Delhi Sustainable Development Summit 2004

Organised By

TERI, New Delhi

On

4th to 7th February, 2004

At

India Habitat Centre, Lodhi Road

New Delhi

Sulabh Sanitation Technologies to achieve Millennium Development Goals on Sanitation

Dr. Bindeshwar Pathak

Ph.D., D.Litt.

Founder

Sulabh Sanitation Movement

Sulabh International Social Service Organisation

Sulabh Gram, Mahavir Enclave

Palam-Dabri Marg, New Delhi-110 045, India

Tel. : 011-23381686, 23073753, 23073672, Fax : 011-23381511

Email: sulabh1@nde.vsnl.net.in

Sulabh Sanitation Technologies to achieve Millennium Development Goals on Sanitation

Dr. Bindeshwar Pathak*

Due to burgeoning population, rapid urbanization, industrialization and uncontrolled use of natural resources, there has been gradual imbalance of ecosystem in recent years causing severe health hazards and environmental pollution, resulting in poor economic growth in developing countries. Continued urban migration, congregation of urban poor in slums without safe water supply and sanitation facilities and increasing resource constraints have all led to rapid deterioration in quality of life and community health.

There are 2.4 billion people in the world who either have no organized system of sanitation or have access only to a noxious and unhygienic facility. The health implications for this state of affairs are appalling. Globally, 2.2 millions people die every year from diarrhoeal disease (including cholera) associated with contaminated water supply, sanitation and hygiene. The majority are children under the age of five in developing countries. Improved hygiene and sanitation help reduce sickness from diarrhoea considerably. Intestinal worms infection about 10% of the population of developing countries, can be controlled through better sanitation, hygiene and water supply. Sanitation facilities help check transmission of many faecal – oral diseases by preventing human excreta contamination of water and soil. Epidemiological evidence suggests that sanitation is at least as effective in preventing disease as improved water supply.

In India, out of the total population of 1027 million, according to 2001 census, about 736 million people lack basic sanitation facilities resulting in high mortality and morbidity and poor economic growth. One of the challenging problems of the country is to abolish the inhuman practice of manual scavenging. There are still more than 500,000 scavengers engaged in the demeaning practice of cleaning and carrying others' human excreta from over 7 million bucket privies.

Low sanitation coverage in India is primarily due to insufficient motivation/awareness of people and lack of affordable sanitation technology. Most of these people are from lower socio-economic groups and are not aware of the health and environmental benefits of sanitation. It is still not seen as a high priority, resulting in absence of people's participation. The lack of choice of toilet design, area-specific technologies, inadequate supporting delivery systems and absence of trained masons, skilled workers and technical manpower are the factors for low coverage. Additionally, by tradition, Indian society and culture value personal hygiene, but give little importance to a clean and healthy community environment. Sanitation is regarded as a matter of individual initiative and not as a collective obligation of the community. In this socio-cultural background, environmental sanitation has not been given required priority.

The Millennium Development Goal aims at halving, by the year 2015, the proportion of people who do not have access to basic sanitation, which would include action at all levels, to develop and implement efficient household sanitation systems, improve sanitation in public institutions, especially schools, promote affordable and socially and culturally acceptable technologies and practices, promote safe hygiene practices and integrate sanitation into water resource management strategies. One of the important questions is which half part of the population should be focused upon to provide sanitation first? Sanitation in rural areas is an urgent priority; so also uncontrolled population growth in urban and peri-urban areas resulting in increase in slums where health & hygienic conditions are even worse than in the rural areas. Should we begin with the need for creation of awareness or should we without further delay, straightway start acting and implementing programmes creating sanitation facilities. A realistic programme has to commence by creating awareness initially, followed by formulation of plans, strategy and implementation. The concept of creation of awareness does appear to be rather amorphous and intangible. But, the acronym IEC, though hackneyed, is significant. Years ago I asked myself when I founded Sulabh in 1970, how I come into the picture in all this? We began with the beginning. Sulabh when was a child, first practiced IEC on itself and subsequently used it for spreading

the Sulabh concept. I should acknowledge the lesson I learnt from the WHO publication (Excreta Disposal for Rural Areas and Small Communities" by Edmund A. Wagner and J.N. Lanoix) wherein it is said "Suffice it to say here that out of the heterogeneous mass of latrine designs produced all over the world, the sanitary pit privy emerges as the most practical and universally applicable type". This was the seed which germinated; this was the genesis.

The point is why did I need technology of twin pit pour flush Sulabh system. I remember the days when I was in the Gandhi Centenary Committee. Gandhi's ideas and idealism influenced and inspired me to try to remove the stigma of untouchability attached to the class of people known as scavengers who manually clean the excreta of others. They clean but the world continues to treat them as unclean. They touch the excreta of others and in turn become untouchable themselves. The task is demeaning. Unfortunately, attitude of others towards them is more undignified than the indignity attached to the profession. I decided to wage the battle. I started as a one-man army. As they say *"Karvan Chalta Gaya, Log Shamil Hote Gaye"* and the one man army by now has grown into nearly 50,000 soldiers of sanitation.

The strategy that I adopted was to devise technology which would eliminate the need of excreta being cleaned by scavengers. This was the twin pit pour flush system.

Sulabh is the pioneering organization in India, involved in development and implementation of socially and culturally acceptable sustainable technologies in the fields of low cost on-site sanitation, public toilets, recycling and reuse of biogas from public toilets, wastewater treatment through duckweed and composting of biodegradable waste matter. The Sulabh Flush Compost Toilets developed and modified by Sulabh is nationally and internationally recognized design for safe and hygienic disposal of human wastes. The new design developed by Sulabh for efficient production of biogas from community toilet linked biogas plants, is approved by the Government of India for its implementation in different states. Wastewater treatment through duckweed and its economic return from pisciculture developed by this organization is perhaps only technology having direct economic return out of

wastewater treatment. The technology is gaining momentum in different states of India. Sulabh Thermophilic Aerobic Composting (STAC) a technology that biodegrades any organic matter within ten days is a landmark achievement of Sulabh in the field of solid waste management. The technology does not require manual handling of solid wastes during composting period. Details of the above technologies are described in the following pages.

Sanitation Technologies

In developed countries, the standard solution for the sanitary disposal of human waste is water borne sewerage. Due to severe financial constraints and exorbitant cost, sewerage is not the answer to solve the problem of human waste management in India. Sewerage was first introduced in the world in London in 1850, followed by New York in 1860. Calcutta in India was the next city in the world to have this privilege in 1870, yet only 232 towns/cities out of 4,700 have sewerage system that too with partial coverage.

Septic tank is beyond the reach of the common man as its cost is unaffordable to common people. It requires large volume of water for flushing. It has other problems like periodic cleaning and disposal of sludge. Effluent disposal is a potential source of foul smell, mosquito breeding and health hazards, if not properly disposed of. After the tank is filled, it contains fresh and degraded excreta mixed with water. Since mechanical device is rarely available to empty the tank, it has to be cleaned manually by scavengers, which is an unsocial and unhygienic process. The Government of India has banned the system of scavenging, but unless the technology of septic tank is completely banned, it would be practically difficult to ban scavenging. Even after the septic tank is emptied mechanically, its sludge has to be kept in ditches for at least two years to make it free from pathogens, which is a very cumbersome process. Generally, such undigested human wastes with water are discharged into open drain or on soil surface causing nuisance, health hazards and environmental pollution.

Sulabh Flush Compost Toilet

Sulabh Flush Compost Toilet is a pour-flush water-seal twin-pit toilet that is technically appropriate, socio-culturally acceptable and economically affordable. It is an indigenous technology and the toilet can easily be constructed by local labourers and materials. It provides all the health benefits by safe disposal of human excreta on-site. It requires only 1.5 to 2 litres of water for flushing and thus conserves water. It does not need the services of scavengers to clean the pits. There are two pits; size & capacity of pits vary according to the number of users. The capacity of pit is kept generally for 3 years. Both the pits are alternately used. When one pit is full, excreta is diverted to the second pit. In about two years rest period, the sludge gets digested and is almost dry and pathogen free, thus, safe for handling as manure. Digested sludge is odourless good manure and soil conditioner that can be dug out easily by the beneficiary and used for agricultural purposes.

Again talking about goals and targets I would like to mention that Sulabh has constructed more then a million Sulabh toilets in individual households. Lest I may sound boastful, let me remind that use of Sulabh toilets by over 10 million people on a daily basis juxtaposed against 700 million indulging in open defecation may seem insignificant. But the technology devised has had its own role to play especially considering that it was implementation of a new technology. It was a pioneering effort to eradicate the evils of open defecation and scavenging. The figures given above give an idea of the effort made on the one hand and the colossal magnitude of the problem on the other and establishes that only one organization cannot solve all the sanitation problems and there is need for others also to come in. I am glad to say that others have also entered the field. I only wish they display the same dedication as was expected of Sulabh and which it has fulfilled and continues to do so.

Though legislation prohibits scavenging, it required technology back up and its implementation to create conditions which eliminate the need of employing the scavengers. A large number of towns have been made scavenging free and more than fifty thousand scavengers have been liberated. They have found other avenues and employment like cleaning streets etc. Efforts of Sulabh did not end here. To prevent children of the scavengers reverting to the

profession of scavenging Sulabh has started, vocational training institutes, where training is imparted in different trades like in the field of computers, motor mechanic, tailoring and beautician courses etc. Besides a school is run for children of the scavengers on the basis of mixed grouping concept with ratio of 60:40 between children of the scavengers and those of other classes.

The sum and substance of what has been said above is that Sulabh has developed a technology which is practical and cost effective as opposed to water borne sewerage and septic tank based ones. The Sulabh technology has also led to social transformation serving a social purpose.

Sulabh Public Toilet Complexes

Provision of public toilet complexes at public places and in slums on pay and use basis is an important landmark of Sulabh in the field of community health & hygiene and environmental sanitation. Although in 1873, the then Bengal Government enacted a law to set up toilet facilities in Calcutta, due to one reason or another such facilities could not be provided / maintained. During the 100 years between 1873 and 1973 public toilets could not be made practicable. The concept of implementation of public toilets and its maintenance on pay and use basis, originated by Sulabh in 1974, got a roaring success throughout the country. It was felt that along with the community toilets, if facilities for bathing and washing clothes could also be provided and above all they could be kept clean, people would have no hesitation in using them and pay for the use.

Sulabh has constructed so far nearly 6000 such toilet complexes in different parts of the country, where maintenance is provided round the clock. These complexes are located at public places like bus stands, hospitals, markets etc. and slums. For the construction, operation and maintenance of these complexes, the organization plays the role of catalyst and a partner between the official agencies and the users of the toilet complexes. The system of operation and maintenance of community toilets evolved by the organisation has

proved a boon for the local bodies in their endeavour to keep the towns clean and improve the environment.

This is a unique example of partnership of local authorities, non-governmental organization and the community. The local government pay only once for the construction of toilets. Sulabh constructs the system and takes its maintenance guarantee for at least 30 years from the amount received as users' charge, without any burden on local government.

Community Toilets Linked with Biogas Plants

Recycling and reuse of human excreta for biogas generation is an important way to get rid of health hazards from human excreta. Sulabh is the pioneering organization in the field of biogas generation from public toilet complexes. After a series of experiments, the organization developed a more efficient design of biogas plant that has been approved by the Ministry of Non-conventional Energy Sources, Govt. of India for its implementation through state nodal agencies. Human excreta contains a full spectrum of pathogens, which cause over 50 infections when transmitted from one diseased person to healthy ones. During biogas generation, due to anaerobic condition inside digester most of the pathogens are eliminated from the digested effluent making it suitable for using it as manure. Thus, biogas technology from human wastes has multiple benefits - sanitation, bioenergy and manure.

Based on 'Sulabh Model' design, 118 nos. biogas plants of 35 to 60 cum capacity have been constructed by Sulabh in different states of the country so far. The Sulabh Model of Biogas Plant does not require manual handling of human excreta and there is complete recycling and resource recovery from the wastes. Digester is made underground into which excreta from public toilets flows under gravity. Inside digester, biogas is produced due to anaerobic fermentation by the help of methanogenic bacteria. The biogas, thus produced, is collected inside digester itself due to liquid displacement chamber. One cft of biogas is produced from the human excreta per person per day. Human excreta based biogas contains 65-66% methane, 32-34% carbon dioxide and rest hydrogen sulphide and other gases in traces. Biogas is utilized for cooking,

lighting through mantle lamps, electricity generation and body warming during winter etc. Cooking is the most efficient use of biogas. Biogas burners are available in a wide range of capacity ranging from 8 cft to 100-cft biogas consumption per hour. Biogas mantle lamp consumes 4-5 cft per hour having illumination capacity equivalent to 40 W electric bulb at 220 volt. Motive power can be generated by using biogas in dual fuel internal combustion (IC) engine. At optimum condition only 20% diesel is required, rest (80%) is substituted by biogas. Biogas consumption by engine is 15 cft /BHP/hour. A public convenience visited by about 2000 persons per day would produce approximately 60 cum of biogas which can run a 10 KVA genset for 8 hours a day, producing 65 units of power.

Sulabh Effluent Treatment (SET) Technology

Produced biogas from human excreta is being used for different purposes e.g. cooking, lighting, electricity generation and body warming. Besides, effluent of biogas plant can be used as fertilizer, as it contains good percentage of nitrogen, potassium and phosphate. But simultaneously its aesthetically bad colour, odour and presence of pathogens, limit its use for agricultural/horticultural purposes.

Since Sulabh is maintaining over 6000 public toilet complexes spread all over country, out of which 118 are linked with biogas plants, it was an important task for the organization to make effluent free from odour, colour and pathogens, to use it safely for agricultural purposes. After a series of experiments, the organization has developed a new and convenient technology by which effluent of human excreta based biogas plant turns into a colourless, odourless and pathogen free manure. The technology is based on filtration of effluent through activated charcoal followed by ultraviolet rays. The filtration unit makes it colourless, odourless and free from organic particles and UV eliminates bacteria. It reduces BOD, COD of the wastewater drastically. Since such wastewater is from human wastes, its BOD (Biochemical Oxygen Demand) is around 200 mg/l that comes down to <10 mg/l after treatment- safe for aquaculture, agriculture

purposes or discharge into river or any water body. It can be used for floor cleaning of public toilets in drought prone areas.

Advantages of Sulabh Biogas plant with SET system

- No manual handing of human excreta is required.
- Aesthetically and socially acceptable.
- Technically appropriate and financially affordable.
- Operational & Maintenance cost very low.
- Biogas is used for different purposes.
- Treated effluent is safe for reuse or discharge into any water body.
- In drought prone areas treated effluent can be used for cleaning of floor of public toilets.
- Direct economic return by using effluent in agriculture and aquaculture.

Duckweed based waste water treatment

One of the major problems with wastewater treatment methods is that none of the available technologies has direct economic return. The available technologies are unaffordable due to high capital and maintenance costs. Due to non-economic return, local authorities are generally not interested in taking up treatment of wastewater causing severe health hazards and environmental pollution. In our country out of about 5000 towns / cities only 232 have sewerage system that too partial.

Sulabh has demonstrated projects on duckweed based cost effective wastewater treatment in rural as well as urban areas with direct economic return from pisciculture. Although duckweed is found in ponds and ditches, due to near complete absence of know-how of any such technology in the country, potential of duckweed for the wastewater treatment, its nutrient value and economic benefits have not been exploited.

Duckweed - a small free floating and fast growth aquatic plant has tremendous ability to reduce BOD, COD, suspended solids and bacterial and other pathogens from wastewater. It is a complete feed for fish and due to high content of proteins and vitamins A & C; it is a highly nutritious feed for poultry and animals. The yield of fish increases two to three times when fed with duckweed than with conventional feeds in ponds. Reduction of BOD, COD of effluents varies from 80-90% at the retention time of 7-8 days. The first project funded by the Ministry of Environment & Forests, Govt. of India was completed in collaboration with the Central Pollution Control Board, New Delhi. The CPCB has made a guideline on the use of duckweed for the wastewater.

Sulabh Thermophilic Aerobic Composting (STAC)

Sulabh International Institute of Technical Research & Training has developed a new technology - Sulabh Thermophilic Aerobic Composter (STAC) that requires only 8 to 10 days to make compost from any biodegradable waste without any manual handling during composting. It is based on thermophilic aerobic method. The technology does not require recurring expenditure. The plant is G.I. sheet made having double wall filled with glass wool, partitioned with perforated sheet into three chambers. After biodegradation, liquid is collected in bottom chamber that can be easily taken out and used for agricultural/horticultural purposes. Manure that contains 30-35% moisture can be directly used for agriculture/landfill purposes or it can be dried, granulated and stored till further use. The practical utilities of this technology are: (i) organic solid waste can be efficiently converted into manure and soil conditioner having direct/indirect economic return, (ii) it controls diseases transmitted from wastes, as at high temperature pathogens are eliminated from the waste, (iii) due to reduction in volume, carriage cost of wastes to disposal site as well as area needed for landfills will be drastically reduced, and (iv) spread of weeds from wastes will also be controlled.

The technology is more suited for rural areas as its by-products (compost) can be readily used for agricultural purposes,.

The appearance of Sulabh, a pioneering voluntary organization, principally dedicated to eradication of scavenging and liberation of scavengers through low cost technologies, has proved to be a significant milestone on the road to human waste management. It is evident that the government or non-governmental organization alone cannot fulfil the gigantic task of sanitation in India. The problem can be solved effectively where both work in cohesion. Our experience as NGO has been that the Government alone cannot face the challenge of carrying out community centered social development programmes. NGOs are used to adopt innovative approaches and provide services to support sustainability and effective use. NGOs with trained social workers work as activators and good communicators. The Millennium Development Goals can be achieved when government bodies in close co-operation with NGOs/CBOs/community work together for dissemination and implementation of cost effective technologies for sanitation.

❖