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GOI - DDWS SPONSORED SCHEME ON

Research Project on "Techno-economic adaptability of Ecological Sanitation"

COMPLETION REPORT
(01.01 2012 to 31.07 2013)

PRINCIPAL INVESTIGATOR

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Tamilnadu

COMPLETION REPORT

1. Project Report : Details enclosed

2. Date of the project : 01.01.2012 to 31.07.2013

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4. Budget and Duration : Rs. 5,06,000/- for 18 months
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   From January 2012 to July 2012

Introduction

Sanitation is a wider concept encompassing personal hygiene, hand washing, safe drinking water and sanitary latrines and so on. The World Health Organization defines it as Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Inadequate sanitation is a major cause of disease worldwide and improving sanitation is known to have a significant beneficial impact on health of households and communities. The available methods of sanitation can be classified into three types viz., dry toilet, pour flush toilet (leach pit and septic tank) and underground sewerage system. All these models have some limitations in their usage and maintenance.

As per the Census Report of the Government of India 2012, the percentage of households in India involved in open defecation stood at 49. 8. The root of this problem can be attributed to socio economic factors, failure to develop innovative, People friendly techniques, insufficient allocation of funds by government to change the mind set of people deep rooted in old customs and traditions. Improper disposal of human excreta is hazardous. One gram of human faeces contains 10 million viruses, 1 million bacteria, 1000 parasites and 100 parasites eggs. The UNICEF confirms that diarrheal death in the world was one child for two minutes.

Under the three other forms of toilets, single pit toilet, septic tank and UGD disposal is not fully environmentally friendly. Often the construction also is not as per the standers and guidelines fix by the Government. Hence a new model namely ECOSAN UDDT model is being introduced which is more environmentally friendly.

Ecological sanitation goes a step ahead in devising a mechanism to place economic value on human wastes in a scientific manner. **Werner et al 2003** defined Ecological sanitation as a holistic approach to sanitation and water management based on the systematic closure of local material flow-cycles. Ecological sanitation is the need of the hour and more research and development in this sector is necessary to provide healthy environment for life. One such method developed is ECOSAN (Ecological Sanitation) toilets, which follows the principle of disposing the waste on site and not taking it to far off places for treatment as it involves huge cost for infrastructure and maintenance. The next innovative principle in ecological sanitation is separation of urine and faeces, its treatment and disposal by different ways. The third main principle is recovery of nutrients from human waste urine and excreta. Urine collected separately is used as liquid fertilizer. Faeces is getting processed as a soil conditioner and used for raising crops. Ecological Sanitation is thus a modern method of managing human excreta, by means of recovering nutrients in both urine and faeces, facilitating sustainable agriculture, preventing contamination of surface and ground water and most importantly conserve water. Analysing the drawbacks in all the three models of sanitation, ECOSAN could be the only possible models that would fill the gaps in all other models and lead to sustainable sanitation.

Urine – liquid fertilizer

Each individual contributes 500 liters of urine and 50-60 kilograms of faeces per annum. Of this urine is sterile and can be used directly as a liquid fertiliser as it contains nitrogen, potassium, phosphorus after proper dilution. It has been estimated if the urine of the 30 crores population could be collected it could produce fertilizer of 1.65 million tonnes of value Rs. 800 crores per annum.

On the other hand faeces are not safe for direct disposal as they contain harmful pathogens. Of the 200-250 grams of faeces produced per capita per day, 80 percent is water and the remaining organic content. Dry sanitized faeces can be used as soil conditioner. One person needs approximately 256 kg of food per year and the quantity of NPK needed to produce this is 5.7 kg Nitrogen N, 0.6 Kg Phosphorus P and 1.2 Kg. Potassium K, and this same quantum of nutrients can be recovered from the excreta of an individual per year. ***(Austin & Van Vuuren 2001)***

Objectives of the DDWS – SCOPE study

a. Primary objective:

To examine the technological options of materials used in composting and in construction of Eco-san toilets towards identifying a cost effective method.

b. Secondary objectives:

1. Estimation of cost of construction of ecosan toilets with alternative materials will be carried out.
2. Cost of composting with varied alternatives will be estimated along with the analysis of time duration for composting.
3. Evaluation of the best option suitable to the needs of the community in terms of economy, social acceptability, hygiene and time span.
4. Evolve a methodology to popularize and implement ECOSAN all over the country.

In realizing the stated objectives, earnest efforts were made to collect reliable information pertaining to eco-san practices as data relating to this process is scanty. Upon collection, the data were classified and analyzed and inferences drawn are discussed in the following manner. Thrust of the study is to

discern the cost effective means of achieving eco-san. Both composting and construction materials are case in point here. Purpose behind this exercise is to find out the possibility of utilizing the locally available materials for composting and constructions are important. The discussion in the following paragraphs will through light upon the problem under study.

Methodology

Experiments were conducted to discern the differences in composting materials and its efficiency in recovering nutrients. Dehydrating and composting materials (additives) like wood ash, saw dust, dry soil, lime powder and burnt paddy husk have been tried as an alternative to wood ash. An ECOSAN toilet an additive ash is added for dehydration of the human faeces. Generally compost were taken out from the ECOSAN UDDT chamber after nine months. Under this study the five above additives were added in five different household ECOSAN toilet for composting in the chamber from the beginning of the use of the toilet for defecation. After six months, every month the compost was taken out and biological parameters and E-coli, salmonella status were studied every month up to twelve months. The efficiency of the different additives were also analyzed after six months, every month up to twelve months. removed after six months. The main aim of the study is to identify the material which performs better than the other in reducing the time period of composting and nutrient recovery. The study also aims at finding out the minimum period the compost should be in the chamber so that it is safe to handle.

Laboratory experiments have been carried out in three different places; Environmental Monitoring Service, Aurobrindavan, Auroville, Tamilnadu. Department of Environmental Management, School of Environmental Sciences, Bharathidasan University, Tiruchirappalli, Tamilnadu. Department of Agriculture, Government of Tamilnadu, Tiruchirappalli. Results obtained from three different labs are consolidated and presented in the form of tables.

Study of Literature

A detailed study of the available literature on the safe time limit for total dehydration and elimination of all dangerous micro organisms, for removal of the dehydrated faeces from ECOSAN UDDT toilet for use as manure (soil conditioner) was made.

The cost of construction of the toilets using the different materials was studied. The feasibility of applying different dehydrating agents during the composting period and to find out the impact on the nutritional value of the compost was studied.

Villages Selected:

It was felt that the two villages could be selected which had different geographical and soil and water sources so that the study would be more comprehensive, one village in a dry zone and another village in a high water table area. Thennatherayanpatti Village in Pudukkottai District (Dry Zone) and Karuppampatti Village near Musiri in Trichy District (high water table area) were selected. In each village five ECOSAN toilets were constructed. For the study of efficiency of additives five ECOSAN toilets were selected in Karuppampatti village

Thennatherayanpatti Village (Dry Zone):

In consultation with the research staff of the Bharathidasan University it was decided to selects a village in the drought prone Pudukkottai District. After detailed study and interaction with the local residents it was decided to conduct the experiments and research in Thennatherayanpatti village of Viralimalai Block of Pudukkottai District.

Five ECOSAN Toilets constructed :

A meeting was arranged in the Thennatherayanpatti village on the need for toilets in general and advantages of ECOSAN toilet in dry area were explained to the residents. Five of them agreed to construct ECOSAN toilet in their houses but wanted to see the functioning toilets in Musiri.

Exposure Visit:

Mr. P.Muthuraman, President of the village along with five other residents of the village were taken on an exposure visit to karuppampatti, Musiri Block for first hand information of ECOSAN UDDT toilet and an interaction with residents who have been using ECOSAN toilets for the past three years. The members of the exposure visit team were Mr.Durai, Mr.Thangarasu, Mr.Jayaraman, Mr.Balu and Mr.Murugesan. The team members inspected both IIHL and ECOSAN Community Compost Toilet (ECCT). They interacted with the family members and users ECCT. They were convinced they could learn the usage practices without difficulties and model will be quiet useful for them.

With the help of the family members five toilets with cement hallow block and brick were constructed. The usage and do's and don'ts pamphlets were given to the families.

The members of the five families were given training on usage practices and do's and don'ts and they started using the toilet from March 2012.

The toilet identity card has been issued to all five families. The card gives details of the number of members in the household, their age, the date of commencement of usage of the first chamber, closure date of the first chamber, commencement of use of the second chamber, opening of the first chamber for removing compost etc.,

Karuppampatti Village (High water table area):

A preliminary visit to different villages was made in Evoor Panchayath in Musiri Block of Trichy District. Evoor Panchayath is situated on the banks of river Cauvery and hence it was a high water table area where other models of toilets could not function. Similarly a meeting was held in Karuppampatti village. The villagers had known the functioning of ECOSAN toilet since already about 40 residents of the Panchayat had built and were using the ECOSAN toilet. The following five beneficiaries were selected Ms. Periyakkal, Ms. Rajalakshmi, Ms. Kupulakshmi, Ms. Suseela and Ms. Jaya.

Sl.No.	Name of the householder	Dehydrating agents used in ECOSAN toilets
1	Ms. Periyakkal	Burnt paddy
2	Ms. Rajalakshmi	Ash
3	Ms. Kupulakshmi	Lime powder
4	Ms. Suseela	Saw dust
5	*Ms. Jaya	Dry soil (taken from the same compound and is applied after sieving the same)

The materials were supplied by SCOPE under the project. Under the programme five ECOSAN toilets were constructed (the beneficiaries contributing their labour) under the supervision of trained masons. In Karuppampatti village beneficiaries are using the toilet from April.

Study of different additives as dehydrating agents:

In order to find the nutritional value of different dehydrating agents applied in the chamber after defecation the householders have been asked to use different materials. They are Burnt paddy, Ash, Lime powder, saw dust, dry soil. These materials were supplied four householders since they were not available near their houses. In the case of Ms. Jaya the earth from the same compound was used.

The toilet identity card has been issued to all five families. The card gives details of the number of members in the household, their age, the date of commencement of usage of the first chamber, closure date of the first chamber commencement of use of the second chamber, opening of the first chamber for removing, composting etc.,

Beneficiaries of ECOSAN UDDT at Karuppampatti

Mrs. Suseela w/o Mani

Inner View of ECOSAN UDDT

Mrs. Periyakkal w/o Murugesan

Mrs. Kuppulakshmi w/o Rathinam

Mrs. Jaya w/o Chelladurai

Rajalakshmi w/o Sekhar

Special Features:

- Knowing the advantages of having an environment friendly sanitary napkin incinerator in their own home Mrs. Rajalakshmi constructed the an incinerator attached to the ECOSAN UDDT. No longer she throws used sanitary pads on the roads or bushes.

- Mrs. Jaya w/o Chelladurai has constructed a bathroom- cum -UDDT toilet.

Study of Different construction materials

In constructing eco-san toilet, the cost component is crucial. Householders will be induced to take to ecosan if the cost is cheaper when compared to other alternatives. As part of the study, a detailed data pertaining to ecosan toilet construction was gathered from the users during the year of 2012-2013. The total cost of construction worked out to be Rs. 16,350 at current prices (Table 1). Over 24 percent goes for both skilled and unskilled labors as wages towards. Construction cement hallow blocks costed 16.5 percent of the total cost, while the cement bags showed 11.4 percent of the total expenditure. Materials required like sand, rod, wire, PVC pipe and other paraphernalia comprised the remaining nearly 50 percent of the total cost of construction of eco-san toilets. It may be interesting to compare the cost of construction of Eco-san vis-à-vis conventional western commode toilets, generally found in urban areas in some pockets of rural areas as well. Another advantage of eco-san is to utilize the locally available cost effective materials in constructing eco-san toilets. The subsidy given by the Government in promoting eco-san toilets is a welcome step in this direction

Results and Discussion

Hollow blocks were used for construction of ECOSAN toilets since it was quite strong, environment friendly, cost effective and the most popular material used for construction in the area.

Studies revealed that substructure construction should be given top most priority. Super structure could be made with any materials depending on the financial capacity and the aesthetic appeal of the house holder.

Use of different compost materials

The another focus of the study was to find out and understand the efficiency of different compost materials and the optimum time for composting. Conventionally, wood ash was the only material used in composting process of human waste. The efficacy of the wood ash in composting continues to be good. However there is a need for utilizing different materials depending upon the locations and the availability of composting material in reducing the time taken for composting and exploiting the locally available materials.

Wood ash

In regard to use of wood ash as composting material, it is found that all the physicochemical, biological Parameters showed considerable reduction; particularly the faecal indicator microbes are like E.coli and salmonella sp (Table 2). The E.coli was present till sixth month and gradually decreased and absent from eighth month on wards. The NPK values were also observed to be increasing from the sixth month to the tenth month.

Dry soil

Human faeces are treated with dry soil (taken from the same compound and is applied after sieving the same) for composting as part of the study. The pH and Electrical Conductivity levels of the compost in sixth month are 7.80 and 1050 µS/cm, respectively after the sixth month to tenth month the level is slowly decreased. The Carbon Nitrogen ratio is found to decrease during the entire composting period due to carbon losses in the decomposition process. Organic carbon and organic matter of this compost is high. Interestingly the nutrient values of the total nitrogen, total phosphorous and total potassium (NPK) showed a lower level in the beginning stage of composting but eventually registered a high value during the final stage of composting (Table 3). Further microbes like e.coli and salmonella become totally absent from the sixth month onwards. On the whole from using dry earth soil as composting materials the physicochemical, nutrients and biological parameters showed good results to be used as manure.

Lime powder

In this table lime powder is used as a composting material in ecosan compost chamber, which shows the following results. Moisture level of composting is crucial as it was less before the addition of composting material of lime powder (Table 4). The moisture level of the compost showed an increase of 2.4 percent in the tenth month. However, the moisture level registered high in the sixth month (3.9%) as a result of adding lime powder as compost material. Gradually over the months the moisture level got reduced and settled at 2.4% in the tenth month. The status of physicochemical, nutrient and pathogens level is zero. After the tenth month of composting all the above parameters are presented in low level.

The composting material is alkaline in nature, before and after composting. E.coli and salmonella sp. are absent since they cannot survive in alkaline condition

Saw dust

Saw dust is used as a composting material for human waste, its characters and the results are presented in table. The pH of Saw dust before composting was alkaline. The pH of the compost is nearly neutral after the tenth month of the composting process. EC of compost from sixth to tenth month has reduced from 2930 µS/cm to 2470 µS/cm. Total nitrogen, from sixth to tenth month increased from 0.24% to 1.16% total phosphorous from 0.08 to 0.82% and total Potassium increased from 0.33% to 1.32% (Table 5). In E.coli most probable Number per gram (MPN/g) is 75. Salmonella sp. was absent in the Saw dust before composting, but it was present during composting period from sixth month to eighth month and it was again absent at the tenth month.

Burnt paddy husk

Human waste is composted by burnt paddy husk; the results and the characteristics are discussed in the table. The pH of paddy husk before composting and after tenth month of composting are found to be alkaline. Electrical conductivity of this compost before and after the tenth month of composting has reduced from 7650 – 3230 µS/cm. Total nitrogen from sixth to tenth month increased from 0.42% to 1.02%. Total Phosphorous also increased from 0.18% to 0.31% and total potassium from 0.47% to 0.97% (Table 6). Pathogens are like both E.coli and Salmonella sp. was totally absent in this process. Still further analysis is required to figure out the efficiency among the

different composting materials. Field survey also revealed the need the constant monitoring of constructed eco-san toilets and promotion of eco-san toilets in other parts of districts as well. The mind set is crucial in practicing this. Awareness programs are needed to take the message to larger section of population and rigorous strategies ought to be formulated to imbibe this environment friendly method by highlighting the possible economic and ecological benefits to the practitioners.

Cost of Construction in Eco-san Toilet

S.No.	Details	Quantity	Amount in Rupees
01.	Earth work, Foundation using R.R rough stones	Lump sum	600
02.	4” Cement Hollow Block (16”X8”X4”)	180 Nos. Rs.15/- each	2,700
03.	Cement (53 Grade)	6 bags Rs.310/- each	1,860
04.	Sand	1 Unit	750
05.	6mm Rod	25 kg Rs. 44/-	1,100
06.	Binding wire	250 grams	25
07.	Steel Door (Size 5’ X2’) with4” steel clam	1 no.	750
08.	4” PVC Pipe	10 ‘	200
09.	4” PVC ‘L’	1 no.	60
10.	4” PVC Cowl	1 no.	40
11.	4” Steel Clam	2 Nos.	50
12.	2” nail	4 Nos.	5
13.	1 ¼ “ PVC Pipe	16 feet	225
14.	1 ¼ PVC ‘L’	4 Nos.	100
15.	1 ¼ PVC ‘T’	2 nos.	60
16.	PVC Paste	100ML	30
17.	Red Oxide	250 gram	50
18.	White cement & coloring	10kg	150
19.	Blue Paint	100 ml	40

20.	Yellow Paint	100ml	40
21.	Black Paint	100 ml	40
22.	2” Brush	1 No.	35
23.	4” Brush	1 no.	70
24.	Cana Indica Plant	2 Nos.	-
25.	5 Liter capacity Plastic Bucket with lid (Red 1, Green1)	2 nos.	90
26.	Mug	1 no.	10
27.	5 liter capacity mud Pot & Jerry can	1 no.	100
28.	Brick Jally	2 Basket	30
29.	Charcoal	2 Basket	50
30.	Mosquitoes Net	1 sq.f	40
31.	FRP Pan Three in One	2 Nos.	2,400
32.	Labour - Skilled	6days Rs.500/- each	3,000
33.	Unskilled labour+ (Female)	5 Nos.Rs.200 each	1,000
34.	Labour charges for White & colour washing	Lump sum	250
35.	Transportation Charges	Lump sum	400
Total Cost			**16,350.00**

- The ten toilets were constructed with hollow block
- The cost will be higher if bricks are used instead of hollow block

Source: Data generated from Field survey.

USE OF DIFFERENT COMPOST MATERIALS

Table 1: Wood Ash as compost material

Parameters (Wood Ash)	Units	Before the addition of faeces	6-Month compost	7-Month Compost	8-Month Compost	9-Month Compost	10-Month Compost
Moisture	%	1.9	3.7	3.4	3.0	2.8	2.3
pH (at 25°C)		11.36	9.37	9.27	9.12	8.78	8.64
EC (at 25°C)	µS/cm	5680	3400	3360	3280	2890	2265
Organic Matter (as OM)	%	44	52	54	60	62	64
Organic Carbon (as OC)	%	22	26	27	30	31	32
C:N Ratio		244:1	124:1	124:1	56:1	43.5	38.1
Ammoniacal Nitrogen	%	0	0.1	0.26	0.47	0.52	0.54
Total Nitrogen (as N)	%	0.09	0.21	0.36	0.54	0.68	0.72
Total Phosphorous (as P)	%	0	0.06	0.09	0.14	0.16	0.16
Total Potassium (as K)	%	0.12	0.34	0.48	0.62	0.79	0.96
E.coli	MPN/g	Absent	15	3	Absent	Absent	Absent
Salmonella sp.	Pres./Abs. in 25g.	Absent	Absent	Absent	Absent	Absent	Absent

Table 2: Dry Soil as compost material

Parameters (Dry Earth)	Units	Before the addition of faeces	6- Month compost	7- Month Compost	8-Month Compost	9-Month compost	10-Month Compost
Moisture	%	3.2	4.7	4.5	4.0	3.6	3.6
pH (at 25°C)		7.80	7.52	7.49	7.38	7.19	7.10
EC (at 25°C)	µS/cm	1050	685	670	640	635	630
Organic Matter (as OM)	%	32	42	44	44	48	50
Organic Carbon (as OC)	%	16	21	22	22	24	25
C:N Ratio		106:1	34:1	34:1	30:1	30:1	27:1
Ammoniacal Nitrogen	%	0.0	0.09	0.12	0.12	0.16	0.17
Total Nitrogen (as N)	%	0.15	0.62	0.64	0.76	0.83	0.94
Total Phosphorous (as P)	%	0.06	0.22	0.28	0.28	0.31	0.36
Total Potassium (as K)	%	0.39	0.56	0.62	0.65	0.72	0.79
E.coli	MPN/g	Absent	Absent	Absent	Absent	Absent	Absent
Salmonella sp.	Pres./Abs. in 25g.	Absent	Absent	Absent	Absent	Absent	Absent

Table 3: Lime Powder as compost material

Parameters (Lime Powder)	Units	Before the Addition of Faeces	6-Month Compost	7- Month Compost	8-Month Compost	9-Month Compost	10-Month Compost
Moisture	%	1.3	3.9	3.4	3.2	2.6	2.4
pH (at 25°C)		10.10	9.64	9.58	9.12	8.96	8.77
EC (at 25°C)	µS/cm	5520	3730	3640	2990	2820	2770
Organic Matter (as OM)	%	0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Organic Carbon (as OC)	%	0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
C:N Ratio		------	0	0	0	0	0
Ammoniacal Nitrogen	%	0.0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Nitrogen (as N)	%	0.0	< 0.1	< 0.1	< 0.1	0.21	0.22
Total Phosphorous (as P)	%	0.1	0.012	0.012	0.016	0.016	0.018
Total Potassium (as K)	%	0.0	0.003	0.006	0.010	0.012	0.012
E.coli	MPN/g	Absent	Absent	Absent	Absent	Absent	Absent
Salmonella sp.	Pres./Abs.in 25g.	Absent	Absent	Absent	Absent	Absent	Absent

Table 4: Saw Dust as compost material

Parameters (Saw Dust)	Units	Saw dust Before the addition of faeces	6- Month Compost	7- Month Compost	8-Month Compost	9-Month Compost	10-Month Compost
Moisture	%	2.6	3.4	3.1	2.7	2.4	1.8
pH (at 25°C)		7.92	7.39	7.24	7.10	7.11	7.08
EC (at 25°C)	µS/cm	3460	2930	2800	2750	2540	2470
Organic Matter (as OM)	%	56	62	66	68	74	78
Organic Carbon (as OC)	%	28	31	33	34	37	39
C:N Ratio		117:1	86:1	68:1	47:1	39:1	34:1
Ammoniacal Nitrogen	%	0.39	0.56	0.64	0.69	0.74	0.89
Total Nitrogen (as N)	%	0.24	0.36	0.48	0.72	0.96	1.16
Total Phosphorous (as P)	%	0.08	0.21	0.34	0.46	0.56	0.82
Total Potassium (as K)	%	0.33	0.46	0.62	0.86	0.98	1.32
E.coli	MPN/g	56	1800	1350	800	240	75
Salmonella sp.	Pres./Abs. in 25g.	Absent	Present	Present	Present	Absent	Absent

Table 5: Burnt Paddy Husk as compost material

Parameters (Burnt Paddy Husk)	Units	Burnt Paddy Husk Before the addition of faeces	6- Month Compost	7- Month Compost	8-Month Compost	9-Month Compost	10-Month Compost
Moisture	%	1.0	4.4	3.6	3.2	2.9	2.1
pH (at 25°C)		9.24	9.58	9.54	9.42	9.21	9.10
EC (at 25°C)	µS/cm	7650	4300	4110	3870	3600	3230
Organic Matter (as OM)	%	36	56	56	59	62	64
Organic Carbon (as OC)	%	18	28	28	29.5	31	32
C:N Ratio		85:1	67:1	45:1	40:1	35:1	31:1
Ammoniacal Nitrogen	%	0.04	0.11	0.14	0.19	0.24	0.32
Total Nitrogen (as N)	%	0.21	0.42	0.62	0.74	0.88	1.02
Total Phosphorous (as P)	%	0.06	0.18	0.18	0.22	0.23	0.31
Total Potassium (as K)	%	0.32	0.47	0.61	0.75	0.89	0.97
E.coli	MPN/ g	Absent	Absent	Absent	Absent	Absent	Absent
Salmonella sp.	Pres./ Abs. in 25g.	Absent	Absent	Absent	Absent	Absent	Absent

Conclusion

The eco-san toilets help achieving green economy which envisages sustainability and equity. The basic methodology to achieve this is *Reduce, Reuse* and *Recycle* of all natural resources so as to avoid degradation and depletion. Any process that inculcates these three principles from the initiation stage to process stage will be the best suited strategy accomplishing green economy. In addition to the benefits like recovery of the nitrogen-rich human waste by products, ecosan promotes Organic Farming. Food security is crucial in preparing a road map for green economy. The fall out of green revolution is increasingly felt as the organic carbon content has come down drastically due to excess use of chemical fertilizer and pesticides, farming practices need greener measures like application of green-organic fertilizer. In this regard, eco-san facilitates sustainable agriculture and increased food grain output. Fresh Water availability has also been on the decline owing to groundwater depletion and pollution of surface water. Eco-san utilizes less water compared to flush toilets. Water as an environmental medium could be free from E.coli, if human faeces reach soil as organic fertilizer, instead of water. Ecological sanitation is a typical approach to improve human health and economy.

Field level experiments were conducted in comparing different composting materials like Wood Ash, Dry soil, Lime Powder, Saw Dust, and Burnt Paddy Husk. Each composting material was added with faecal matter for composting, and it was found that Dry soil turned out to be the most efficient when compared to all the other materials. Dry soil composting showed robust results as microbes were totally absent, while the pH level was neutral and the nutrient recovery of NPK was far better when compared to others. This was not the case with Wood Ash, Lime Powder, Saw dust, and Burnt Paddy Husk as either the microbes were

present or pH showing high values, unsuitable for crops, and with weak nutrient recovery. The upshot is that Dry soil is highly suitable for composting.

Studies also revealed the presence of E.coli and salmonella in small quantities up to eight months. Hence it is advisable to remove the compost from the chamber after nine months.

SCOPE, திருச்சி

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பெயர்	ஆ/பெண்	உறவு	வயது	வேலை	குறிப்பு
1.					
2.					
3.					
4.					
5.					

கழிப்பறை கட்டிய நாள் : .....

முதல் அறை தொடங்கிய நாள் : .....

முதல் அறை மூடிய நாள் : .....

முதல் அறை திறந்த நாள் : .....

இரண்டாம் அறை தொடங்கிய நாள் : .....

இரண்டாம் அறை மூடிய நாள் : .....

இரண்டாம் அறை திறந்த நாள் : .....

பார்வையிட்டவர்களின் கருத்து :

Government of India

SCOPE
Change Your Future With Us

சுமேசு கம்போஸ்ட் கழிவறை உபயோகிக்கும் முறைகள்

ECOSAN USAGE STEPS

1

Take off the lid

2

Sit in a proper position and defecate

3

Move one step back and apply ash on the faeces in the drop hole

4

Close the drop hole with the lid

5

Wash the body

6

Wash hands with soap