TOILET MANURE IN ORGANIC FARMING

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Introduction

Human faeces and urine (Toilet manure) constitute serious waste disposal problems especially in areas with high human population density. At the same time these materials are rich in nutrients that are essential to plants. Toilet manure also functions as organic matter to maintain the humus in the soil. Use of toilet manure in agriculture was extensively practiced in China, Japan, Korea, Singapore etc. In Bangalore Acharya and his team has suggested the use of night soil in the compost production. However, the introduction of toilets and sewage systems has drastically reduced the use of this valuable nutrient source. In rural India recent propaganda of popularizing the toilet construction has further reduced the recycling possibilities. So it is high time to popularize toilets appropriate recycling technology.

Nutrient potential: On an average 454 kg fecal matter and 500 l urine is produced per person per year. Fecal matter contains 5-7% N, 3.5-4% P, 1-2.5% K, 4-5% Ca and 40-55% Carbon. All are precious to plants. As per the conservative estimations a house hold of 5 people could supply enough nutrients to 0.2 hectares of cultivated land. So 53 million population of Karnataka State of India could provide enough manure to 2.12 million hectares or 18% of total cultivated area of 11.6 million hectares.

Technology: A good number of R&D efforts have been made on the utilization of toilet manure. Being a potential source of pathogens it needs to be managed appropriately. Composting toilet is widely published method. These toilets are a little different from normal water flushed toilet, cannot be acceptable to most of the people. Varanashi Research Foundation (VRF) has developed models where in there is no modification in the existing toilet bowl. Modifications are made in the septic tank and subsequent utilization of the digested material.

Methods and Materials

VRF has developed a few models for utilization of the toilet manure. The methods and materials are briefly described here below.

1. Individual house model: Soak pit is the most popular design to dispose toilet waste in rural/semi urban areas. Connecting the toilet to impermeable two chambered tank, allowing the waste to digest and letting off the supernatant liquid to far off fields is other practice. Ready made two chambered cylindrical RCC tank (100 cm diameter, 135 cm length) was used in the experimental model. A third chamber (100 x 100 x100 cm) is added to collect supernatant liquid and distributed to the plant basin through drip pipes. This design could be adopted by individual houses which are building a new toilet. It is also possible to modify the existing toilet effluent disposal system. The detailed material list and cost is given table 1.

Tabel 1. Cost estimation (in INR) for Toilet manure utilization of house hold with 5 people (One US $ = INR 45 Indian National Rupees)

Description	Cost INR
Low cost Toilet room with bowl, stoneware/ PVC pipe connecting to the silt trap chamber	6,000
2 Soil/ silt trap chamber with cover	550
110 mm pipe connection to septic tank with fittings	300
2 chambered septic tank	6,600
Supernatant liquid collection tank	1,800
Telescopic PVC distribution line with LLD drip pipes*	14,400
Installation cost	6,000
Total	**35,650**

* In case of hose pipe system (1.2), distribution line cost is INR 3,855 and the total is INR 25,105.

1.1. Telescopic PVC distribution line with LLD drip pipes: The following table gives the estimated cost of toilet liquid manure distribution pipe line. As an example, mixed areca nut garden of Varanashi Farms having 128 Areca nut, 128 Banana / Cocoa in area of 972 m^2 is taken into consideration.

Tabel 2. Cost estimation for drip distribution line

Material	Quantity	Price / unit INR	Total cost INR
Ball valve	5 No.	295	1,475
75 mm PVC pipe	30 m	70	2,100
63mm PVC pipe	40 m	46	1,840
50mm PVC pipe	40 m	42	1,680
32 mm PVC pipe	40 m	22	880
16 mm LLDP pipe	256 m	8.50	2,176
End cap	256 No.	3	768
4mm.pipe	77 m	3	231
Fittings and labor			3250
Total			**14,400**

1.2. Toilet manure distribution by hose pipe: In a cheaper simpler design the effluent colleted in the third tank is used to irrigate the plant basin using a hose pipe.

Tabel 3. Cost estimation for distribution by hose pipe

Materials	Quantity	Unit Price INR	Total cost INR
Ball valve	1	295	295
63 mm. inch PVC pipe	30m.	42	1260
32 mm. Green Hose	One 30m. roll	1150	1150
Fittings and labor			650
Shoe and Rubber Gloves	1 pair each		500
Total			**3,855**

As per the estimations a toilet with septic tank and drip distribution system costs INR 35,650 for mixed areca nut garden. Normally when a new low cost toilet is installed with soak pit, same will cost INR 13,000. So the extra cost is INR 22,650. This cost estimation is okay when the house is situated near to garden with at least 3 meter higher than the farm field. If the field is at a longer distance additional pipe line

has to be added. Depending on available area / plants near to the house the distribution of the nutrient could be planned from 100 m^2 area to 2000 m^2. The above plan is given to about 972 m^2 having 266 plants.

All the household waste water could be also transported to the plant basin through the same pipe line. If the distribution is done through a hose pipe, the total cost will be INR 25,105/- in total or INR 19,105/- for collection and distribution part against INR 29,650/- for drip system.

1.3. Suggested location specific modification

a. In case a family having a small site with few coconut, rubber / other plants. The liquid manure from the septic tank could be made to flow (using flexible hose pipe) to the small trenches dug around the plant basin and then filled with organic matter. Every available tree which is lower to the house site could be irrigated.
b. Septic tank/ collection tank size need to be increased if the number of people is more.
c. In case field is far off the supernatant water could be collected in a Power tiller/Tractor drawn tank and used to irrigate the plant basin/fields.
d. If the plants/field is at higher elevation a slurry pump need to be used.

2. Community units

Connecting toilet to gobar (cattle manure) gas or bio-gas unit fed with animal manure is well established technology. VRF has working modified biogas unit to utilize toilet, kitchen and bathroom water. Cost of the unit for 25-50 people is given here below.

Table 4. Community toilet manure utilization model (For 25 – 50 people)

Particulars	**Cost INR**
6 cubic meter underground biogas unit	32,000
3000 lt. supernatant liquid collection	12,000
Spent liquid distribution unit to an area of 0.4 ha	50,000
Total	94,000

2.2. Maintenance and precautions:

1. Entry of sand and soil to the system should be avoided. 2. Sufficient water should be used to flush the toilet, so that good quantity water should go to the system. 3. Remove the sand from the sand trap once in 2-3 months. 4. Clean the distribution line with fresh water once in 1-2 months. 5. Clean the septic tank once in 3-4 years.

Results and discussions

Psychological inhibition to use human fecal matter in agriculture is the biggest hindrance. To over come this mental block, the distribution method in the VRF system is made user friendly. The out let from the effluent collection tank is provided with a valve. Just by opening the valve, nutrient rich digested liquid directly goes to the plant basin. By inserting a piece of PVC pipe in the basin and putting the drip pipe it is possible to deliver effluent under ground. Further, there is no reason to hesitate to use for non edible crops like rubber, cotton, mulberry and also for flowering perennial garden plants. The *E.coli* population, the indicator of food contamination on the fruits harvested from these fields has been estimated. No contamination was found.
In the model explained for individual household the nutrient supplied by the fecal matter from the house hold of 5 people could supply 50% organic matter and nutrients

to 266 plants. The cost of the same is estimated at INR 2,560/- which means 11.3% return is obtained on the investment of INR 22,650/- or within 9 years the entire extra investment comes back. If a simpler hose pipe design is adopted, the return is 21.1% and the investment will come back in 5 years!! Same pipe line could be also used for giving additional irrigation.

In case of community unit the value of nutrient rich water to about 1055 plants could be valued at INR 10,550 gives 11.46% return. Since 2002, Areca nut, Cocoa and Banana have been successfully grown with 100% toilet manure. Growth and yield found to be in par with the plants fed with organic compost manures. However, in the methods and materials suggestion is made to construct the distribution system in such way that 50% of the nutrients are supplied by human waste and 50% by other organic input sources.

Toilet manure and Organic standards: As per the IFOAM norms, human excrement could be used as fertilizers but not to be directly applied on edible parts. Europe, Japan, and the United States prohibit the use of human excrement or sewage sludge. The prohibition is often tied to a policy related to the handling of urban effluent where human excrement is mixed with household and industrial wastes. The resulting solids are known as sewage sludge. Indian organic standards totally prohibit use of human excrement. This kind of negative approach is not justified. IFOAM norm is more balanced and effort should be made to allow and popularize the use of human excrement a rich source of plant nutrient which if completely recycled can provide enough manure for over 18 per cent of cultivated land.

Conclusion

The models developed and demonstrated at Varanashi Research Foundation for utilization of toilet manure is user friendly. For small growers it would be a valuable organic nutrient source. There is no fear of pathological contamination when used in root region, avoiding the contact with the edible part.

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