Emergency sanitation

Feacal sludge management: *'one fits all?'*

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Emergency situations vs. sanitation

- The immediate provision of clean water supplies and sanitation facilities is essential to the health, well-being and the survival of the refugees.
- Sanitation is usually allocated a much lower priority than clean water, but it is just as important in the control of many of the most common diseases found in emergency situations.
- SANITATION GOAL: Protection of the food-chain and water supplies from contamination

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Technological measures

- 3 functions to minimize health risks:
  - Separation → toilet
  - Containment → trench, tank ...
  - Destruction → treatment (natural decomposition, enhanced decomposition, pathogens dye-off, volume minimisation, odours)

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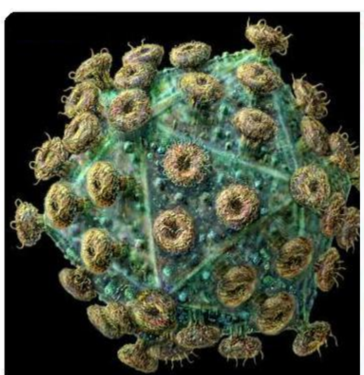
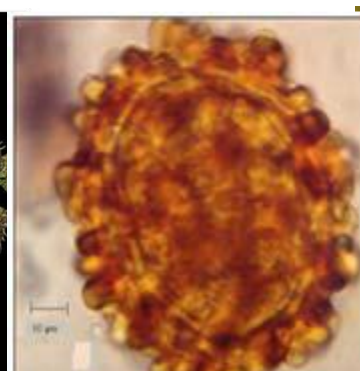
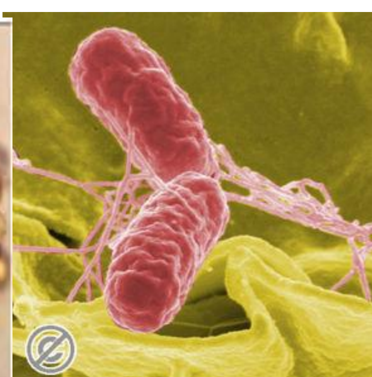
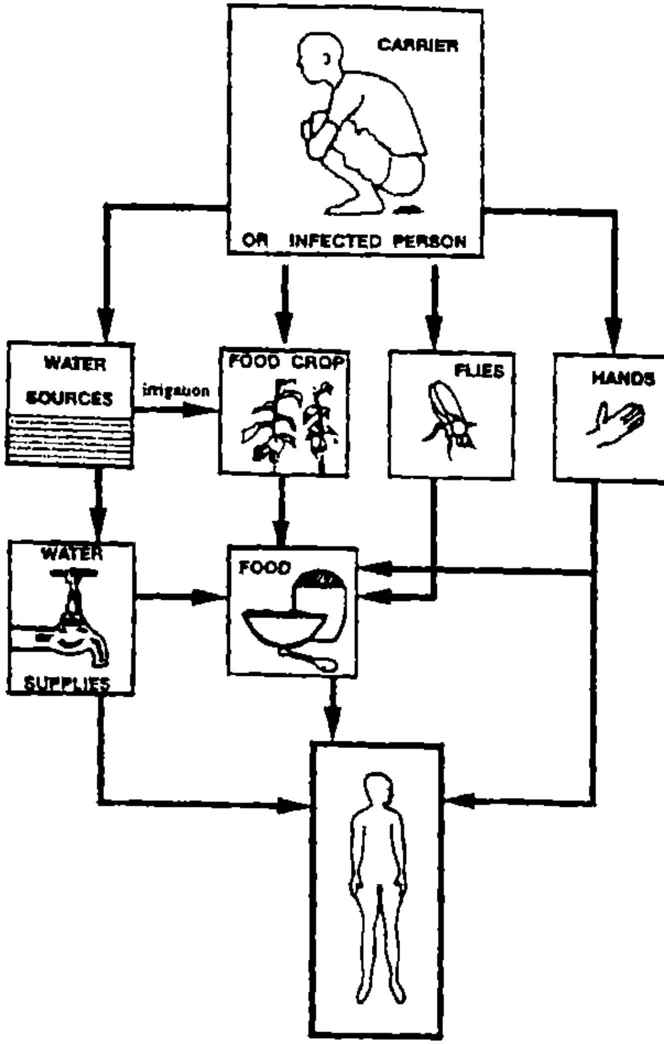
Human waste and health: faeces

- range of disease-causing organisms: viruses, bacteria and eggs or larvae of parasites
- the microorganisms contained in human faeces may enter the body through contaminated food, water, eating and cooking utensils and by contact with contaminated objects (diarrhoea, cholera and typhoid as prevailing)
- others: organic matter, nutrients


Human waste and health: faeces

- Children are especially vulnerable to infections, particularly when they are under the stress of disaster dislocation, high-density camp living and malnutrition.
- While specific measures can be taken to prevent the spread of infection through contamination by human faeces (e.g. chlorinating the water supply, providing hand-washing facilities and soap), **the first priority is to isolate and contain faeces.**



Human waste and health: urine

- Urine is relatively harmless, except in areas where the urinary form of schistosomiasis occurs. This parasite species resides in the veins around the bladder and its eggs are excreted with urine. In these areas, urinating in water courses should be prevented; otherwise, indiscriminate urination is not a health hazard.
- Nutrients, organic matter: potential fertiliser

The technical options: immediate measures: limited and simple

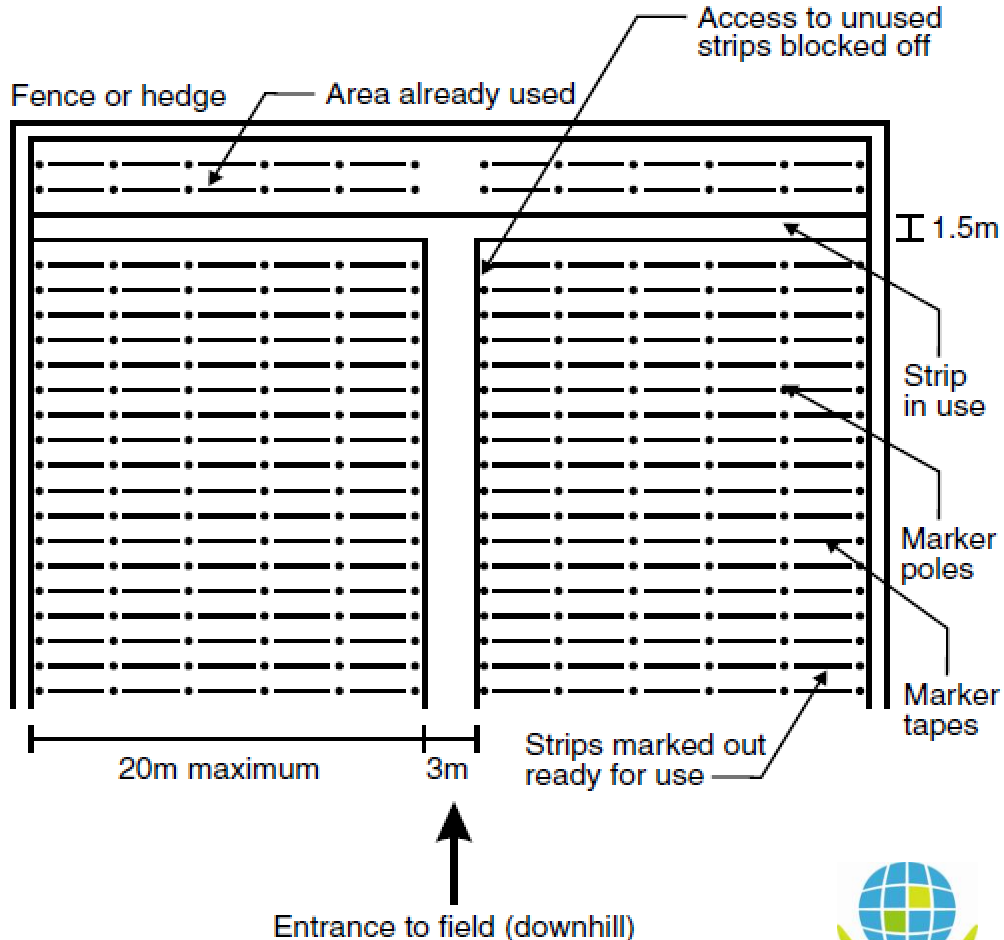
- must be managed well and be **understood and supported** by the community
- Surveying the site to gather information on existing sanitation facilities (if any), the site layout, population, surveying the site clusters, topography, ground conditions, and available construction materials;

Excretion, defecation fields

Areas with fixed boundaries within which defecation is permitted

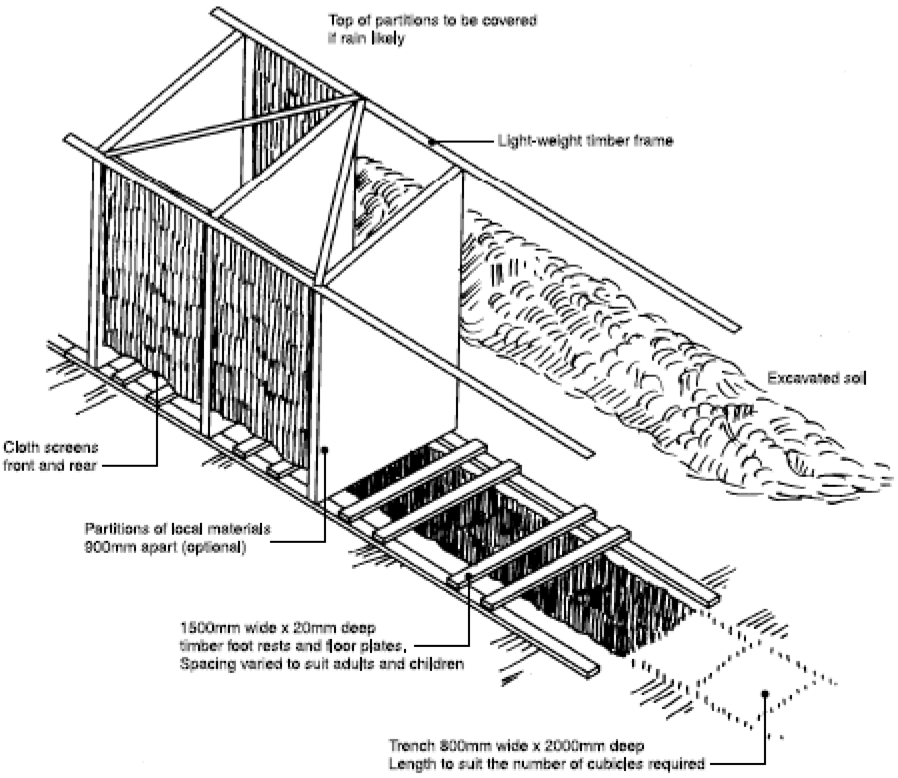
Pollution localization

Management and the cleaning of the site easier



The technical options: intermediate measures

- communal latrines
- quick and cheap to construct
- commercially available, but these are expensive and take time to transport
- 'trench' latrines provide the simplest solution



Making use of existing facilities
Mobile package latrines

- When refugees settle in or near urban areas
- use of existing facilities: sewers, public toilets, bucket latrines, or stormwater drains

- In the North, mobile package latrines are common
- Can be used in other places provided provision is made for the ultimate disposal (and treatment) of the excreta

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Disposal requirements: **very important**

• Ability to process different types of sludge (liquid, solid, semi solid)	3.7
• Ease of adhering to safety, health and environmental norms and standards during operation and maintenance	3.7
• The disposal facility should be an effective solution to decrease and remove pathogens, by a minimum reduction of X %	3.5
• Should prevent the possibility of access by vectors and vector breeding (to allow the possibility to be put up close to human settlements)	3.5
• Can be easily adapted or has the ability to function above ground (for areas with hard surface or at risk of flooding)	3.3

Options: drying

Material characteristics:	
Dry/semi-dry	**Dehydration** (passive, intensive) - Volume reduction (8 times per x time) - Disinfection (additives) - Product not offensive to handle - Handling safe - Reuse possible (no high priority) - Ventilation/heating technical systems - Climate characteristics (cheap) - Acceptance to handle waste - Use of additives (e.g. lime, ashes: availability)
	On-site and after X transport to central facility Off-site frequent transport of large volumes

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Example: conversion of pit-latrines into UDDT

- Back side of one renewed pit latrine block with hot air drying system for dehydration enhancement of human waste
- Bags with dry faeces

Options: composting

Material characteristics:

Dry/(semi-dry)[?]

Aerobic decomposition (passive, intensive)

- Volume reduction (less than with dehydration)
- Desinfection (additives or natural)
- Product not offensive to handle
- Handling safe
- Reuse possible (no high priority)

- Acceptance to handle waste
- Use of additives (co-composting)

On-site and after X transport to disposal/reuse
Off-site frequent transport of large volumes

? How is semi-dried defined?

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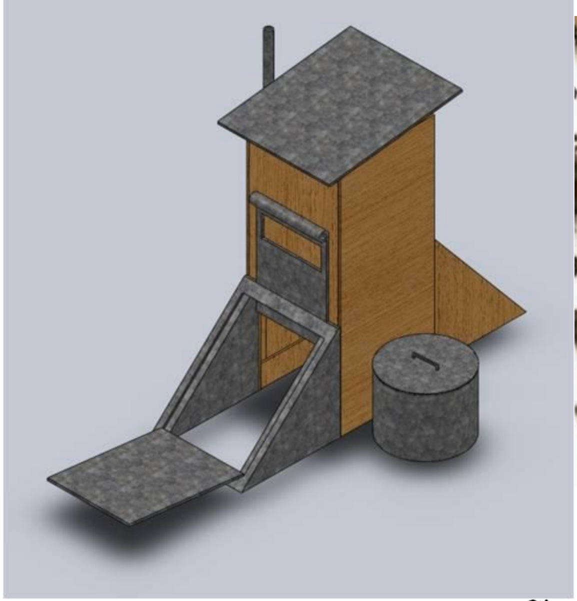
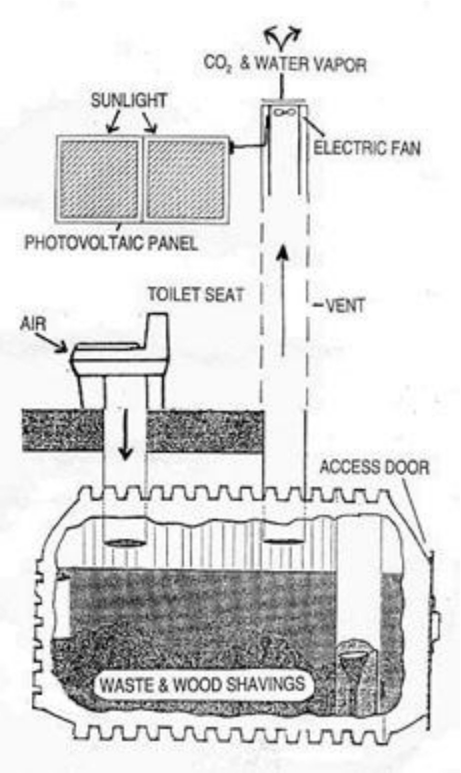
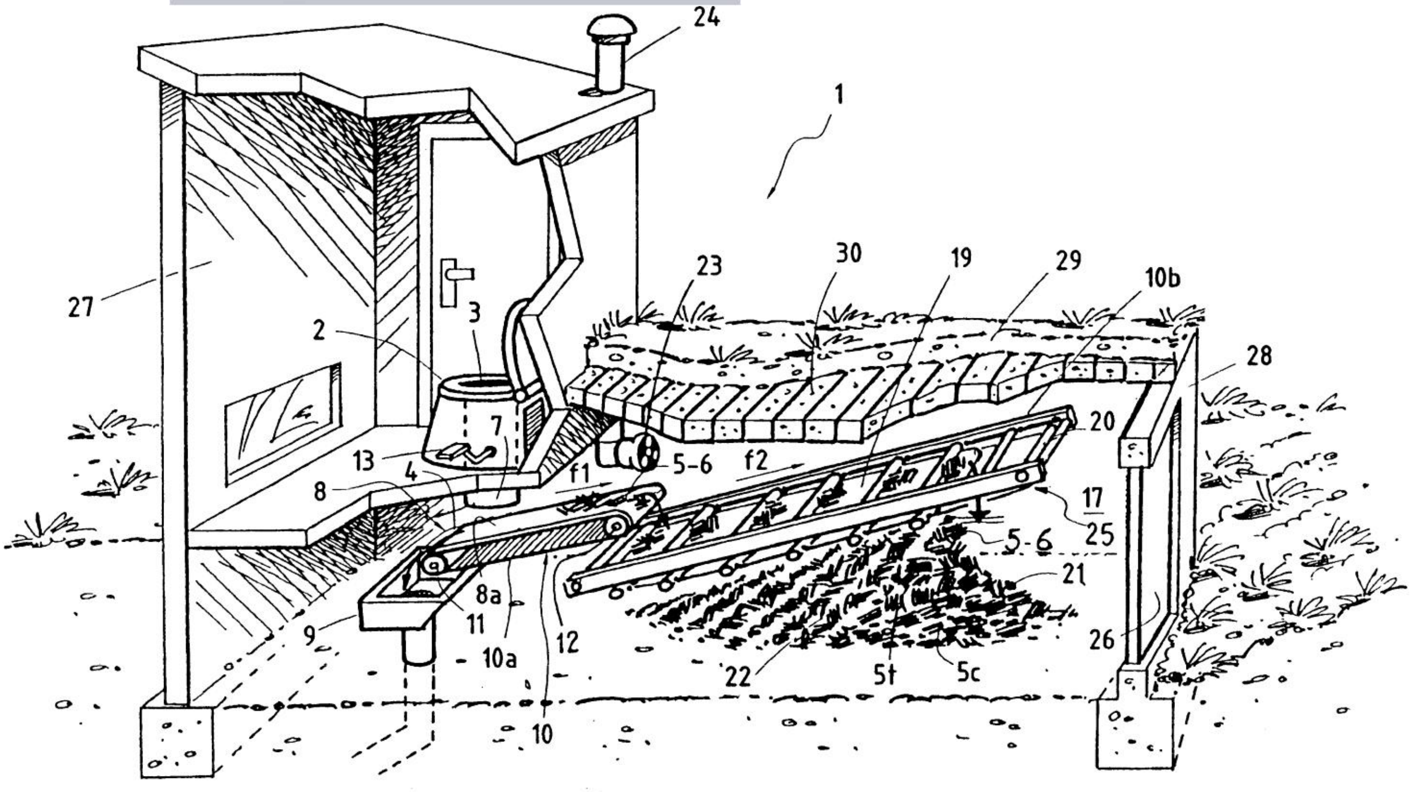
Composting







http://www.freepatentsonline.com/6601243.html

Options: digestion

Material Dry/semi-dry/wet	**Anaerobic mesophilic decomposition** - No volume reduction - Insufficient disinfection - Product (partially) stabilised - Digestate has to be further handled - Reuse of digestate possible (no high priority) - Biogas produced – reuse options - Various configurations possible - For longer term uses if higher engineering involved - Simple on-site solutions possible
	On-site and after X transport to disposal/reuse Off-site frequent transport of large volumes to centralised facility (new to build or existing infrastructure)

Options: digestion

Material Dry/semi-dry/wet	**Anaerobic thermophilic decomposition** - No volume reduction - Disinfection - Product (partially) stabilised - Digestate has to be further handled/reuse - (More) biogas produced – reuse options - 'Faster' process – smaller volumes - For longer term uses as higher engineering involved - Little experience! Process seems to be sensitive.
	Off-site (centralised) (new to build) Expensive but maybe effective

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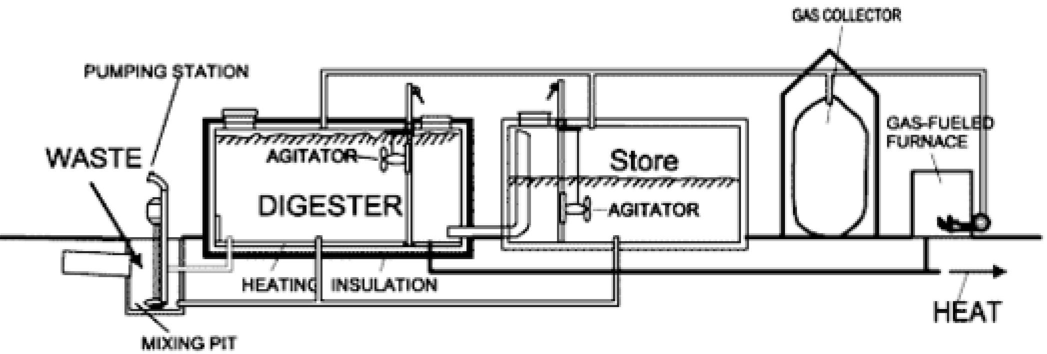
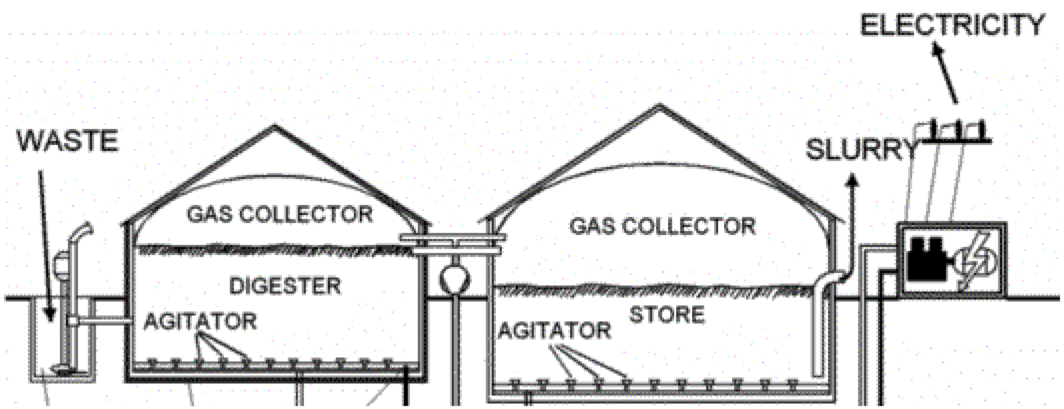
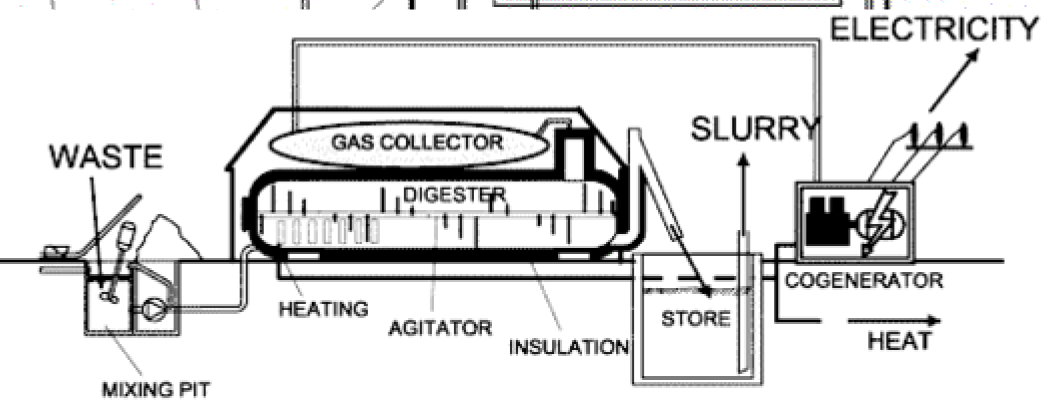
Anaerobic digestion

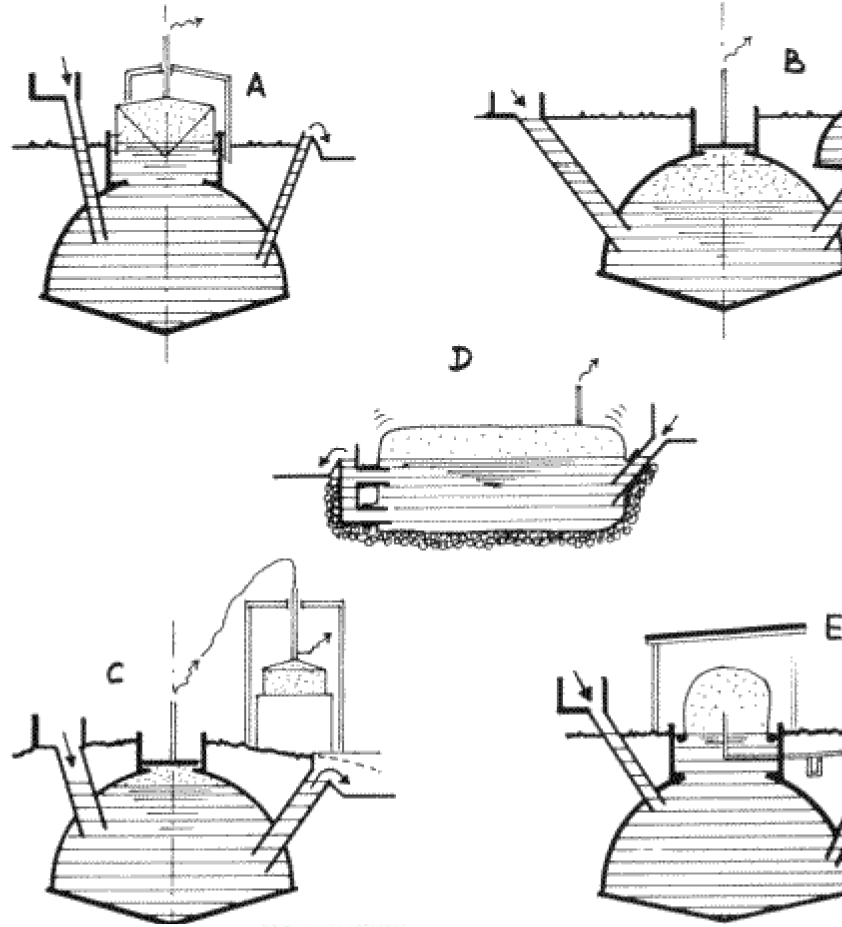
- Suitable for waste with varying water content (reactor configuration has to be tailored)
- Suitable to stabilise the sludge for final disposal
- If carried out at ambient temperatures (20-30^{o}C) not efficient in pathogens reduction
- Thermophilic (55^{o}C) digestion theoretically able to hygenise feacal matter but vulnerable (?), higher degree of engineering (use of biogas/solar energy); experience with feacal sludge
- Variety of configurations depending on water content, scale of application, etc.

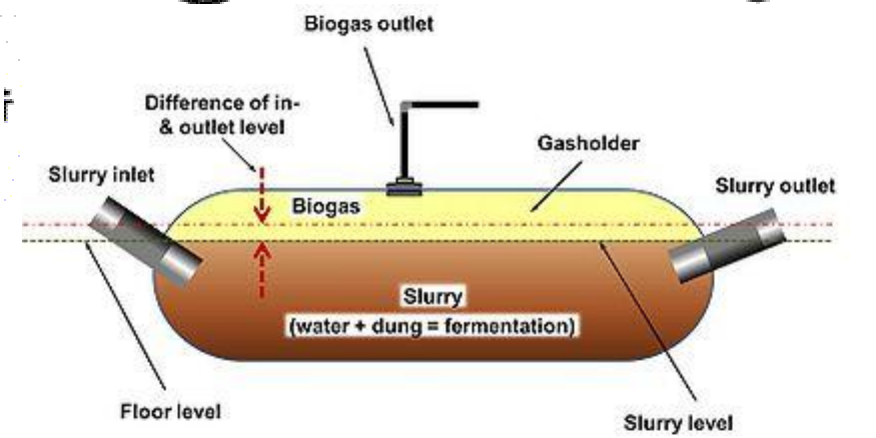
Types digesters











easily adapted/has the ability to function above ground

- Dehydration: elevated toilets
- Composting idem; semi-centralised isolated place; roof against excessive irradiation (drying) and rain;
- AD – closed tanks
- All systems if semi centralised need transport to be solved: for dry/semi dry material a problem (if not to be done manually)

Type of toilet important starting point as it strongly determines the whole FSM chain

Disposal requirements: important

Placement: • The disposal facility is designed to be able to be installed above ground (in case of rocky surfaces)	3,1
Adaptability: • Can be easily adapted or has the ability to function above ground (for areas with hard surface or at risk of flooding)	3,3
Ability of local establishment: • The disposal facility should have the ability for local establishment (not have any international flight restriction) WHICH MATERIALS ARE AVAILABLE LOCALLY: QUICK SCAN OR CAN BE EASY IMPORTED (COSTS)	3,0
Dimensions: • To decrease flooding risk and risk of overflow, the minimal height of the disposal facility should be X mtr. FLOODING CHARACTERISTICS: INFO AVAILABLE PER LOCATION	3,0

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Disposal requirements: important

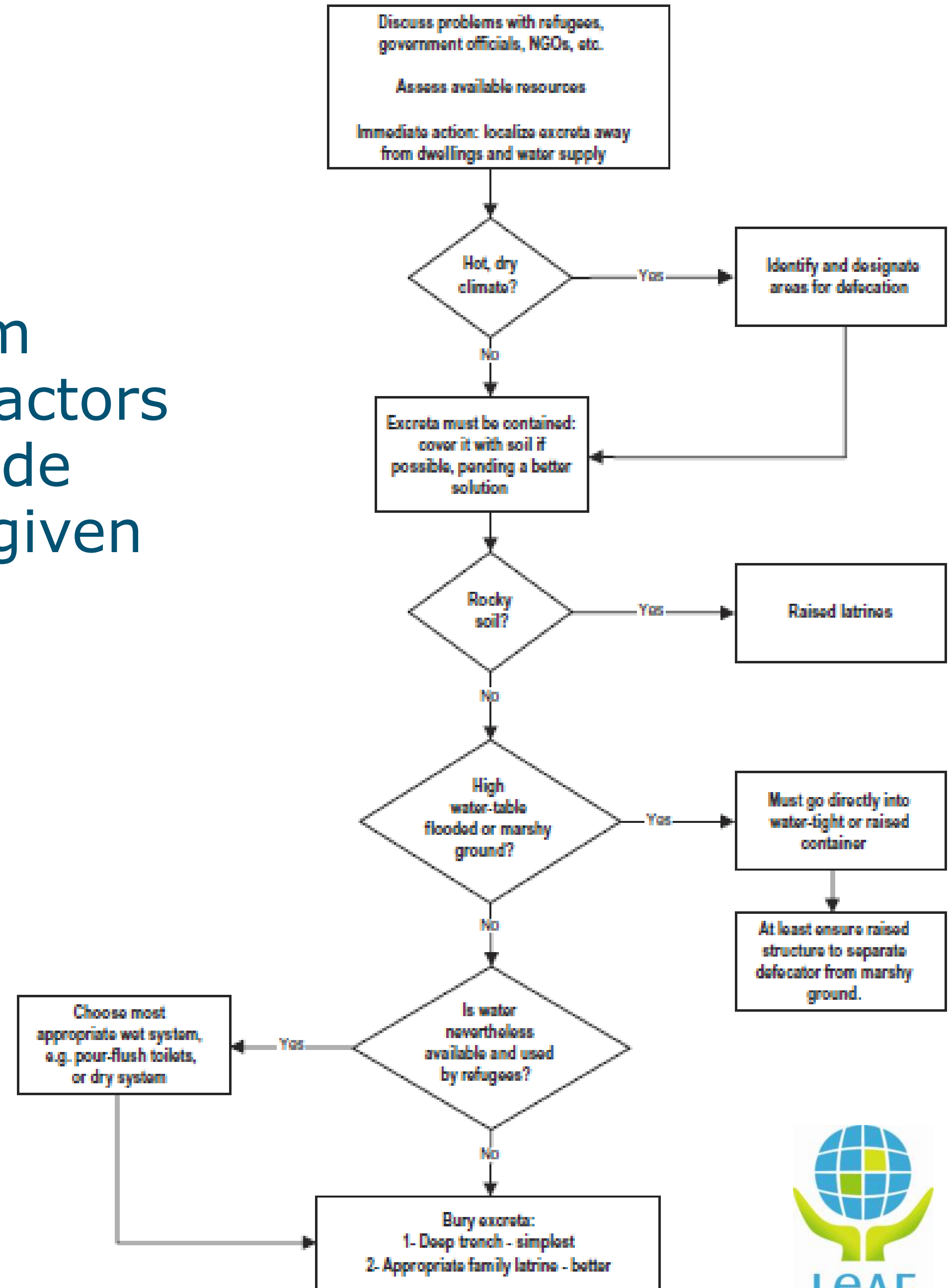
• The installation of the disposal facility should not require heavy construction work DRYING FIELDS, PLASTIC DIGESTERS, COMPOSTERS, SOIL DIGESTERS	3,2
Deployment: • Ability to deploy the disposal facility within short period (X weeks) upon arrival in the field COMPOSTING, DIGESTION IS SIMPLE TANKS	3,5
Modular configuration and scalability: • Should be modular SMALLER DIGESTERS IN SERIES, COMPOSTING COMPARTMENTS	3,5
Accessibility: • The outputs produced by the unit should be accessible by standard emptying/ transport devices CHARACTER OF THE OUTPUT (WATER CONTENT) OR LOCALISATION OF DISPOSAL FACILITIES	3.3

Disposal requirements: less important

Space availability: • The disposal facility should require a limited amount of space at required treatment capacity X m3 sludge per day INTENSIVE (HIGH RATE) SYSTEMS	2.6
Integration in urban context: • The disposal facility should have the ability to be integrated in urban context CONNECTION/MAKING USE TO/OF EXISTING INFRASTRUCTURE	2.6
Robustness: • The product should have a robust design	-
Labour intensity: • The installation of the disposal facility should not require a large amount of labour AND EXPERTISE??	2.6

Universal solution?

- Decision supporting system encountering majority of factors so a quick scan can be made leading to optimal, under given conditions, solution



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