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IMPACT OF URBANISATION ON WATERBODIES - CHENNAI

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Abstract *- Chennai, the capital city of Tamil Nadu, has witnessed very fast urbanization because of the attractive employment opportunities available. During the last two decades Velachery, the Southern part of Chennai has witnessed rapid growth and hence a land use pattern change. Sometimes the growth is not in accordance with the Chennai Metropolitan Development Authority's, Development Control Rules. Encroachment both public and private in the water bodies and water courses also adds on to this problem. So the study area is severely affected by flood even during less precipitation, which causes inundation of the area. The flood discharge from the Velachery area has to drain into the Pallikaranai swamp, which is receiving the discharges from a larger area comprising of 96 tanks. Due to heavy inflow into the swamp during floods the swamp swells causing afflux so that the discharge from the study area is not able to readily enter into the swamp and causing flood. This study has been aimed to brining the impact of urbanisation in the study area by analysing both quantity and quality of water. Using Geographical Information System (GIS) the extent of urbanization has been analysed and the physical and chemical parameter of water present in the tanks has been done to find the extent of water pollution. The secondary data has been collected from the Public Works Department (PWD) and Survey of India. The data and information has been analysed and some conclusion will be drawn and according to the results the recommendation or suggestion had presented.*

Key words *– Urbanisation, Encroachment, Flood discharge and Geographical Information System.*

I. INTRODUCTION

Chennai, the capital city of Tamil Nadu, has been expanding on all four directions after 1950s. Particularly, in recent times, the city has been urbanized very fast in the last two decades. Lot of industries has been set up in the Chennai Metropolitan Development Area (CMDA) and this provides lot of employment opportunities. The construction industry is also providing lot of employment to skilled and unskilled workers. On the other side the agricultural activities in the rural areas have been highly mechanized and there is a trend of shrinkage in the area cultivated. Therefore, lot of rural workers have migrated to city in search of a good job with attractive wages. Due to this, there is an ever increasing population growth and the pressure on land use within the CMDA. Even though there is a development plan prepared by the CMDA, the actual development is not happening strictly, as per CMDA's master plan. This leads to encroachment on water bodies and water courses, unplanned laying of roads against natural slope in unapproved layouts and construction of buildings over and above the coverage area specified by CMDA.

In 2008, more than five lakhs people were affected in Chennai and its suburbs after rain-fed rivers and lakes inundated almost three-fourths of the city (*The Hindu, dated 9th July, 2008*). This is mainly because of the rapid urbanization of the city and encroachment of the water bodies which leads to urban flooding. Therefore the study on analysing the impact of urbanisation on water bodies in the study area is very much necessary.

II. OBJECTIVE

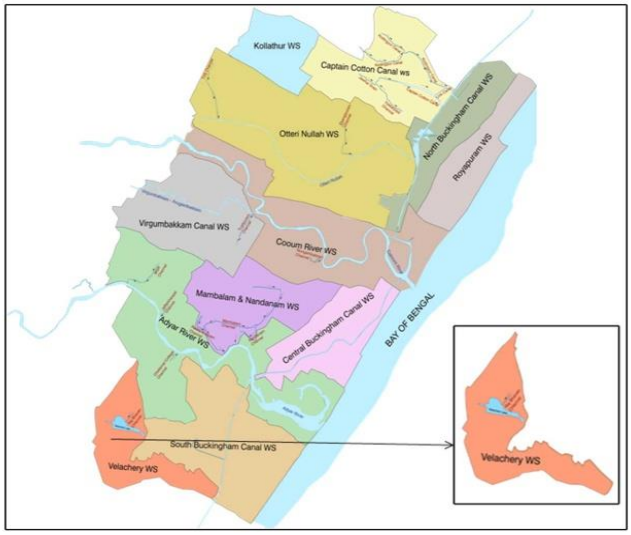
The aim of the study is to analyze the extent of encroachment of the tanks as well as the quality of water. Keeping this view the following objectives were formulated:

- To study the extent of encroachment on water bodies
- To analyse the present quantity and quality of water in the water bodies.
- To suggest improvements/ recommendation based on results obtained.

III. STUDY AREA AND METHODOLOGY

Velachery is geographically located at latitude of $12^0 59'18.32"$ S and a longitude of $80^0 12'45.70"$ E and having a population of about 35,000. It is located in the southernmost part of Chennai Metropolitan Area (CMA) and this is shown as a watershed in Fig 1. This watershed by nature is located in a low lying area compared to the other watersheds of CMA. The Velachery lake is situated in the northern part of the study area, which has a vast waterspread area of around 0.98 Mm^2 originally. When 50% of the Velachery lake catchment area was reduced due to urbanization, the capacity of the lake was also reduced nearly to 50%. This was done based on the

request of the Tamil Nadu Housing Board (TNHB). So 50% of the area of waterspread relieved off submersion was occupied by TNHB for laying out of developed residential plots. The surplus of the lake was usually flowing over the urbanized area as there was no defined course for the flow. So the Water Resources Department (WRD) has constructed a concrete drain from the lake upto the swamp through which the water is to be drained. Now the problem of flooding in the study area is, the excessive runoff coming from the western side areas like Ullagaram, Adambakkam, Nanganallur, Palavanthangal and Thalakananchery tanks. Out of these five tanks which were existence, four tanks have been completely defunct. Only one tank, namely, the Adambakkam tank is sick with 10% of the storage. So the runoff that was to be absorbed by the defunct tanks and the sick tank, comes as flood to the study area.



Source: Corporation of Chennai (2011)

Fig 1: Velachery Watershed Map

The methodology describes the sequence of steps to be carried out to attain the objectives of the study. The primary data needed for this study were collected by collecting the water samples and the questionnaire from the community people. The water samples which collected has been tested for quality analysis both post-monsoon and pre-monsoon. Using GIS techniques the extent of urbanisation on water bodies has been assessed and because of urbanisation the problems faced by the people have been analysed both quantitatively and qualitatively. The secondary data collection comprises of collecting the Top sheets, Acts, Government Orders, Notifications and Norms related to the study. After completing the above works, the analysis and interpretation of data was carried out to find out the status of the impact of urbanisation in the field. Finally the recommendations and suggestions were given. The methodology flow chart is given in Fig 2.

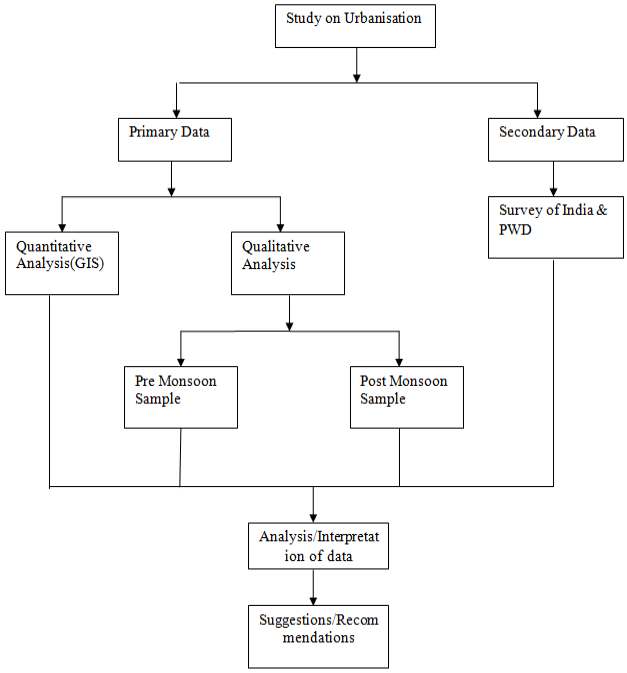


Fig 2. Methodology Flow Chart

IV. RESULTS AND DISCUSSION

This topic deals with the analysis of data obtained in respect of identification of impact of urbanisation and the social and environmental problems caused by quantity and quality of water. Necessary secondary data for this analysis has been obtained from relevant sources and analyzed in detail.

4.1 Quantity Analysis

As the encroachment of water bodies and drainage courses is one of the prime cause of flooding in the study area, the hydraulic particulars of all the tanks contributing flood directly and indirectly to the study area which were identified from the 1930's were obtained from Descriptive *Memoirs* available in the Institute of Hydrualics and Hydrology (IHH)-Poondi. Based on the extensive field visits conducted, the tanks were segregated into two approximate categories viz., (i) tanks in good condition (which are incorporative of even 50% encroached tanks) and (ii) tanks which are completely urbanized and the infiltration component is totally cutoff. Out of the total of 96 tanks, 5 tanks namely, Adambakkam, Ullagarm, Nanganallur, Palavan Tangal and Talaikananchery tanks were belong to study area. The location and spatial distribution of the tanks has been shown in the Fig 3 and 4.

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1948 Source: Google image, 2012

Fig 3 : Tanks in Past Condition

1948 Source: Google image, 2012

Fig 4 : Tanks in Present Condition

Fig 4 shows the present status of the tanks in the study area, which was taken from the Google image. From the toposheet the tanks which was in study area has been identified and the original capacity of the tanks has been given from the memoirs. Then using GIS the current status of the tanks has been delineated. The Figure 1.4 clearly shows that the tanks Ullagarm, Nanganallur, Palavan Tangal and Talaikananchery were completely defunct condition because of urbanisation. Though there is a provision to evict the encroached people the Government failed in this effort. Because of this reason the Velachery area has been frequently affecting flood during rainy season even though there was low intensity of rainfall.

The Fig 5 and 6 show the current status of Adambakkam tank and Velachery tank, where in the encroachment and pollution have been explicitly shown.

Fig 5 : Current Status of Adambakkam Tank

Fig 6 : Current Status of Velachery Tank

4.2 Quality Analysis

Based on the quantity analysis of the tanks it has been clearly indicates that only Adambakkam tank has 10% of water storage capacity and Velacherry tank has 30 to 40% of storage capacity. Remaining all the tanks which is pertinent to study area have completely urbanized. After the quantity analysis the quality analysis was carried on Post-monsoon and Pre-monsoon.

During Post-monsoon period (November to December 2016) the water samples were collected through bore wells which were very near to the Adambakkam and Velacherry Tanks.

Around 14 Chemical parameter was analyzed and the results were furnished in the tables 1 and 2 as below. The results were compared with World Health Organization (WHO) as well as Indian Standard quality parameters.

Table 1 Velachery water sample results

Sl. No.	Particulars	Units	Velachery Tank		
			WHO /BIS	Sample Results (Post-monsoon) December-2016	Sample Results (Pre-monsoon) March-2017
1.	Electrical Conductivity (E.C)	uS/cm @25	2000	1500	1760
2.	pH	mg/L	6.5 to 8.5	7.1	6.9
3.	Calcium (Ca)	mg/L	75	60	132
4.	Magnesium (Mg)	mg/L	30	36	27
5.	Sodium (Na)	mg/L	200 to 400	104	221
6.	Potassium (K)	mg/L	10 to 12	1	55
7.	Bicarbonate (HCO_3)	mg/L	300	366	671
8.	Sulfate (SO_4)	mg/L	150 to 400	24	43
9.	Chloride (Cl)	mg/L	250 to 1000	149	216
10.	Nitrate (NO_3)	mg/L	45	22	33
11.	Fluoride (F)	mg/L	0.6 to 1.2	0.38	0.25
12.	Total Dissolved Solids (TDS)	mg/L	500 to 1500	579	1063
13.	Total Hardness as $CaCo_3$ (TH)	mg/L	100 to 500	300	440
14.	Total Alkalinity as $CaCO_3$	mg/L	120	300	550

Table 2 Adambakkam water sample results

Sl.No.	Particulars	Units	Adambakkam Tank		
			WHO/ BIS	Sample Results (Post-monsoon) December-2016	Sample Results (Pre-monsoon) March-2017
1.	Electrical Conductivity (E.C)	uS/cm @25	2000	1050	1230
2.	pH	mg/L	6.5 to 8.5	7.1	7.2
3.	Calcium (Ca)	mg/L	75	60	78
4.	Magnesium (Mg)	mg/L	30	36	47
5.	Sodium (Na)	mg/L	200 to 400	104	193
6.	Potassium (K)	mg/L	10 to 12	1	0
7.	Bicarbonate (HCO_3)	mg/L	300	366	427
8.	Sulfate (SO_4)	mg/L	150 to 400	24	30
9.	Chloride (Cl)	mg/L	250 to 1000	149	152
10.	Nitrate (NO_3)	mg/L	45	22	30
11.	Fluoride (F)	mg/L	0.6 to 1.2	0.38	0.43
12.	Total Dissolved Solids (TDS)	mg/L	500 to 1500	579	744
13.	Total Hardness as $CaCo_3$ (TH)	mg/L	100 to 500	300	390
14.	Total Alkalinity as $CaCO_3$	mg/L	120	300	350

4.3 Inference from Water Quality Results

From the comparative study of water quality analysis with WHO/BIS standard it has been identified that the water from the tank is utilized as a ground water source both deep well or bore wells and open wells. The water is unfit for drinking purpose. Some of the parameter was deviating from the WHO/BIS standards of water quality like E.C, Mg, Na, K, HCO_3, CO_3, SO_4, Cl, NO_3, F and $CaCo_3$.

After the quality analysis results, the questionnaire survey was carried where the samples collected and some of the nearby houses. The people's opinion was furnished below.

- Normally the bore wells were put deep around 25ft to maximum of 85 feet.
- The ground water mainly used for bathing, cloth washing, dish washing and other cleaning purpose.
- The water is not at all used for drinking purpose though the water is having very less salt content.
- The water is not used even for cooking purpose also.

- Only some of the houses were utilizing water sometimes for cooking purpose also, especially during post-monsoon.
- There is no difference in physical parameters both in post monsoon and pre monsoon even the color of the water.
- Coming to the pumping efficiency of water, during the post monsoon the overhead tank filled by 15 minutes and if it is in pre monsoon will take around 30 to 45 minutes. This indicates that the ground water level will increase or decrease according to the seasonal variations.
- Before 10 years, water in Velachery tank appears to be clear and was used for swimming but after encroachment, tank breadth decreases and sand from the tank was taken out for building construction and that leads to the increase in depth of tank which cause pollution of water to the greater extent due to stagnation of high depth water for long years.

V. RECOMMENDATIONS

The following recommendations were formulated based on the analysis results and the ground truth of the field.

From the quantitative analysis it has been clearly indicating that most of the tanks has been encroached by the public and Government peoples as a developmental purpose. This is against to the State Water Policy as well as CMDA Rules and Regulations. This has to be strictly analysed by the Government.

- Though the Government has taking eviction actions according to **The Tamil Nadu Land Encroachment Act, 1905,** it should be strictly followed in the ground level by the Government of Tamil Nadu because the conservation of water bodies should be very much important.
- Because of urbanisation of water bodies the people who are staying nearby the tanks also affecting very much, both quantitatively as well as qualitatively. This should not be further encouraged by the public as well as private and State Government.
- The developments in the study area are not in line as per the developments permitted in the DCR. There are violations and deviations in plot coverage, FSI and setbacks. This remains as an important factor in causing increased runoff resulting in floods. The CoC must take effective steps at least in future to curtail violations and deviations.
- Inefficiency in removal of the solid waste in drainage courses results in flood and inundation. The Pollution Control Board is less successful in handling solid waste in a scientific way. The Perungudi solid waste dumping site is responsible for the groundwater pollution and indirectly induces the problem of flooding in the study area. This shows the ineffective implementation of rules by the Tamil Nadu Pollution Control Board (TNPCB). So the removal of solid wastes from the drainage courses must be properly done.
- The rain water harvesting system must be adopted properly for all type of buildings and along the bridges, so that it could minimize the inundation of rain water and simultaneously increases the groundwater level.

VI. CONCLUSIONS

To sum up, the study revealed that the eviction of encroachment in the waterbodies is not properly implemented by WRD as the WRD officers are vested with executive powers only. If some judicial powers under delegation of powers like the one granted to the forest department are given to WRD, the eviction of encroachment would be effective and this could go a long way in reduction of quantity and quality of water in the study area and elsewhere in the state. Developments and extension of areas should be in confirmation with Development Control Rules. The master plans should be based on a holistic approach taking into account the future projected demand. Community should be given the awareness that improper garbage disposal leads to the clogging of drainage path which adds on to the increase in pollution of waterbodies. It is high time that stringent rules need to be enacted and enforced to curb the violation against the conservation of the waterbodies.

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