

ACHIEVING TOTAL SANITATION IN THIRUVANANTHAPURAM CITY

(Back ground Paper - II)

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Thiruvananthapuram
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Executive summary

This report is prepared as a back ground paper of the project “ River restoration of Kerala: Developing a co-evolutionary framework and river restoration action plan for Thiruvananthapuram city’ undertaken by RULSG, Centre for Development Studies. Objective of this report is to deliberate on status of sanitation in Thiruvananthapuram city and to suggest the strategy that may be followed to achieve total sanitation. The issue of water supply has also been discussed as it is an essential component of sanitation.

Thiruvananthapuram, the capital city of Kerala spreads over an area 215.86 km² and accommodates 9,86,578 persons according to 2011 census. The present water supply scheme is based on the Karamana river. The existing Water Supply Scheme in Thiruvananthapuram city has the capacity to supply 268 MLD in 2010 for meeting the increasing water demand of city and neighboring Panchayaths. However there are problems of quality of water and also supply. The city mostly depends on septic tanks, leach pit etc and only 30% of geographical area is covered with centralized Sewerage System. The methods to clean these septic tanks and dispose of the septage pose serious environmental threat. Thiruvananthapuram Municipal Corporation generates around 450 tonnes of solid wastes per day. Based on sample studies it is estimated that about 72% of MSW reaches the municipal stream, 19% gets disposed off at sources and the rest about 9% of the MSW is being collected by the Rag Pickers for recycling. Households generate major share of solid waste (55.4%), and among the remaining sources bulk contributors are commercial establishment and markets. The treatment plan established at Vilappilsala for treatment of municipal garbage and for production of organic manure has been beset with various problems including public protest. There are various initiatives to treat solid wastes in the city. However, full proof system is yet to be in place.

For achieving total sanitation in Thiruvananthapuram city decentralized interventions are suggested to create facilities for on-site sanitation, network-based sewerage system, septage management, solid waste management and storm water drainage. The policy reorientation is necessary for spreading awareness about sanitation through an integrated city-wide approach, assigning institutional responsibilities with due regard for demand and supply considerations, and according special focus on the women and urban poor.

ACHIEVING TOTAL SANITATION IN THIRUVANANTHAPURAM CITY

1.0 Introduction

The State of Kerala is well known for human development. It has achieved high standards in human health, education, and other parameters for ensuring a good quality of life. However, the State has been facing significant challenges in the area of societal hygiene especially solid and liquid waste management. Due to various reasons, this sector has remained neglected in the past and has now become a matter of great concern for maintaining health, sanitation and good quality of life for the citizens especially in the 'urban' context.

Sanitation as per National Urban Sanitation Policy (Government of India, 2008) is defined as safe management of human excreta, including its safe confinement, treatment, and disposal and associated hygiene-related practices. The Kerala recognizes the need to integrate solutions that cover sub sectors of supply of drinking water, waste water management (including septage), solid waste management and storm water drainage. The strategy has to be evolved for capacity enhancement, finance, technology, inclusiveness, climate change responsiveness, institution building and strengthening of governance.

Sanitation is intrinsically linked to conditions and processes related to public health and quality of environment, especially the systems that supply water and deal with human wastes. The problem of sanitation is further worsened in urban areas due to increasing congestion and population density resulting in poor environmental and health outcomes. As per 2011 Census, only 81.4% of households in Kerala have latrine facilities within premises, which includes 72.6% households having water closets, 7.1% households having pit latrines and 1.7% households using other types of latrines. Out of 72.6% households with water closet facilities, 32.7% households are linked to piped sewer system and the rest of the households use pit latrines. The remaining 18.6% household are sharing public latrines (6%) and defecate in open (12.60%).

To improve the sanitation situation in urban areas, in October 2008, the Government of India announced the "National Urban Sanitation Policy" (NUSP) which laid down the framework for addressing challenges of city sanitation. The policy emphasizes on the need

for spreading awareness about sanitation through an integrated city-wide approach, assigning institutional responsibilities considering demand and supply and according special focus on the women and urban poor. Government of Kerala (2006) prepared sanitation strategy following the national policy.

As per the NSUP it is necessary to understand the present problems and future requirements in the following areas for achieving total sanitation in Thiruvananthapuram city:

- On-site Sanitation Facilities
- Network-based Sewerage System
- Septage Management Facilities
- Solid Waste Management System
- Storm Water Drainage System

This report is prepared as part of the commission study for the project “River Restoration in Kerala: Developing a Co-Evolutionary Framework and River Restoration Action Plan for Trivandrum City” undertaken by RULSG, CDS

2.0 Contextualizing the Problem of Sanitation

2.1 Drinking Water Supply

Thiruvananthapuram, the capital city of Kerala spreads over an area 215.86 km² and accommodates 9,86,578 persons according to 2011 census. Population density is 4589 persons/km² well above the state average of 860 persons/km². The city houses an IT hub of the state (TECHNOPARK) from where over 80% of the state's software exports are taking place. There are many Central and State Government offices. Apart from being the political nerve center of Kerala, the city possess a number of academic institutions of national importance, and several educational, science & technology institutions, and health care institutions. All these together make Thiruvananthapuram city, the most prominent place in the Kerala state.

Drinking water for Thiruvananthapuram city and its suburbs is drawn from the Karamana, river by impounding two reservoirs, one at Aruvikkara, the first reservoir and another at Peppara. There are also sub urban water supply schemes making use of the pumping stations at Kundamankadavu, Adimadakkayam and Trikkannapuram along the course of river

Karamana. The Water Supply Scheme in Thiruvananthapuram city was established as early as in 1931 with an installed capacity of 20 MLD (Million Liters per Day) with gravity flow of water from Aruvikkara dam. Later the scheme was augmented to 36 MLD in 1962 by introducing pumping systems instead of gravity flow from Aruvikkara Dam with a minimum treatment facility of pre settling tank. Since the storage capacity of Aruvikkara was as low as 2 Mm³, a new dam was constructed at Peppara, 45kms away from Thiruvananthapuram in the year 1983 with a capacity of 70 Mm³ (at present 40Mm³ only). Water is let out from the Peppara dam through the river course to Aruvikkara reservoir as and when required.

Raw Water for the 36 MLD Water Treatment Plant at Vellayambalam is conveyed from Aruvikkara reservoir. The treatment unit there is one pre settling tank. This was the first Water Treatment Plant. The city was divided into three zones, and three reservoirs were constructed, one each at Peroorkada, Thirumala and Observatory hills. The treated water transmitted from Aruvikkara was distributed through these three reservoirs to respective zones and from the reservoirs at Water Works compound to Low level zone.

The Water Supply Scheme in Thiruvananthapuram city was further increased to 84 MLD in 1972, 108 MLD in 1988, 194 MLD in 1998 and 268 MLD in 2010 for meeting the increasing water demand of city and neighboring Panchayaths. At Aruvikkara, there is one old Conventional Water Treatment Plant, known as Chithira Kunnu Plant, with treatment capacity of 86 MLD, established during the year 1998. Water from 86 MLD Water Treatment Plant at Aruvikkara is conveyed to reservoirs at Observatory, Vellayambalam and Thirumala.

The Water Treatment Plant at Aruvikkara is the oldest treatment plant in Kerala and has pH correction facility by addition of lime, clariflocculator for removal of turbidity by adding Alum as coagulant, filter bed for bringing down the turbidity level within 1-5 NTU and disinfection unit by adding chlorine. The older plant at Aruvikkara has treatment capacity of 72 MLD. Along with these additional reservoirs were also constructed at Peroorkada, Vellayambalam, Manvila and Layola. So, water from 72 MLD Aruvikkara Water Treatment Plant is conveyed to Peroorkada and Layola reservoirs

A new technology plant was established at Aruvikkara in 2010 under Japan Assistance (JICA Scheme) with a treatment capacity of 74 MLD. It caters to the reservoirs at Nettayam, Malamukal, Thirumala, Attukal and Nellyyodu. Treatment units under this modern plant comprises of pH correction, pulsating clarifier, filter bed and chlorination unit. Treated water

of about 160 MLD from the conventional old plant as well as the new JICA plant is pumped to PTP Nagar water storage tank through separate lines. Water is supplied to various parts of city from this combined storage.

In brief, water produced at treatment plants in Aruvikkara is conveyed to various reservoirs located at different places in the city. Water to the city is distributed by dividing the entire area into various zones. Each of these zones gets water from a particular reservoir. The major zones in the Trivandrum Water Supply Scheme (TWSS) are Observatory zone, Peroorkada zone, Low level zone, Thirumala zone, Manvila zone etc. One of the major zones of distribution to Thiruvananthapuram City is Peroorkada zone which is fed from Peroorkada service reservoir. This reservoir supplies water to areas like Kowdiar, Ambalamukku, Sasthamangalam, Peroorkada, Kudappanakunnu, Vayalikota, Muttada, Kesavadapuram, Medical college, Prasanth Nagar, Ulloor, Pongumoodu, Pulayanarkotta, Akkulam, Murinjapalam, Kumarapuram, Pattom, Marappalam, Kuravankonam, Rajbhavan, Jawahar Nagar, Dewaswom Board, Cliff House, Mannanthala, Nalanchira, Parottukonam, Paruthippara etc. At present parts of the Panchayats of Sreekariyam, Vattiyoorkavu and Kudappannakunnu are brought into the distribution zones catering to the Corporatopn area. Water in the Panchayat area is supplied from the Central zone and Peroorkada zone.

The Nemom Water Supply Scheme taken up to cater Nemom area is served by a Pumping Station at Thrikkannapuram. It has only chlorination facility and there is no other treatment facility. Therefore, during rainy season, when turbidity of water is very high there is a possibility that the quality of water is affected. Samples of intake water and chlorinated water supplied to different areas from this Pump House were collected and analysed from time to time.

The samples of raw as well as treated water from all treatment plants of TWSS and water supplied (tap water) to different places of Thiruvananthapuram city are collected and analysed in District Laboratory of Kerala State Pollution Control Board (KSPCB) for physical, chemical and biological parameters. Compilation of analytical results reveals that iron content and turbidity exceeds the prescribed limit in the sub urban water supply schemes.

2.2. Sewage Management

Kerala records good sanitary latrine facilities with more than 90% of households enjoying the service. Since 1991, coverage increased significantly (Table 1). This was possible due to a well organized programme undertaken by the Government and allocation of necessary funds.

Table 1 Access to Sanitation Facilities in Kerala

| Segment\ Time line | 1991 | 1995 | 2001 | 2005 |
|-----------------------------------|------|------|------|------|
| Rural households with toilets (%) | 44 | 73.4 | 81.3 | 94.9 |
| Urban households with toilets (%) | 73 | 90.0 | 92.0 | 98.3 |

In Kerala, coverage of sewerage facilities, even in the City Corporations, is extremely low. Even in the capital city of Thiruvananthapuram, about 30% of geographical area is covered with Sewerage System (KSUDP, 2009). In Kochi Corporation, Sewerage system caters only 5% of area, this is probably one of the lowest in the Country. Rest of the cities and towns in Kerala do not have any sewerage facilities.

In Thiruvananthapuram city, the sewerage network is available only in 5 blocks out of 18 sewerage blocks covering the city. The Thiruvananthapuram sewerage scheme covers the old city having an area of 74.93 sq km covering A,B,C,D,E,F ,and G Blocks. Under ADB scheme works to lay sewerage network are going on in the F & G Blocks. On completion of this scheme 45 % of city area is expected to be covered. In brief, now in Thiruvananthapuram city, 70 % area depends on on-site treatment of sewage. Even though a Sewage treatment plant of 107 MLD is constructed and operating at Muttathara from November, 2013 onwards, only 30 to 40 MLD of sewage is reaching this plant every day. Remaining areas continue to depend on on-site treatment facilities such as septic tanks, leach pits etc. Therefore, there is an immediate necessity for treating the septage collected from septic tanks and leach pits. The practice now is to collect the septage using vacuum suction into tankers which are then emptied into open spaces and even into water bodies, one of the most dangerous practices contributing to water pollution.

2.3 Municipal Solid Waste Management

The study on Municipal Solid Waste Management has been done in Kerala by Socio Economic Unit Foundation (SEUF, 2006), an NGO for the Government of Kerala, sponsored by the Water and Sanitation Programme (WSP) - South Asia, during the year 2006. The study has indicated that the total solid waste generation in the State is about 8300 tonnes per day. Around 70-80% of the waste generated is biodegradable in nature and these putrescible waste needs to be managed within 24 hours. The study also brings out that of the total wastes in the State, 13% is generated by the five City Corporations, 23% by the 53 Municipalities and the

rest 64% come from 999 Gram Panchayats. Details of the solid waste generated in the State are given in Table 2.

Table 2 Municipal Solid Waste Generation in Kerala

| Local Governments | Population (Census 2001) | Per capita waste generation in gm | Waste generation per day in tonne (2006) |
|--------------------------|-------------------------------------|--|---|
| 5 City Corporations | 2456618 | 400 | 1091 |
| 53 Municipalities | 5810307 | 300 | 1935 |
| 999 Grama Panchayats | 23574449 | 200 | 5312 |
| Total | | | 8338 |

Thiruvananthapuram Municipal Corporation (TMC), will cross 1 million population size by the year 2021 (Table 3). Accordingly, the waste generation will increase, however, nature of waste will change due to change in living habit of people and also technology. The waste stream will also change.

Table 3 Decadal Population and Projected Population of Thiruvananthapuram Municipal Corporation

| Year | 1981 | 1991 | 2001 | 2011 | 2021 | 2031 |
|---------------------------|--------|--------|--------|--------|---------|---------|
| Population | 781592 | 885483 | 955494 | 986578 | 1018642 | 1032292 |
| Rate of growth | - | 13.29 | 7.91 | 3.25 | 1.34 | 0.55 |

Waste generation based on projected population from 100 wards of Thiruvananthapuram Municipal Corporation will be around 450 tonne per day (tpd). However, it emerged from the studies, so far undertaken in the city that the entire waste generated at various sources will not reach the municipal stream as some portion of waste gets disposed and treated at the source itself, and the Rag Pickers collect some of the wastes for recycling industry. Prior to 2011, the waste that reached the municipal stream was mainly from the markets and public places distributed in the erstwhile 50 wards covering municipal corporation boundary. Based on sample studies it is estimated that about 325 tpd (72%) of MSW reaches the municipal stream, 85 tpd (19%) gets disposed off at sources and the rest about 40 tpd (9%) of the MSW is being collected by the Rag Pickers for recycling. The various sources of MSW that reached the municipal stream and the quantity generated at different sources are given in Table 4.

Physical composition of the MSW by weight that reaches the municipal stream has been worked out based on sample survey. Details about the composition and their occurrence in selected locations are provided in Tables 5 and 6. Chemical characteristic of the MSW that reaches the municipal stream based on sample studies is given in Table 7.

Table 4 Sources of Municipal Solid Waste and Their Respective Contribution in Total Municipal Solid Waste in Thiruvananthapuram Municipal Corporation

| Sl. No. | Source of MSW | Contribution (%) | Quantity (tpd) |
|---------|---------------------------|------------------|----------------|
| 1 | Domestic/Households | 55.4 | 180.05 |
| 2 | Street sweepings | 18.9 | 61.43 |
| 3 | Commercial establishments | 8.1 | 26.33 |
| 4 | Hotels & Restaurant | 2.2 | 7.15 |
| 5 | Markets | 6.1 | 19.83 |
| 6 | Hospitals | 3.8 | 12.35 |
| 7 | Schools & Institutions | 1.4 | 4.55 |
| 8 | Museum & Zoo | 1.2 | 3.9 |
| 9 | Slaughter houses | 1 | 3.25 |
| 10 | Marriage halls | 0.6 | 1.95 |
| 11 | Lodges | 0.3 | 0.98 |
| 12 | Temples | 0.2 | 0.65 |
| 13 | Construction | 1 | 3.25 |
| | Total | 100 | 325 |

Table 5. Physical Composition of Municipal Solid Wastes in Thiruvananthapuram Municipal Corporation

| Sl. No. | Physical composition | Contribution (%) | Quantity (tpd) |
|---------|--------------------------|------------------|----------------|
| 1 | Compostable organics | 80.65 | 262.10 |
| 2 | Paper | 4.78 | 15.54 |
| 3 | Plastics | 4.33 | 14.07 |
| 4 | Metals | 0.83 | 2.70 |
| 5 | Glass | 129 | 4.18 |
| 6 | Rubber & Leather | 1.51 | 4.92 |
| 7 | Inerts, Ash & fine earth | 6.06 | 19.70 |
| 8 | Domestic hazardous | 0.55 | 1.79 |
| | Total | 100.00 | 325.00 |

Table 6. Physical Composition of Municipal Solid Wastes at selected locations in Thiruvananthapuram Municipal Corporation (in per cent)

| Sl. No. | Physical composition | Households | Business establishment & Institutions | Hospitals |
|---------|----------------------|------------|---------------------------------------|------------|
| 1 | Organic waste | 51.5 | 41.3 | 39.4 |
| 2 | Paper | 10 | 11.2 | 16.4 |
| 3 | Glass | 1.63 | 3.4 | 14.1 |
| 4 | Textile | 2.68 | 2.2 | 10 |
| 5 | Plastic | 5.56 | 10.7 | 9.1 |
| 6 | Wood | 1.38 | 0.7 | 0.1 |
| 7 | Metal | 1.75 | 2.8 | 1.3 |
| 8 | Ash | 4.57 | 2.6 | 1 |
| 9 | Sand | 12.84 | 7.9 | 3 |
| 10 | Miscellaneous | 8.02 | 9 | 5.5 |
| | Total | 100 | 100 | 100 |

Table 7. Chemical Characteristics of Municipal Solid Waste in Thiruvananthapuram Municipal Corporation

| Sl. No. | Density (Kg/m ³) | Moisture (%) | Calorific Value (K.Cal/kg) | PH | C (%) | N (%) | C/N | P as P ₂ O ₃ (%) |
|---------|------------------------------|--------------|----------------------------|------|-------|-------|-------|--|
| 1 | 204.8 | 74.1 | 1698 | 7.57 | 25.74 | 0.98 | 26.27 | 573.2 |

It emerges from Table 4 that households generate major share of solid waste (55.4%), and among the remaining sources bulk contributors are commercial establishment and markets. There is one main market (Chalai), four sub-markets (Manacaud, Palayam, Vizhinjam and World Market), seven zonal markets, forty-six local markets and four road side markets (Table 8). Four markets at Sreekaryam, Kazhakoottam, Kanjirampara and Palayam have waste management facility.

Table 8: Type of Markets and Their Locations

| Market type | Locations |
|------------------|--|
| Main market | Chalai |
| Sub-market | Manacaud, Palayam, Vizhinjam and World Market |
| Zonal market | Kazhakoottam, Pangode, Peroorkada, Pettah, Poojappura, Thirumala and Vattiyoorkavu |
| Local market | Aniyoor, Balanagar, Chandavila, Chengottukonam, Cheruvaykkal, Kalippankulam-Kuthukallinmoodu, Kanjirampara, Karamana, Karaykkamandapam, Kattaikkonam, Kizhakkumkara, Koliyoor, Kulathoor, Kumarichantha, Kunnapuzha, Kuravankonam, Mannanthala, Manvila, Maruthankuzhi, Mudavanmugal, NS Depot, Nalachira, Nandankode Jn, Cheruvaykkal UPS, Nettayam, Oolamkuzhy-Nadakkavu, Pachalloor, Panathura, Pappanamcode, Parappachan Vila, Paundukadavu, Perunnelli, Poonthura, Paudikonam, Prasanth Nagar, Pulayanarkotta, Puthen road jn., Sree Chithra Nagar, Sreekaryam, Sreevaraham, Therakam, Thycaud, Ulloor, Valiyathura, Vettucaud and Vetturoad) |
| Road side market | Ilipod, Kaithamukku, Kanjirampara and Chengachoola |

Vilappilsala Plant

The TMC (Thiruvananthapuram Municipal Corporation) was transporting about 220 to 240 tpd of Municipal Solid Waste (MSW) to Vilappilsala. M/s. Poabs Envirotech Pvt Ltd., had established a treatment plant for treatment of municipal garbage and for production of organic manure @ 60 t/day at Vilappil village situated in Vilappilsala Grama Panchayat in the outskirts of Thiruvananthapuram city. The plant was initially started with 12.5 acres of land area, which subsequently extended to 46 acres of land. Windrow Composting Technology is used for processing the Municipal Solid Waste. The processing activities in the plant were carried out in an area with roof for rain protection and concrete flooring. The TMC had entered into a contract with a private entrepreneur for establishing a Windrow Compost Plant during the year 2000 and applied to the Board for the Authorisation.

The process consisted of inoculum spray on the wastes to accelerate biological degradation, turning windrows every 5 days for aeration and keeping waste in the yard for 15 days. Following which it was transferred to the sieving area and after sieving it was allowed to mature. The matured product was finally sieved and packed as manure. Once the compost was made there were spoils/ rejects of about 30% to 40 % from the plant, which was dumped within the compound of compost plant since there was no sanitary landfill facility.

There were three ordinary landfill (dumping grounds) sites in this compound. Of these the oldest landfill, located to the west of the processing plant was capped with HDPE liner and soil for which, authorization was issued by the Board. The area of the capped landfill area comes to about 3150 m². The capping work was completed during the year 2006-2007. The Second landfill located in the south-eastern part of the processing plant is yet to be capped. Action had been initiated by the Corporation to move this waste to the sanitary landfill proposed to be constructed at the site utilizing JNNURM Funds. Now the second dump is covered with soil and there is no chance to generate leachate (waste water) and reach to the Meenampally thodu, since the site is away from the source point of the thodu. The third landfill of 3000 m² area used for disposing non-biodegradable waste and rejects from the processing plant is situated adjacent to the capped area. Leachate was generated from landfills. The Thiruvananthapuram Municipal Corporation had not provided permanent leachate treatment facility as part of existing solid waste processing plant. Leachate was collected in temporary ponds and was disposed after addition of alum, lime and bleaching powder. These temporary measures were inadequate. As a result, the leachates frequently

flowed into the nearby stream and reached the Karamana river through Meenampally thode and caused river water pollution. This had created several problems and there were demands to close down the plant. Subsequently, the plant stopped operation. As there was no fresh waste added, the leachate generation reduced to a great extent. The TMC had initiated action for construction of Leachate Treatment Plant under JNNURM Project, however, the plant is yet to be operational.

Due to public protest transport of municipal solid waste to the processing plant was stopped since November 2011. The Corporation is now (as of July 2015) concentrating on decentralized and source level treatment of solid wastes. It had also established 127 Aerobic Compost Units at various places in the city for treatment of Municipal Solid wastes. As part of decentralized waste management, large size community level biogas plants (6 nos) have been set up in various markets. There is also a proposal to set up Aerobic Compost Unit (OWC) at 19 centers. Pipe composting units (78, 585 Nos) and various types of composting units including portable models of biogas plants (1074 Nos) are also being encouraged at household level. Increased subsidy to the tune of 90% for different type of compost units and 75% subsidy for biogas plants are being given for promoting source level treatment of solid wastes generated at households.

All these measures have helped to bring down quantity of municipal solid waste to be treated in the Vilappilsala Plant, significantly. Source level treatment of biodegradable waste at households and institutions including decentralized waste management at various places with active involvement of public has helped considerably in reducing quantity of waste. Plastic and e-waste are being collected and handed over to recycling units. Environmental problems cropped up due to operation of Vilappilsala Solid Waste Processing Plant have reduced to a great extent as solid waste transfer to the plant from the city stopped since November 2011.

Due to prolonged storage of solid waste at the compound of compost plant for about 3 ½ years' period in the Capped site at Vilappilsala biodegradation of waste is seen almost completed. The Board collected water samples from different places to test quality of water flowing through the areas just outside the capped site, water flowing through the drain, and near the boundary of Vilappilsala solid waste Processing Plant. The test reveals that water quality in this area conforms to standards prescribed for treated leachate under the Municipal Solid Waste (Management and Handling) Rules, 2000.

2.3.1 Plastic Waste Management

An important component of Municipal Solid Waste is plastic waste. Since plastic materials do not undergo degradation easily, the most effective method of managing these materials is to restrict the use of such materials, collect the used plastic carry bags and utilize it for reuse/recycle. Several efforts have been taken up in the State for restricting use of plastic carry bags but success rate is very low. Dumping of used carry bags in open places, water bodies and drains is common. Lack of people's habit to keep segregated storage and collection of segregated plastic carry bags by concerned local body including Thiruvananthapuram city are major concern. Realizing this, the Government has banned production, transportation, storage, sale and usage of plastic carry bags (20 cm x 30 cm size) of thickness below 30 microns, from 1 September, 2007. The Government has also attempted to bring in a ban on plastic carry bags of thickness up to 50 microns, but, had to give it up owing to a stay from the Hon'ble High Court of Kerala.

During the year 2011 the Plastic Waste (Management and Handling) Rules as per the Environment (Protection) Act came into force. According to this rule the ban on the plastic carry bags of less than 40 microns thickness should be implemented strongly. The LSGIs including Thiruvananthapuram Municipal Corporation are keen on taking action against the defaulters. Attempt is made for segregated collection of plastic carry bags at source of generation itself.

3.0 Critical Appraisal of Initiatives Taken so far

3.1. Drinking Water Supply

Water produced at treatment plants in Aruvikkara is conveyed to various reservoirs located at different places in the city. The quality of water in this sector is found conforming to drinking water standards, in general. Samples of intake water and chlorinated water supplying to different areas from this Pump House was collected and analysed. Most of these water samples are found to conform to the general parameters of Bureau of Indian Standards (BIS standards) for drinking water. There is problem with respect to pH for a couple of samples. The bacteriological analysis indicated that there is no contamination with Coliform Bacteria, and the values are well within limit in most of places. It indicates that the disinfection of water is efficient and the standard value of Residual Chlorine of 0.2 mg/L is maintained at all places.

Even though the water quality is maintained during the non monsoon period, during rainy season there is a problem due to very high turbidity level (as high as 150 NTU) in the river water. It is difficult to maintain the allowable turbidity level of 1 NTU after treatment, especially at the sub urban areas where there is no treatment facility particularly at Kundamon Kadavu and Trikkannapuram (Nemom Water Supply Scheme) Pump Houses. This also may increase visible colour of treated water.

3.2 Sewage Management

The coverage of sewage facilities, even in the City Corporation, is extremely low- only catering to 30% of area in Thiruvananthapuram city. Due to land constraints the septic tanks have volume constraints and due to high water table scenario, leach pits overflow, especially during rainy seasons, which sometimes extend up to 150 days in a year. Therefore, there is a requirement of clearance and removal of septage, the facilities for which are not available at present. Therefore, there is an immediate necessity of installing sewage treatment plants, at least for treating the septage collected from septic tanks and leach pits. The technical details are being worked out. Models are to be set up in the state for the purpose.

On site sanitation system for disposal of human excreta consists of leach pit or septic tank and soak pit. Septic tank is basically a settling tank and sludge accumulated at the bottom of the septic tank is anaerobically digested. Sludge which is not biologically degradable accumulates at the bottom of the septic tank. According to the norms specified by the Bureau of Indian Standards (BIS), sludge from the septic tank is to be cleared once in 2 or 3 years depending on size of the tank. Periodicity may vary according to the working efficiency of the plant. However cleaning of septic tank is essential.

At present around 96% of households in Kerala possess toilets at their premises. As most of toilets are connected to septic tanks, periodic emptying of septic tanks is essential, which is not attended regularly. Moreover, the Vacuum Sucker, a pump and tanker fitted on a truck / tractor is used to draw septage from the septic tank in Thiruvanthapuram City. People avail this facility for cleaning their septic tanks against payment. As facilities for treatment of septage are yet to be installed in Thiruvananthapuram, the Vacuum Suckers discharge the sludge in the water bodies and open places, which have serious negative environmental impacts. If the septage is not safely disposed of, and is dumped into open streams/rivers, paddy fields and other areas, contamination of drinking water sources is possible. This draws regular media attention, especially in Kochi Corporation area.

Thiruvananthapuram city needs to formulate its own sanitation strategy in overall conformity to the National Policy. About 300 m³/day of septage is generated in Trivandrum district from onsite sanitation facilities, which can be treated along with sewage at Muttathara, if proper mixing arrangements are made in the plant. Considering all the issues of technical, financial and social dimensions it may be a challenging task to cover the entire city by a single system. Therefore a variety of options, site and technology specific, might have to be considered to accomplish the task.

3.3 Municipal Solid Waste Management

Solid Waste Management is a mandatory responsibility of Local Self Government Institutions as per the provisions of the Kerala Municipality Act 1994, Kerala Panchayat Raj Act 1994 and the Municipal Solid Waste (Management & Handling) Rules, 2000 notified under the Environment (Protection) Act. In order to make the waste management system more effective, the Municipal Solid Waste Rules have been implemented. This necessitated introduction of Integrated Solid Waste Management System (ISWMS) comprising of segregated storage of waste at source, primary or secondary collection system, street sweeping, regulated transportation, processing and disposal of rejects through engineered landfills. According to the provisions under the legislations, the Thiruvananthapuram Municipal Corporation (TMC) has been assigned with the mandatory responsibility to provide basic infrastructure for collection, conveyance, treatment and disposal of Municipal Solid Waste. TMC is also responsible for operation and maintenance of such facilities. The District Collector is vested with the responsibility of overall co-ordination of solid waste management activities undertaken by the TMC as per the MSW Rules. This essentially brings the State Government as the final authority for coordinating and assisting the TMC for implementing the MSW Rules. Implementation of the Municipal Solid Waste (Management & Handling) Rule, 2000 has significant importance. It envisages segregated storage of waste at source, collection from source, protected transportation to the treatment facility, establishment of environmentally safe treatment system and its operation and maintenance and safe disposal of inert rejects.

Strategy involved for waste management from the year 2010 onwards follows a three pronged approach: (i) Up gradation of existing common treatment facilities using traditional technologies; (ii) Establishment of modern waste to energy treatment plants; and (iii) Increased subsidy for encouraging source level treatment of solid waste at household level from 50% to the tune of 90% for composting (75% by Suchitwa Mission, and 15% by local

body), and 75% for biogas plants (50% by Suchitwa Mission and 25% by local body) from the year 2011 onwards.

Considering the public protest and lack of common treatment and disposal facility for Municipal Solid waste for the capital city, a policy decision needs to be taken for promoting source level treatment in a big way at the same time a number of common facilities need be developed for managing non degradable waste.

4.0 SUGGESTED APPROACH: TECHNICAL AND MANAGERIAL

4.1 Human Excreta Disposal

There is need for providing individual / common Toilets in colonies / areas of low income group for ensuring the city free from open defecation. The city area should be made safe for living and for achieving cent percent sanitation the following areas should be covered:

- City must be open defecation free
- Must eliminate the practice of manual scavenging
- Municipal wastewater and storm water drainage must be safely managed
- Recycle and reuse of treated wastewater for non-potable applications should be implemented wherever possible
- Services to the poor and systems for sustaining results
- Improved public health outcomes and environmental standards

In order to achieve the goal of Open Defecation Free City the following activities shall be undertaken:

- Promoting access to households with safe sanitation facilities (including proper disposal arrangements);
- Promoting community-planned and managed toilets wherever necessary, for groups of households who have constraints of space, tenure or economic problems in gaining access to individual facilities;
- Adequate availability and 100 % upkeep and management of Public Sanitation facilities in all Urban Areas,
- Integrated City-Wide Sanitation

Treatment and environmentally safe disposal of human excreta and liquid wastes from all sanitation units including toilets is a major challenge for achieving total sanitation and clean city. In order to achieve this goal, the following activities shall be undertaken:

- Promoting / encouraging safe and properly constructed on-site sanitation arrangements wherever it is cost efficient and sustainable;
- In case of network-based sewerage systems, adequate connectivity of households and demonstrated financial viability for Operation & Maintenance would be required to ensure sustainability and proper functioning of the system;
- Promoting proper disposal system and treatment of sludge from on-site installations (septic tanks, pit latrines etc.);
- Ensuring that all the human wastes are collected safely, confined and disposed-off after treatment so as not to cause any hazard to public health or the environment;
- Promoting recycle and reuse of treated waste water for non-potable applications wherever possible.
- Promotion of proper collection, segregation, transportation, treatment and disposal of solid waste.

4.1.1 Enhanced Awareness and Sustained Behavioral Change

The overall goal is to transform urban areas of the city into community driven, totally sanitized, healthy and livable cities and towns. The specific goals are:

- Generating awareness about sanitation and its linkages with public and environmental health amongst communities and institutions;
- Promoting mechanisms to bring about and sustain behavioural changes aimed at adoption of healthy sanitation practices;
- Re-orienting Institutions and mainstreaming Sanitation
- Mainstream thinking, planning and implementing measures related to sanitation in all sectors and departmental domains as a cross-cutting issue, especially in all urban management endeavours;
- Strengthening national, state, city and local institutions (public, private and community) to accord priority to sanitation provision, including planning, implementation and operation and maintenance management and

- Extending access to proper sanitation facilities for poor communities and other unserved settlements.

4.2 Sewage Management

Proper Operation and Maintenance of all Sanitary Installations shall be done and following action shall be taken:

- Promoting proper usage, regular upkeep and maintenance of household, community and public sanitation facilities;
- Strengthening ULBs to provide or cause to provide, sustainable sanitation services delivery;
- Stoppage of discharging waste water from households to storm water drains
- Stoppage of overflow from septic tank to storm water drains/ water bodies
- Stoppage of overflow from sewage pumping stations in to surface water bodies

Improved institutional governance and enhanced human resource capacities for city-wide sanitation role, clarity for guidance and advisory at State level are required. There is also need for regulatory function at the State level and implementation and operational functions at the city level.

4.2.1 Re-Orienting Institutions and Mainstreaming Sanitation

It is necessary to reorient institutions and mainstream sanitation programme along with other departmental activities and planning. It is important to devise implementing measures related to sanitation in all sectors and departmental domains as a cross-cutting issue, especially in all urban management endeavors. State, city and local institutions (public, private and community) to accord priority to sanitation provision, including planning, implementation and Operation and Maintenance management may be strengthened.

4.3. Municipal Solid Waste Management

Decentralized and source level treatment of Municipal solid waste is necessary to overcome the problem of solid waste management in different parts of Thiruvananthapuram city. At the same time a common plant is also required for meeting the total requirement of the city. This is necessary to manage part of the biodegradable wastes which cannot be managed at source or by decentralized systems. A small size centralized waste management system may be helpful. It is also required to arrange collection of non-degradable waste like plastics, glass wastes, e- waste and other non-biodegradable wastes in order to expedite the process of source level treatment of waste. Indigenous technologies including pipe composting, pot composting, bucket composting, bio-bin composting, pedestal composting, vermi composting, ring composting and biogas plants shall be promoted to cover all aspects of solid waste management covering the entire city.

5.0 Conclusion

The deliberations in this paper is limited to four items, namely, (i) drinking water supply, (ii) sewage including human excreta management, (iii) solid waste management and (iv) storm water drainage. The issues that warrant due focus under each of these four items for converting the capital city in to a totally sanitized city are as follows:

- Establishing Water Treatment Plants for the Sub urban water supply schemes.
- Establishing Iron removal facilities in the existing Water Treatment Plants.
- Promotion of reuse/ recycle of treated grey water from institutions, hotels and common STP for construction / gardening purposes.
- Ensuring safe collection of human excreta, treatment at source or in the common facility so as not to cause any hazard to public health or the environment.
- Providing safe sanitation facilities to achieve the target of Open Defecation Free City. Move towards a situation where all urban dwellers have access to and use safe and hygienic sanitation facilities and arrangements so that no one defecates in the open. Achieving Open Defecation Free City, toilet coverage in the following areas is required.

- Household
 - Institution
 - Community and
 - Shared facilities for families
- Promoting community-planned and managed toilets in slums and underserved areas and wherever necessary, for groups of households who have constraints of space, tenure or economic problem in gaining access to individual facilities;
- Providing adequate availability, total upkeep and management of Public Sanitation facilities for migrant and floating population and community toilets for urban poor in all urban areas.
- Provide public sanitation facilities with hygienic upkeep in the following areas:
 - Commercial area
 - Industrial area
 - Office area
 - Institution area
 - Service centers
- Ensuring improved Institutional governance and enhanced human resource capacities. Building and strengthening of human resources in the field of sanitation
- Re-Orienting Institutions and mainstreaming sanitation especially in all urban management endeavors;
- Provisioning financially sustainable sanitation services delivery.
- Proper Operation & Maintenance of all Sanitary Installations
- Promoting proper usage, regular upkeep and maintenance of household, community and public sanitation facilities, sewage / septage treatment facilities and management of solid waste.
- Expanding of sewerage system to cater to the whole area may not be feasible in near future hence, the policy of adopting decentralized liquid waste management may be promoted for the up keep of sanitation.
- Promote on-site sanitation and the concept of intercepting sewer, ie. collection of overflow from septic tanks may be promoted for avoiding delay in coverage of pucca Sewerage system .

- As part of JNNURM and KSUDP Projects, Integrated Sewerage System including the sewage treatment plant has been established. Septage can be treated in this Sewage Treatment Plant at Muttathara by adding a simple module in the plant.
- Technological efficiency and appropriateness shall be ensured by following:
 - i) Issue of guidelines on range of technology options that are energy efficient, ecologically and climatically suitable and financially sustainable.
 - ii) Building system capacities for a range of technological options and its management for comprehensive range of water and sanitation services.
- Promotion of proper collection, segregation, transportation, treatment and disposal of solid waste from public places.
- Reduction of solid waste at source by promoting decentralized treatment facilities wherever possible in small scale and ensuring proper operation and maintenance through NGOs or Service providers.
- Promote household level/ source level treatment facilities for Municipal Solid Waste with active participation of Resident Associations.
- Establish Resource Recovery Centers (RRC) for promotion of collection of non-degradable wastes including plastics and e waste for promotion of recycle, reuse and recovering of resources in a big way.
- Following Kerala Municipality Act,1994, an Ordinance promulgated by the state Government on 25th November 2011 made it mandatory for all commercial and non commercial establishments like Hotels, Chicken stalls Kalyanamandapams, hostels, hospitals, educational institutions, apartment complexes, houses more than 4 floors etc to arrange for their own waste treatment facilities. Hence, the city Corporation shall insist these establishments to install their own source level treatment facility for biodegradable waste and hand over the non-degradable waste including e-waste to city Corporation.

6.0 References

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