

The Problem of Human Waste Disposal and Preserving a Clean Environment

In May 2008 (*JGSI*, v.71, p.605), I commented on the deplorable condition of sanitation in both rural and urban parts of our country. Nobody apparently took any serious notice of the comments and the country continues to remain insanitary and far from clean. Meanwhile, the world has had a chance of viewing the conditions prevailing in one of the slums of a city like Mumbai. The film, 'Slum Dog Millionaire', viewed by millions all over the world, portrays the abominable sanitary conditions in parts of a metropolitan city of India. Instead of making us hang our heads in shame, the entire leadership of India has joined the rest of the world, in showering accolades on the film, with no efforts made to blot out of existence the realities of Indian sanitation. A look at the Yamuna at New Delhi, the capital of India, or the Ganga at Varanasi, the holiest of the holy places, will make it clear that not only has all the crores of money budgeted for cleaning up the rivers has gone down the drain but the rivers even-flow has not been restored and both continue to be clogged with human waste and industrial effluents. Our planners however, are not discouraged! They continue to plan, and the money spent during 60 years of independence has not effected any marked change. Japan, China and Singapore, with previously similar conditions, have improved and now have some of the cleanest cities in the world. This has resulted from an inculcation in every citizen of sanitary discipline and the efficiency of municipal and central administrators in providing the necessary education and facilities. What prevents us from adopting similar measures? Why the continued indifference to sanitation?

Some Earlier Experiments

Gandhiji returned to India after his great work in South Africa, found appalling neglect in respect of cleanliness and narrates, in his autobiography, his first attendance at a meeting of the Indian National Congress at Calcutta. He writes "there was no limit to insanitation. there were only a few latrines and the recollection of the stink still oppresses me. I pointed it out to the volunteers. They said point blank, that was not their work, but a scavenger's work. I asked for a broom and cleaned the latrine for myself. The rush was so great and the latrines so few, that they needed frequent cleaning, but that was more than I could do". He found the delegates to the Congress session had no scruples and used the verandah outside their room for calls of nature in the night. No volunteer was ready to clean any part of the place or even share with Gandhi the work of cleaning. The prejudice against handling of human excreta was and continues to remain deep-rooted.

Although he practised personal cleanliness and saw to it that all the inmates kept the surroundings clean and that every inmate took care to clean his toilet himself, outside the *ashram* it was different. It is unfortunate that Gandhiji did not persist on this cleanliness campaign and

make it a nation-wide movement, which he could have achieved, despite the difficulties, but more urgent was the riddance of British rule and securing independence for India. However, no other leader of national stature took much interest in sanitation and conditions have steadily worsened since then. If timely action is not taken soon, even the little greenery left in India will vanish and give place to heaps of garbage, converting whole cities into slums and cesspools. Even now, all open spaces in cities including public parks have become, to some degree, toilets causing degradation of the entire environment.

Kanshiram, the dalit leader of Uttar Pradesh, is reported to have stated that if elected to office, he would not build *mandirs* and *masjids* — his topmost priority would be to build latrines but he died before he could fulfill his promise, and his disciple Mayawati, who has become the Chief Minister of the largest province of India has forgotten the words of her mentor and, instead, taken to erecting statues (none of them known for an interest in sanitation) – an unnecessary luxury which the country can ill afford.

Jimmy Carter, former President of the United States of America, did not become famous for any of his political decisions. On retirement from his high office, he undertook to relieve the poverty of a backward area in Ethiopia as he felt the root cause of poverty was the lack of proper sanitation and undertook to build latrines there for the common man's use. He built as many as 340,000 latrines in a single year and became famous, not for his efforts at building friendly relations between Israel and Ethiopia but as the No.1 statesman who built the largest number of latrines in Africa?

These are a few instances of improving sanitation in undeveloped countries, but their net effect is negligible.

Changed Conditions of Today

India has changed since and, with it, its image and lifestyle. Industries have expanded, cities have enlarged and multiplied, but the old mindset which considers work of cleaning up the waste generated as degrading still persists, with the result, Indian cities for the most part continue to remain filthy and dirty. Politicians have become a well-provided class, dressed in immaculate clothes, in suits of western style in a country where day temperature in summer months is over 42°C! They roll about in luxurious cars with armed escorts in front and behind. Industries have prospered and are to be reckoned as among the most prosperous and pampered in the world. As against this, the condition of *āām admi* (common man), for whose sake all activities of the ruling government are ostensibly planned, remains one of poverty, ill-educated and crowded together in slums, which are a disgrace to any society tolerating such conditions. The disgrace is aggravated by a nation claiming to be in the forefront of developing nations and forgetting that “the toilet is the single biggest variable in changing human life span”.

I have often wondered why such a prejudice has grown against handling human waste, as it does not exist in handling cow dung and urine, also products, like human faeces, of a digestive system based on micro-organisms in the stomach of all animals, including man. Animal dung is less pungent than man's due to simpler diet. The cow dung and urine are cleaned regularly without

any reservations, since it is known that they are of particular value in agriculture. In fact, human waste when fully decomposed is also of value for the plant nutrients it contains. While the stuff remains in the body, it is a part of the digestive system, but when it is thrown out and not allowed to remain *in situ* and decompose, it becomes filth and everyone is anxious to see it removed as quickly as possible, least bothered as to how it is done or how the final disposal is made. There is also a great reluctance to have even a discussion on the subject. The media, which should take special interest in all matters relating to the health and well-being of the community, revels in reporting accidents, murders, suicides, etc., furnishing gruesome accounts of such tragedies. Rarely does it focus attention on the lack of sanitation and the heaps of undisposed garbage. A collective effort throughout the nation appears necessary to instil a sense of cleanliness individually and collectively in all strata of our society which should take precedence over everything else. While the major responsibility for this remains with every individual, State and Central Government representatives will have to provide extensive basic facilities as well as actively encouraging those NGOs engaged in such work. It has to be a joint effort to succeed.

“BIG NECESSITY: the Unmentionable World of Human Waste”

A book with the above title was added recently to the library of the Society and landed on my table. The author, a charming lady, has taken the trouble of travelling all over the world, walked through the sewers of the cities of London and Paris, as well as the notorious slums of Mumbai. She visited China, saw their efforts in the utilization of human waste, in biogas generation and liquid fertilizers, admired sanitation arrangements in Japan and has certified the Japanese as the cleanest people. Her book's coverage is thus global and by going through its pages, one learns more about a field of human activity that most people avoid talking about. She has not spared India, exposing the hollowness of the claim of 'Developing India'. Our deficiencies are highlighted, more particularly the callous indifference to matters connected with elementary sanitation and the utter irresponsibility in the way the enormous amount of waste generated is allowed to stagnate making you feel ashamed of your country.

My attempt, however distasteful it may be to our readers, is to project the enormity of the problem and to emphasize the fact that while the rest of the world has advanced markedly in making their cities clean, we have refused even to look at the problem and allowed half the population to wallow in filth of their own generation, allowed pollution of all our water bodies and virtually converted our sacred rivers into sewers. The way in which our administrators, our legislators and the intellectual elite brush aside paying no attention to a problem of which they are a part and must be set right if our nation is to progress, is too tragic. In the recent budget, claimed as oriented towards the amelioration of the 'common man', there is barely a mention of improving rural sanitation and no effort indicated for reducing and eventually eliminating open defecation by providing the essential functional sanitation facilities.

What is the Real Nature of Human Waste?

The term for human waste is generally 'faeces' or 'excreta'. 'Shit' is more common in America.

The waste generated by animals, especially cows is called 'dung'. Most defecation by men and women is done in the squatting position. The British introduced stools with a detachable bucket and the inhuman practice of engaging a low-caste individual – *Bhangi*, to remove this came into vogue. The waste generated was termed 'stools', which remains in common use in the medical profession. Stool is generated from the digestion of food taken and is the part left after digestion. Constituents like nitrogen and phosphorous which are removed from the soil by the plants eaten, continue to exist in the stools after the digestive process. It is logical to expect that these are returned to the soil to restore its fertility. The present practice of considering stools as waste, flushing it away with water down drains and finally into rivers, appears to be a criminal act of negligence of throwing away a badly needed nutrient and, in the process, polluting the entire river system. Urine and faeces are not waste products which have to be discarded as filth, but valuable ingredients of the life cycle to be returned to the soil as manure, especially where chemical fertilizers are not available but are also expensive. The easy way open to the farmer is to use faeces and urine by a simple process of curing as is done in the case of cow dung, which is used as manure, but this process has not been extended to human waste and urine. It is high time that these are utilised in crop production by adopting suitable methods and modifying the sanitation system currently in practice.

In order to ascertain the different proportions of constituents present in the urine and faeces, I made serious efforts to obtain a 100% analysis of these products generated in different parts of India, where food habits are widely different. I have so far failed to get this information and in the absence of authentic, readily available, local information, I had to fall back on world literature, specially the detailed composition of urine, faeces, bio-water and grey water. A study by Hakan Jonnson and others of the University of Agricultural Sciences at Uppsala, Sweden has estimated excretion of urine, faeces, grey water and household waste from different countries (Chelmanns Univ. Technology, Gottenberg, Sweden, www.urbanwater.org). Data expressed as kg/year.

Parameter	Urine	Faeces and toilet paper	Greywater total	Household wastewater	Compostable household waste
TS	7	19	26	53	25
VS	3	17	15	35	21
COD _{tot}	3	23	23	49	34
BOD ₇	2	12	12	27	12
N _{tot}	4.0	0.5	0.6	5.1	0.6
P _{tot}	0.33	0.18	0.25	0.76	0.10
S _{tot}	0.26	0.06	0.17	0.48	0.05
K _{tot}	0.88	0.33	0.29	1.49	0.23

Another study furnishes estimates of extraction of nutrients per capita of urine in different countries of the world

Country	Nitrogen Kg/person/year	Phosphorous kg/person/year
China	4.0	0.6
India	2.7	0.4
South Africa	3.4	0.5
Uganda	2.5	0.4

Conclusions drawn from the study are of interest and are reproduced in full.

- Urine and faeces are both complete high quality fertilizers. The best fertilizing effect is achieved if they are used in combination with each other, but preferably not at the same time.
- Urine is a quick-acting N-rich complete fertilizer. Its nutrients are best utilized if the urine is applied from prior to sowing, up until two-thirds of the period between sowing and harvest.
- Urine can be applied neat or diluted. However, the application rate should always be based on the desired N application rate and the urine or urine mixture should be quickly incorporated into the soil, to minimize ammonia loss. Any potential need of supplementary water should be met by plain water, not diluted urine.
- The recommended application rate and time of chemical N fertilizers (urea and ammonium if available) is the best starting point for developing local recommendations on application rate and time for urine.
- If no recommendations can be obtained, a rough rule of thumb is to apply the urine collected from one person during one day (24 hours) to one square metre of crop. If all urine is collected, it suffices to fertilize 300-400 m² per person and year. For most crops, the maximum application rate before risking toxic effects is at least four times the dosage above.
- For most crops and under most circumstances, the yield is consistent for the same total application rate, whether it is applied in one large dose or in several smaller ones.
- Faecal matter is especially rich in phosphorous, potassium and organic matter.
- Both ash and lime, which are often added to the faeces, increase the buffering capacity and the pH of the soil, especially important on soils with low pH.
- Organic matter also improves the structure and the water holding capacity of the soil.
- Faeces should be mixed into and covered by the soil before cultivation starts. Application in holes or furrows close to the planned plants is one way of economizing on this asset.
- For faeces, the application rate can be based on the current recommendation for the use of phosphorous-based fertilizers. This gives a low application rate, and the improvement due to the added organic matter is hard to distinguish. However, faeces are often applied at much higher rates, at which the structure and water-holding capacity of the soil are also noticeably improved.

There has been hardly any serious study of the composition of urine, faeces, or where treated, of the composition of the waste and the grey water which is generally allowed to become mixed with it during drainage. In the Norwegian countries and Japan, a considerable research effort is continuously pursued by a number of scientists. It is surprising that there are no similar studies undertaken in our country, which faces serious problems of water shortage, sanitation and scarcity of fertilizers. It is high time that the average value of parameters like flow of water, total suspended solids, organic matter, BOD, total fractionated COD, nitrogen, phosphorous, potassium, sulphur and heavy metals – lead, cadmium, mercury, chromium, nickel and zinc are determined and the information is furnished for urine and solid waste separately.

We have no clear estimate of the average weight in kg of urine and solid waste produced by a person in India per day to get an idea of the enormity of the problem and to make even a rough estimate of the valuable constituents we are discarding into the rivers, instead of utilizing the waste in supplementing the soil, which is progressively becoming degraded for lack of these very constituents. These ingredients are available in ionic form and are easily absorbed by plants.

Researches carried out elsewhere clearly show that human waste (urine and faeces) contribute badly needed constituents to the improvement of soil structure. Obviously, this is a field of great potential for effecting improvements in the field of agriculture.

Wasting of Precious Water in Flushing Toilets

A good percentage of potable water is being wasted in cleaning toilets! The municipal service is concerned in getting the waste out of sight sluicing it through sewer pipes and not on conservation.

India, despite its much advertised growth and economic progress, is noticeably poor, dirty and its urban and rural poor are strangers to the luxury of a clean toilet. Governments are spending considerable sums of money on rural sanitation (whatever it may mean). The Indian bureaucracy is occupied more with collecting statistics as to the money spent, the number of villages covered under the scheme – everything except keeping track of the number of toilets provided and whether they are being properly used. ‘Infosys Foundation’, a charitable institution, provided a munificent grant of 8 crores for the building of sanitary kiosks (*Nirmala Sauchalaya*) in different parts of Bangalore city. The toilets were well designed and built as per plan and ought to have proved an asset to the city. In reality, however, neither the donor, nor the municipal agency, has any system of inspecting and checking whether the facility provided at great cost is functioning properly, with adequate water supply, and being used. The bureaucracy refuses to move out of Delhi. It revels in paper work and is least bothered about the realities on the ground. What the big bosses see are just paper? There is no personal check of the progress. Much of the money is wasted on salaries of the bloated bureaucracy and real progress achieved, most often, is illusory.

Waste can become Wealth if Properly Utilized

I wish to repeat that what we are all so anxious to get rid of, is really not waste! It contains elements badly needed for plant growth and science should devise easy and economical ways of converting what has been wrongly considered as waste into useful compost and be less dependent on costly and often not easy to obtain artificial fertilizers which, in all probability, will disturb the natural soil structure. The habit of flushing out and discharging human waste to nearby rivulets and polluting them has to be stopped. Our scientific community and engineers, who are entrusted with the task of keeping cities clean should devote attention to this important problem.

'Sulab Sauchalaya'

Sulab Sauchalaya, introduced by Bindeswar Pathak (see Editorial, *JGSI*, v.71, p.606), has shown how waste can be converted into compost. This is the best way of achieving rural sanitation and make compost available at the farmers' door step. Squatting 'drop-and-store' type latrines are more hygienic and easy to clean and should be adopted for the rural parts.

Bindeswar Pathak, the lone crusader from Bihar, has thus been able to achieve success in eliminating manual scavenging with his *sulab* toilets and conferred immense benefits to large number of mute, suffering, humanity. "How a society disposes of its human excrement is an indication of how it treats its humans" and Pathak takes this truism and the toilet culture to even a higher plane. Defecation is shown to be necessary and not something very lowly. He throws light

on a whole spectrum of human behaviour, natural economy, national politics, role of media, cultural preference, etc.' In the absence of an assured water supply and sewers, the only available alternative is to have pit latrines with drain pits which do not require human handling of waste. Faecal matter can be flushed into a nearby pit by just a tumbler of water instead of a bucketful, as at present practised by many of the flush latrines in the country.

The most important point to note is that this improvement has been achieved by a single individual with a vision and a set task to banish human scavenging. Governments, with all their paraphernalia, could not have achieved what Pathak has been able to achieve within a short time. No wonder Bindeshwar Pathak, founder of *Sulab Sauchalaya* has been honoured and is the recipient of the 2009 Stockholm Water Prize Laureate at the Annual World Water held at Stockholm between 16 and 22 August, 2009. It is fervently hoped that many will come forward, including governments, to emulate his example in easing the miserable plight of both urban and rural poor as regards sanitation.

Need for Specialized Study of the Problem

Few in our country have given much thought to toilet design, separation of urine from the excreta, and converting the solid waste into a usable product. As stated earlier, in a city like Bangalore with a population of over 7.5 million, and still growing day by day, there is a serious shortage of water in many parts of the city. It is the poor people who are badly affected as they have no alternative but to defecate in the open. Institutes of technology should have a separate section to study methods aimed at elimination of water as far as practicable in the sanitation system, and recycling human waste by dehydration, decomposition and converting it into a usable product. This is an active field of research whose results will be of immense benefit to the country, providing desperately required fertilizer and contributing to a cleaner environment.

There is presently a total lack of awareness in the minds of our people in all walks of life of the seriousness of the problem. Huge rallies are permitted, needlessly creating traffic jams and putting a large number of people to great inconvenience. The entire route gets littered with plastic bags, plates and discarded food and takes several days to clean. If this is the civic sense, not of the multitude, but of the party members and even educated youth, how can we expect things to improve? There is a great need to reform our attitude to life, to cleanliness, neighbourliness, and a willing submission to law and order. These should form essential parts of our education system at all levels.

Hitherto, we have been working on the assumption that water is available in plenty. Not satisfied with the water supplied by the municipality, estate developers are drilling deep into the ground, tapping the deepest aquifers to satisfy their needs. As a result, the water table has sharply declined, making all the shallow bore wells which were supplementing water to the poorer sections of the society go dry, thus denying water supply even for the limited purpose of drinking and cooking. It is essential, under such conditions, we develop appropriate technologies which greatly reduce, if not completely eliminate, the present misuse of water. By so doing, they will help to maintain our water supplies and keep our water ways clean and environmentally safe.

Recycling of Waste Water – 'Toilet to Tap'

California is at the forefront of modern technology in facing water problems and has been forced to take up projects for treating sewage water to yield water for domestic use. San Jose, San Diego city waste-managers have approved a plan to use abundant recycled water. The finished product from these plants is stated to excel drinking water standards but is not allowed to flow directly into taps because of State regulations. Instead, water is injected underground and filtered in the aquifers which supply water to the cities. Such type of projects are believed to supply 70 million gallons per day, propping up the city affected by water scarcity.

A case exists of construction of toilet complexes with urinals which do not use water, but do not stink has been reported from Pune, Maharashtra. The technology involved is simple, with a membrane attached costing Rs.130/- which closes when the flow of urine stops, thus acting as a smell trap. Urine is used in the campus as a liquid fertilizer and solid waste is used to generate biogas (*Down to Earth*, Sept.1-15, 2009, p.34).

The Indian Institute of Science, Bangalore, is planning to employ membrane technology to purify waste water and thereby save up to half a million litres per day as the campus is consuming 4 million litres per day. The technology is imported and not one of the Institute's own design.

But all such attempts can be termed successful only if the treated water is re-used in flushing toilets and attempts have to be multiplied. Installation of economically sound systems, in different parts of the city will avoid heavy investment in sewage and the risk of large-scale pollution.

The recent moves of the Bangalore Municipal administration and the Bangalore Pollution Board to make it mandatory for large apartment blocks to install waste treatment plants at the basement and make use of the regenerated water for flushing toilets is to be welcomed. Solid waste could be collected by farmers as organic compost. Such attempts have to be multiplied to reduce water consumption and make the city clean.

I have tried in this note to highlight some facts about sanitation which are seldom discussed in the hope of turning the present state of apathy to one of action. Tolerance of insanitary conditions is a crime which has to be rooted out. Our scientists and technologists have an important role to play and should bestir themselves to eliminate this evil which is degrading our society.

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