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Implementation of Dry Composting Toilets as a Sustainable Alternative for Rural Sanitation of Gangadhara Village

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Abstract— In India majority of the population still lives in villages. A lot of work needs to be done in making the villages clean. There are different aspects of clean village such as: water supply, sanitation, indoor air quality, solid waste management and renewable energy etc. All these aspects have different alternatives with the associated merits and demerits. In some aspects such as public toilets, considerable work is done whereas in some areas like sanitation lot of work is required to be done. We can learn lot of lessons based on success and failure in adopting different alternatives. Keeping in touch with technology dry composting toilet projects should integrate technology and digital design, which will make the village not only clean but also smart. The paper discusses all these aspects with reference to Gangadhara village of Gujarat state. This discussion plans to give important inputs and alternatives to policy makers so that they can redirect and reformulate the policy. Engineering students can design and implement projects of dry composing toilet which will help in their skill development.

Keywords— Sustainability, sanitation, Dry composition, Rural Health, Rural development

I. INTRODUCTION

Almost 600 million Indians living in rural areas defecate in the open. Most of the people still defecate in the open space, most of the villages lack waste disposal and drainage systems and many in the villages are ignorant about the consequences of poor sanitation and unhygienic conditions. As a result, many people suffer and even die of diseases caused by unhealthy practices of personal and environmental hygiene.

Rural sanitation figures prominently in the National Agenda for governance. At present the extent of sanitation coverage in India is around 16 percent of all rural households. This figure is one of the lowest in the world, at par with countries like Niger and Afghanistan and possibly lower than Bangladesh.

The absence of safe sanitation contributes significantly to the poor quality of life as reflected by well accepted indicators like Infant mortality and morbidity rates. According to the Union Ministry of Health, around 7, 00,000 children die each year due to diarrhoea and other water sanitation-related diseases. To overcome this situation Dry Compose Sanitation is a better solution. It will use as organic fertilizer.

II. THE NEED OF STUDY

Rural society presents a scientific picture of rural life. Villages are important because they are the spring to feed urban areas. The need of study is put under following heads:

a) It gives Rural Population
b) It Gives Complete Knowledge of Village Life
c) Rural Reformation is possible
d) Organization is improved.
e) Helps in Economic Betterment and raise living standard
f) It can Provide Technology and Systematic Knowledge and reforms in Farm Production:
g) It provides Solutions of Pathological Social Problems:
h) It helps in improving rural education
i) It gives Planning for Development easy.

The needs of the study is required when,

- Where there are no latrines people resort to defecation in the open.
- 665 million Indians practice open defecation, more than half the global total. 1,000 children younger than 5 years die every day in India from diarrhea, hepatitis- causing pathogens and other sanitation-related diseases. The crisis is especially acute for girls.
- Many drop-out of school once they reach puberty because of inadequate lavatories, depriving the country of a generation of possible leaders. The toll on human health, due to unhygienic sanitation conditions is grim.

III. GANGADHARA VILLAGE PROFILE

Gangadhara village is situated in plasana Taluka of Surat District of Gujarat State, India. It comes under Bardoli Division. Gangadhara is a combined village as Gangadhara-Kareli.

Nearby Places**:** Bhestan, Mota Varachcha, Navsari
Coordinates: 21°8'17"N 73°2'29"E
PIN: 394310
District: Surat
State: Gujarat
Taluka: Palsana

The area of the village is 676 hectare.

A. Demographical Details:

According to census 2011, the population details are shown below:

TABLE I
DEMOGRAPHICAL DETAILS

	Male	**Female**	**Total**
SC	78	61	139
ST	1673	1534	3207
OBC	0	0	0
General	428	404	830
Total	2179	1997	4175

B. Geographical Details:

Fig. 1 Map – Satellite view

C. Physical Infrastructure Facilities:

TABLE II
EXISTING FACILITIES

Sr. No.	**Description**	**No. of structure**
1	Water tank	3
2	Railway station	1
3	Bus stand	1
4	Lake	2
5	PHC	1
6	Community Hall	1
7	Play Group	4
8	High school	1
9	Post Office	1
10	Bank	2
11	ATM	1
12	Private Clinics	3

IV. METHODOLOGY

Fig. 2 Methodology

V. DESIGN OF DRY COMPOSTING TOILET

Composites toilets are those which utilizes natural environment with bacteria to decompose human waste. They do not require separate drainage system for disposal of waste. A closed chamber is constructed under the toilet which collects all the faeces. The chamber is provided with a base of soil, bagasse/straw waste to support bacterial growth and to maintain warm environment.

The microorganisms are usually thermophillic (which are active at temperatures greater than 60°-120°C). These organisms literally feed on the human waste and convert solid waste into dry non-pathogenic product that can be used as fertilizers for agricultural fields. The human faeces contains about 90% water and only 10% solid waste and thus the water content is evaporated and the solid waste is broken down to simple products by the bacteria. And hence the end product is less than 10% of total waste & can be discarded once a month.

In biological toilets, the maximum moisture/liquid level should not cross 50±10%, if not, it would encourage anaerobic digestion resulting in bad odours. And therefore there is provision to separate the urine from the faeces. These toilets have been effectively implemented and are in use in USA, UK and Sweden.

A. Construction materials:

A dry compose toilet is designed with a leak proof faeces and urine collection chambers / tanks and super structure with pans / arrangements that help in source separation of faeces, urine and wash water. Dry compose toilets can be constructed using locally available materials like bricks, cement blocks, concrete, bamboo or other suitable materials can be used for construction of dry compose toilets. Cost of household dry compose toilets can be drastically reduced by using low cost materials like bamboo, thatch, gunny bags, etc., for the construction of superstructure. However, care should be taken to prevent entry of rainwater into the dry compose toilet.

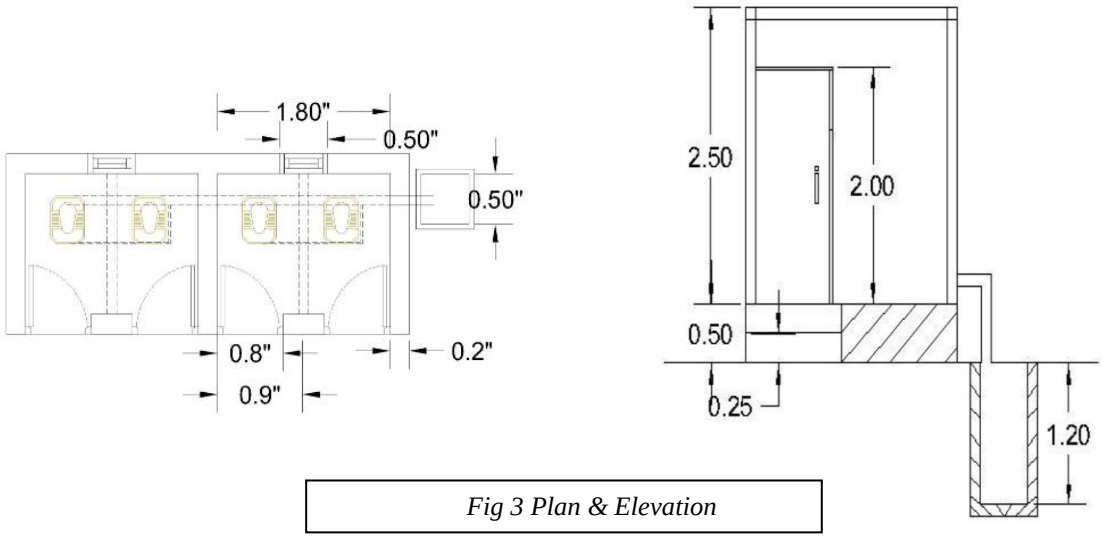

Fig 3 Plan & Elevation

B. Working:

Composites toilets are those which utilizes natural environment with bacteria to decompose human waste. They do not require separate drainage system for disposal of waste. A closed chamber is constructed under the toilet which collects all the faeces. The chamber is provided with a base of soil, bagasse/straw waste to support bacterial growth and to maintain warm environment. The microorganisms are usually thermophillic (which are active at temperatures greater than 60 1200C). These organisms literally feed on the human waste and convert solid waste into dry non-pathogenic product that can be used as fertilizers for agricultural fields. The human faeces contains about 90% water and only 10% solid waste and thus the water content is evaporated and the solid waste is broken down to simple products by the bacteria. And hence the end product is less than 10% of total waste & can be discarded once a month. In biological toilets, the maximum moisture/liquid level should not cross 50±10%, if not, it would encourage anaerobic digestion resulting in bad odours. And therefore there is provision to separate the urine from the faeces.

C. Abstract sheet:

TABLE III
ABSTRACT SHEET

Item	**L**	**B**	**H**	**Q**	**Rate**	**Money**
Excavation	8.7	0.4	0.25	O.87	250	220
BBLC	8.7	0.4	0.10	0.348	4000	1400
Masonry up to plinth	8.7	0.3	0.65	1.696	125	220
` Deduction of doors (2)	0.75	0.3	0.4	0.18		
				1.516	2817	4270
Masonry in super structure	7.2	0.2	2.5	3.6		
Deductions:						
Door	2	.0.2	0.8	0.32		
Ventilator	0.5	0.2	0.5	0.05		
				3.23	2900	9367

Slab at plinth	2.2	1.8	0.1	0.396	3392	1343
Roof of asbestos sheet	1.8	1.4		2.5	1000	2500
Both side plaster	7.2		2.5	36		648
Deductions:						
Door	2	-	0.8	1.6		
Ventilator	0.5		0.5	0.25		
				34.15	100	3415
Cost of pans and doors					2600	2600
						25061

The cost of one composite toilet will be 25000 Rs. Hence, we provide 4 toilet so total cost of construction= 4*25000

=1, 00,000 Rs.

VI. SWOT (STRENGTH, WEAKNESS, OPPORTUNITIES, THREAT) ANALYSIS

TABLE IV
SWOT ANALYSIS

Strength	**Weakness**
It does not require any water for flushing	Difficult to maintain cleanness in dry toilet
It is easy to construct, operate, and maintain	Lack of public hygiene
Opportunities	**Threat**
It is better to use DCS over conventional toilets as we can use its waste as byproduct – Fertilizer	If DCS is not maintain properly it may spreads disease which can be dangerous to human beings.

VII. CONCLUSION

Taking into consideration the experience of this study, we prefer to conclude that no issue touches the lives of women particularly poor rural women as intimately as that of access to sanitation. Dry composting sanitation is one of the best solution to this problem. With Dry composting toilets we can solve the problem of sanitation as well as we can take advantages of organic fertilizer.

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