Urban liquid waste management: bane to boon - a study of Palakkad town in Kerala

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Abstract. A clean and healthy environment is part and parcel of the wealth and the quality of life that desire for ourselves now and for children in the future. The mismanagement of wastewater in urban areas possesses a major challenge. Together, the waste water discharge and waste disposal had brought about degenerative effects on human well-being and environment which made uneasiness on urban day to day life. Thus, there is an immense need of an effective liquid waste management for a sustainable healthy environment. Since Palakkad municipal area which is chosen for the study lacks a well-defined sewerage network within the city which possesses immense health and environmental risks owing to chaotic urban life. Thus, there is a need for an integrated liquid waste management plan for the region for a booming and healthy urban life. This research explores the effective management of liquid wastes generated within the study domain as part of urban life and how it could be carried out in an effective manner minimizing environmental and health risks. Also, suggesting reuse alternatives from the processed wastes to restore the 3Rs to bring back sustainability. An effective liquid waste management is an essential service core of an urban area and a most important sector for a planned development which cannot be secluded and have to be given equal priority as that of other sectors. Thus, adopting some effective practices would minimize the issues spawned due to the haphazard management of liquid wastes, enabling a clean and healthy city.

1. Introduction
A clean, healthy, and sustainable environment is now accompanied as a major component along with the other basic necessities of the people. Together with incomes and basic needs, a clean environment also possesses an integral part of human well-being. The under-management of wastewater in urban areas presents a major challenge. The accumulation of human waste and unmanaged wastewater directly contributes to the contamination of locally available freshwater supplies. Additionally, the cumulative results of under managed wastewater can have broad degenerative effects on both public and ecosystem health. Thus, there is an immense need of an effective liquid waste management for a sustainable healthy environment.

In communities where there is constant contact with the polluted environment, sanitation is an important concern. As these communities continue to grow and practice the unsanitary means of waste disposal, their presence can cause harm to themselves and to their environment. Therefore, the proper collection, transportation, treatment and disposal of liquid wastes are crucial in the protection of community health and in the improvement of their environment.
Since Palakkad town is one with higher population density than other urban municipalities and forms the district’s administrative headquarters. Growing population and densely urbanized town without a proper LWM system imposes adverse effects on people and environment. Thus, it is an indispensable need for Palakkad town to have a proper LWM system to protect health and environment. The study will focus on the impacts caused due to the absence of effective LWM in Palakkad town. And from the analysis, it helps to draw out a Management plan for the concerned place as a study output.

2. Objectives

- To understand the concept of liquid waste & liquid waste management (LWM) and the recent trends & technologies in sewerage management adopted in urban areas.
- To understand the components of liquid waste management plan (LWMP) and to study the legal framework, policies and institutional reforms/ government Initiatives related to LWM in the Kerala.
- To study the existing scenario of LWM in Palakkad town.
- To analyze the study with respect to various components in the LWMP within the study area.
- To form strategies & recommendations for liquid waste management plan in Palakkad town.

3. Definitions of Liquid wastes & Liquid waste management

Liquid waste is as any waste in liquid form. The composition of liquid waste, also known as wastewater, is highly varied and depends principally on its source. These liquids are hazardous or potentially harmful to human health or the environment. Liquid wastes are generated from residential, commercial, industrial sectors. Liquid waste management is a systematic administration of activities which provides the proper handling, treatment and disposal of liquid waste/wastewater or sewage. Procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of no hazardous liquid materials.

4. Study area description

Palakkad town extends over an area of 26.60 Sq.km. The town is bounded by Kalpathy River, Puduppariyaram Panchayat on north, Kannadi River on south, Marutharod Panchayat on east and Pirayiri panchayat on west. In the 2011 census Palakkad (M) has a population of 130955. The population density of the town is very high and comes to about 4923 persons/Sq.km, which forms to be the highest among all other municipalities.

Palakkad town is one of the hottest places in Kerala. The annual average temperature is 27.330 Degree Celsius. The average annual rainfall is 2023 mm. About 75% of the annual rain is received during the south west monsoon period. Palakkad town lies in the midland region. Palakkad town having percentage of slope of 3 to 5% and comes under gently sloping area. The prevailing environmental resources include surface & ground water resources, wetlands towards periphery of the town area.

5. Land use pattern

Depending upon the land use concentration and population density, 67% of total municipal area constitutes urban land use. 45% of total land use forms the residential settlements, 20% is shared by commercial, industrial, transportation and public spaces. Figure 1 shows the land use pattern of Palakkad town.
6. Existing LWM Infrastructure.
The existing urban infrastructure in terms of liquid waste management includes sewerage and storm water management. Palakkad town has no underground sewerage system so far.
The present system of sewage disposal and treatment is through septic tank. About 90% of the total households have septic tanks, 7% use pit latrines and 3% of the households have no access to individual toilets. Both the storm water drainage and sewer drains act as one system in the municipal area. Sewage water and rainwater gets discharged into these drainage lines which eventually join with surface water bodies.

7. Liquid Waste Management Components
The components involved in a liquid waste management system are as follows which has to be reviewed in detail for a proper waste management outcome.

7.1. Sources of liquid wastes
The main sources of liquid wastes are from residential settlements, commercial centres and transport hubs which possess a major threat to the surface water bodies owing to its degraded quality and contamination. During monsoon, the storm water gets mixed with sullage and the effluent from the drains overflow into low lying areas. This causes environmental pollution and consequent health hazards. The waste water outlets from these establishments are discharged into primary drains and canals which get eventually mixed with the major rivers. Thus, makes the water bodies unfit for human consumption.

7.2. Impacts
Environmental pollution includes water and odor pollution persists as the sewage is discharged into the surface waters, degrading its quality. Communicable diseases spread by mosquitoes and through contaminated water shows that from 2016 to 2020, dengue fever and dysentery possess high rate of patients over the years. Thus, the improper liquid waste management has adverse effects on public health.

7.3. Water & Sewage Loading
As per Urban and Regional Development Plans Formulation and Implementation (URDPFI) Standards, the water consumption for urban area is found to be 135 lpcd (litter per capita per day). As per current scenario, total water consumption for the assumed population 2020 is 1,39,570 x 135lpcd = 18.8 mld (millions of litter per day). As per Central Public Health and Environmental Engineering Organization (CPHEEO) norms, sewage generated will be considered as 80% of the water reaching the consumer end. Thus, the total sewage generated within Palakkad town is found to be 80% of 18.8 mld which is 15.04 mld (millions of litter per day).

7.4. Waste water Quality
The water quality tested by taking samples from the polluted water bodies is found to have the presence of E.Coli bacteria and fecal coliform. This marks the presence of domestic sewage water esp. black water within the surface water bodies. The allowable limit for these parameters is as it should be absent per 100ml of water. In the case of Palakkad Municipal area, due to absence of sewerage network, the waste water is directly discharged into roadside drains which are meant for storm water drainage. Thus, polluting the water bodies and environment.

7.5. Storm water Management
Development generally increases the volume and rate of storm surface runoff, due to an increase in the amount of impervious area caused by the construction of roofs and paved surfaces. The increased runoff caused by development can cause flooding in downstream areas, increase erosion in watercourses, and reduce dry season stream flows due to lower groundwater reserves. Water logging incidence occurs in some roads, intersections and residential colonies during rainy seasons. These areas are prone to water logging and subsequent flooding during monsoon seasons. Due to congested settlements in and around the flood plains of existing rivers and streams. Also, concrete pavements
inhibit the percolation of water into the ground which results in heavy surface runoff. Ultimately dirty water stagnation has become the part of urban life in Palakkad town and is always exposing the urban life towards the chances of spreading epidemics in the town area.

7.6. Watershed Hydrology
There exist 2 watersheds within the town. Kalpathy River has 4 catchments and Kannadi River has 1 catchment area. The annual average rainfall accounts for 2023mm. Out of which normal runoff is taken as 506mm. For the optimum drain capacity design, the urban runoff and sewage quantity has been considered for a town.

8. Plan Criteria
The parameters or criteria that are proposed for use in developing and evaluating liquid waste management alternatives.

8.1. Population
The present population for the year 2020 is found out to be 1,39,590. And the projected population for the year 2040 planning period is estimated as 1,49,798.

8.2. Wastewater Flows & Load Projections
The total waste water flow for 2020 is found to be 34 MLD (millions of litre per day) and 36.4 MLD (millions of litter per day) for 2040 considering both domestic & non domestic waste water flows.

8.3. Beneficial Use of Bio solids.
Beneficial reuse of stabilized municipal sewage for other purposes.

8.4. Discharges to Surface Water
Proposed criteria for treated wastewater discharges are based on existing CPCB, CPHEEO and BIS 10500 guidelines & regulations.

8.5. Discharges to Land
Disposal of treated wastewater effluent to land is normally accomplished by drain fields that allow the effluent to seep into the surrounding soil. This type of system is designated “onsite”, since wastewater is treated and disposed of within individual lots or parcels.

8.6. Reclaimed Water
Beneficial recycling and reuse of treated water.

9. Planning Recommendations.
The long-term vision for liquid waste management is that all elements of liquid waste will be efficiently recovered as energy, nutrients, water or other usable material or else returned to the environment as part of the hydrological cycle in a way that protects public health and the environment.

9.1. Vision Statement
The long-term vision for liquid waste management is that all elements of liquid waste will be efficiently recovered as energy, nutrients, water or other usable material or else returned to the environment as part of the hydrological cycle in a way that protects public health and the environment.

9.1.1 Goal 1: Protect public health and the environment. Public health and the environment are protected by managing sanitary sewage and storm water at their sources, and providing wastewater collection and treatment services protective of the environment.
9.1.2 **Goal 2: Use liquid wastes as a resource.** Energy will be recovered from the heat in the sewage and from biogas generated in the treatment process. Materials which have nutrient value will be recovered from wastewater treatment plants. Water will be recovered from the wastewater treatment process and storm water.

9.1.3 **Goal 3: Effective, affordable and collaborative management.** Monitoring, maintaining and investing in liquid waste infrastructure are essential to ensuring effective system performance and preventing costlier repairs. Innovative alternative approaches will be explored. Effective governance and management coordination’s are achieved.

The urban waste water issues can be resolved through the application of below mentioned strategies.

9.2. **Strategy 1.1: Reduce environmental impacts from liquid waste management to a minimum (Wastewater Treatment)**

This can be achieved by adopting a well-defined sewerage network within Palakkad Town with an appropriate Sewage Treatment Plant of desired capacity.

9.3. **Strategy 1.2: Reduce liquid wastes at their source. (Source Control)**

This strategy seeks to enhance the effectiveness of regional wastewater treatment plants and municipal storm water management programs by minimizing liquid wastes at their source. Actions that keep excessive rainwater and groundwater out of sanitary sewers will reduce the risk of sewer overflows, and help maintain sewer capacity and treatment effectiveness.
9.4. **Strategy 1.3: Reduce waste water volume generation**
Universal metering to help minimize water use
Public education to reduce water use; Effective reuse of waste water for non-potable purposes

9.5. **Strategy 1.4: Storm water Management**
Develop a Comprehensive Drainage Master Plan for the Town Using innovative techniques like Sustainable drainage practices for new/proposed developments
Infiltration trenches, Concrete Grid pavements, Grassed Swales where treatment occurs using sand/gravel/pebble filters - Allowing 25% of deep/shallow infiltration &10% runoff. Encourage onsite infiltration of precipitation wherever feasible; in order to enable ground water recharge, i.e., rejuvenation of drains without concreting the base.

![Different Sustainable drainage practices for Storm water Management](image)

**Figure 4.** Different Sustainable drainage practices for Storm water Management

9.6. **Strategy 2.1: Reclamation of wastewater & Reuse.**
For Agricultural irrigation and industrial cooling, the waste water quality parameters obtained such as PH, Electrical conductivity and presence Of Boron are within the standard limits as per KSPCB. Thus, it can be effectively reused within the study area. The effluent obtained after treatment is found to be 26.1 mld + 9.9 mld = 36 MLD (millions of litre per day) in total from two STP’s. Which can be effectively utilized for agricultural purposes and industrial cooling as Palakkad is known for paddy cultivation & industrial corridor in Pudussery panchayat in Palakkad district.

| Table 1. Reuse Standards |
|--------------------------|
| **Agricultural Irrigation/ Industrial Cooling** | **KSPCB Standards** | **Obtained** |
| PH                        | 6.0-8.5             | 6.8-7.3       |
| Electrical Conductivity   | 2250 micro s/m      | 260-890 s/m   |
| Boron                     | 2 mg                | 0.2-0.9mg     |

9.7. **Strategy 2.2: Bio solids Management**
The stabilized sewage sludge can be used for various purposes as growing medium for topsoil, compost and bio solid manure alone. As per PKVY Scheme, organic manure cropping has been practiced in other rural local bodies but not yet in this municipal area. Organic farming gives better yield & productivity after 2 years when compared to chemical fertilizers usage. Chemical Fertilizers aid crops from 1hectare gives max. Of 5000 -6000 kg yield in a year. Whereas organic cropping gives 2500-3000 kg yield for 1 acre in a year and it keeps on increasing each successive year. Total Stabilized sludge produced from the two STP’S = 1645+629kg = 2274 kg Rs.70 - 110 per Kg for organic rice in local markets. Due to high export quality, Rs. 400 - 500 per Kg is the marketing price.
Also, Organic manure is Rs. 28/kg whereas Chemical fertilizers are Rs. 16/kg, thus, enabling marketing.

9.8. Strategy 2.3: Effective, Affordable & Collaborative Management through Assessing the performance and condition of regional sewerage systems.
Update and implement asset management plans for wastewater treatment plants which address risks. And undertaking an annual internal audit of best practices of one regional liquid waste management sub program and environmental management system Monitor the ambient environment conditions of relevant water bodies in the region. Monitor the quantity and characteristics of Palakkad town’s liquid waste point. Discharges to the environment in conformance to meet Environmental Discharge Standards as per CPCB.

9.9. Strategy 2.4: Use collaborative management to address evolving needs.
A key feature of the plan is collaborative management— collaboration in monitoring progress, identifying challenges, and finding solutions to overcome challenges. Through collaboration, it will continue to adapt and evolve their liquid waste management operations and infrastructure and create more resilient and adaptable systems.

10. Conclusion.
Liquid waste management became a major concern in urban areas due to its mismanagement of waste water resulting in negative impacts towards man and environment. Thus, an integrated liquid waste management is required for its efficient management for a booming urban life.

Based on the study conducted, we can conclude that out the lack of an efficient liquid waste management system within Palakkad town possess enormous health and environmental risks owing to degraded quality of living. Thus, adopting the mentioned planning, it will swipe out the current urban chaos concerned with liquid waste management issues and minimizes the impacts caused. Any system adopted would get successful only if the background support is efficient. So effective and collaborative governance along with better infrastructure only could bring about a best outcome. The reuse alternatives from the processed liquid wastes ensures sustainability in terms of 3R’s – Reduce, Reuse, Recycle and gets benefited by local communities.

Thus, the management of liquid wastes forms a crucial part in urban planning due to the concerns emerging against it nowadays. Thus, adopting efficient practices mentioned would minimize the issues spawned due to the haphazard management of liquid wastes and eliminates critical urban chaos.

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