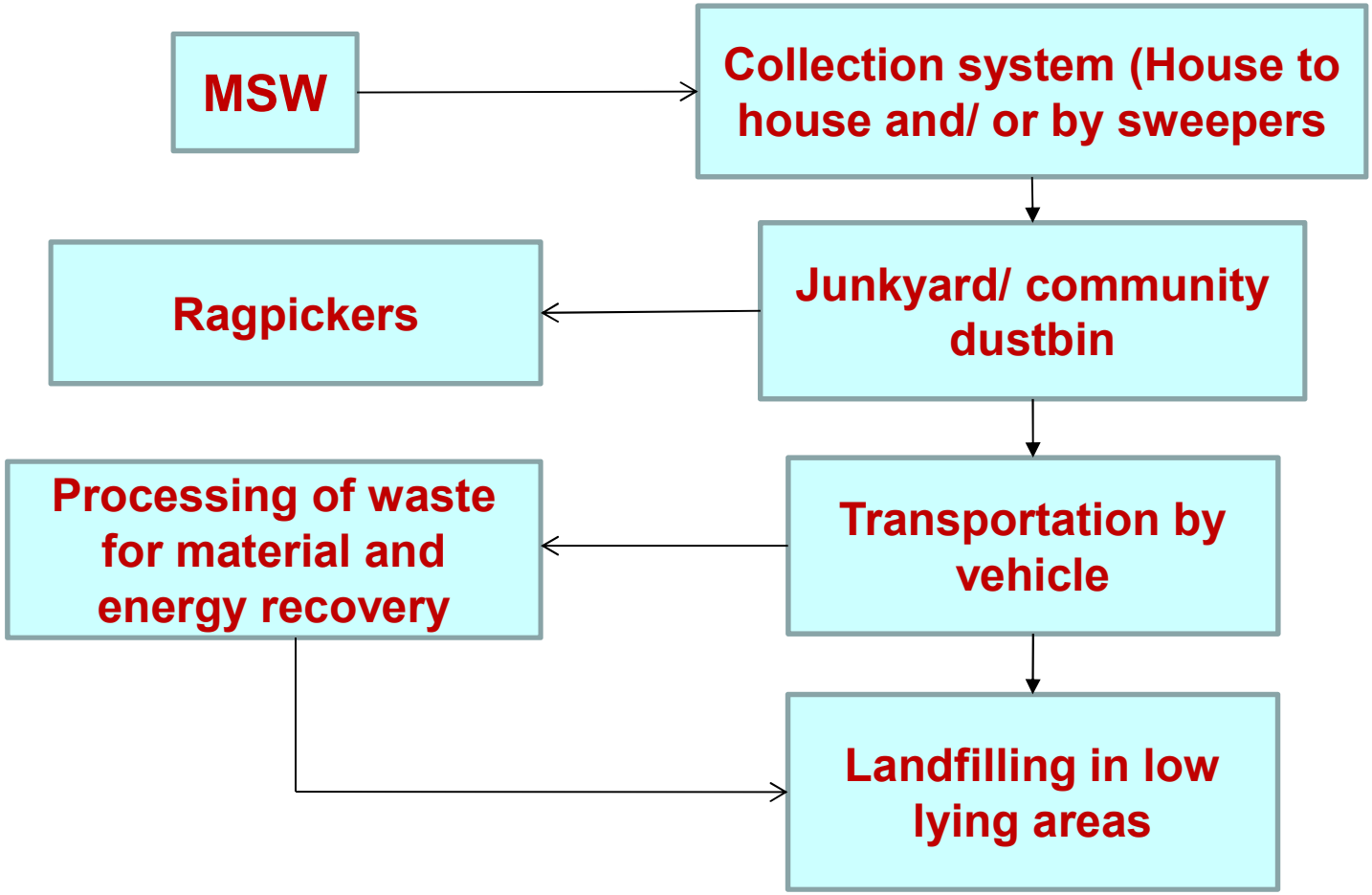
Classification of MSW



Open Dumping

More than 90% of the total MSW is landfilled or open dumped.

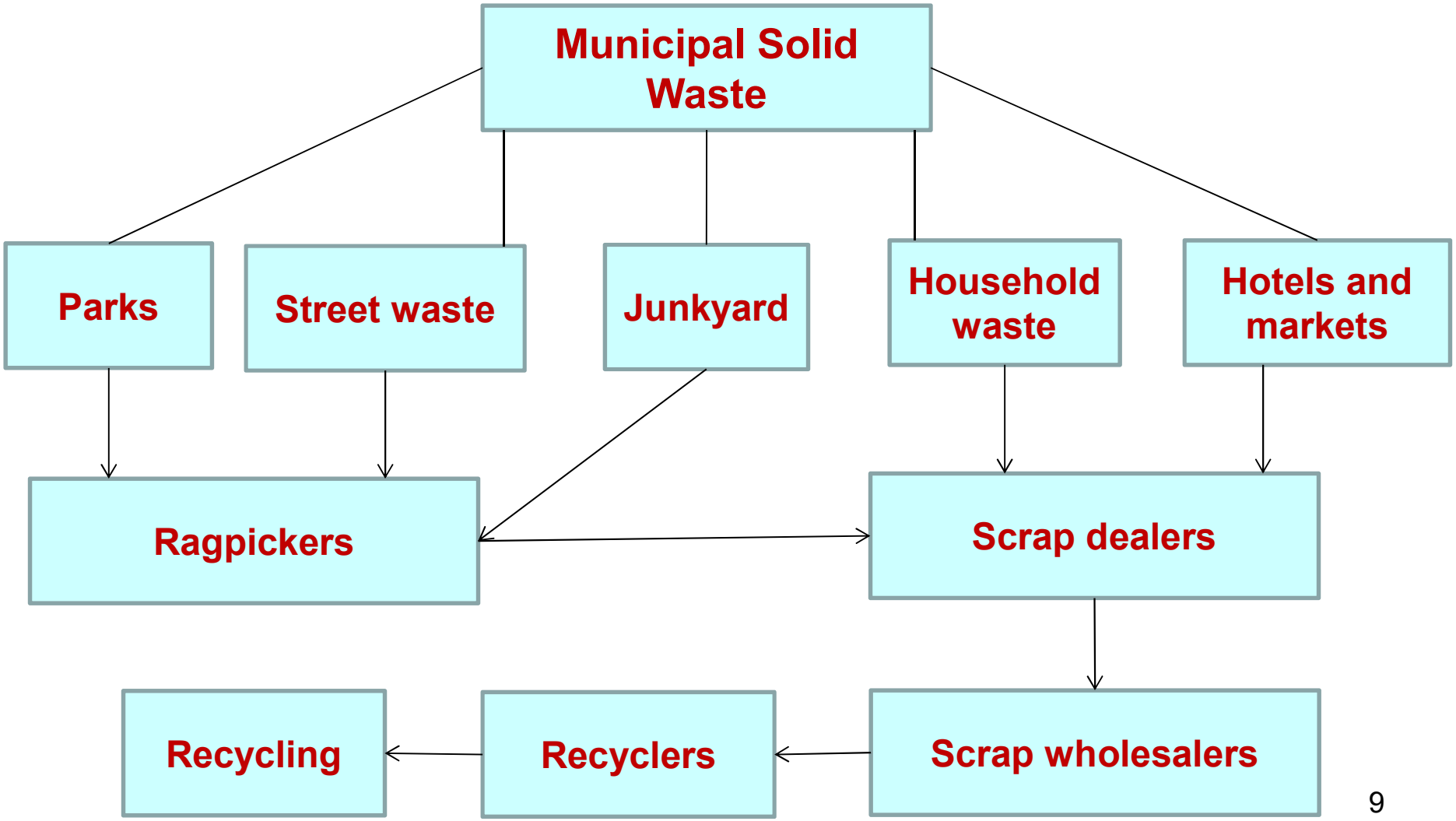
Existing Generalized MSW Management System in India



Source: Srivastava et al., 2014

Existing MSW Recycling System in India

Source: Srivastava et al., 2014



Adverse Impacts of Unsustainable Waste Disposal

- **Health impacts**

✓ **Can cause direct and indirect impacts**

- **Environmental impacts**

✓ **Soil**

✓ **Water**

✓ **Air**

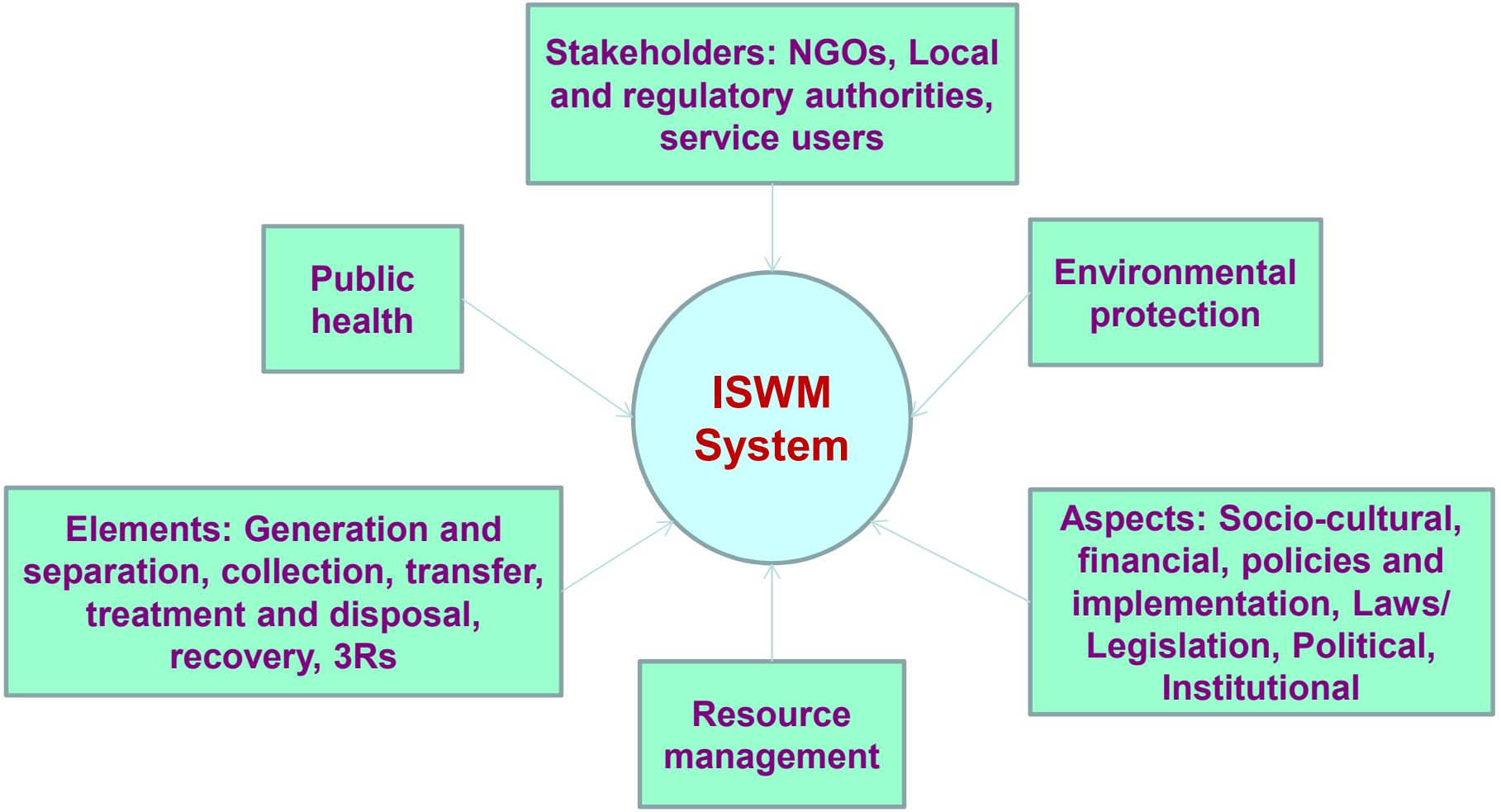
Need to Shift from Landfilling to 3Rs

http://www.downtoearth.org.in/coverage/waste-smart-cities-54119#0

Integrated Solid Waste Management (ISWM)

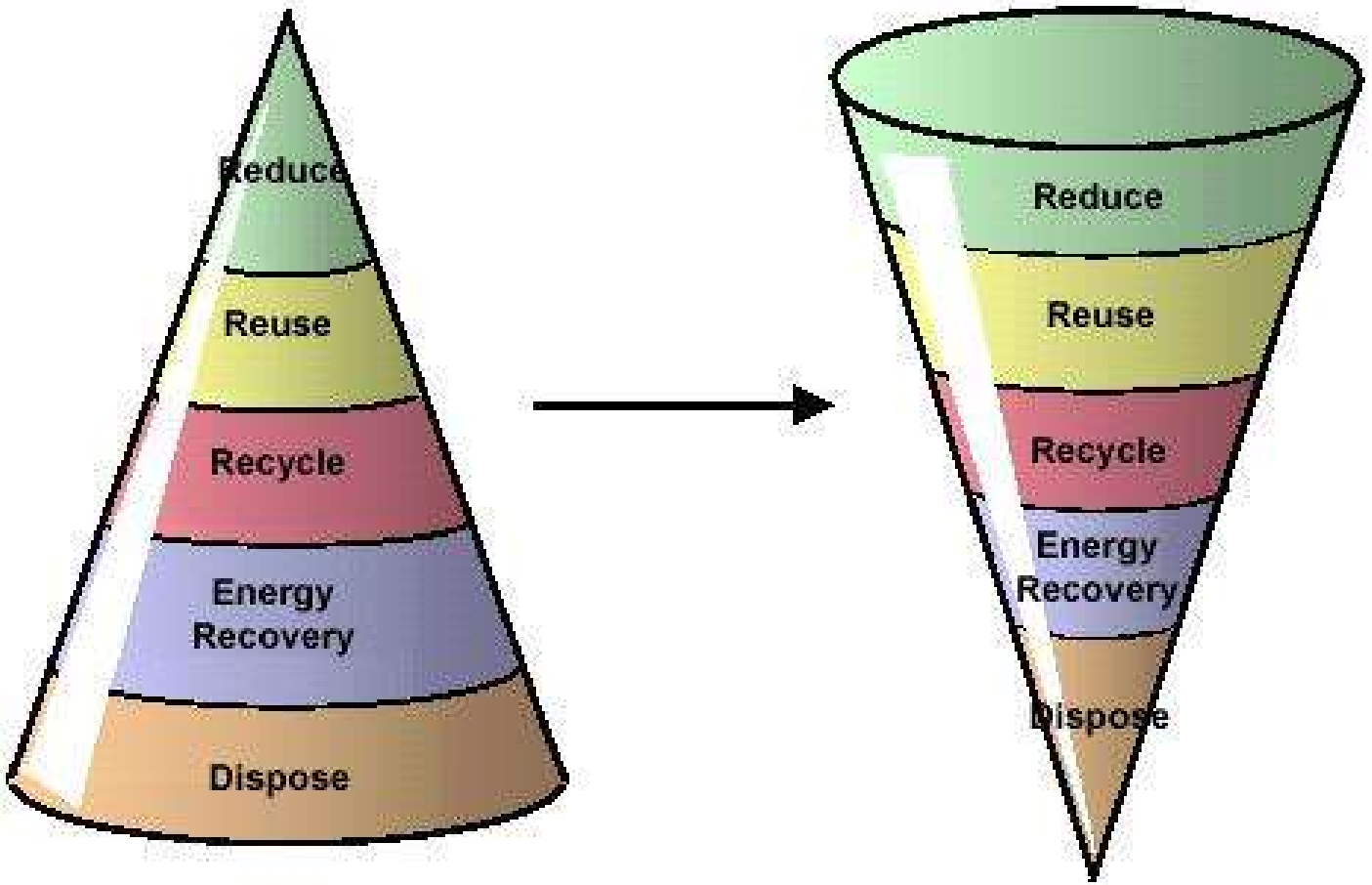
- **ISWM can be defined as the selection and application of suitable techniques, technologies and management programs to achieve specific waste management objectives and goals.**

Integrated Solid Waste Management System



Source: Srivastava et al., 2014

Waste Hierarchy – A Shift in Thinking



Challenges/ Issues Related to MSWM

- Source segregation
- Technical issues
- Financial issues
- Social issues
- Education/ awareness programs
- Legislative issues

Some Important Information required about MSW

- Types and quantities
- Rates at which various types of material will arrive
- Properties of MSW (as received)
- Temporal and seasonal variation in MSW property
- Changes in property during processing
- The properties which makes the MSW of economic value

Typical Data on Various MSW Constituents

(Tchobanoglous et al., 1993)

Waste type	Moisture (%)	C (%)	N (%)	Calorific value (MJ/kg) (ar)	Biodegradability
Food waste	40 – 80	48	2.6	3.5 – 6.7	0.82
Paper	3 – 10	44	0.3	12 - 17	0.22 (newsprint) – 0.82 (office paper)
Plastics	0.2	60	-	25 - 38	-
Textiles	10	55	4.6	14 - 17	-
Yard waste	60	47.8	3.4	2.3 - 17	0.72
Wood	20 – 50	49.5	0.2	15 - 18	-
Metals	2 – 5	4.5	< 0.1	0.7	-
Glass	2	0.5	< 0.1	0.2	-

Physical Properties of MSW

- **Specific weight**

✓ **It can vary from 180 – 415 kg/m^3 with an average of around 300 kg/m^3.**

- **Moisture content**
- **Particle size and size distribution**
- **Field Capacity**

✓ **Total amount of moisture which can be retained in a waste sample**

- **Permeability of compacted waste**

Chemical Properties of MSW

- **Proximate analysis**

✓ **Moisture**

✓ **Volatile combustible matter**

✓ **Fixed carbon**

✓ **Ash content**

- **Ultimate analysis**

✓ **C, H, O, N, S and ash**

✓ **The determination of halogens can also be included in the analysis**

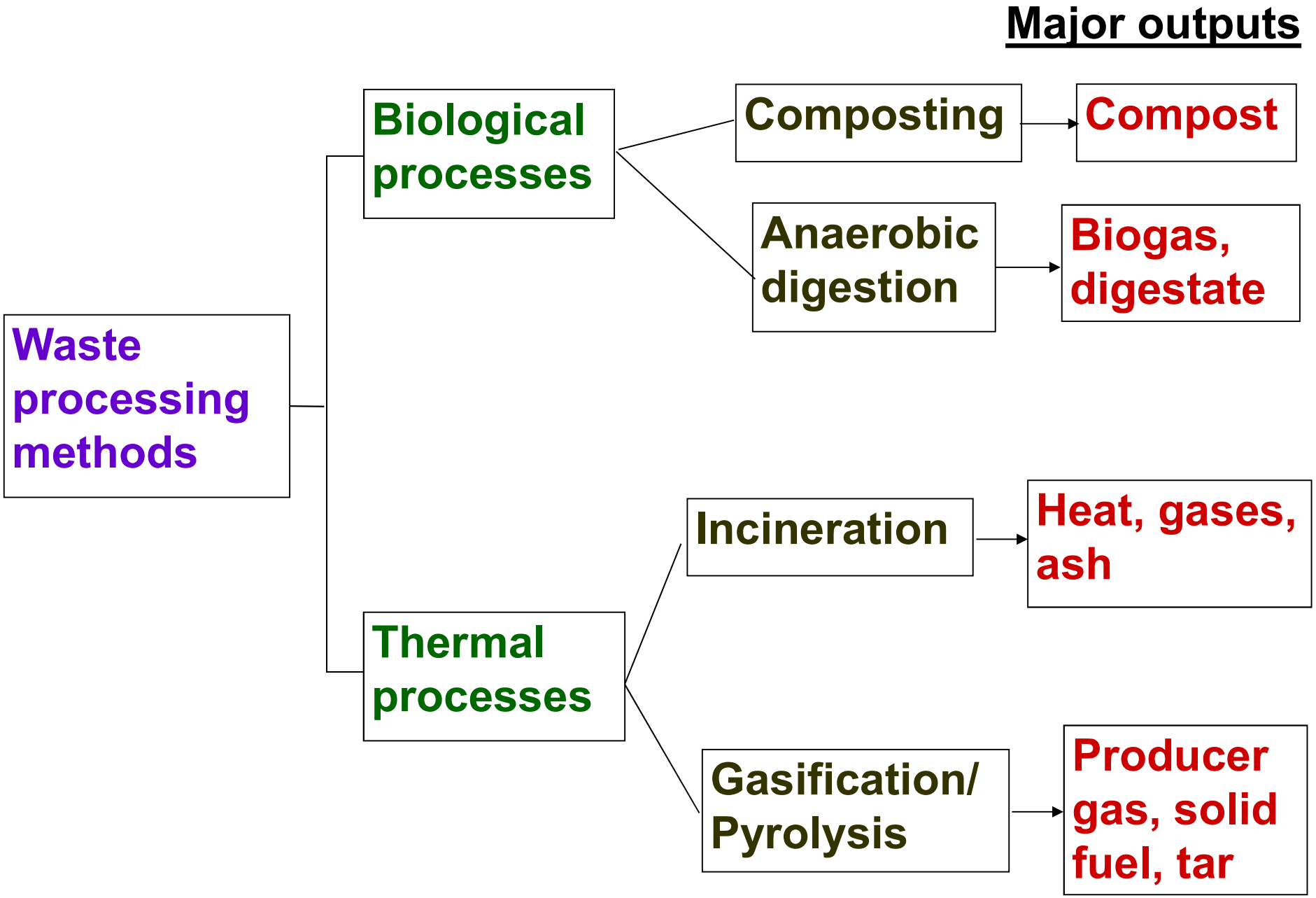
Chemical Properties of MSW……

- **Energy content**
  - ✓ **HHV and LHV**
  - ✓ **By calculation**
    - ➢ **Modified Dulong formula**

      Heating value (Btu/lb) = 145C + 610(H – 0.125O) + 40S + 10N

- **Essential nutrients and other elements**

Major Treatment Processes for MSW



Additional Reading Material (Available online)

- **Srivastava et al., 2014. Urban solid waste management in developing world with emphasis on India: Challenges and Opportunities. Reviews in Environmental Science and Biotechnology, pages 17. (Available online)**
- **Sharholy, M., Ahmad, K., Mahmood, G., Trivedi, R.C., 2008. Municipal solid waste management in Indian cities – A review. Waste Management 28, 459-467.**