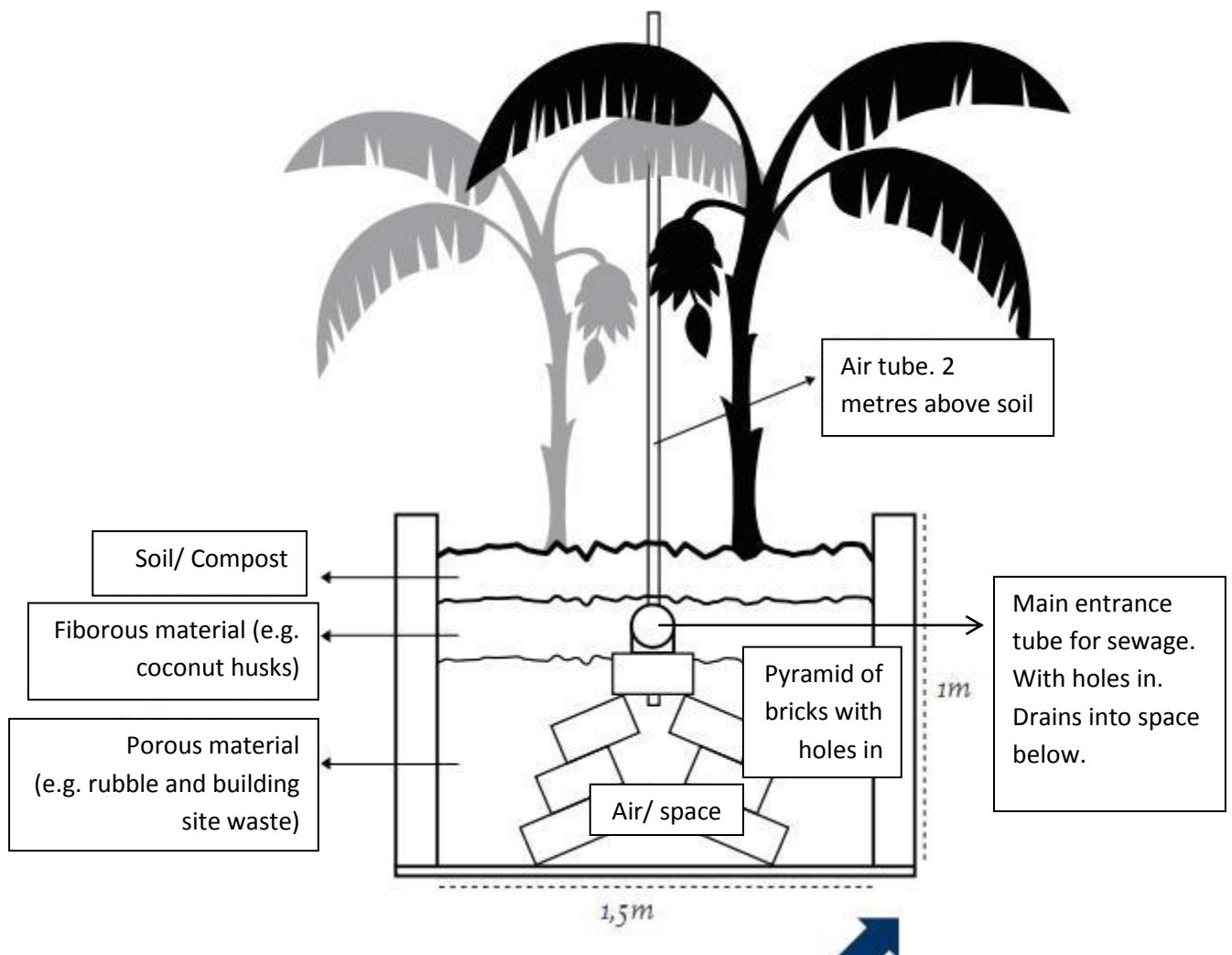


EVAPTRANSPIRATION BASIN or BIO SEPTIC TANK (BST)

If for any reason you have decided to use flush toilets at your project and are not connected to a mains sewage treatment system, then it is most likely that you will have an underground septic tank and soak-away system. These are sometimes leaky and contaminate groundwater or well water. This design is an improvement on the conventional septic tank and leach-field design which uses plants inside a sealed open-topped tank as a living filter to evaporate excess water into the air, and to consume and benefit from the nutrients in sewage. At the same time we gain a valuable yield of food and biomass. All food from fruiting plants are 100% safe from any contaminants that may be in the sewage.

The fungi and bacteria living in the bottom of the tank and on the plant roots actually do a lot of the work too. Your system needs about 2 cubic metres of volume per person that will be using it. So a system for a family of 4 will need to have a tank that is at least 8m³.

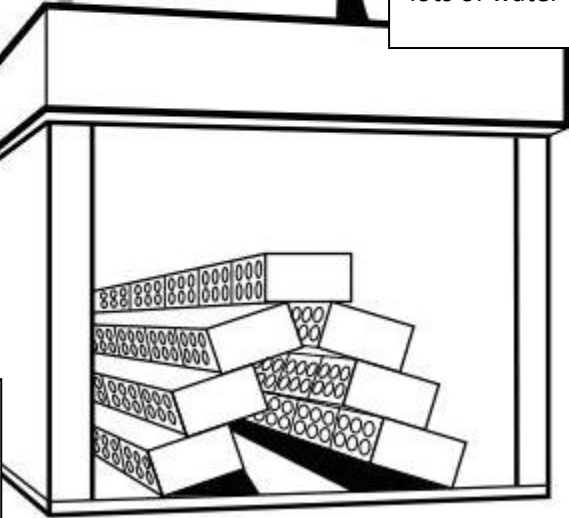
Here's how it looks.



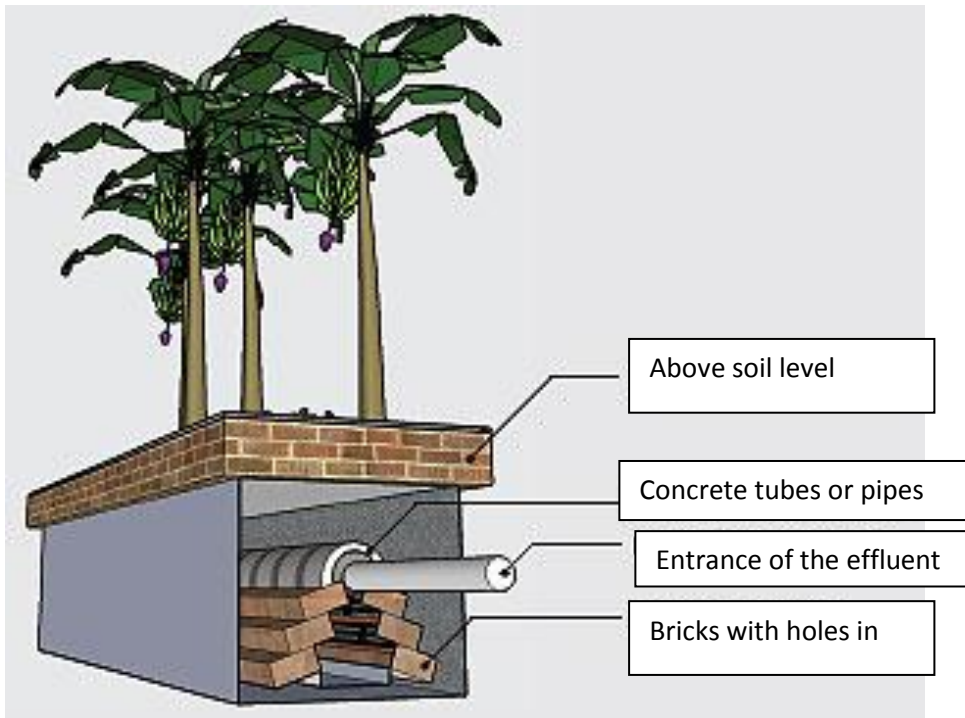


Use compost and plant bananas and other plants that like lots of water

The pit is dug and made impermeable with cement render above a second floor of approx. 5cm

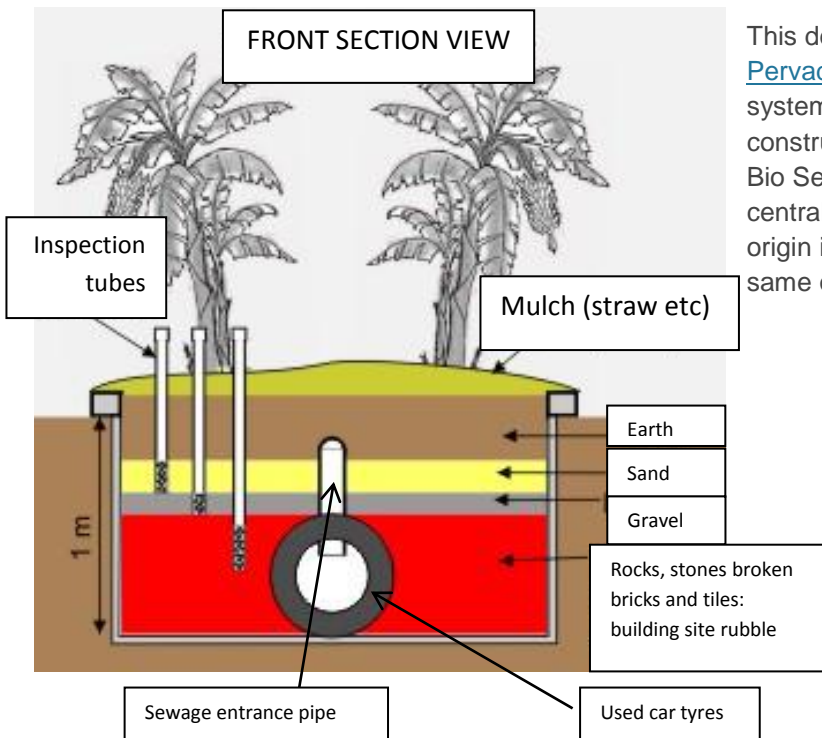


You can even have a low wall above ground level to raise the beds up from the path and avoid any rainwater from flooding in, or just to get extra growing room (shown here on the left). This system has 2 pits a metre wide, a metre deep and 4 metres long. They each have a volume of 4m³ and together would treat the sewage of 4 people.

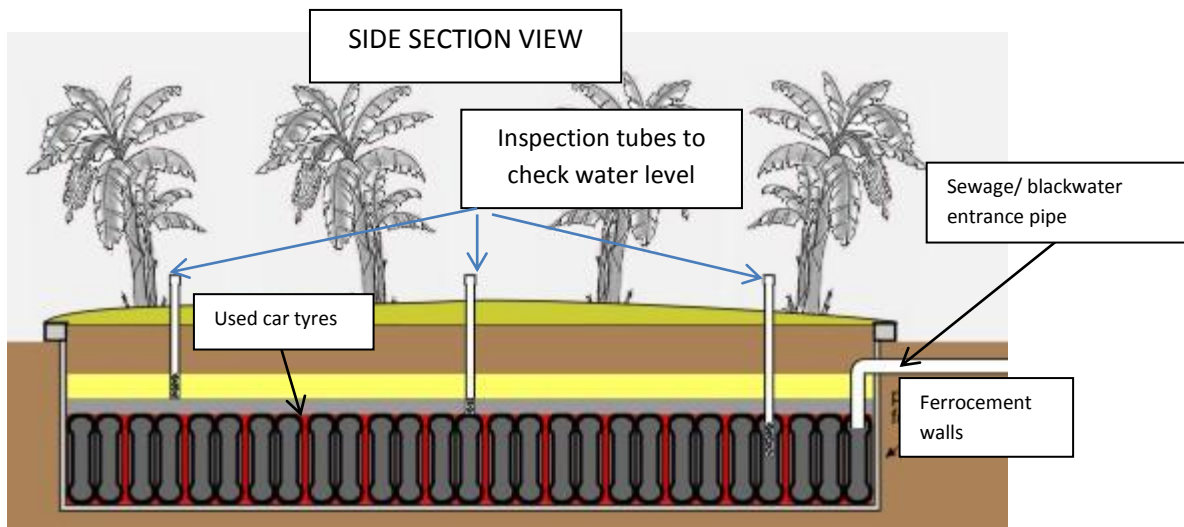


BST ADAPTATION USING TYRES INSTEAD OF BRICKS

Popularly known as "banana pit", is a Bio Septic Tank (BST) closed system of treating black water used in conventional flush toilet. This system generates no wastewater and prevents the pollution of soil, surface water and groundwater. Therein human waste is transformed into plant nutrients and the water leaves only by evaporation, thus completely clean.



This design is published by [Network Pervade](#), mainly in Santa Catarina. This system has some characteristics of construction and development of different Bio Septic Tank methods most used in central Brazil. But both have the same origin in permaculture and share the same operating principles.



OPERATION AND PRINCIPLES

A prerequisite for using the BST is the separation of wastewater in the house, into grey and black water. Only the black water, which comes from toilets, should go to BST. The grey water, that which comes out of the washing machine, sinks and showers, should go to another treatment system as a banana circle. See links here for more information:

<http://treeyopermacultureedu.wordpress.com/chapter-10-the-humid-tropics/banana-circle/>

<http://permaculturenews.org/2008/06/23/build-a-banana-circle/>

1. Fermentation

Black water is decomposed by fermentation process (anaerobic digestion) made by bacteria in the septic bio-chamber made inside the waste tyres (or holed bricks if you are using them) and the spaces created between the stones and rubble placed beside the chamber.

2. Security

The pit is sealed and the pathogens are enclosed in the system because this guarantees their complete elimination. This is achieved thanks to the fact of being closed basin without outlets. The basin needs to have free space for the total volume of water and human waste received during a day (or it will overflow). The basin should be constructed with a technique that prevents infiltration and leaks: ferrocement, or block or brick walls lined with render. If you have a lot of toilets you can have one or two large systems, or several smaller ones. As long as you have around 2m³ volume per person using the system at maximum capacity.

3. Percolation

As water is trapped in the basin it percolates upwards, which separates out the human waste as it passing through layers of gravel, sand and soil, finally reaching plant roots, 99% clean.

4. Evapotranspiration

This is one of the main principles of the BST because it makes possible the final treatment of all the water, which only leaves the system as water vapor, without any contaminant. Evapotranspiration is performed by plants, especially broadleafed ones such as bananas, papayas, taro, etc... Moreover, these consume the nutrients for their growth process, allowing the BST to never fill up.

5. Management

First (mandatory), the vegetation should always be mulched with its own falling leaves and stems of plants of banana trees after harvesting fruit. And if necessary, this should be complemented with the trimmings and prunings other garden plants, so that the rain does not enter the basin.

Second (optional), from time to time to observe the inspection tubes and collect water samples for testing. And watch the overflow box to see if the sizing was correct. This box should only exist if required in urban areas by the city to connect the system to channel storm water or sewage. Otherwise you can plan an overflow into a nearby garden bed or banana circle for emergencies.

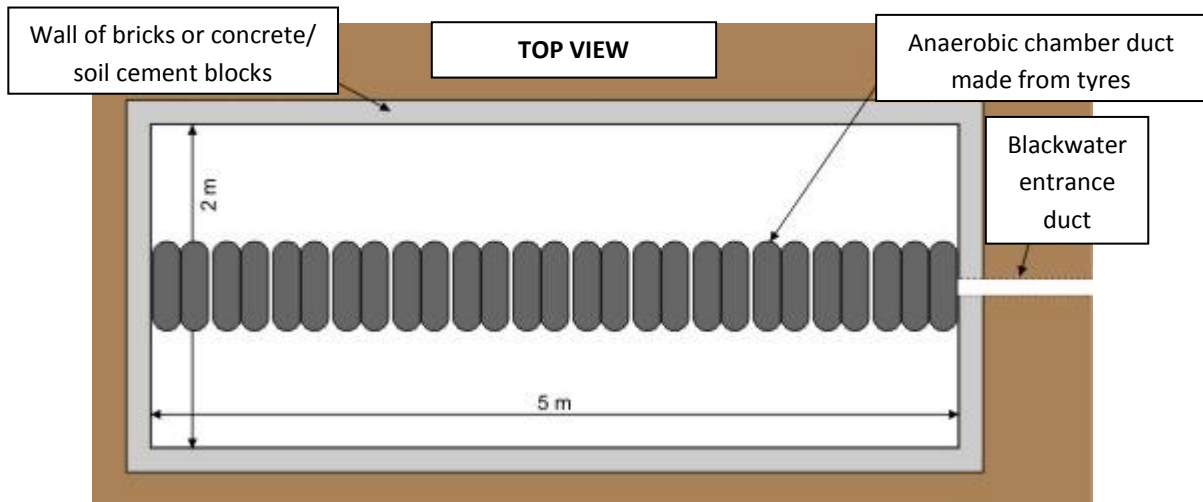
CONSTRUCTION STEP-BY-STEP

1. Orientation to the sun

As evapotranspiration depends largely on the location of the sun, the BST should be oriented to face north (southern hemisphere) or south (in the northern hemisphere) and without obstacles like tall trees next to the basin, so as not to shade and to allow for ventilation.

2. Sizing

By practice, we observed that 2 cubic meters for each resident is enough to make the system work without overflowing. The shape of the basin is sizing: 2m width and depth of 1m. The length is equal to the number of usual residents home. For a house with five residents, the scale looks like this: (WxDxL) 2x1x5 = 10 m³.



3. Basin

You can build the basin in many ways, but aiming for economy while upholding the security. The best method of construction of the walls and the bottom is ferrocement, as seen in the photos below. The walls are lighter, less bearing materials. The ferrocement is a construction technique with iron mesh and chickenwire covered with mortar. The mortar of the wall should be two (2) parts sand (normal washed building sand) for one (1) part cement: and floor mortar should also be two (2) parts sand (washed) per one (1) part cement. One can use a layer of concrete under (below) the floor if the floor is not very firm. If you have a good solid clay floor underneath this is OK.

4. Anaerobic chamber

After the basin is ready, ensure its imperviousness by keeping it moist for three days. Then comes the construction of the anaerobic chamber that is super easy with the use of used tires and building rubble. As shown in the photo below, the chamber is made of a duct of horizontally stacked tires and cemented bricks (with holes in), surrounded by more whole or broken bricks, tiles and stones, placed to the height of the tyres. This creates an environment with free space for the water to flow through and benefits the proliferation of bacteria that break down the solids in micronutrients molecules.

5. Inspection Tubes

At this point you can start to fix 3 pipes of 50mm diameter, as shown in the drawings above for inspection and collection of water samples. They can go down to the different levels and sections of the system, as shown in the drawing above.

6. Layers of materials

As the tyre height is about 55cm, which together with the honeycomb bricks each side will form the first layer (lower) of the basin. This will still leave 45 cm in average height to complete the BST, and four more layers of material. The second layer is gravel (+ / - 10 cm). At this point I have used a fabric blanket or shade net to prevent the sand falling down into the spaces between the gravel. The third layer is the sand (+ / - 10 cm). And the fourth is the soil (+ / - 25 cm) that goes to the upper basin. Try to use a soil rich in organic matter and more sandy than clay. The last layer is the mulch that lies above the BST.

7. **Protection**

As the bowl has no lid to prevent flooding by rain, it should be covered with mulch. All the leaves that fall from plants and cuttings and grass prunings etc, is placed over the basin to form a mattress where rainwater drains out of the system. And to prevent ingress of water that drains through the soil a row of bricks or concrete blocks is placed as a bed edge wall around the basin so that it is higher than the ground level. By leaving some holes in the mortar joints of this wall you can let the water that falls on the mulch layer filter out sideways onto the path instead of down into the basin.

8. **Planting**

Finally, it should be planted with broadleaf plant species such as papaya (4), banana (2), taro, etc...The banana plants can be planted in several ways. But I prefer to use the entire rhizome or a wedge (part of a rhizome). After making the holes (at least 30x30x30 cm) you should fill them with plenty of organic matter (straw, leaves, etc.). Mixed with soil. The rhizome should be some 10 cm long on average, below ground level. When planted from seedlings, position them leaning out, as it will facilitate the collection and handling of bananas.

PHOTO ALBUM







More photos below







