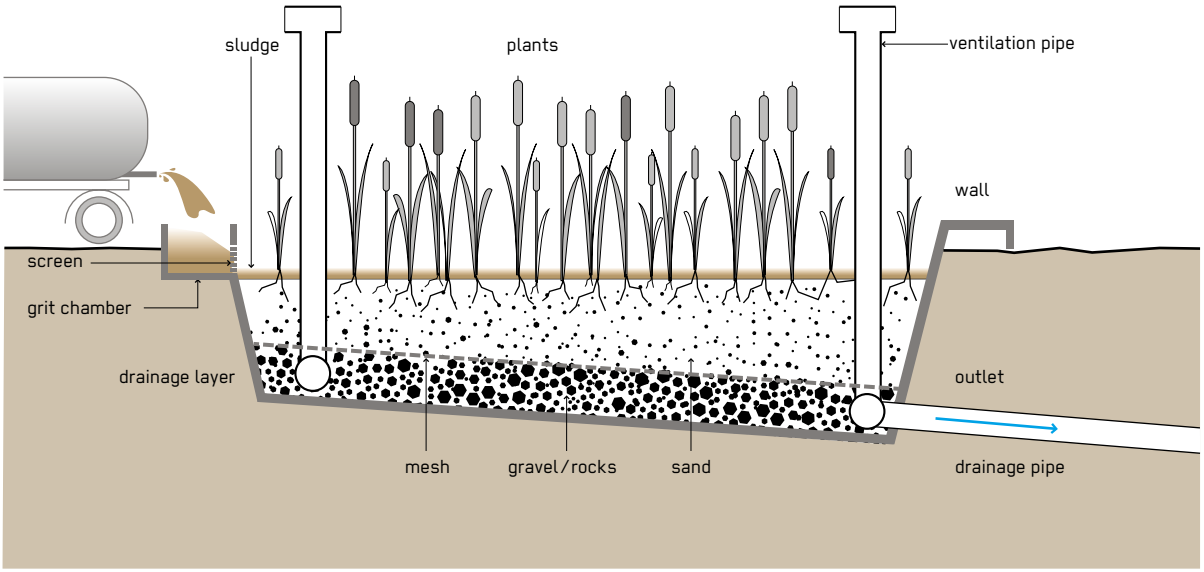
Planted Drying Beds

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	Household * Neighbourhood ** City	Household Shared ** Public	Sludge drying and humification, Biomass production
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
*** High	** Medium	● Sludge	● Sludge, ● Effluent, ● Biomass



A Planted Drying Bed is similar to an Unplanted Drying Bed (T.9), but has the added benefit of transpiration and enhanced sludge treatment due to the plants. The key benefit of the planted bed over the unplanted bed is that the sludge does not need to be removed after each feeding/drying cycle, but does need to be removed every three to five years. Fresh sludge can be directly applied onto the previous layer.

Planted Drying Beds dewater and stabilise the sludge. Plants with their root systems maintain filter porosity, while creating pathways through the thickening sludge that allow water to easily percolate. Compared to Unplanted Drying Beds, Planted Drying Beds have the advantage that they function in humid climates. However, they need a continuous supply of sludge in order to keep plants alive. The appearance of the bed is similar to a vertical flow Constructed Wetland **(T.6)**. The beds are filled with sand and gravel to support the vegetation. Sludge is applied to the surface and the filtrate flows down through the subsurface where it is collected in drains. The final moisture content of humus after a few years should be around 60 %, depending on the climatic conditions and the initial characteristics of the sludge.

Design Considerations: Ventilation pipes connected to the drainage system contribute to aerobic conditions in the filter. A general design for layering the bed is: 25 cm of coarse gravel (grain diameter of 2–4 cm); 10 cm of middle-sized gravel (grain diameter of 5–15 mm); 20 cm of fine gravel (grain diameter of 2–6 mm); and 5 cm of earth or coarse sand. Free space (1 m) should be left above the top of the sand layer to account for about three to five years of accumulation; a classic accumulation rate under tropical conditions is 20–30 cm/year. Reeds (Phragmites sp.), antelope grass (Echinochloa sp.) and papyrus (Cyperus papyrus) are suitable plants for the filter. Local, non-invasive species can also be used if they grow in damp

soil conditions, are resistant to salty water and readily reproduce after cutting. Sludge should be applied every three to seven days in layers between 7 to 10 cm thick, depending on the sludge characteristics, the environment and operating constraints. Sludge application rates of 100 to 200 kg total solids/m^2/year have been reported in warm tropical climates. In colder climates loading rates from 50 to 70 kg total solids/m^2/year are common. Two or more parallel beds should be alternately used to allow for sufficient degradation and pathogen reduction of the top layer of sludge before it is removed. The leachate drained by the drainage pipes must be treated properly, for example in Waste Stabilisation Ponds **(T.5)**, depending on where it is discharged. The infrastructure must be designed to ensure good access for vacuum trucks and for removal of humus.

Materials: Planted drying beds require availability of gravel and sand with the right grain size. Local plants can be used. Furthermore, piping is needed for drainage and ventilation. To remove dried sludge, shovels and rakes are required as well as personal protective equipment (PPE). The bed itself can be constructed with cement and bricks or concrete and needs to be sealed at the bottom.

Applicability: This technology is effective at decreasing the sludge volume (down to 50 %) through decomposition and drying, which is especially important when sludge needs to be transported elsewhere for end-use or disposal. It facilitates treatment of low-concentrated sludge. The sludge should be stabilised before being applied; in emergency settings where sludge often does not have much time to stabilise (e.g. in holding tanks with high emptying frequency), a prior treatment step may be needed. In dry climates, beds should be fed regularly to avoid drying of the plants. Planted Drying Beds are appropriate for towns or camps generating a constant sludge supply. They should be located as close as possible to initial sludge emptying to avoid high transport costs.

Operation and Maintenance: Trained operation and maintenance staff are required. They should be trained to distribute the sludge on the different beds properly and to manage the plants. The plants should be grown sufficiently before applying the sludge. The acclimation phase is crucial and requires much care. Plants should be periodically thinned and/or harvested. After three to five years sludge can be removed, manually or mechanically. Drains must be maintained, and the effluent properly collected and subjected to further treatment and disposal options.

Health and Safety: Faecal sludge is hazardous and anyone working with it should wear proper PPE. The degree of pathogen reduction in the sludge will vary with the climate. Depending on the desired end-use, further storage and drying might be required. The leachate should be further treated. The planted beds may attract wildlife, including snakes.

Costs: This is an option with medium capital and low operating costs. The main capital costs are for civil engineering work and for appropriate filter media. The main operating costs are for the staff in charge of maintenance of the beds, and for sludge removal and replanting.

Social Considerations: Because of the pleasing aesthetics, there should be few problems with acceptance, especially if located sufficiently away from dense housing. The treatment process being aerobic, the odours are not strong and are mainly generated during the discharge from the trucks.

Strengths and Weaknesses:

- ⊕ Can handle high loading
- ⊕ Better sludge treatment than in Unplanted Drying Beds
- ⊕ Can be built and repaired with locally available materials
- ⊕ No electrical energy required

- ⊖ Requires a large land area
- ⊖ Requires specific skills to manage the plants
- ⊖ Odours and flies may be noticeable
- ⊖ Leachate requires further treatment

→ **References and further reading material for this technology can be found on page 194**