Research Paper

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Ecological Sanitation and Green Economy

Environment

KEYWORDS : Eco-san, Green Economy, Human waste, and Nutrient recovery.

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ABSTRACT

Green Economy is a global call. Every nation endeavors to achieve this without compromising the imperatives of economic development. Sanitation is indispensible for enhancing human well being and in turn productivity of economic agents. The plight of major chunk of Indian population with little access to toilet facilities is deplorable. Ecological Sanitation (Eco-san) in this milieu assumes great importance. Eco-san exemplifies how even human wastes can also be converted into manure with cost effectiveness. Authentic information is engaged to prove the point that ecological sanitation is essential in accomplishing green economy. This paper focuses on the eco-san case experience of Tamilnadu.

Introduction

Green Economy is, a new paradigm, envisaging an act of enhancing human wellbeing and protection of environment in tandem. The United Nations defined it as that which *results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities*. The concept of green economy is highly comprehensive, comprising myriad aspects like green products, green technology, green energy, organic food, and composting, recycling, conservation of in-situ biodiversity, green building, green inputs, and green lifestyle and so on. Apparently it might appear to be a process of sustainable development, which is time honored, however, green economy is a way forward and a step ahead. Integrating economy, ecology and equity is a continuum and dynamics of it is more holistic in green economy. Literature on green economy suggests host of means of achieving this. Focusing on efficient use of resources and recycling of wastes in specific is one of the approaches towards green economy. Improving human wellbeing through improved health with ecological sanitation is the case in point of this paper.

Economic rationale of Ecological Sanitation

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*. 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 it as *Ecological sanitation is a holistic approach to sanitation and water management based on the systematic closure of local material flow-cycles.* This may not be a specific technology but a know –how backed by institutional arrangements. Improper disposal of human excreta is hazardous. The UNICEF confirms that diarrheal death in the world was one child for two minutes and nearly 7 lakh Indians die every year due to this. One gram of human faeces contains 10 million viruses, and 1 million bacteria. As high as 66.5 crore Indians still defecate in open area.

Economic development with scant regard for environment is unsustainable. Sanitation is a prerequisite for human wellbeing which in turn decides the quality of life and service rendered towards the growth and development of an economy. Inadequate provision of sanitation creates problems for human beings on the one hand and to the environment on the other (Aarti Dhar 2009). Systematic disposal of human excreta has received less attention for long. Provision of toilets was once considered a matter of routine, but now there is increased realization that lack of toilet facilities shall have implications for human wellbeing and environmental upkeep.

Ecological sanitation aims at two things: waste water management and recycling of nutrients from human wastes. Basic ecological principle is what is derived from soil ought to go back to the same medium and not elsewhere. Food crops derive nutrients like nitrrogen, phosphorus, and potassium (NPK) from soil as dictated by nature. Upon consumption of food grains by human beings, there is corollary of excreta in terms of urine and faeces. Human wastes in turn disposed off without treatment would ultimately reach water and pollute the water medium. Basically pollutants are *misplaced resource.* Along with pathogens if NPK reach water bodies, then slowly find its way to food chain. In addition, excess of NPK will be washed off by rain and pollute the water bodies. This is where ecological sanitation comes into picture. Nutrients like NPK need to be recycled from human waste and put them back into soil as manure for raising food crops. Ecologists call this as *closed loop* system.

Thus ecological sanitation plays a crucial role in closing the loop of soil nutrients by returning the nutrients obtained from soil. Plants are the primary producers that they trap sunlight and produce food energy for all life forms on earth. Soil supports this activity in multiple ways by providing roots, water, nutrients, micro- organisms etc. for plants to grow and provide food. Over population, over extraction and pollution have lead to fallow lands that cannot yield expected returns. Depletion of soil nutrients and water scarcity are major factors that affect productivity. Human and animals being the sole consumers of the produce must find a way to return the nutrients back to soil after energy utilization in the form of the waste, thus closing the nutrient loop. Eco sanitation propounds to do this scientifically and sustainably.

Fresh water is increasingly becoming scarce, conventional flush toilets consume five to six times higher quantity of water for sanitary purposes. In this milieu, ecosan toilets have come into being. Toilets are designed specifically to separate urine and faeces and stored in septic tanks. Following a simple procedure of sprinkling ashes over faeces to kill pathogens and to be used as manure after a lapse of three or four months is the mechanics of ecosan. Human wastes get converted as manure through ecosan. Essentially, this envisages *recycling* process, which is central to green economy, helps *reduce* the use of fresh water besides transforming human waste into manure to be *reused*.

Another important corollary to eco san is water conservation. It is to note that *one adult's meat based diet will produce from 100*

to 250 grams of faeces per day. On a vegetarian diet, an adult will produce from 300 to 600 grams per day (both with 24-27 per cent dry matter). And normal values for urine are 1 to 1.6 liters volume per day (House and David 2006*)*. The conventional flush toilet facility leads to wastage of waste; every flush deprives the availability of drinking water. Lack of potable water is a major issue that most of the countries have to focus so as to save its millions of marginalized from disease and death. Awareness of such unsustainable practices has lead to usage of smaller flush tanks and reuse of treated water to fill the tanks in modern households. These methods conserve water to some extent but still carry the waste through water to far off area to be treated and finally dumped into water bodies. The nutrients of soil become *misplaced resource*s in water bodies, leading to eutrophication and depletion of aquatic life. Eco san proposes to bring back the soil nutrients after proper treatment of human urine and faeces.

Energy is central to green economy, that fast depletion of fossil fuels has lead to search of alternate energy sources. These scarce fossil fuels are the raw materials for production of chemical fertilizers and they are needed in huge amounts to balance the depletion of soil nutrients. Chemical fertilizers further deplete the fossil fuels and are energy intensive throughout their production and distribution process. Contrary to this is organic manure from eco san, which saves fossil fuels for alternate use and are less energy consuming in their production process. From all three aspects viz. closing the nutrient loop, water conservation and energy conservation, eco san would be a best option of green economic practice.

Interestingly, an estimate by Austin, L.M and Van Vuuren shows the quantity of human waste of one individual in a year and the nutrients recycled thereof- is just equal to the fertilizer required to produce food grains per person per annum (see Table 1). Hence ecosan facilitates the recovery of nutrients from human wastes and its reuse in raising food crops. The bottom line is positive externality of preserving soil quality and ensures food security in the long run.

Table 1: Nutrients from human waste and the amount of fertilizer needed to produce Cereal per annum

Fertilizer	500 liters urine	50 liters faeces	Total Excreta	Fertilizer needed for 230 kg of cereal
Nitrogen	5.6 kg	0.009 kg	5.7 kg	5.6 kg
Phosphorous	0.4 kg	0.19	0.6 kg	0.7 kg
Potassium	1.0 kg	0.17 kg	1.2 kg	1.2 kg
Total (N+P+K)	7.0 kg (94%)	0.45 kg (6%)	7.5 kg (100%)	7.5 kg (100%)

Source: Wolgast (1993), Quoted in Austin & Van Vuuren (2001)

Cost of construction of Ecosan toilets

The construction cost of ecosan toilets is crucial in understanding the economics of ecosan. The secondary source of information suggests that it costs Rs. 5870 per ecosan toilets, while the conventional flush toilets costing Rs. 25000. Flush toilets need to be supported by sewer system and the construction cost of it is more than four times higher than ecosan due to this (Table 2.). Difference is due to the type of materials used in construction. Research investigation is underway as to find out locally available resources that can be utilized for construction and thus reduce the cost further down.

Table 2: Cost of Construction

Variable	Eco-San Toilet	Conventional Toilet
Space	Height – 9' Size – 5'-6.4'	Height – 9' Size – 5'-6.4'
Investment (In Rupees)	5870	25000
Maintenance (In Rupees)	300 / annum	1200 / annum

Source: R.K.Srinivasan, 'Collector's item', Down to Earth, November 16-30, 2008

Positive spill over of Ecological sanitation

In addition to the already stated 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. Ecosan 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.

Socio-cultural barriers

Conventional practices of sanitation are mainly of two types, *flushsan* and *pitsan,* excluding open air types as it is practiced due to non availability of facilities. People used to *pitsan* would have more adaptability towards eco san as it functions far better than what they use on all fronts. Eco san scores higher compliance grade in aspects like health, hygiene, smell, privacy, user friendliness and aesthetics than usual pit type of sanitation. On the other hand *flushsan* used by majority in developed countries put forth barriers to changing over to ecosan as the concept is entirely different from what they have been practicing for years. *Flush it and forget it* has been in vogue with development of aesthetic sanitary ware in different shapes and colours and sizes though the underlying principle remains the same. The psychological feeling flush toilet users is that human waste once goes out of sight, there will be absence of smell, infection and hazard but seldom realize the excreta travel and the destination of faeces and urine mixed with water and how it gets disposed of ultimately. On the contrary, ecosan manages waste locally and works on the principle of separation of urine and faeces. Efforts need to be put by individuals in maintenance of ecosan toilets and only when they start to use it the compatibility and hygienic aspects would be best understood. The structure of the toilet pan, using different openings for urine, faeces and washing, keeping faeces dry by applying ash, saw dust etc., removal of compost once in 6 months to be used as manure, cleanliness and aesthetic maintenance may seem to be difficult and create barriers to implementation. Most people may find it uncomfortable those excreta remains near their bedroom till it gets decomposed and not washed out of sight as in conventional flush toilets. Usage of decomposed excreta as manure in our locality for garden and farm land is still more difficult to adapt as households would fear odour and infection through this. Consumption of food grains grown out of this manure, though it is only organic farming, is another hurdle to overcome.

Notwithstanding the fact, this process has been in vogue before the advent of sewerage systems, it has to be brought back again with more user friendly techniques. Need for open space, cleanliness, protection from pathogens, health, privacy and aesthetics are certain criteria that lead to the development of sewerage system, this no doubt being a good practice at its inception. Failure to foresee the fact that the nutrients from the soil are dumped into water bodies and not returned to soil has lead to its deleterious effects on nature. Sewerage system controls the pathogenic aspect only, sustainability of soil and water forgotten. On the other hand, Eco san combines both, return of nutrients and control of pathogenicity, so as to create a sustainable methodology for good sanitary practices.

Global and Indian scenario of sanitation

UNICEF and WHO furnish reliable information on sanitation at the global level. The South Asian countries registered the highest percentage of population using open air for defecation. Understandably, the developed regions of the world are absolutely free from open defecation (UNICEF & WHO Report 2012). Even the poorest regions of the world viz., Sub-Saharan African countries, where even death occurs due to starvation , the percentage of population involved in open defecation was 25 per cent.

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This is better than the Southern Asian nations. It is not uncommon to witness the difference in sanitary practices between urban and rural areas.

As per the Census Report of the Government of India 2011, the percentage of households in India involved in open defecation stood at 49. 8. The state of Jaharkhand recorded the maximum of 77 percent of households using open toilets, while the state of Lakshadweep showed the least of 1.8 percent. In South, Kerala state posted 3.8 percent the lowest, while Tamilnadu with 45.7 per cent, Andhra with 48 per cent and Karnataka with 45 per cent. Among the north eastern states of India, Sikkim, Manipur, Mizoram, and Tripura fared better in this regard by registering less than 12 per cent.

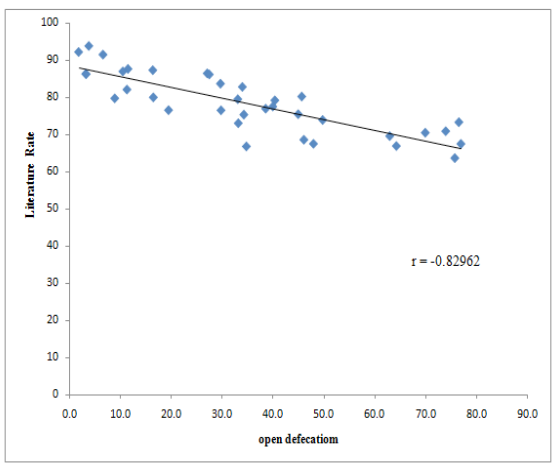
Factors causing open defecation are many. Poverty, lack of dwelling units, shortage of water supply and illiteracy are a few forces behind the insanitary practices. An attempt was made to find out the correlation between literacy rate and open defecation practices of different states in India and figured out negative correlation between the two (Table 3). Higher the literacy rate, lower the open defecation and vice-versa (Figure 1). A survey from Nepal also revealed a same picture; Pradhan and Heiinonen (2010) confirmed that hygienic sanitary practices have a bearing on education and highlighted the lack of awareness among different socio-economic strata.

Table -3 Sanitation Vs literacy rate

India / States/ Union Territory*	Open defecation (%)	Literacy Rate (%)
India	49.8	74.04
Jammu & Kashmir	46.1	68.74
Himachal Pradesh	29.7	83.78
Punjab	19.5	76.68
Chandigarh*	3.2	86.43
Uttarakhand	33.1	79.63
Haryana	29.8	76.64
NCT of Delhi*	3.3	86.34
Rajasthan	64.3	67.06
Uttar Pradesh	63.0	69.72
Bihar	75.8	63.82
Sikkim	11.3	82.2
Arunachal Pradesh	34.8	66.95
Nagaland	16.5	80.11
Manipur	8.9	79.85
Mizoram	6.6	91.58
Tripura	11.5	87.75
Meghalaya	34.3	75.48
Assam	33.2	73.18
West Bengal	38.6	77.08
Jharkhand	77.0	67.63
Odisha	76.6	73.45
Chhattisgarh	74.0	71.04
Madhya Pradesh	70.0	70.63
Gujarat	40.4	79.31
Daman & Diu *	10.5	87.07
D & N Haveli *	40.0	77.65
Maharashtra	34.0	82.91
Andhra Pradesh	48.0	67.66
Karnataka	45.0	75.6
Goa	16.4	87.4
Lakshadweep*	1.8	92.28
Kerala	3.8	93.91
Tamil Nadu	45.7	80.33
Puducherry*	27.1	86.55
A & N Islands *	27.5	86.27

Source: Calculated by using Census Data-2011

Figure 1: Sanitation Vs literacy rate



Status of Tamilnadu

The state of Tamilnadu is no better as the percentage of households using open stood at 45.7 as against the national average of 49.8 (Census Report, Government of India 2011.). However, ecosan practices have been initiated in two districts; Musiri, a taluk in Tiruchirappalli and Mamallapuram, a taluk in Kanchipuram. The Ministry and Rural Development, Government of India encouraged the NGOs like SCOPE to construct ecosan toilets. The SCOPE has succeeded in constructing nearly thousand units of ecosan toilets in Musiri and the functioning of the same is worth reckoning. Research investigation is underway to find out the cultural barriers in using ecosan, besides finding a suitable locally available materials for construction, experimenting with different composting materials like wood ash, saw dust, earth soil and so on to enable the quick composting of faeces in particular. The difference in cost of construction of ecosan vis-à-vis conventional toilets is also under investigation.

Even in Tsunami affected area like Nagappatinam, coastal district of Tamilnadu there were ecosan toilets albeit in small numbers. However for want of operation and maintenance ecosan toilets were unsuccessful in that district. The NGOs in Tamilnadu take up this challenge and trying in different regions of the state in constructing ecosan toilets. Both the Central and State Governments do come forward in offereing subsidy for the construction.

Policy Initiatives

Environmental policies have been in vogue in India since mid seventies. Regulatory method *ipso facto* command and control mode as strategy was engaged towards protecting air, water and solid waste and so on. Economic instruments like pollution tax and subsidy backed by financial incentives like excise duty

exemption, depreciation allowance and capital gains tax in making the policies more effective. Green economy would warrant revamping the existing regulations by means of green standards and to bring in innovative green measures in supplementing the policy initiatives.

The World Summit on Sustainable Development held in 2002 at Johannasburg, declared provision of adequate sanitation and guarantee potable water as one of the set goals warranted to protect human health and the environment. The Millennium Development Goals (MDG) initiated by the United Nations in 2005 came out with eight goals. *Ensuring sustainable Development* is the seventh goal, where improved sanitation is central to achieving sustainability before the target period of 2015. All the member nations including India have been endeavoring to reach the set target. Total Sanitation Programme in India is an offshoot of the same. In 2012 it has been renamed as Nirmal Bharat Abhiyan (NBA) and the Cabinet Committee on Economic Affairs had allocated Rs. 3000 Crores in 2012-13. Gram Panchayats are entrusted with the responsibility of implementing the mission of NBA in India. Out of the 2.4 lakh Gram Panchayats, less than 10 per cent i.e 24000 Gram Panchayats were completely free from open defecation. Even the Planning Commission of India gave an approval of Rs. 36000 crores towards NBA under twelfth five year plan (2012-17).

More importantly, ecosan has relevance to green house gas (GHG) emission reduction (Gert de Bruijne and Nadine Dulac 2003). The Kyoto Protocol 1997 proposed a few options in motivating institutions, and countries to take part in GHG reduction exercise. Clean Development Mechanism (CDM) chiefly meant for this. Human wastes, after simple treatment, besides serving as organic fertilizer may also be used to produce biogas (methane), a green energy, as an alternate source of energy. Generation of green energy fetches carbon credit under CDM. It is known that global warming potential of methane is 21 times higher than CO_2. Developing countries have this option to participate in GHG emission reduction and stand to earn money for provision of better sanitation.

Conclusion

In sum, Green economy 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. Our biosphere- planet earth- is self sustaining that nothing comes in nor anything goes out- one form changes to another but the substance exists. The constant flux of materials on earth form the basis of sustaining life, matter changes from one form to another or shifts from one place to another, the total remains the same. Taking into consideration the dynamics of earth, a systematic and scientific recycling of materials would be the only option to save earth from degradation and depletion.

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