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# Organizational responsiveness and significance of population linked modifiers to the permissible limits $BOD_5$ present in onsite waste water discharges

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## ABSTRACT

The permissible value of $BOD_5$ of effluent is to be linked with population and to be modified. Environmental sustainability of operations, particularly in the use of water, is considered as a key component in all organizational management initiatives. Different types of innovative concepts in water use and management for wide range of industrial or commercial operations are being implemented all over the world. In the case of a rapidly expanding developing country like India, the evaluation of the sustainability in various environmental management initiatives is necessary to give proper framework for the future initiatives. The domain of wastewater treatment is a vital area of environmental management in most of the organizations. The technologies that are used for the aforementioned purpose are often influenced by factors that might not have direct bearing on the process sustainability. The prevailing globally accepted norm for the selection of wastewater treatment units is based on the three broad aspects of sustainability: economic, environment and social. This paper evaluates the responsiveness of a few sample organizations from Kerala in the selection and operation of wastewater treatment units based on these norms and significance of population linked modifiers to the permissible limits BOD5 present in onsite wastewater discharges**.**

The research exercise also identifies specific areas that demand more attention to improve the organizational attitude towards sustainability concepts.

*Key words;- sustainability, responsiveness, embodied energy, wastewater treatment.*

## INTRODUCTION

Majority of sustainable development initiatives have centered on efficient water use and thus the treatment, disposal and reuse of wastewater formed a significant component for sustainable water use in the recent years. With the objective of ensuring ecological sustainability, the wastewater

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treatment operations implemented all over the world are mostly technology driven treatment processes capable of generating clean water (Gujer, 1996). The life cycle of water in any water supply system usually start with the collection of raw water from a surface or subsurface source and then passing through different stages of water purification before entering the distribution network. Through the water distribution system, the treated water is supplied for various activities and is later collected back in sewers as wastewater. This wastewater is treated to remove the contaminants and is either disposed or reused as per the water quality norms (Metcalf and Eddy, 2003; Lundin and Morrison, 2002). It is understood that the wastewater treatment units installed to ensure better environmental health and hygiene, often tend to cause small disturbance to the existing local hydrological and ecological balance. The treated wastewater containing low concentration of dissolved impurities could lead to objectionable mass concentrations of pollutants in the receiving water bodies when the disposed wastewater volume become very high (Muga and Mihelic, 2008). In addition, more stringent water quality standards often culminated in more sophisticated treatment technologies resulting in higher operational energy, accumulation of more sludge and finally higher cost of treatment (DETR, 1998). Also, setting up of huge centrally managed facilities to treat the wastewater also resulted in systems having high level of embodied energy (Muga and Mihelic, 2008).

## METERIALS AND METHODS

Evaluation of the policies and practices adopted by the organizations towards the management of environmental technologies is the approach adopted by the authors for obtaining valid information on their decision making process. Table-1 shows the description on the cases chosen for the study. The industries from different types of wastewater production units are taken in to consideration.

The major challenge in these types of exercises is to frame the questions for their evaluation and proposing a fool proof criteria for making an effective judgment, specifically relating to the operational aspects of the wastewater treatment units. Most of the assessment programmes, undertaken in the past, are found to have serious limitations like absence of a generic tool for the evaluation process, lack of flexibility in the effective implementation of the evaluation methods and the need for inter-disciplinary and participatory based programmes (Rothmans, 2009). Also, a coherent approach could be chosen as general guidelines that take into account of identification of worldviews, defining the scenarios and also evaluation of risks and opportunities (De Vries and Peterson, 2009).

## RESULT AND DISCISSION

The method adopted by the population residing in the sample regions for disposing the domestic wastewater is through the on-site disposal systems using septic-tank and soak pit. The majority of the designs adopted by them are not standardized and hence the quality of effluents draining into the ground is anticipated to vary widely. Thus inorder to compute the organic loading from the on-site disposal units, $BOD_5$ value of effluent is taken as 80 mg/l for per capita release of 100 litres per day. The above values are combined with the average population densities reported for the three regions. Fig–1 shows the percentage growth of population of the state of Kerala for the past 10 decades. The study is focused on the three major districts in Kerala Trissur, Ernakulam and Kottayam in which the

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growth proportion of population is same as that of the state. Table –2 and Table-3 describes the density of population in these 3 districts. A standard quantity of 75 litres of water per day per capita is considered for the calculation. $BOD_5$ deposit Litres/sqkm/day is worked-out from the data. The Fig-2shows the graph Discharge vs Time. It is observed that the shape of the obtained graph is an S curve which clearly indicates that the $BOD_5$ deposit is in directly proportional to the time. Table – 4 indicates the current level of BOD5 and crosses the permissible limit in 1981. Table -5 shows the quantity of $BOD_5$ deposits in 50 years.

## CONCLUSION.

The research work presented in this paper have illustrated the environmental responsiveness that existed among different organizations from India. These results were reported based on the evaluation undertaken on the wastewater treatment operations carried out by them. The feeble perception about the organizational environmental sustainability of wastewater treatment was reflected in the investigation. Organizations view their business operations and environmental sustainability of processes as two different set of activities and an integrated strategy to address them is yet to emerge in this region.

The values of surface loading rates for three districts across different periods of population is estimated. In order to evaluate the impact of the wastewater releases from different treatment facilities, the surface loading from the effluents released by all the organizations is computed. The design capacity of the wastewater treatment facilities was obtained from the design documents and the production register to gather the prevailing volume or capacity. Further, the effluents are presumed to have satisfied the pollution control norms, based on the remarks given by the plant supervisors. The projected quantity of $BOD_5$ deposit /Hectare/ Day in 50 years will be a huge quantity. For efficient functioning of wastewater treatment plants, quality of effluents discharged into water bodies shall be taken as $BOD_5$ 25 mg/l.

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## TABLES AND FIGURES:-

**Table 1. Descriptions on the cases chosen for the study**

| Type of Organization (with case reference) | Type of waste water | Year of installation and treatment technique | Specific remarks on treatment |
|---|---|---|---|
| Health care institution (Org 1) | Sewage treatment | • Installed in the year 2000<br>• Uses Attached aerobic. Treatment.<br>• Sludge used as farmyard manure. | Spends 1 percent of the capital investment as energy charges. . |
| Milk processing unit (Org 2) | Diary waste water treatment | • Started operation in 2002<br>• Uses activated Sludge Process (ASP).<br>• Sludge used as farmyard manure. | Absence of data to understand the operational details. |
| Milk processing unit (Org 3) | Diary waste water treatment | • Started operation in the year 2003<br>• Uses upflow anaerobic sludge blanket (UASB) reactor combined with aerobic filter.<br>• Sludge used as farmyard manure. | |
| Milk processing unit (Org 4) | Diary waste water treatment | • Started operation in the year 2004.<br>• Both aerobic and anaerobic components in use.<br>• Sludge used as farmyard manure. | |
| Tannery unit (Org 5) | Tannery effluent treatment | • Started operation in the year 1998<br>• Uses anaerobic reactor.<br>• Sludge collected by private agents. | Spends 1.5 to 2 percent of the capital investment as energy charges. |
| Newspaper manufactur-ing (Org 6) | Pulpwaste water | • The industry started operations during early 1982.<br>• Aerobic lagoons for the treatment operations.<br>• Uses large drying beds for sludge and later used as landfill | Provision in the Budget for environmental management. Initiated several methods for pollution reduction like (i) complete discoloration of paper pulp effluent. (ii) Substituted 90 percent of chlorine in bleaching process. |

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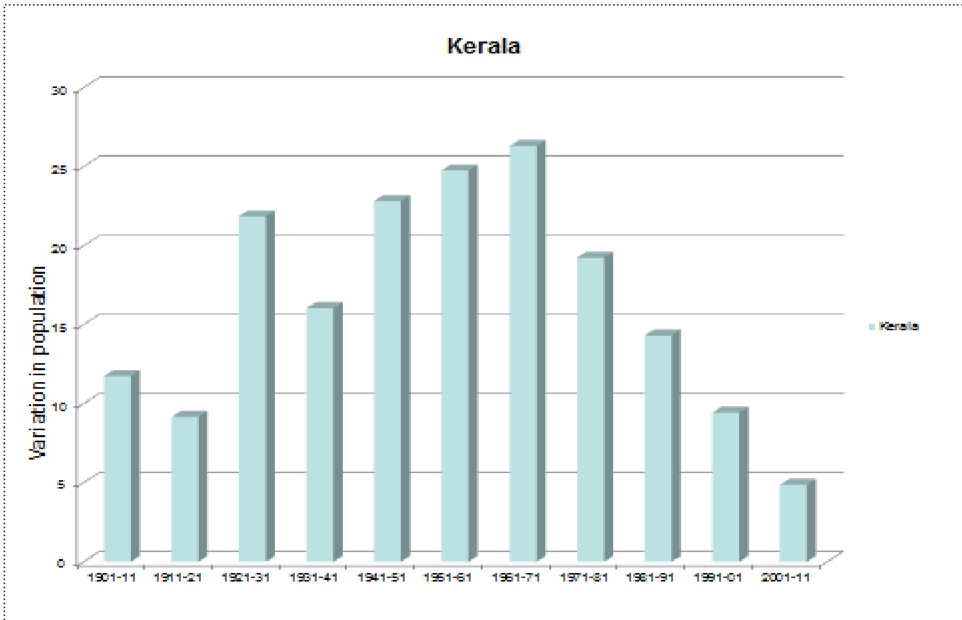
## Fig 1. Population graph




## Table 2. Density of population in 3 major districts in Kerala

| | TRISSUR Area = 3032 sqkm | | ERNAKULAM Area = 2407 sqkm | | KOTTAYAM Area = 2203 sqkm | |
|---|---|---|---|---|---|---|
| Decade | Population | Density | Population | Density | Population | Density |
| 1901-11 | 769660 | 253.84565 | 736281 | 305.8916 | 487940 | 221.48888 |
| 1911-21 | 813685 | 268.36577 | 790397 | 328.3743 | 585332 | 265.69768 |
| 1921-31 | 993835 | 327.78199 | 984677 | 409.0889 | 774863 | 351.73082 |
| 1931-41 | 1154538 | 380.7843 | 1174425 | 487.9206 | 942697 | 427.91512 |
| 1941-51 | 1403110 | 462.76715 | 1396509 | 580.1865 | 1132275 | 513.96959 |
| 1951-61 | 1688222 | 556.80145 | 1702763 | 707.4213 | 1313892 | 596.41035 |
| 1961-71 | 2128679 | 702.07091 | 2170852 | 901.8912 | 1538960 | 698.57467 |
| 1971-81 | 2439467 | 804.57355 | 2549233 | 1059.091 | 1697319 | 770.45801 |
| 1981-91 | 2737081 | 902.7312 | 2840355 | 1180.039 | 1828183 | 829.86064 |
| 1991-01 | 2974112 | 980.90765 | 3105928 | 1290.373 | 1953597 | 886.78938 |
| 2001-11 | 3110327 | 1025.8334 | 3279860 | 1362.634 | 1979384 | 898.49478 |
| | | | | | | |

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## Table 3. $BOD_5$ Deposit in Litr/sqkm/day

| | | Trissur | | | | Ernakulam | | | | Kottaym | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Decade | Density | Discharge percapita /day in litr | volume/ sqkm/day | Litr/sqm / day | Density | Discharge percapita /day in litr | volume/ sqkm/day | Litr/sqm / day | Density | Discharge percapita /day in litr | volume/ sqkm/da y | Litr/sqm / day |
| 1901-11 | 253.846 | 75 | 19038.424 | 0.01904 | 305.892 | 75 | 22941.87 | 0.02294 | 221.489 | 75 | 16611.67 | 0.01661 |
| 1911-21 | 268.366 | 75 | 20127.433 | 0.02013 | 328.374 | 75 | 24628.073 | 0.02463 | 265.698 | 75 | 19927.33 | 0.01993 |
| 1921-31 | 327.782 | 75 | 24583.649 | 0.02458 | 409.089 | 75 | 30681.668 | 0.03068 | 351.731 | 75 | 26379.81 | 0.02638 |
| 1931-41 | 380.784 | 75 | 28558.823 | 0.02856 | 487.921 | 75 | 36594.045 | 0.03659 | 427.915 | 75 | 32093.63 | 0.03209 |
| 1941-51 | 462.767 | 75 | 34707.536 | 0.03471 | 580.187 | 75 | 43513.988 | 0.04351 | 513.97 | 75 | 38547.72 | 0.03855 |
| 1951-61 | 556.801 | 75 | 41760.109 | 0.04176 | 707.421 | 75 | 53056.598 | 0.05306 | 596.41 | 75 | 44730.78 | 0.04473 |
| 1961-71 | 702.071 | 75 | 52655.318 | 0.05266 | 901.891 | 75 | 67641.84 | 0.06764 | 698.575 | 75 | 52393.1 | 0.05239 |
| 1971-81 | 804.574 | 75 | 60343.016 | 0.06034 | 1059.09 | 75 | 79431.825 | 0.07943 | 770.458 | 75 | 57784.35 | 0.05778 |
| 1981-91 | 902.731 | 75 | 67704.84 | 0.0677 | 1180.04 | 75 | 88502.925 | 0.0885 | 829.861 | 75 | 62239.55 | 0.06224 |
| 1991-01 | 980.908 | 75 | 73568.074 | 0.07357 | 1290.37 | 75 | 96777.975 | 0.09678 | 886.789 | 75 | 66509.2 | 0.06651 |
| 2001-11 | 1025.83 | 75 | 76937.505 | 0.07694 | 1362.63 | 75 | 102197.55 | 0.1022 | 898.495 | 75 | 67387.11 | 0.06739 |

## Fig -2 . Discharge vs Time graph

| | TRI | EKM | KTYM |
|---|---|---|---|
| 1901-11 | 0.019 | 0.0229 | 0.0166 |
| 1911-21 | 0.0201 | 0.0246 | 0.0199 |
| 1921-31 | 0.0246 | 0.0307 | 0.0264 |
| 1931-41 | 0.0286 | 0.0366 | 0.0321 |
| 1941-51 | 0.0347 | 0.0435 | 0.0385 |
| 1951-61 | 0.0418 | 0.0531 | 0.0447 |
| 1961-71 | 0.0527 | 0.0676 | 0.0524 |
| 1971-81 | 0.0603 | 0.0794 | 0.0578 |
| 1981-91 | 0.0677 | 0.0885 | 0.0622 |
| 1991-01 | 0.0736 | 0.0968 | 0.0665 |
| 2001-11 | 0.0769 | 0.1022 | 0.0674 |

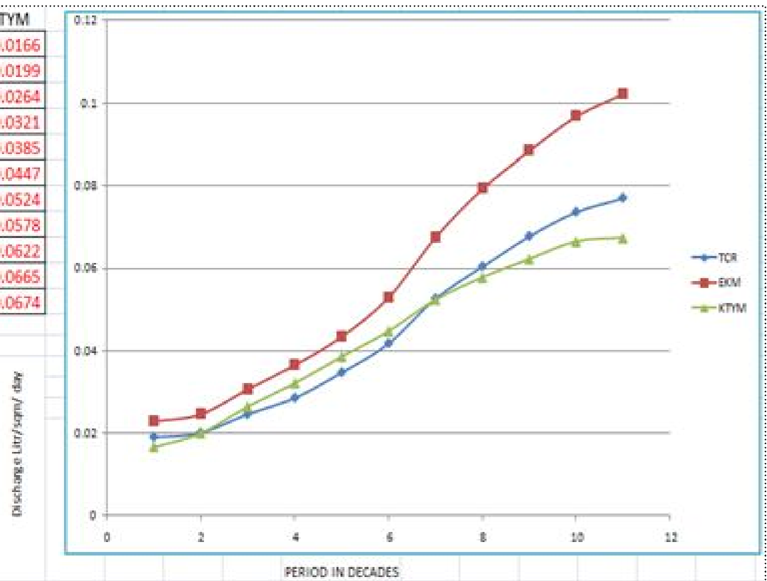


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**Table 4. Current State of environment**

| Year | BOD5/mg/sqm/day in Mg | Permissible limit of BOD5 Mg/sqm/day | Current state of environment |
|---|---|---|---|
| **1961** | **35.37** | **52** | **-16.63** |
| **1971** | **45.22** | **52** | **-6.78** |
| **1881** | **56.65** | **52** | **+4.65** |
| **1991** | **61.55** | **52** | **+9.55** |
| **2001** | **65.23** | **52** | **+13.23** |
| **2011** | **68.13** | **52** | **+16.13** |

**Table 5. Projected $BOD_5$ level** [BOD5/Hectare in 50 years]

| $Bod_5$/Hectare/Day in Gm | $Bod_5$/Hectare/Day in Kg | $Bod_5$/Hectare in 10 Years in Kg | $Bod_5$/Hectare in 50 Years in Kg |
|---|---|---|---|
| **353.7** | **129.10** | **1291** | **6455** |
| **452.25** | **165.07** | **1650.70** | **8253** |
| **566.49** | **206.76** | **2067.60** | **10338** |
| **615.535** | **224.67** | **2246.70** | **11235** |
| **652.340** | **248.67** | **2486.70** | **12433** |

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