Technology Options: Session 3 : Treatment

Module 5: Session 3

Treatment Options

Sewage treatment options come in two broad categories:

- Aerobic systems where micro-organisms oxidise wastes using oxygen.

- Anaerobic system which do not require oxygen to breakdown wastes

Key Features of Aerobic and Anaerobic Systems

Aerobic	Anaerobic
Needs land (0.06 sqm pp for activated sludge up to 3 sqm pp and more for facultative ponds and constructed wetlands)	Requires little land
Needs energy for intensive treatment (eg activated sludge and extended aeration)	No energy requirement - can be net energy producer
Remove most sewage organic load (upto 90 percent)	Removes only half sewage organic load (between 40 – 70 percent). May need secondary aerobic treatment.
Good Pathogen Removal (to WHO guidelines) in systems with long retention (ponds and constructed wetlands)	Poorer pathogen Removal
Not sensitive to changes in load and flow (esp. systems with longer retention such as ponds and constructed wetlands).	Sensitive to changes in flow and loading
Higher sludge production	Low production of well-stabilised sludge

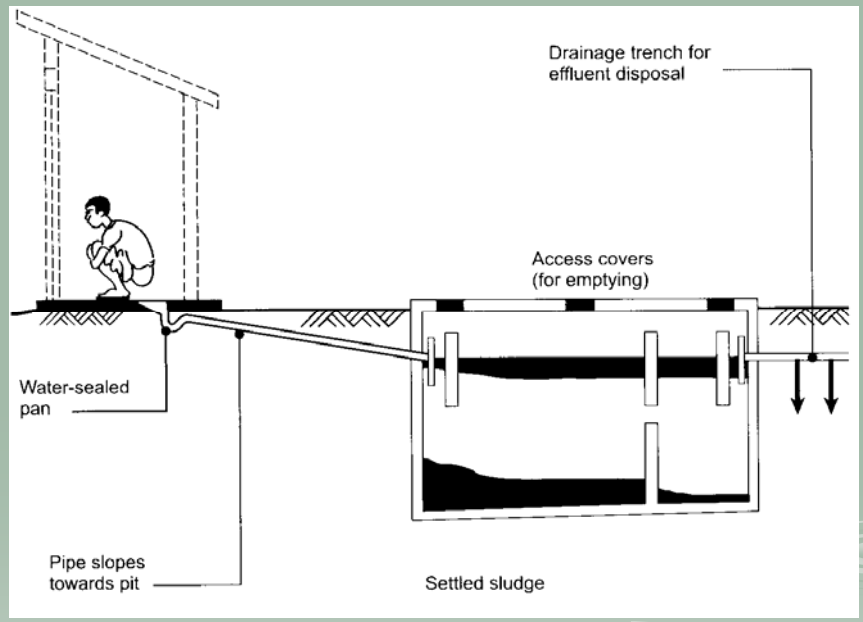
Treatment Options suitable for Decentralised Use

- Anaerobic Treatment
  - Septic Tanks
  - Baffled Reactor
  - Upflow anaerobic filter
  - Anaerobic waste stabilisation ponds
  - Upward flow anaerobic sludge blanket reactor (UASB)
- Aerobic Treatment
  - Facultative and maturation waste stabilisation ponds
  - Constructed Wetlands
  - Duckweed ponds and other aquatic plant systems
- Management Options

Read session note

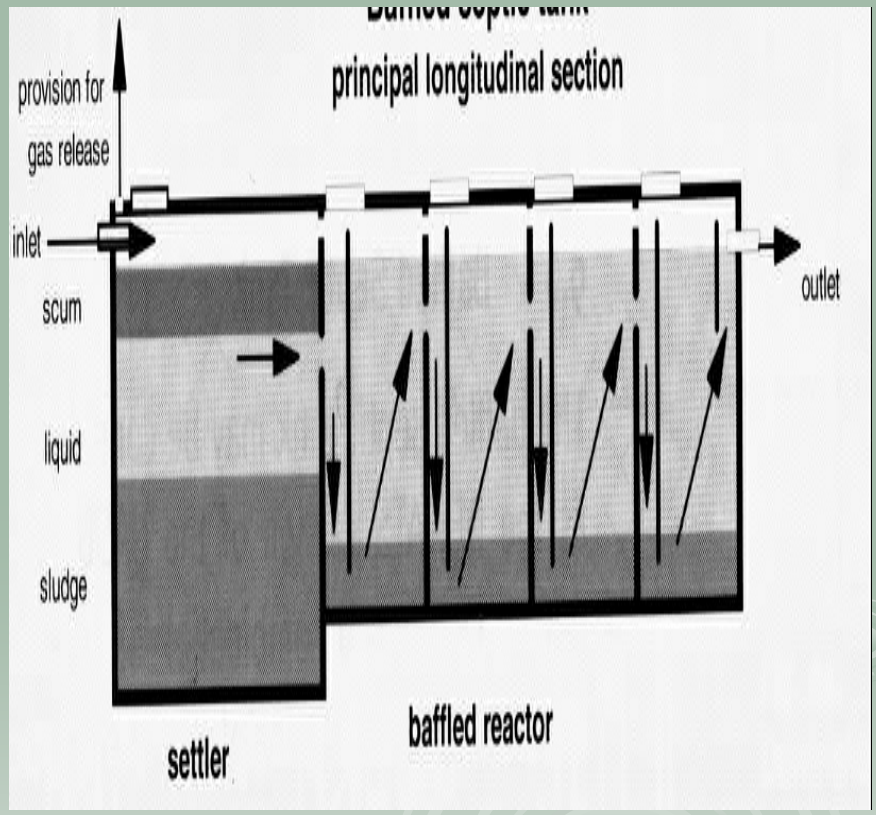
Septic Tank

- Watertight tank where oxygen free digestion takes place.
- Require infrequent desludging to remain effective.
- Standard practice in many countries.
- Much work has been done on cost effective and efficient technical specifications



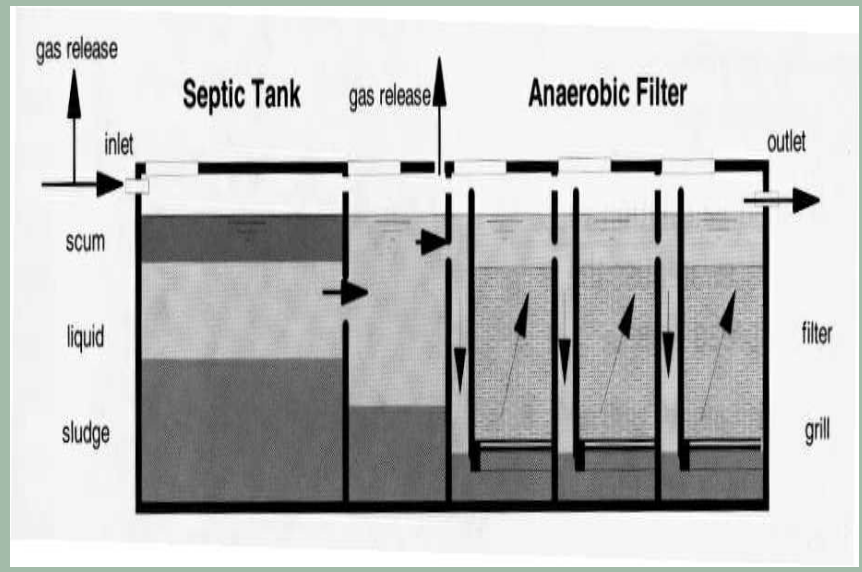
Baffled Reactor

- Provide treatment option for use at local or neighbourhood level.
- Construction similar to septic tank with four or more narrow compartments. Waste flow is directed to encourage biological waste breakdown.



Upflow Anaerobic Filter

- Variation of a baffled reactor.
- Also useful for local and neighbourhood treatment
- Simple operation and construction.



Upward flow anaerobic sludge blanket reactor (UASB) produces similar results

Anaerobic Waste Stabilisation Pond

- Open ponds providing first stage treatment
- Anaerobic process does smell and ponds need to be located away from houses
- Provide larger scale treatment but need land

Waste Stabilisation Pond (Aerobic)

- Facultative ponds - Large shallow ponds that retain sewage and allow treatment.
- Maturation ponds (follow facultative ponds) – are smaller ponds placed in series – good for reducing pathogen levels.
- High land requirement but simple to build and can deal with fluctuations of load over time.

Constructed Wetlands

- Artificial reed beds – wastewater flows through under gravity.
- Purification occurs through chemical, physical and biological processes.
- Needs land, although simple technology and maintenance requirements.

Duckweed Ponds etc

- Treatment with duckweed is simple.
- Require large amount of land.
- Not common but information on operation by Prism NGO in Bangladesh in DWWM case study of Khulna

Management Options

- Treatment of water used for irrigation rarely meets WHO guidelines.

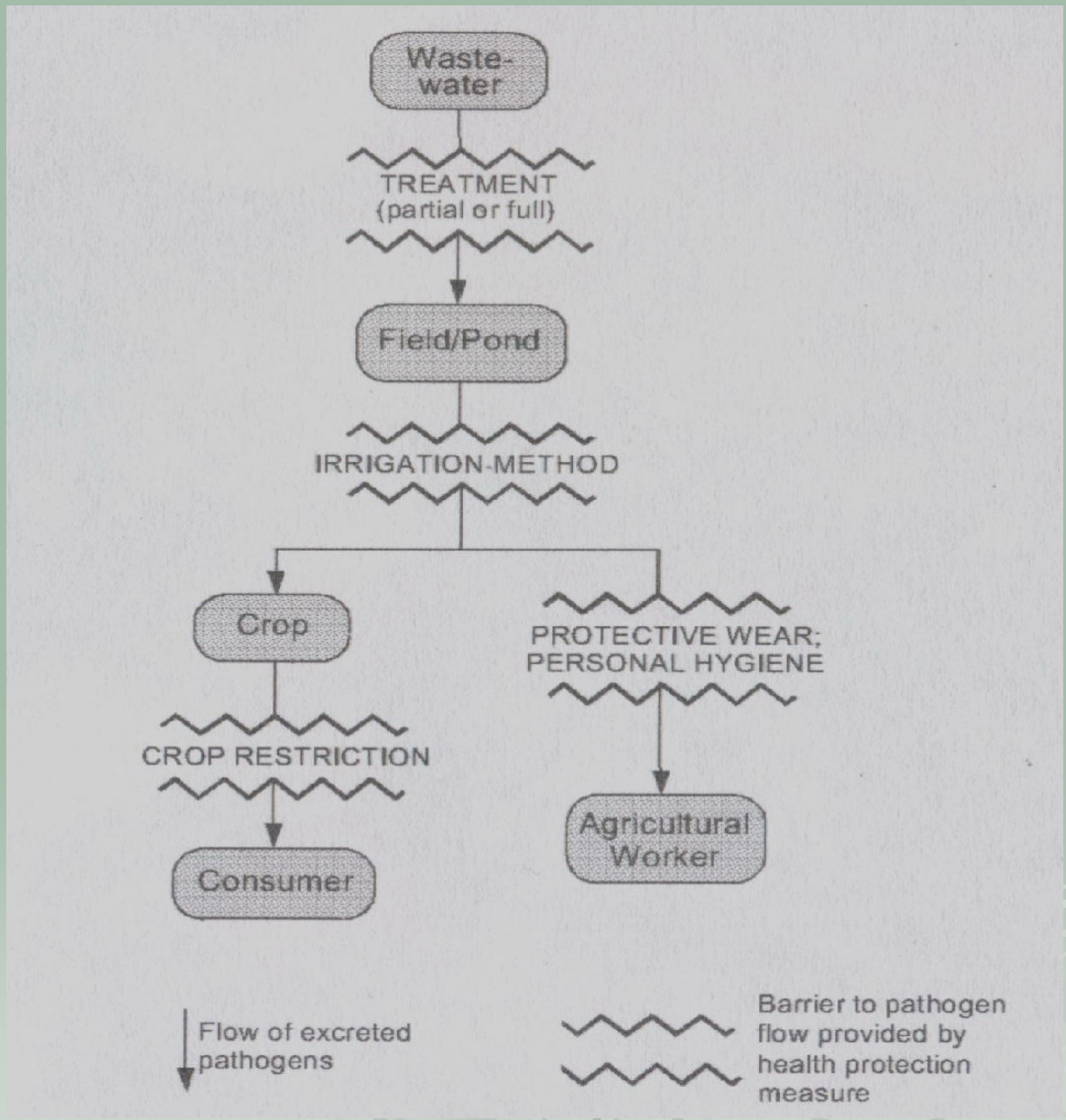
- WHO guidelines note that under typical conditions a retention period of 22 days in waste stabilisation pond is needed for unrestricted irrigation and 11 days for restricted irrigation.

Management Options

- Wastewater application methods
  - Drip irrigation reduces risks and exposure and minimised irrigation water required
  - Ridge and furrow irrigation reduces risks to some extent
  - Spray irrigation is most hazardous, causes inundation of area

- Other options include:
  - Stopping irrigation with wastewater 2 wks before consumption,
  - Crop Restriction - Growing crops that are cooked before consumpton or crops used as feed.
  - Reduce Human Expose - Providing protective clothing for workers.

Points to interrupt pathogen flow



Crop Restriction

Restriction of crops grown :

- rather than growing crops such as lettuce or certain aquatic plants which are eaten raw, the following present less of a risk to consumers :
  - cereals
  - industrial crops such as cotton
  - tree crops
  - fodder crops such as grass pasture or duckweed
- unfortunately crop restriction is often unrealistic as vegetables are the most profitable for farmers, who aim to maximize their earnings

Control Human Exposure

Control of human exposure, and improved personal and household hygiene.

- farmers are continually exposed to wastewater experience skin irritation. They rarely wear protective clothing which is uncomfortable in the tropics and when working in water
- it is essential to wash and cook food well. Food transmitted trematode worms are infectious in raw fish
- steps should also be taken to avoid cross contamination in the kitchen between wastewater raised produce and other food eaten raw.