

ESSENTIALS
OF
**GARBAGE
SOLUTION**



Ganga Narayan Ghosh

GARBAGE SOLUTION for **CLEAN INDIA : BEAUTIFUL INDIA**

For seeing the world and meeting people has taken me to 192 cities in India and 80 cities of six continents. I have covered almost all cities of West Bengal. I have observed painfully that foreign cities are clean but Indian cities and their surroundings are getting dirtier. **India's garbage pollution is rising fast. How to manage it? Please know from this short write-up.**

On my own volition I have been working on all aspects of garbage for over thirty five years. For the last three years, I have also been working on public urinals and toilets. I have studied centuries of historical aspect of some Indian cities. Now I have workable and economical solution. I need your help.

I am a successful mechanical engineer from Jadavpur University of 1952 batch and owned factories in Kolkata and Mumbai. During my professional career, most of the time as a design engineer I have solved many long-time problems.

My patented waste bins are successful at many places. I can show you the way to make places clean and make you healthy. I can justify my concepts, ideas, designs and writings of this booklet, '**Essentials of GARBAGE SOLUTION**'. Also, please see my leaflet on '**Closed and Elevated Garbage Bins**'. Government may please arrange an open debate where I can defend against all your experts in this area. I am not supported by any government or private agency. So my views are unbiased. My main book on '**GARBAGE SOLUTION**' is getting completed soon.

I live in Houston, U.S.A. and visit India every year. I am familiar with current happenings in India. Although, I do not have much faith on accuracies, I use statistical figures of pollutions as indicators of giganticness of the problems. According to a government supported private institute, in 2011 India produced 1,88,500 tons of garbage per day. The forecast for 2041 is 4,40,000 tons per day, an alarming rise of 2½ times in just thirty years.

Open burning of garbage within the city and self-ignited fires at garbage dumps release nearly 22,000 tons per year of pollutants in Mumbai air alone.



Ganga Narayan Ghosh

These pollutants include carbon monoxide, hydro-carbons, carbon particles, nitrous oxide, sulfur dioxide and carcinogenic cancer causing fumes. Other cities are no better. Through inhalation, these fumes and solids react with our bodies and settle in our lungs causing various deadly diseases. Recently, I had been to Mumbai. From Bandra I could not see even Dadar two kilometers away, the sky was so hazy. In 1969 I could see beyond Worli seven kilometers far. It is all due to burning of garbage and un-burnt gasoline. In Kolkata, I have seen garbage dumps on Barrackpore Trunk road on fire.

With my technical and professional expertise, I have designed and constructed, multi-advantageous garbage bins which will keep every place clean. **Garbage Bins must be closed and elevated to keep areas clean** The designers of garbage container have never given any consideration to the garbage-handlers. I have given them better working and sanitary condition.

Finding new dumping areas have become big problem for every city. I have shown how dumping capacities can be vastly increased in their existing places. Fuel gas methane can be obtained from some landfills.

No electricity can be produced from Indian garbage as it is wet and has no calorific (heat) value. Except leaves from park and garden, compost production from regular garbage should be banned. Municipal and house garbage is often a mix of electronic and electrical waste containing harmful metals and hospital wastes with deadly pathogens. This is my direct observation from close visits of 23 dump sites.

Govt. of India's National Environmental Engineering Research Institute in Nagpur and the Ecological Department of Indian Institute of Science in Bangaluru are only collecting and generating data on different aspects of garbage without producing any effective solution for waste management, and people keep on suffering. They have number of research schemes and producing theoretical Ph. Ds. These are my conclusion after visiting them.

Some court rulings were of no use. Fruitless mega budget brain storming sessions on Waste Management are held. Crores of rupees of tax-payers money are wasted. Only curative healthcare business is booming. Not much attention is paid towards preventive public healthcare aspects.

Also, huge money is being laundered by a nexus of politicians, officials and contactors at municipal levels. Citizens should not continue to suffer any long, and raise their voice against these ever rising ill practices.

Without going further at this stage, I summarize my observations and suggestions below:

1. **All municipalities allot huge sum of money for garbage removal.**
The money is thoughtlessly spent, mostly on expensive items.
2. In every city **wrongly designed costly garbage containers and vats are used.** That is the prime reason of garbage strewn all around.

3. In small cities and villages no garbage container exists. Residents therefore **throw garbage anywhere and everywhere.**
4. **Garbage-handlers are treated inhumanly.** They are not given the essential items like dress, gumboots, gloves and face-masks.
5. Municipal commissioners, generally I. A. S. who administer the municipal corporations do not like to hear public. **Some of them are curt.**
6. **People living adjoining the cities are rightly resisting dumping of garbage near their homes.** In Kerala, I saw such confrontation..
7. **No electricity can be produced from Indian garbage** as it is wet and their contents have very low calorific (heat) value.
8. **Compost & fuel gas methane can be produced from biodegradable kitchen waste & leaves** from parks & gardens and vegetable markets.
9. As municipal garbage is mostly mixed with hospital waste and electronic & electrical waste with harmful hazardous materials, **no compost should be made from municipal garbage.** Stop making compost in Puri & Bangaluru plants.
10. **Open dumping must be stopped. Sanitary landfill should be adopted to prevent 'leachate' contamination of underground water.**
11. Utilizing garbage, **crores of rupees of fuel gas methane should be produced** from sanitary landfills.
12. Dumping ground capacities can be vastly increased in their existing spaces by making them pyramid-like conical shaped.
13. **An Independent Central Organization directly under the Prime Minister for Uniform Garbage Management headed by a mechanical engineer is a must. All municipalities must follow their guide-lines. Only then India will be clean.**
14. **Excreta and urine NOT to pass inside the earth and contaminate underground water. If this practice continues mass deaths may occur. I have written some details in page 22. Public health is most important.**



Park on old garbage dumpsite, Lucknow

Salute to creator of such a place.

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GARBAGE & Some Details:

Garbage is also called waste, solid waste, and municipal solid waste. I have stated it as garbage, as it is commonly called.

Garbage falls in two categories by its use:

i. Biodegradable Garbage is vegetable and fruit peelings, food waste, leaves, fish, meat, poultry and leaves which could produce fuel gas, methane or soil conditioner compost.

ii. Non-Biodegradable Garbage includes floor and road sweeping and other wastes usable as covering for biodegradable garbage or filling lowlands.



Posh Ballygunge Circular Road, Kolkata



Garbage Dump within Patna city



Garia: in a Door-to-Door collection area



Garbage is Burnt by Municipality , Trivendrum

Garbage in Cities: A Few Glimpses

Hospital & Nursing Homes generate following wastes.

i. Food & Office Wastes are produced in kitchens and offices.

ii. Pathological Waste & Sharps are body parts & needles, scissors etc: these wastes are hazardous in nature and collected in yellow bags.

iii. Infectious Waste is infectious agents from laboratories and infectious patients. All these wastes are hazardous and collected in blue bags.

iv. Radioactive Waste is waste contaminated with radio nuclides. This waste is extremely hazardous and specially collected and destroyed.

Electronic & Electrical Waste or simply E-waste comes from electronic & electrical appliances, both of which contain metals and plastics.

Among metals, lead affects kidneys and the reproductive system. Mercury affects the central nervous & immune systems and kidneys. Beryllium causes lung diseases. Cadmium causes severe pain in the joints and softens bones. Burning of plastics produces dioxins which are carcinogenic and can harm the reproductive and immune systems.

Origin of Garbage:

Homes, community places, markets, road sweepings, parks, gardens, hotels, hospitals, nursing homes, business & office areas, cattle sheds, etc.

Why So Much Garbage around Us? Some of the reasons are:

- i. Rise in Urban Population:** Villagers are migrating to cities.
- ii. Lack of Well-Designed Garbage Bins:** Container's size, shape, opening area for throwing garbage, height of the opening, etc. are not based on sound research. Hence, people throw garbage indiscriminately.



Lucknow Design:
Two users to operate the lid



Belgharia
Garbage Around Mobile Unit



Kolkata Design
Small & Wrong position of Inlet



North Barrackpore Design: Swivel-empting
Container, Too Heavy to Swivel

A Few of the Wrongly Designed Garbage Containers in Cities

- iii. Rise in Standard of Living:** The affluent produce more garbage.

iv. Laxity of People: Years of suffering have made people lax.



Rupees 8.5 lakh Garbage Room is totally ineffective thoughtless design. People do not like to go near smelly too small opening. People prefer to throw garbage indiscriminately. Garbage handlers have to go inside the room which is extremely unhealthy situation.



Heaps of uncollected garbage at the gate.

Thoughtless Design of Large Vat

- v. Inadequate & Improperly Located Garbage Containers:** The World Bank observed that people do not like to carry garbage more than fifty metres. When located farther, people will throw garbage here and there.
- vi. Poorly Maintained Containers:** Often, these containers are broken and rusted. No regular maintenance is done by municipalities.
- vii. Animals inside Vats or Masonry Containers:** Cows, pigs, dogs, are found inside vats.
- viii. Irregular Garbage Removal:** Municipalities are often irregular in removing garbage.

- ix. **Rag-pickers scatter garbage:** Making the entire area filthy.
 - x. **Ignorance of people:** Unaware of the harmful effects of garbage.
 - xi. **People are not civic minded:** They are unconcerned about others.
 - xii. **Lack of Education:** Public hygiene is not taught from childhood.
 - xiv. **Picnickers:** Often, they are lax and make areas dirty.
- From above, it is seen that municipalities do not performing their duties.**

Harms of Garbage:

A. Visible harms:

- i. **Ugly sight & disagreeable odour are the most visible discomforts.**
- ii. **Hindrance to Traffic:** Obstructions to pedestrians and vehicles.
- iii. **Stray Animals:** Cows, pigs, dogs, cats, and rats live on garbage.
- iv. **Self-ignition or Auto-ignition:** Heat generated within causes fire.
- v. **After water-logging,** sewage mix-up causes skin and various diseases.
- vi. **Burning:** Produces a large amount of ash and fine carbon particles.

B. Invisible and Indirect Harms:

- i. **Diseases:** Dogs cause hydrophobia; rats & cats cause plague; house-flies cause a variety of diseases; mosquitoes cause malaria, dengue, and filaria.



Bangaluru



Hyderabad



Barrackpore



Bhubaneswar

These garbage-eating cows will produce toxin-infected injurious milk.

- ii. **Leachate:** Poisonous liquid leachate is formed in rotting wet garbage in which germs of cholera, hepatitis, and bacillary dysentery originate and thrive. Leachate contaminates underground water and city underground potable water lines.

- iii. **Water-logging** on road occurs due to garbage-clogged sewage entry-points and underground pipes. In 2015 besides Kolkata & Mumbai, it took a virulent form of water-logging in many towns of West Bengal. Vehicular traffic, pedestrians, and buildings suffered immensely.
- iv. **Menacing Rat problem:** Rats were cutting computer wires and underground electric cables. In Kolkata, rats have made very large holes under a road in a prominent business locality causing a portion to sink.
- v. **Cows eating garbage:** Cows eating from the garbage dump which is often a mix of hospital, and electronics waste. Their milk is contaminated.
- vi. **Stray Dog Problem:** The dogs thriving on garbage creases fast as they produce puppies twice a year.

A Few Important Garbage-Related Matters:

Increasing the Capacity of Garbage Dumping Grounds:

Indiscriminate dumping of garbage outside all cities have been going on from ages. With increased garbage people living near those dumps are now rightly resisting the dumping. In Siliguri, a city in the north West Bengal, and Thiruvanthapuram in south Kerala, such agitations have taken a virulent form. Thiruvanthapuram municipality is not collecting garbage and asked the residents to burn the garbage which is contrary to government law.

The Solution is Simple: Flatten the existing dumping grounds. Over them, pour only biodegradable garbage like a mountain until its natural “angle of repose” allows it to flow down. Lay a thin layer of non-biodegradable garbage over it. Repeat the process. That process will take years. After three years, fuel gas methane is produced. This method is practiced the world over.

Employment Generation of Youth:

I have made the design of garbage containers simple. Aided with detailed manufacturing procedures, items can be mass-produced by youth with short training with lower costs. This process will create mass employment.

Creating Goodwill among Countries of Indian Sub-continent:

Way of life and living conditions are broadly similar in India, Pakistan, Bangladesh, Nepal, Bhutan, Myanmar, and Sri Lanka. The garbage situation is no different. Our technology could provide relief to the people of those countries. Thus we will have a better understanding with them. There is also a possibility of exporting garbage containers.

The Right Garbage Bins:

**Garbage Bins must be elevated to keep surrounding areas clean.
Without elevating bins, all places cannot be cleaned. See the existing bins.**

After yearlong studies of garbage situations in cities of India and the west, I have followed the proven way of Singapore but modified to suit our situation. I had been there to study their plan. Singapore first designed the right type of garbage containers, improved their garbage collection, educated the people, and thereafter enforced the laws strictly. I thoughtfully designed economic closed and elevated bins with sloping top and sloping bottom. Over the years I made several improvements. Final designs are shown on the cover page.



First Steel Bin, Mumbai -1980



Fibreglass Bin installed in Ramakrishna Mission, Belur, West Bengal in 1983 is Still working for 35 years.



Fibreglass Swivel-emptying Bin, Mumbai - 1983



Steel Bins, Mumbai-1983

Steel and Fibreglass Bins made in Mumbai during 1980-83



Large Bin for 300 Homes-2004



Mid-size Bin for 60 Homes-2004



Swivel-Emptying Bin-2005

Three Steel Bins Made by Vocational Training Centre Boys in 2003-2005

Why Closed & Elevated Bins?

All garbage bins must be closed to prevent overflow of garbage, the ugly sight, and the nauseating stench. Wherever garbage bins are sitting on the ground, there is garbage strewn around them, and the bottom gets corroded.

Places will be clean when garbage bins are above the ground.

Why Three Sizes of Bins?

On the basis of demography, per capita garbage produced, standardization, economy of cost of bins and mass production, I decided three sizes.

Why Best Engineers Do Not Join Municipalities?

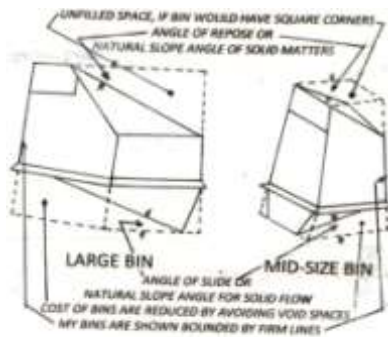
Best engineers do not like to join municipalities as there is much interference from non-technical bosses. Another reason for poor design of containers in use is that the subject of garbage is considered non-glamorous and has not received involvement of senior engineers.

Steel Bins & Mass Production:

Between the years 2003–2005, the steel prototypes of these containers were manufactured under my guidance by the six-monthly welding trainees of the Vocational Training Centre of Ramakrishna Vivekananda Mission, Barrackpore, north of Kolkata. During that time, from Houston, USA I visited the training centre every year to train the teachers and students. Nowhere in the world has a junior technical training institute produced such large items.

Mass production can be undertaken by the contractors of customer's choice with written permission from me or my nominees in India. All technical support and guidance will be provided. I have developed manufacturers both in Kolkata and Mumbai.

Two Important Factors for Solid Holding Bin Design:



Angle of Repose & Angle of Slide explained

Angle of Repose: While filling the bin with solids from one corner, the other side never gets filled, and the solids make a slope, which is called 'angle of repose'.

Angle of Slide: Any solid material flows downward along a slope which called 'angle of slide'.

In the absence of these data, I found these angles experimentally.

All three types of bins have a sloping top and a sloping bottom for maximum space utilization. By opening the door of the bin, the garbage will slip into the lorry or hand-cart placed by its side. A pusher, like a letter T, has been provided for ejection of garbage in case of clogging.

Following are the Garbage Bins designed with best principles:

Large Bins: These bins are unloaded to lorries directly. Thus, filling time of lorries will be much shorter. These bins are for 300 to 400 homes, large housing complexes, large hotels, and large markets. Their ground space requirement is 8 ft x 7 ft. As these bins are new to the public, initially a helper needs to be provided at the container to guide and help the users.

Mid-size Bin: These bins are for 60 to 80 homes, small housing complexes, schools, colleges, parks and lanes, clubs, railway and bus stations, and small markets. The bins take 2 ft x 2 ft of ground space. Over 75% of the roads in cities are narrow with high population density where garbage lorries cannot enter. Garbage from this bin will be carried to the lorry by light-weight covered **hand-cart with removable basket**. The basket can be lifted by two persons, and the garbage can be poured into the lorry. This method will eliminate the present filthy practice of unloading the garbage from the hand-cart to the road and then again filling the garbage into baskets for filling into the lorry. Hand cart with removable basket is a new concept taking care of garbage-handlers working condition as well and better working atmosphere. Further, filling time will be cut by less than half.

Swivel-emptying Bin: The smallest is a galvanized steel bin fixed on steel poles or walls. These bins can be easily emptied by turning them upside down. These bins require a floor space of 1 ft x 1 ft. Placed about 100 metres apart, pedestrians will be able to throw bus and train tickets, small cartons, bits of papers, cigarette and *bidi* butts, ground-nut shells, etc. In Singapore, a larger version of such bins are used.

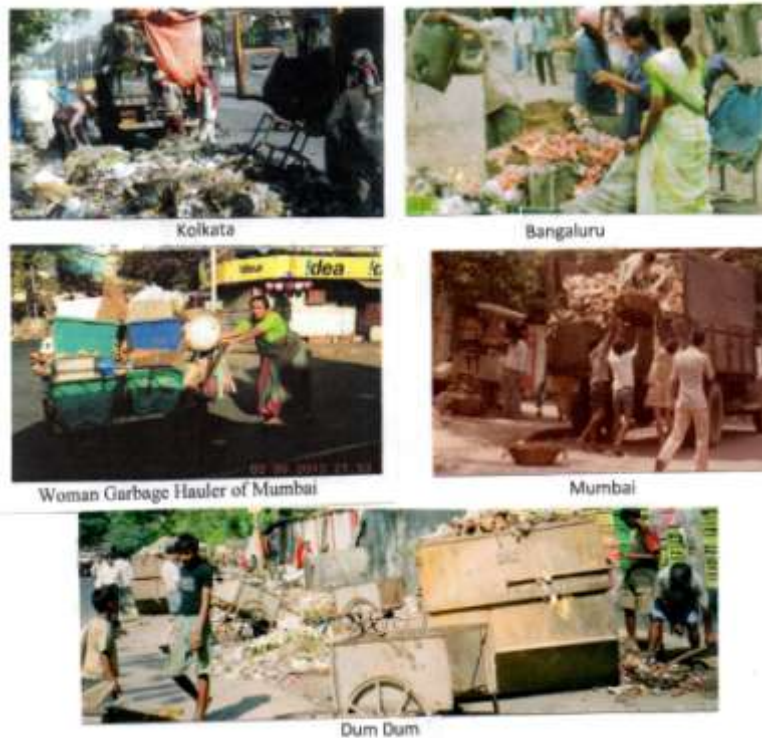
Unique Features of These Bins:

1. Being closed, no overflow of garbage, no ugly sight, and no stench.
2. No access to flies, cockroaches, rats, birds, animals, & rag-pickers.
3. Easy to drop & easy to discharge; large bin directly discharges into a lorry.
4. The undersides can be repaired and painted at the site.
5. Vertical design holds more garbage in a small area.
6. No spreading of garbage by wind, rain, and passing vehicles.
7. No choking of sewage entry points and thus less water-logging.
8. Since the bins are elevated, the surrounding areas will remain clean.
9. Lorries can collect garbage at any time.
10. Garbage loaders will have less contact with garbage.
11. Prevent 'leachate' percolation and contamination of underground water.
12. Being simple to make, these containers will generate large employment.

Manufacturing The Bins: For mass production, uniformity & precision jigs, fixtures, and templates have been designed.

Assembly & Erection: For convenience of assembly and erection, each component is numbered, and an instruction booklet for assembly and erection will be provided.

The Garbage Handlers:



Sub-Human Working Condition of Garbage Handlers in India

Sad Plight of Garbage-handlers:

India gained independence 70 years ago, but the working condition of garbage handlers remained the same wretched way. No city has provided basic safety gears like gumboots, face masks, and gloves. Some of them died inhaling poisonous gas from garbage. These low-paid workers are under the clutches of money-lending sharks. They are addicted to poisonous country liquor. Working conditions of workers under contractors are far more miserable. **Their conditions must improve.**

Essential Welfare Measures for the Garbage Handlers:

1. Working dress, gumboots, gloves, and face-masks must be provided.
- ii. Free medical facilities for them and their families during service and after retirement and also preventive health check-ups.
- iii. Provide improved designs (Mumbai) of brooms and implements.
- iv. Cooperative banks for them.
- v. Garbage-handlers Welfare Society started by the writer has just started.

My Nut-shell Plan for Garbage-free India

1. Provide adequate number of garbage bins.
2. Regularly collect garbage from containers.
3. Dump garbage only in sanitary landfill.
4. Extract fuel gas methane
5. Entire country is strewn with plastic plates, carry-bags bottles etc. as seen below. Those are to be picked by rag-pickers by a simple device seen below.



Everywhere strewn with plastic items.
India must not remain like this.



Using a mechanical device, 'Gopher'
Cleaning can be done much faster.

6. Change law to recall concerned municipal councilors for non-performance.

TOILETS

**Human Waste & Urine Should Never Get Inside The Earth:
Pathogens therein will Cause Mass Deaths in Future.**

Harms from Human Feces:

On average, an adult produces 200 to 300 grams of feces in a day. Human feces provide nurturing ground for many injurious pathogenic organisms that badly affect the human body. These organisms are the potential source of infection through water and food contaminations.

Harms of Open Defecation:

Open defecation is an unpleasant sight, and feces emit strong stench. House flies sit on human feces and are carriers of pathogenic organisms. Every year, 40 lakhs of children die and a few crores suffer from water-borne diseases spread due to open defecation. India loses seven crores man-days due to defecation-related diseases.

Mass Deaths from Feces-related Diseases:

During 1975-76 on the other side of river Yamuna, in New Delhi, three large resettlement colonies named Anand Nagari, Sundar Nagri & Gokul Puri were established to rehabilitate Uttar Pradesh flood victims. There, in July & August 1988, hundreds of people died of cholera, diarrhea, and other waterborne diseases. From Mumbai, I went to there to find the cause of the tragedy. There I saw many poorly-constructed public toilets and pits full with human waste.

Although a large amount of money was allocated for deep tube-wells, shallow tube-wells of about 30 feet were sunk. Apparently clean-looking tube-well water contained germs of cholera, diarrhea, and other waterborne diseases. The water contained pathogens of human feces and urine from toilet pits. The use of that highly contaminated water caused mass deaths.

The Present Plan for 0.8 Billion Rural People:

Most of 0.8 billion rural people and some urban people go out in the open for defecation. India's government's *Swachh Bharat* scheme initiated by the Prime Minister, Mr. Narendra Damodar Modi, aims to make India "Open Defecation-free" by the 2nd of October 2019. It has a plan to build 12 crore rural toilets i.e. 66,000 toilets/day for five years by the 2nd of October 2019 at a cost of ₹1.96 lakh crores (US \$31 billion) i.e. ₹16,000 per toilet. Under this plan, for a toilet in home, first home-owner has to pay ₹900, then central and state governments pay ₹9,000 and ₹3,000 respectively.

It was reported that during an earlier regime there were about 3 crores and 75 lakhs of missing toilets. Those toilets existed in record books, but in reality, no toilets could be found. By simple arithmetic, ₹12,000 x 3.75=₹45,000 crores were unaccounted. *Swachh Bharat* scheme is an ambitious plan, but a vast number of the villagers are opposing it.

Technical Aspect of the Toilet:

Toilet pits are seen below; on the left is from Uttar Pradesh and on the right is from West Bengal. Both are too small and poorly constructed.



- Most of rural people are not accepting the facilities. The reasons are:
1. They are skeptical about defecating in toilets next to their living rooms.
 2. They feel the pit is small and will fill up soon.
 3. Who will empty the pit? 4. Where will the muck be thrown?
 5. In the event of heavy rains, water will enter into the pit. Then the stored muck will overflow the pit and spread over vast areas of homes.
 6. Years later, the pit brick-work may collapse inwardly due to external pressure of the earth during torrential rains. This event may happen anytime.

These are reasonable apprehensions, for which no answers have been provided.

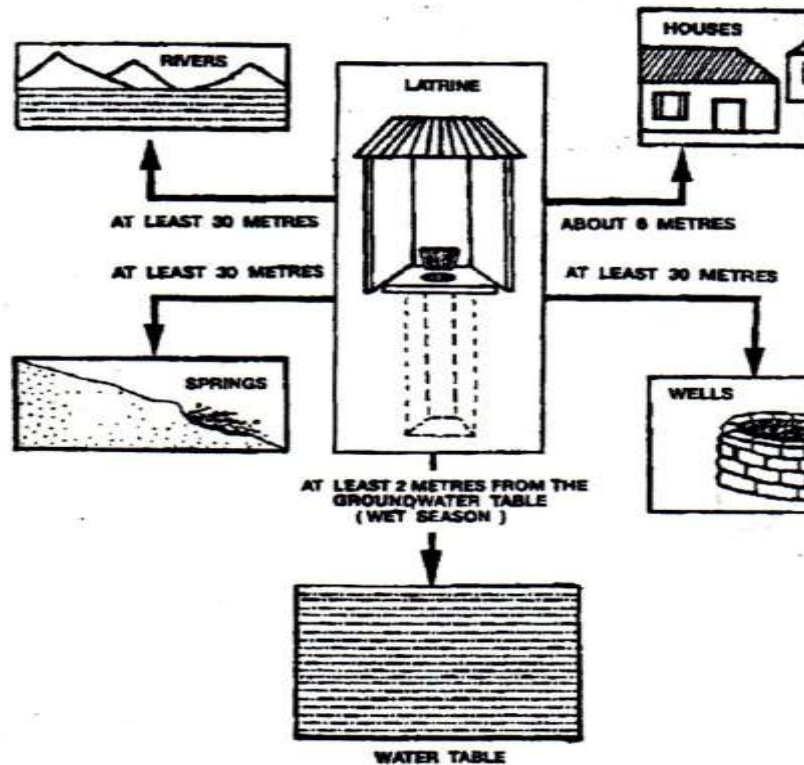
Future Predicament: Consider a situation after 1/10/20 years or more:

If every rural home is provided with a toilet room and a waste pit, and every person is using that facility. In a year, 0.8 billion rural people will produce $(200 \times 365 \times 800) / 1,000 = 58.40$ billion or 5,840 crore kg of feces. The disease-filled pathogens from human waste eventually contaminate underground potable water used for domestic use. Usage of that water will cause many more times of 1988 deaths of Yamuna-par, New Delhi. This scheme will create a havoc in 1/10/20 years from now. Besides this, on surface filth will be enormous.

Alarming Figures:

From the afore-stated paragraph, 5840 crore kg of germ-laden-pathogen-contained human waste would be going inside the earth annually. These numbers will translate into huge figures in the coming years. All this waste will contaminate underground water. What havoc will be caused under those situations? In the event of outbreak of a mass epidemic, our rural healthcare system will not be able to handle the situation. Mass deaths will occur.

The matter should be reconsidered before erecting toilet rooms & pits.



World Health Organization Waste Pit with Surroundings

It is worthwhile to see the World Health Organization drawing above showing distances of rivers, houses, springs, wells, and underground water tables from a toilet. These conditions are not maintainable in our rural areas.

The Solution: The Community Toilets

Two Situations:

There are two separate situations requiring community toilets:

The First Situation:

Where No Sewage & Underground Water Lines Exist:

Under this situation lie vast rural areas with no piped water or underground sewage system. Those areas are where 69% or 80.3 crores rural people live. They need closed toilets to prevent open defecation. For them, I propose community public toilets. The schematic drawing is shown on the next page. These toilets will suit villages, schools, community centres, remotely located areas, and slums. These community toilets will produce fuel gas methane and organic manure. The size will vary according to the number of users.

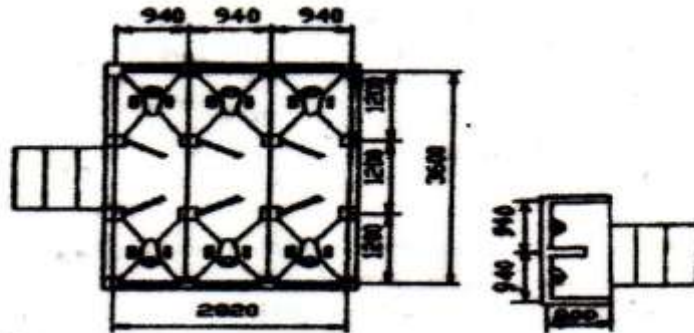
This is Khadi & Village Industry Commission (KVIC), a Central Government Organization design. KVIC be consulted for sizing the toilets along with a digester for producing gas and manure and detailed drawings. I have seen such unit operating in Pimpri near Pune, Maharashtra where a factory of Tata Engineering and Locomotive Co. Ltd. is located. The gas was used in a community kitchen, and manure in marigold flower garden.

Keeping the concept of the scheme, a drawing in page 21 shows two separate six-toilet units for men and women, and A two-urinal unit for men. Women will use their toilets as urinals. A model of a six-toilet unit is shown on page 22. The waste and urine lines are connected to a common line leading to a segmental ferro-concrete digester with a gas holder. All these items are considered as a **single entity**. This system will prevent pathogen-laden waste and urine from going inside the ground and contaminate water therein.

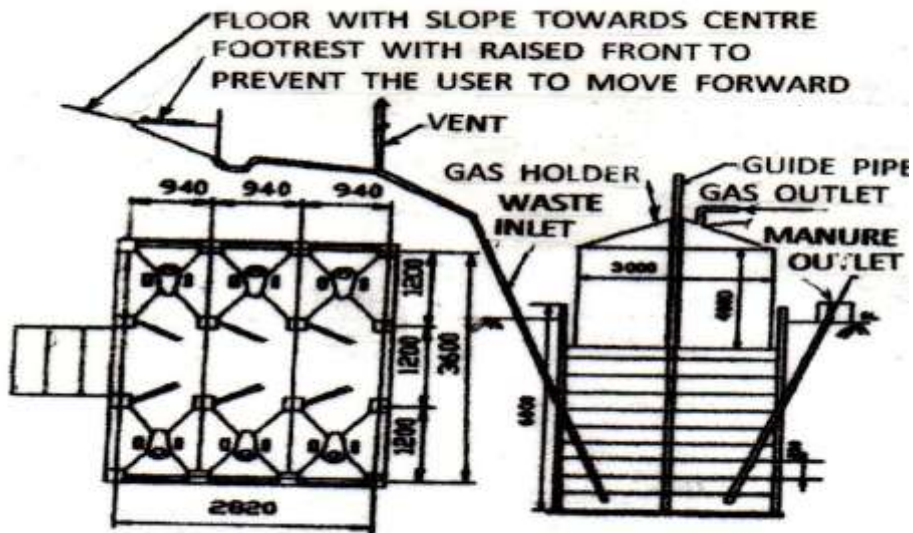
This entity shown in the diagram will serve about 300/400 people. This entity is to be constructed at convenient places in villages, small towns, and slums. This entity can be erected in the nearest municipal land for the slums illegally constructed on railway lands. The population of such slum-dwellers could be several lakhs.

A full-time sweepers should clean the toilets and adjoining areas at least twice a day and maintain the surroundings. Each user will be provided with only one litre of water for cleansing. More water will affect working of the digester. A few cheap common flower plants could be planted in the area.

A place for washing hands is to be provided outside the toilets. These will be free self-sustaining entities. Revenue earned from the sale of gas and manure will offset wages of an attendant-sweeper.



**Six-toilet unit and two-urinal unit for men
Connected to a common waste line (shown below)**



**Six-toilet unit for women Digester and gas holder
Toilet and urinal unit for 300/400 users**

Construction of Six-Toilet Unit:

These toilets can be constructed in traditional brick & mortar or in steel. Steel-constructed toilets will be faster to make, could be mass-produced, and will be cheaper.

Dispelling a Myth:

The belief that gas from human waste cannot be used for cooking has been



Six-Toilet Unit (Roof removed to show interior plan)

belied by the fact that for more than seventy years, over one hundred bio-fuel plants using human and cow waste are operating in Maharashtra alone, and the gas is used for cooking. The unit in Pimpri was supplying fuel gas to a village community cooking room without any objections from the people. I was there when *chapaties* were being prepared.

Utilization of Human Waste:

The waste and urine an adult excretes in a day gets converted in the digester to about one cubic foot of gas, of which about 65% is methane, and semi-solid organic manure. After about thirty days from the start, the unit continuously produces odourless pathogen-free methane and manure. When the tank is full, semi-solid manure keeps on exiting the unit and is dried for agricultural use. During the digestion process, pathogens get mixed with the bubbling gas, which passes to either gas ovens or to gas lamps and gets burned. In this way the excreta and urine is put to use and ecological balance would be maintained.

ii. The Second Situation:

Where Sewage and Water Lines Exist:

In cities and towns where sewage and water systems exist, the current 'Pay-and-Use' urinals and toilet facilities have to be improved and their

numbers increased. I have gone inside many such facilities and found them stinking. I found that some facilities are locked.

What Happens to Human Waste in the U S?

With a population of 6.3 million, the fourth largest city in the USA, Houston has 40 automated sewage treatment plants spread over a wide area.. Solid materials, mostly human waste, are processed as organic fertilizer. The treated clean pathogen-free water is discharged into cemented bayous (canals). Efforts are being made to make that water drinkable.

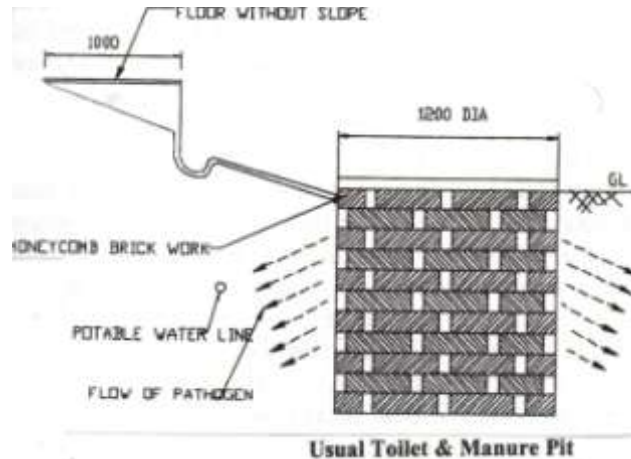
Isolated homes in rural areas have two-stage septic tanks with automatic pathogen-destroying processes. Time-to-time, pathogen-free solid mass is taken away for further processing as organic fertilizer.

What Happens to Mass Human Waste in India?

In West Bengal, 270 crore litres of human waste is poured in the river Ganga daily from adjoining towns. Sewage treatment plants are not functioning. Besides, human waste is collected by municipalities from lakhs of homes and dumped in open land which contaminates underground water. In other states such practices are followed. **Citizens should rise against these serious health concerning practices.**

Wrong Needs to be Stopped:

Under no circumstances should human waste pass into the earth. The perforated walled waste chamber as shown below allows pathogens from



human waste and urine to reach and contaminate underground water. When potable water supply lines are not full, a partial vacuum is created. If lines are cracked, pathogenic liquids would be sucked inside the water lines and would

contaminate the water therein. This contaminated drinking water could lead to cholera, diarrhea, and other waterborne diseases. The use of such toilet systems should be banned immediately.

URINALS

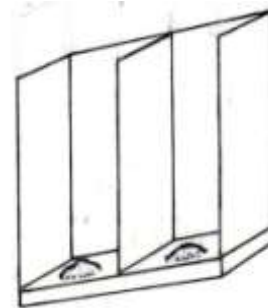
Present Scenario:

Travelling thousands of miles across India, I found only a few public urinals. Most of those are unfit to use. Men are seen urinating along street corners or near garbage dumps. Even women are forced to urinate in the open. Often, people use urinals as toilets.

An Urban Scene:



Garbage attracts urination



Urinals used as toilets

The population density in cities is rising daily, but the civic facilities are not keeping pace with the rise. Additionally, lakhs of people from far away suburbs come to cities for jobs, and for seeking services from banks, hospital, and courts. These people and the local public need urinal and toilet facilities.

Rural Scene:

From time immemorial, men and women have been going outside their homes to urinate. This practice is indecent and unhygienic.

Harms of Urine:

On average, an adult person produces one to one and a half litres of urine per day. A pair of kidneys in the human body excretes harmful toxic wastes as urine. The urine is stored in the bladder and needs to be exited regularly.

Ammonia with a strong disagreeable odor is contained in the urine. It is generally not realized by people that the enormous quantity of urine in the open by crores of people passes into the earth adversely contaminates the underground water therein.

Harms of Holding Urine for Long Times:

Holding urine for a long time is highly uncomfortable and causes mild to excruciating pain. Holding urine for a long time could lead to urine retention, i. e. difficult to urinate which could result bladder infection. The longer the urine stays in a person's bladder, the more the bladder becomes a fertile ground for the bacteria to develop and multiply.

Urologists and nephrologists say that not urinating on time could cause infections in the urinary tract and bladder and may lead to kidney stones or even kidney failures. The working outdoors while drinking less water in order to avoid the urge to urinate causes fatigue and exhaustion. Most affected people are policemen and policewomen and outdoor construction workers.

The Solution: Waterless Urinals

Four Situations:

With high population coupled with wide corruption, poor quality of workmanship and vandalism, it is virtually impossible to come up with an ideal economic urinal. In India, one has to reconcile with a minimum privacy without water and sewage lines. Under these trying circumstances I have considered four situations for public urinals.

The First Situation: Rural Areas with no Sewage and Water Lines:

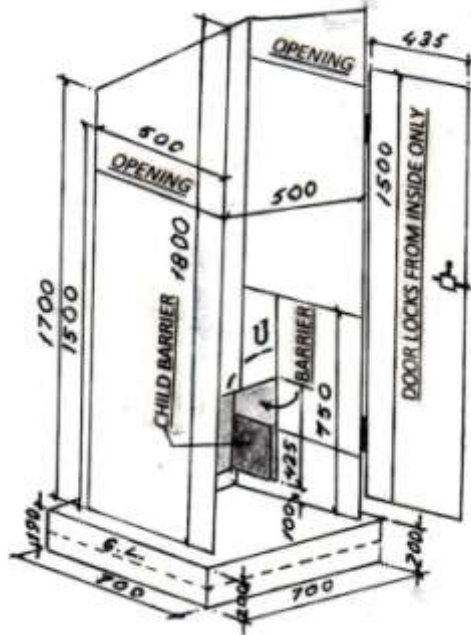
There are vast rural areas where about 83 crores of India's people live. For them, I recommend waterless urinals as shown in page 26. The urinal room and the door are factory-made from steel for quick, lower cost and quality production at an estimated cost of around ₹15,000. Women have use in standing position. Gynecologists warn that women urinating in squatting position in dirty urinals without water facilities can have urinary infections.

The walls and the door are made of segmental small hung cut pieces to prevent it being blown away by severe winds. A model has been shown in page 27. With naphthalene balls, the room could be made stench-free. The area of the room will be 500 mm x 500 mm. The urinating room and barriers are positioned in such a way that a child will not be able to defecate there.

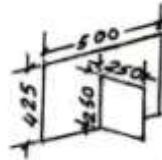
To throw cigarettes and bidi butts or any such small thing, a small swivel-emptying receptacle will be provided inside the room. Also, two brackets will be provided to hang small bags usually carried by men and women.



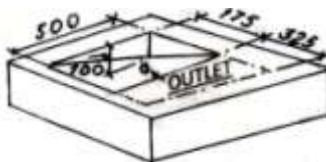
Sun-Dried Urine Pan for Waterless Urinal



Waterless Urinal for Men and Women



Splash Barrier & Child Barrier



Base for Waterless Urinal for Men

Behind the urinal, there will be a glazed-tiled pan with a plastic mesh-covering 100 mm lower than a urinal level will be provided. The urine from urinating room will pass to this tray. The sun's rays will evaporate the urine. Approximately 80% of days in India are sunny. Occasionally the urinal and outside pan will need simple cleaning. Once every three months, thorough cleaning of the urinals will be necessary.



Urinal as Shown in page 26

The design of the urinal room will be such that the door will always remain closed without an outside latch. The door can be bolted from inside only. These urinals will be sited near a cluster of homes, 50 or so, and will be located some distance away from homes in consultation with the '*Village Panchayat*' & home owners. The design is practical, simple, cheap, and could be mass-produced. Villagers have to be educated about use of these urinals.

ii. The Second Situation: For Highways & State Road Travelers:

There are vast stretches of sparsely habituated areas through which interstate roads and state roads pass. For men and women, I propose similar

waterless urinals with all barriers as shown in page 26. Women would have to use these urinals in standing position. These sparsely used urinals could be provided on either sides of roads about one to ten km apart alternately on both sides of the road depending on population density.

iii. The Third Situation:

City Outskirts & Slums where Sewage Systems Exist:

The vast populated city areas adjoining interstate highways and state roads and some slums fall under the third situation. Mostly there exists sewage systems with scant or no water lines. Here I suggest waterless urinals as in the second situation. The sun-dried pan will not be required.

The outlet of the standard pan with a strong replaceable plastic or stainless steel mesh is fitted to the line with a 'U' seal connected to the underground sewage lines. Here, also men and women have to use it in standing position.

These urinals have to be located in the concerned localities every two kilometers alternatively on either side of the roads so people do not have to walk or travel more than one kilometer from wherever they feel the need.

iv. The Fourth Situation:

Inside Cities Where Sewage Systems and Water Lines Exist:

Urinals are badly needed in areas within cities where offices, markets, recreation centers, courts, places of worship, etc. are situated. Maintained well, free urinals attached to usual 'Pay and Use' toilets is to be used.

Pee-buddy:

To facilitate women to urinate in a standing position, a one-time use of a paper device known as 'Pee-buddy' is available in New Delhi and may be in other cities. The cost is not affordable to a vast number of low-income women.

Advantages of Steel (Factory-made) Modular Urinals:

1. Small space requirement. 2. Cheap. 3. Quick installation. 4. Elegant-looking. 5. Quality maintainable.

I have made the manufacturing process simple. The manufacturing can be done by workmen with little training. Thus, large numbers of youths can be employed.

Disadvantages of Bricks and Mortar (Site-constructed) Urinals:

1. Good masons don't like to work in remote areas. 2. Their wages are very high. 3. Theft of cement. 4. Supervision will be lacking. 5. Overall shoddy and delayed construction. 6. No quality control.

Breakage & Theft Prevention:

Vandalism and theft of properties in open places are common in India. In steel-made items, I have provided an adequate number of foundation bolts with extra nuts to secure the room to the ground.

Conclusion:

I feel the need of the hour for an effective waste management, and I have hope on the strength of my plan. I have always pushed through adversities to achieve what was worthwhile. I will continue to do the same even in pursuing my dream of a clean India. Swami Vivekananda's paradigm of "Arise, awake and stop not until the goal is reached" will continue to inspire me as I remain an optimist towards the fulfillment of his goal.

'Swachh Bharat' Scheme:

I offer my services in making Bharat, a *Swachh Desh* (clean country). Since 1979, I have been working voluntarily for garbage solution. Lately, I have been working for toilet and urinal solutions. I welcome P.M. Mr. Narendra Modiji's initiative of **'Swachh Bharat'**.

Central Design Office for Garbage, Toilet & Urinal:

For making India clean a Central Design Office for Garbage, Toilet & Urinal should be created directly under the Prime Minister headed by a mechanical engineer. Waste Management department should be taken out from National Environmental Engineering Research Institute (NEERI), Nagpur & Indian Institute of Science, Bangaluru which are carrying out theoretical work no practical application.

India has to make changes in outdated environmental laws and to make the law makers accountable for their action. Citizens should not be made to suffer for their inaction or wrong action. Citizens should be more vigilant for their own welfare.