



# Decontamination of Water Resources through Sustainable Ecological Sanitation of Night Soil With Production of Biofertilizer

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### ABSTRACT

India and certain other countries have the legacy of using environmental friendly and non-polluting ways of disposing fecal matter and domestic waste by converting them to biofertilizer. Animal and fecal wastes were routinely used to improve the fertility of soil. However, in 20th century due to increased urbanization, these traditional methods were replaced by flush toilets, producing sewage. Sewage is now the number one cause of water pollution. The water pollution decreased the public utility of water resources and resulted in public health problems. The widespread water pollution has left only a few surface and groundwater bodies in good condition. Traditional methods in India and elsewhere and research done in Sweden will be helpful in designing water less management of night soil including composting/digesting fecal matter mixed with domestic and agricultural waste and suitable industrial waste products, to produce fuel gas and biofertilizer. Technological intervention is needed to carry out research on these alternative processes to achieve decontamination of water bodies and to improve the fertility of widely occurring nutrient deficient agricultural soils.

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## Introduction

Freshwater is a scarce resource and very small part of inland fresh water is available for public use. However, major part of available fresh water is highly polluted and is unsuitable for public use. Around 1.8 billion People in the world don't have access to safe water; 2.4 billion lack access to adequate sanitation and more than 840,000 people die each year from water-related diseases. Huge amount of infrastructure and enormous cost is now involved in the treatment of sewage to make it suitable for domestic use, however with inadequate success. Experience during River Ganga and River Yamuna cleaning projects showed that even after spending huge amount of public money, it is beyond the capacity of available technology to clean the water bodies to their pristine status. It is unfortunate that the politicians and scientists did not find way to remediate sewage production, the culprit of pollution. Logically the simple solution to prevent sewage production is to avoid use of water to flush and carry night soil. Traditionally, water was never used for management of night soil in India and elsewhere. Preventing sewage production can be achieved by amalgamating the principles of traditional methods and research carried out in Sweden on ecological sanitation. The traditional waterless management of night soil needs to be researched in modified engineered form to suit our modern way of urban and rural life. These modified technologies will be helpful in treating and converting the night soil in useful biofertilizer and to divert pollutants away from water bodies. Organic biofertilizer, the product of night soil treatment, will improve the poor agricultural soils on long term basis, thus helping to improve the regional economy. The issues of water pollution and possible remedy are discussed in this article to find the solution to decontaminate the water bodies. This would save the enormous public money being currently used in river cleaning. The conversion of toilet waste of 1.32 billion population in India would produce huge amount of compost resource for the betterment of the agricultural soils and crop production.

## Legal Human Rights for Clean Water

The human right to water has been recognized in international law through wide range of international documents, including international human rights treaties, declarations and other standards (<http://www2.ohchr.org/english/issues/water/iexpert/standards>). In terms of political declarations, the main resolutions were passed by the UN General Assembly and the UN Human Rights Council resolutions both in 2010. The Resolution calls upon States and international organizations to provide financial resources, help capacity-building and technology transfer to help countries, in particular developing countries, to

provide safe, clean, accessible and affordable drinking water and sanitation for all [1].

According to the Indian constitution, every citizen has the right to have the environment protected through reasonable legislative and other measures that promote environmental conservation. In India, there are legal measures for protection and conservation of environmental quality of water resources like Water (Prevention and Control of Pollution) Act, 1974 and implementing agency like Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) under the Ministry of Environment and Forest and Climate Change (MOEF&CC). The main duty of CPCB is to plan and execute a nation-wide program for the prevention, control or abatement of water and air pollution and all related activities. The other water quality requirements are BIS Water Quality Standards (IS 10500: 2012) related to drinking water, CPCB effluent disposal standards, CPCB Surface Water Quality Classification for various uses, irrigation water standards, etc. all these water quality standards help to maintain the required water quality, if the prevention and control of water pollution is efficient.

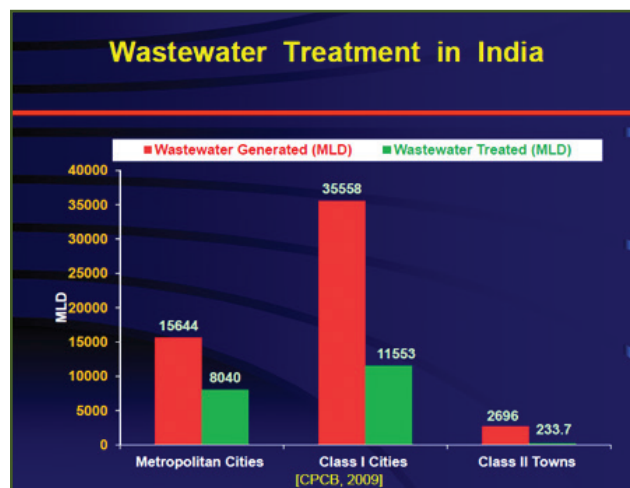
## Growing Water Demand

All the social and economic activities rely heavily on the supply of quality water. As the population and economic activities grow, many countries including India are rapidly reaching conditions of water scarcity and facing limits to economic development. Water scarcity is also due to pollution of water bodies which made them unsuitable for various uses. Water demands are increasing rapidly, with 70-80 per cent required for irrigation, less than 20 per cent for industry and a mere 6 per cent for domestic consumption.

## Pollution Potential of Domestic Sewage

The largest source of water pollution in India is untreated sewage due to lesser than required number of sewage treatment plants (STPs) (Figure 1) [2]. A 2007 study by CPCB found that discharge of untreated sewage is the single most important source of pollution of surface and groundwater in India. The problem is not only that India lacks sufficient treatment capacity but also that the sewage treatment plants that exist do not operate satisfactorily and are not maintained properly [3].

The scientific analysis of water samples under National Water Quality Monitoring Network of CPCB from 1995 to 2008 indicates that the organic and bacterial contamination is severe in water bodies in India, mostly due to domestic wastewater discharged from urban centers of India. Indian cities produce nearly 40,000 million litres of sewage every



**Fig. 1: Scenario of Treatment of Wastewater Produced in Towns and Cities in India [2]**

day and barely 20 percent of it is treated, and the untreated waste dumped into rivers & seeps into groundwater, thereby creating a ticking health bomb in India according to “Excreta Matters” report [4]. Above observations have shown that pollution control by STPs is not a practicable solution on the basis of its inadequacy on the basis of cost and efficiency, and also the precious fertilizer resource to be generated from fecal matter is lost.

#### **Present Mitigation (Futile) Measures**

Presently the sewage, which is mix of sullage (Kitchen and bathroom wastewater) and fecal matter from toilet and other waste, is treated and the effluent is discharged in water bodies or used for irrigation. However, many cities don't have sewage treatment plants of adequate capacities, or do not have any sewage treatment plant, therefore raw sewage, and partially treated or untreated sewage with eutrophication potential are discharged into water bodies. Now the Indian Government is trying to depollute and sanitize the rivers by spending crores of rupees on conventional methods of sewage treatment and sewer construction. The government and the environmental organizations and environmental managers do not realize that how much public money will be spent in the name of restoration of rivers and reservoirs, which is not successful on permanent basis. The money which should be utilized for the socio-economic improvement is flown in drain in the name of cleaning of rivers and reservoirs, which is a futile exercise.

Presently Ganga Action Plan is mainly based on development of sewage treatment plants in the cities along the bank of the river. The cost of development of one STP ranges from Rs. 70 lakhs to Rs. 1.2 crores. Now the

standards for effluent discharge are made more stringent, as an exercise to control the river pollution. This will increase the cost of new STP development and up gradation of existing STPs. The concern is people have to bear this enormous cost.

#### **Environmental Friendly Traditional Practices in India and Many Other Countries**

Without knowing the jargon of environmental theory, the traditional practices used in India and elsewhere for management of domestic waste, fecal matter were environmental friendly and now provide the basis for developing, designing and planning the efficient management system for the waste of different types with the production of fertilizer byproduct, ultimately to save and preserve the rare, life sustaining water resource on the earth. Some of the examples of traditional methods are given below:

Traditionally, the waste matter such as fecal matter and urine was never discharged in water bodies but were put through natural degradation process of composting to convert them into useful fertilizer which used to be applied in farms for the crops. This is, in recent terminology, is the conversion of waste into resource and uses it for constructive purpose by the principle of recycle and reuse. In other terms, the materials taken by living component from the earth are returned to earth to make it rich to support biological life further, thus helping the natural cycle of elements through living and non-living components of the earth. Such treatment at source would be helpful in treating the human waste and animal waste and would not pollute the water bodies; otherwise the demon of water pollution would destroy the ecology and human race. This is as per the natural doctrine that human has no right to deteriorate and convert the rare, life supporting resource into useless commodity. The traditional practices of waste management in India are described below:

- Every village had the system of reserving some area under the jurisdiction of the village for open discharge of fecal matter, separately for men and women. The fecal matter such discharged used to be degraded by the soil bacteria and other microorganisms and convert them into soil humus, making the soil fertile.
- There was also practice to discharge the fecal matter in the agricultural fields and then cover it with soil or ash so that in due course of time the fecal matter is naturally converted into soil humus improving the fertility of the soil.
- Whenever, the large residential areas are concerned, there used to collect the fecal matter by trucks and used to deposit in the trenches made in a barren land away

from the residential area, which was then covered with soil and allowed to degrade naturally into soil humus and fertilizer, which can then be taken out and used as fertilizer in the agricultural fields.

- The urine is rich in ammonia-nitrogen which is necessary to improve the fertility and can be used as fertilizer when it is discharged in soak pits and the matter in soak pits can be used as nitrogen fertilizer in the agricultural farms.
- Every village farmer used to collect the animal waste of cows, oxen, sheep etc. and other farm waste in a small ditches, and allowed it to get composted and the compost was used in the farms for fertilizer.
- The animals were used to remain in farms during non-crop season, so that the dung was discharged in farms and was naturally converted into fertilizer which used to improve the soil fertility for long time.

### Traditional Methods in Other Countries

**Ancient Attica:** The use of sewage as fertilizer was common in ancient Attica. The sewage system of ancient Athens collected the sewage of the city in a large reservoir and then channeled it to the Cephissus river valley for use as fertilizer [5].

**Japan:** The use of feces as fertilizer was common in Japan. In Edo City, compost merchant gathered feces to sell to farmers. That was good additional income for apartment owners as their feces were better due to their good diet and more nutrients remained in their excreta. Various historic documents dating from the 9th century detail the disposal procedures for toilet waste [6]. Selling human waste products as fertilizers became much less common after World War II, both for sanitary reasons and because of the proliferation of chemical fertilizers. Modern Japan still has areas with ongoing night soil collection and disposal.

**China:** Human excreta, or night soil, have been used in China to fertilize crops and feed fish for thousands of years. The night soil has helped China's land to retain crucial nutrients and fertility for longer duration of time. Because the night soil was often untreated or partially treated, pathogens could easily be transferred to both humans and food (so eating raw vegetation was seriously frowned upon). However, public health problems due to fecal pathogens were not solved due to this practice. This indicates night soil treatment must be accompanied by the pathogen removal technology.

Before 1979 in China, urban night soil was cleared away jointly by farmers and environmental sanitation bodies. It was fermented in small-scale storage tanks, with or

without urban domestic waste, in the rural areas. It could be applied to the farmland directly when needed. After mixing both materials simple piles were made for composting. In 1997, community system was replaced by the family responsibility system. This made it difficult for individuals to collect and transport night soil from cities. Hence in some cities, night soil had to be disposed of through sewers and this caused environmental pollution. After a period of disinterest, night soil again gets the attention it deserves, being a valuable resource rather than a contaminant. In recent years, as prices for vegetables and commercial fertilizer rose and the market remained stable, farmers became motivated to use night soil again. Also, farmers recognize more and more the advantages of using treated night soil in farm lands or fish ponds. But for sanitary reasons, the State now demands that night soil is treated before application. However, to make safe handling possible, treatment of the raw night soil is necessary [7].

### Deviation from Traditional System of Composting, Recycle and Reuse

**Bhangi Mukti Yogana:** Bhangi Mukti Yogana was implemented, due to struggle of Harijan Sevak Sangh, with the noble purpose of eliminating the human labour for transporting human excreta from houses to the place of disposal. But this was implemented without planning for environmental friendly method of disposal of human excreta. This issue is explained in detail below.

Traditionally, a section of poor & illiterate community, named as 'Bhangi', was assigned the task of transportation of night soil from individual houses to a designated place for onward transportation for composting of night soil. This task was effectively done for centuries by hated head for elite few whereas, the same task was being performed from time immemorial by the mothers and those who loved you in childhood and also when it was needed most in case of illness, to clean the excreta by disposing it in the soil. This continued for centuries till the year 1960. This system had its uniqueness of night soil getting treated in no time to valuable bio-fertilizer due to high temperature & humid conditions in most of the area & most of the time. Till this time the water bodies in India were considerably good for domestic use.

### Neglected Down-to-Earth Approach Made by Social Workers

**Central Gandhi Smarak Nidhi,** which was established in Delhi in 1956, took to many activities in a move to liberate the scavengers. Finally after 1969, the Nidhi has been working to abolish scavenging by converting the service latrines into pour-flush sanitary latrines of Sulabh Shauchalaya type by constructing new latrines new latrines



which do not required services of scavengers, namely Sopa type and Naigaon type latrines in which arrangement are made to collect the effluent in containers for use as fertilizers in farms. This pioneering experiments in the field were done by the Appa Saheb Patwardhan, the then Chairman of the Central Gandhi Smarak Nidhi, in Gopuri Ashram in Ratnagiri district of Maharashtra. This research was not facilitated by the scientists in the CPCB who were responsible to control water pollution.

### **Price paid for Neglect of Natural Recycle Process**

But, in the process of the administrative decision of replacing the transporter of fecal waste (the hated head), water was assigned the task without realizing & understanding the technicality. The blunder which was made in London in 1860 A.D during industrial revolution was repeated in many countries some time or other including India. Unfortunately, since then the water is being used in larger and larger amount to flush the fecal matter from toilets into sewerages, which ultimately dumped in the final sink i.e. lentic and lotic water bodies and coastal water, thus polluting all the surface and groundwater. This demon has now polluted mostly all the clean water bodies, including sacred ponds and rivers and drinking water resources. Due to this practice, apart from resulting pollution of the water resources, the night soil did not reach the soil though composting to make it enriched with biofertilizer.

There has been rise in population and industries in 20<sup>th</sup> century in India, at the same time more water was used to flush out night soil and urine, which ultimately reached to its sink i.e. water bodies. Thus, the asset (night soil and urine) which was to grow with rise in population was lost in increasing the pollution load on the scarcest resource i.e. water.

Probably problem was realized by policy makers and an institution called Central Pollution Control Board (CPCB) was formed framed under Ministry of Environment and Forest & Climate Change (MOEF&CC) with an effective act enacted in March 1974 “Water (Prevention and Control of Pollution) Act, 1974”. But the Institution with its entire technical competency did not act in right direction of searching the technology for transportation & treatment of night soil to a product as usual but allowed water bodies to get polluted with loss of bio-fertilizer, aquatic life etc. They were running after creating better & better technology for effluent & sewage treatment and creating more & more infrastructure for sewage collection system etc with investment of public money. No hesitation in saying that they failed in their task and thus, failed a nation

which culturally always worshipped the water body in all its forms. Worshipers of water body culturally, where even a ‘Tyagi’ or “Aghor”, had to carry a ‘Kamandal’ for using water to clean himself by taking water from water body outside its periphery and did not throw night soil in river

It is hoped that the institution would realizes and search for better & better technology with old philosophy to achieve the age old task of transporting and treating the night soil with its natural ally i.e. soil, ash, red mud, slag lime & dolomite dust, oil soaked soil from oil industry domestic discards and so many such things.

Habits die hard so we must kill it slowly. Here, we have not to only kill our dirty habit but need to replace with an old habit which may be a bit uncomfortable on various accounts. Now with this in mind, let us discuss some of transportation technology presently being utilized in industry for night soil transportation and using discards of industries and municipal as treatment associate.

### **Conclusion**

It has been recognized that human fecal matter in sewage is the major source of pollution in polluting most of surface and groundwater resources of India. Traditionally, it was used as resource to convert into fertilizer through composting without using water to flush it out in water bodies as is done today. This traditional practice is required to be modified and implemented into water-less technology to collect and convert fecal matter into fertilizer. Specific toilets (based on model developed by Central Gandhi Smarak Nidhi) may be developed for directly converting sewage into fertilizer and fuel gas. Similarly, water less toilets based on experience in Sweden, Japan and China need to be engineered on small and large scale. Many waste byproducts of industries like fly ash, red mud, metal dust, slag & dross, leather discards from tanneries/slaughter houses, oil soaked soil, sludge from oil industry etc. can be mixed with night soil to condition it for composting and then use as fertilizer and soil conditioner in agriculture.

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### **Competing Interests**

None Declared

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