

# THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

## Rapid Urbanization and Depletion of Water Bodies: A Case Study of Ward No. 8 and 9 of South Dum Dum Municipality

**Monalisha Chakraborty**

M. Phil. Student, Institute of Development Studies, Kolkata, India

**Dr. Suranjana Banerji**

Assistant Professor, Department of Geography, Presidency University, Kolkata, India

### **Abstract:**

*Water bodies have played a vital role in the growth and development of human society. Currently these water bodies are under tremendous pressure due to rapid urbanization. The ponds, lakes and reservoirs, across the country, are in varying degrees of environmental degradation due to various human activities. In this context a study was carried out in South Dum Dum (Ward no. 8 and 9), covering an area of about 17.39 sq. km to identify the impact of expanding urbanization process on water bodies. Different qualitative and quantitative methods were used to study and analyse the rate of urbanization and depletion of water bodies. The result of the study shows that with an increasing rate of urbanization, there have been considerable reductions in the number of water bodies in the area. The study also tries to provide vital clues towards understanding the main reasons behind the rapid shrinkage of water bodies within a rapidly urbanization region. An attempt has also been made to suggest measures for conservation and proper management of the existing water bodies through peoples' participation and implementation of stringent laws.*

**Keywords:** Population, urbanization, water bodies, depletion, management

### **1. Introduction**

Water is of the most important resource on earth. Adequate availability of water is required for human life and hence the demand for fresh water resources is increasing the concern of planners and policy makers towards it. About 1.2 billion people in the world are without access to drinking water and about 2.4 billion are lacking basic sanitation and hence the symptoms of emerging global water crisis are too obvious. It has been projected that the population suffering from water scarcity will rise from 450 million at present to 2.7 billion by 2025 and the Indian subcontinent has already being classified as 'water stressed' which means that availability of water should be exceeded (Ministry of Urban Development, Government of India, 2013). The landscape of India is dotted with large number of ponds, lakes, reservoirs and wetlands. These have met the water demand of population for centuries (Costa, 1996). Through the ages, urban wetlands has been the lifeline of most cities in India, which were well preserved and looked after by the people as the main source of water, mainly for drinking and irrigation purpose. These wetlands are found all over the country which are either natural or man-made. Over the years, they have gradually depleted, leading to a number of problems in urban areas like water scarcity and water logging (Ghosh, 1991).

The aim of the present study is to identify the degree of urbanization and increase of population in the study area from 1901 to 2011; to assess the use of water bodies by the people of ward number 8 and 9; to evaluate the trend of decline in water bodies due to urban growth, to identify the various human activities that leads to the shrinking of water bodies and finally to evaluate the strength, weakness, opportunity and threats of the study area.

### **2. Review of Literature**

Urbanization is one of the main driving forces for large scale changes of land use practices over large areas. Several studies were carried out on the impact of urbanization on ecology. Ghosh (1991) has made an extensive work on the depletion of water bodies for Ward nos. 101 to 141 of the Kolkata Municipal Corporation. Rakodi, (1997) stated that as the rate of urban growth is rapid in developing countries, hence it is essential to study the impact of urbanization on the ecology and environment as well as the patterns of urban consumption and environmental footprint of the cities of the developing world. Hardoy et al., 1997 stated that each urban centre has a number of environmental problems with different range of scale and these are influenced by several factors such as size of population and its density, climatic conditions, water resources and other ecological conditions in and around the urban centre. Schueler and Holland (2000) suggested that growing urbanization may have an adverse impact on the water cycle but this impact can be minimized if decisions are taken wisely during the time of development. At the same time, importance are given to the issues that environmental management and development and economic policy in lower income settings are connected to each other, and these issues have become the subject of policy analysis (Hardoy et al., 2001). In global environmental change research, understanding the

dynamics of land use and land cover has been identified to be one of the vital research imperative (Lambin et al., 2001). Joshi and Suthar (2002) explained the change of urban land use with time its impact on ecology and environment of Jaipur city. Rapid urbanization and haphazard growth of cities are resulting in loss of agricultural lands, open spaces, water bodies and it was reported that with the rapid growth of population and industrialization in the country, air pollution, natural water contamination, health hazards and many micro climatic changes are taking place (Goyal, 2003). Purandara et al (2003) stated that urban expansion has an adverse impact on local environment which may cause climatic changes at the local level, and rampant discharge of pollutants into waterways are causing large scale pollution of water bodies. Maiti and Agarwal (2005) reported some of the important environmental problems which are caused by rapid urbanization and population growth process in the metropolitan cities of India. Rahman, 2006 in his study of Delhi stated that after independence there was a large influx of migrants in Delhi and hence the population of Delhi has increased more than two folds. Thus, to house such a large number of migrants the city had to expand leading to a faster, unplanned urbanization and in many cases development of illegal settlements. Shalaby and Tateishi, 2007, defined urbanization as an inevitable process as there are rapid population growth and economic development. Information about the status and use of water resources and the impact of urbanization on the water resources of Kolkata is found in the work of Ray (2010), whose work is mainly based on the ponds of Kolkata, their location, water quality, significance and their relation with the religious and cultural aspects. Dr. Thippaiah in his work titled *Vanishing Lakes: A Study of Bangalore City* (2010) stated that many of the lakes in the city have disappeared along with their water-spreads due to rapid urbanization. According to him the tanks or lakes and the fertile irrigated area should be kept out of acquisition and dry land can be used for residential purposes if possible. Urban growth, at the periphery of metropolitan areas, has long been considered as a sign of regional economic viability. But its benefits are increasingly balanced against its impact on ecosystem which includes degradation of air and water quality and loss of forests and agricultural lands (Rimal, 2011). Urbanization leads to the degradation of peri-urban biophysical environments. Urban sprawl encroaches and degrades peri-urban ecosystems and alters the natural equilibrium (Khan et al., 2013)

### 3. Study area

South Dumdum municipality is located at 22.61° N; 88.40° E' in North 24 Parganas, to the north of Kolkata, in West Bengal, India.

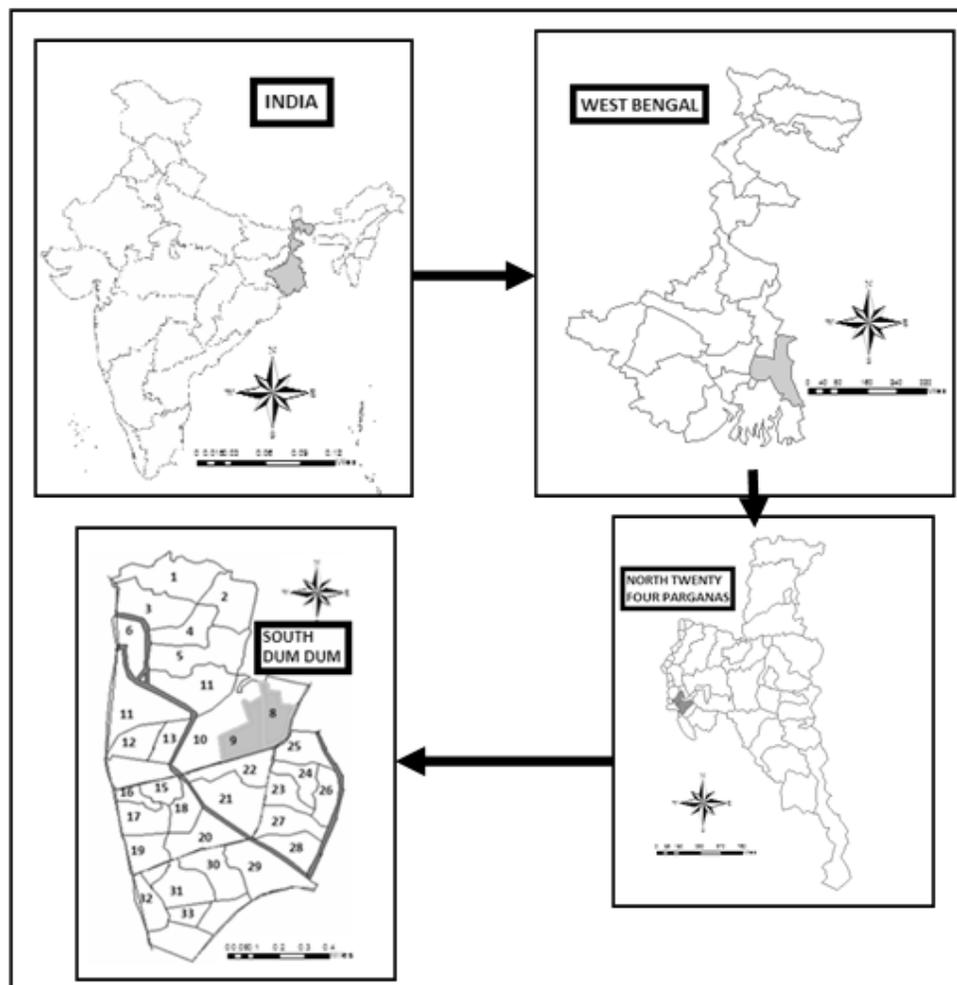


Figure 1: Location map of the study area  
Source: Authors' own elaboration

The area has an elevation of 8 meters. At present its population is estimated to be more than 4.25 lakhs residing in 35 wards spread over an area of 17.39 sq.km (Draft Development Plan, South Dum Dum Municipality,2007-2012). In the past it had 25 wards (Key Map of South Dum Dum Municipality, 1986).But with the increasing rate of urbanization, the area of this municipality has extended with the addition of adjoining 10 more wards. Historically the process of urbanization evolves after the industrial revolution characterised by mass production. Thus it contributed to the expansion of infrastructure, transport and communication network which acted as a magnet to the rural population and they migrated to the urban centres. The present study area is ward number 8 and 9 of South Dum Dum Municipality. It was ward number 5 and 6 in the past, but at present has been renamed as ward number 8 and 9. One of the most important causes of choosing this area is that urbanization has a severe impact on this area leading to large scale conversion of water bodies and open spaces to residential and commercial areas due to the increasing population pressure and increasing demand for infrastructure, goods and services.

**4. Methodology**

The basic methodology adopted for carrying out the present study is primarily by collecting, analyzing & interpreting the primary data along with the review of the available literature on the concerned issue. Primary data for the present study has been collected by carrying out field surveys (site visit & interaction with locals). The methods applied in this study includes :

*4.1. Assessment of the Degree of Urbanization and Change of Population in the Study Area from 1901 To 2011*

Landsat satellite images of 1989, 1993, 2004 and 2011 respectively have been used for generation of land use/ land cover map to show the rate of urbanization in South Dum Dum area.

Sl. No.	Satellites	Sensors	Date	Resolution (meters)	No. of Bands	Path	Row
1	Landsat_5	TM	1989/03/15	30	7	138	044
2	Landsat_5	TM	1993/01/22	30	7	138	044
3	Landsat_5	TM	2004/03/25	30	7	138	044
4	Landsat_5	TM	2011/01/24	30	7	138	044

*Table 1: Detail of satellite images used  
Source: Earth explorer, 1989-2011*

Supervised classification was performed using maximum likelihood classification and four land use/land cover maps were prepared from i) Landsat\_5 1989 ii) Landsat\_5 1993 iii) Landsat\_5 2004 and iv) Landsat\_5 satellite data of 2011 and thereafter changes in different land use/land cover was observed. In addition to this, population data of the area was collected from Census Handbook, Census of India for the year 1901 to 2011 and different cartographic techniques were used to show the rate of change of population in the study area.

*4.2. Appraisal of Individuals’ Perception on the Use of Water Bodies*

Ridit analysis method was used to show people’s perception on the use of water bodies and to analyze the most important parameters among the uses through ordered qualitative measurements. Since Ridit scoring is mainly used to compare two or more sets of ordered qualitative data, one set is used as a reference against other that can be compared. If there are *m* items and *n* ordered categories listed from the most favoured to the least favoured in the scale, then, Ridit analysis goes as follows (Chien-Ho Wu, 2007):

- a) Parameters are selected as a reference data set and population was selected for total responses of survey.
- b) Frequency *f<sub>j</sub>* was computed for each category of responses, where *j*= 1, 2,....., *n*.
- c) Mid-point accumulated frequencies *F<sub>j</sub>* for each category of response is computed.

$$F_1 = \frac{1}{2} f_1 \quad 1$$

Where, *j*= 2,....., *n*.

$$F_j = \frac{1}{2} f_j + \sum_{k=1}^{j-1} f_k \quad 2$$

Computation of ridit value *R<sub>j</sub>* for each category of responses in the reference data set

$$R_{j= \frac{F_j}{N}} \quad 3$$

Where, *j*= 1, 2,....., *n*.

*N* is the total number of responses from the Likert scale survey of interest. By definition, the expected value of *R* for the reference data set is always 0.5.

- d) Computation of ridit value *r<sub>ij</sub>* for each category of scale items.

$$r_{ij= \frac{R_j \times \pi_{ij}}{\pi_i}} \quad 4$$

Where, *i* = 1,....., *n*.

- e) *π<sub>ij</sub>* is the frequency of category *j* for the *i<sub>th</sub>* scale item, and *π<sub>i</sub>* is a short form for the summation of frequencies for scale item *i* across all categories, i.e.

$$\pi_i = \sum_{k=1}^n \pi_{ik} \quad 5$$

f) Hypothesis testing using Kruskal-Wallis statistics W:

$$W = 12 \sum_{i=1}^m \pi_i (\rho_i - 0.5)^2 \quad 6$$

W follows a  $\chi^2$  distribution with  $(m - 1)$  degree of freedom.

**Significance test**

$$\chi^2(m - 1) \quad 7$$

If the statistic is not significant, then there is no evidence of stochastic dominance between the samples. However, if the test is significant then at least one sample stochastically dominates another sample.

#### 4.3. Trend of Decline of Water Bodies and Causes behind Its Degradation and Shrinkage

The trend of decline of water bodies was primarily conducted by analysing maps of the area of the years 1986, 2006 and 2014 and also through field visits. Maps of 1986 and 2006 were collected from KMDA and South Dum Dum Municipality respectively and google earth pro map of 2014 has been used to get the trend of decline of water bodies in the study area. Apart from these, several interactive sessions were conducted with the regional planning officer of KMDA and Engineers of Architecture and Planning Department of South Dum Dum Municipality who look after this area. Discussions were also conducted with the people of the locality and informations related to the filling up of water bodies of ward number 8 and 9 of South Dum Dum were gathered.

#### 4.4. Evaluation of Strengths, Weaknesses, Opportunities and Threats of the Study Area

SWOT analysis have been done in assessing and summarizing both the potential of rapid urbanization and depletion of water bodies in ward number 8 and 9 of South Dum Dum and the difficulties that continue to be encountered. Questionnaire survey and face to face interview methods were used to collect information from the local residents as well as from different government offices in order to generate meaningful information for each category (strengths, weaknesses, opportunities, and threats) to make the analysis useful and also to find their competitive advantage.

### 5. Result and Analysis

The whole study was conducted with the primary aim of identifying the status of water bodies and the rate of urbanization in the study area. Consequently, the empirical and subjective analyses were subdivided into four parts, i.e. Rate of urbanization and change of population in the study area, use of water bodies in ward number 8 and 9 of South Dum Dum, rapid urbanization and its impact on water bodies and strengths, weaknesses, opportunities and threats of the study area. Here, particular attention was given to the assessment of the transformation in natural landscapes and water bodies for human benefits.

#### 5.1. Rate of Urbanization and Change of Population in the Study Area

In South Dum Dum, ward number 8 and 9 are the most affected wards where most of the ponds were filled up and transformed into residential and commercial areas. As the population pressure is increasing rapidly, demand of spaces for residential areas, commercial areas and other services are also increasing. As Dum Dum was mainly an industrial area, many people migrated to this area from different places, particularly from Uttar Pradesh and Bihar. It was found that 33 percent people migrated from these states before independence, 33 percent came between 1950 – 60, 21 percent between 1960 – 70. After these the rate of in migration became slow. Only 8 percent people migrated in between 1980 – 90. (Das et al, 2012). At the time of maximum migration the push factor was less. Most of the places of Bihar and Uttar Pradesh were under developed before 1970. Hence, people started to migrate mainly in search of jobs.

Years	Population
1901	10904
1911	12874
1921	14030
1931	18471
1941	25838
1951	61391
1961	111284
1971	174342
1981	230266
1991	232811
2001	392444
2011	403316

Table 2: Population of South Dum Dum (1901-2011)

Source: District Handbook of North Twenty four Parganas, Census of India (1951-2011)

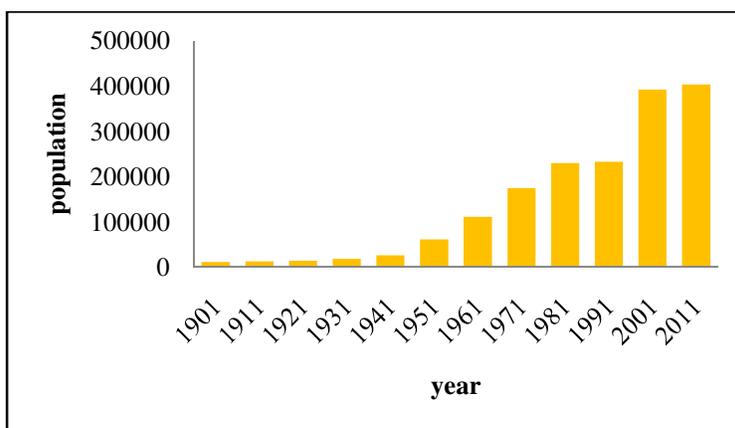


Figure 2: Population growth of South Dum Dum (1901-2011)  
 Source: Census of India handbook, 1951-2011

Years	Population
1981	18283
1991	19364
2001	22404
2011	26422

Table 3: Population of ward no. 8 and 9 of South Dum Dum (1981-2011)  
 Source: District Handbook of North Twenty four Parganas, Census of India (1981-2011)

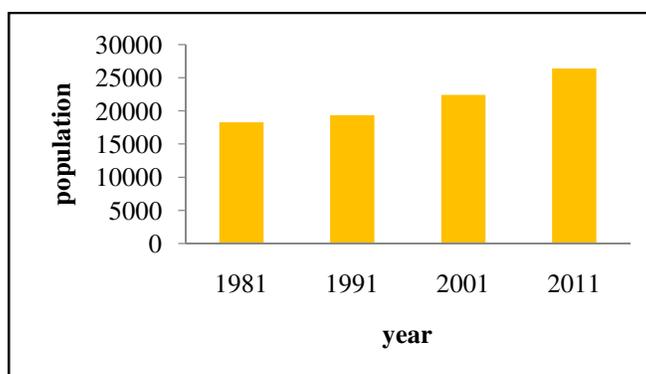


Figure 3: Population growth of ward no. 8 and 9 of South Dum Dum (1981-2011)  
 Source: Census of India handbook, 1981-2011

Land use/land cover maps were prepared from Landsat\_5 satellite images of 1989, 1993, 2004 and 2011 respectively and changes in land use was mapped from 1989 to 2011.

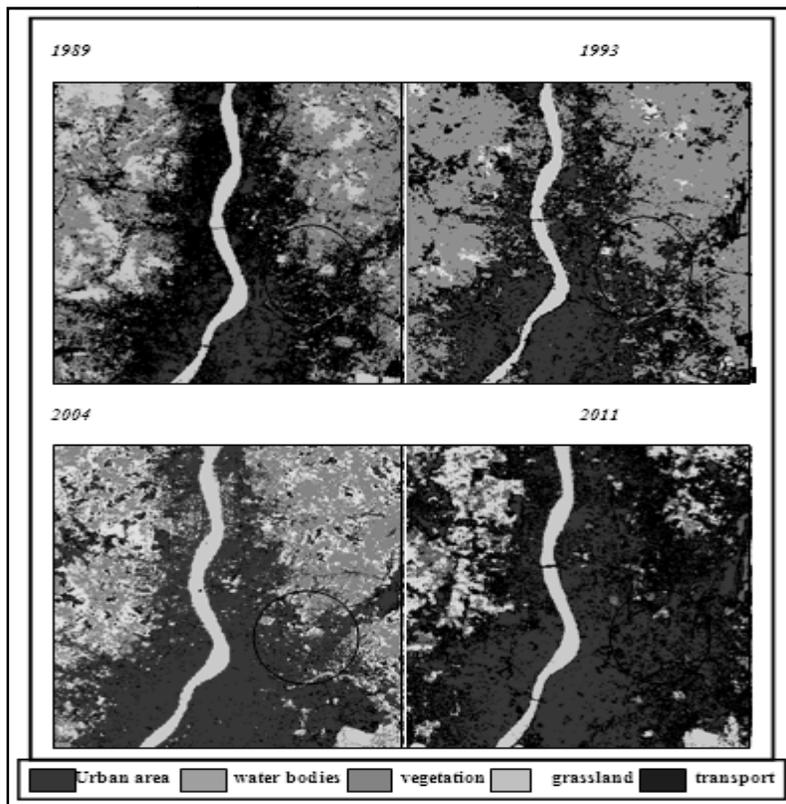


Figure 4: Land use/land cover map showing rapid urbanization in South Dum Dum and its surrounding areas (1989-2011)  
 Source: Landsat\_5 (1989-2011), Earth explorer

The study shows that most of the areas of South Dum Dum had vegetation cover and there were also large number of water bodies in 1989, but in the map of 2011 it can be seen that most of the areas have been transformed into residential areas. The major cause of this unprecedented decline in area under water bodies and vegetation is increasing rate of urbanisation. At the same time, density of residential areas has almost doubled in the last twenty two years. Similarly land transformation has taken place all around South Dum Dum.

5.2. Use of Water Bodies in Ward Number 8 and 9 of South Dum Dum

In South Dum Dum the ponds are mainly used for washing and bathing. Some ponds are mainly used for fish cultivation and from these a large number of fishes are sent to the local markets for sale and thus it carry a huge economic value. Some ponds are also used for immersion of idols; some are used for boating, while some are used for rain water harvesting. Not only these, the ponds also act as carbon sinks thereby reducing pollution at a local level. The water of ponds are also used for extinguishing fire. They are helpful in recharging ground water and also act as repository of rain water during the monsoon months.

Urban Environmental components	Activities	Descriptions
Water resource	Bathing	A large number of people from low economic background use them for bathing.
	Washing	Washing of clothes, utensils and other domestic requirements.
	Repository of rain water	Act as rainwater storage and ground water recharge
Environment	Climate control	Ponds affect local micro climate, making it cooler and soothing
	Open space	Ponds offer open space providing room for air movement and also space for recreational use
	Aquatic ecology	Ponds support many aquatic and other species, a receptacle of biodiversity in urban context
	Carbon sink	It absorbs atmospheric carbon dioxide
Economy	Pisciculture	Source for local employment and good protein
Social	Community gathering	People spend time sitting around these ponds. Many ponds have seats around them and are important venues for local community gathering
Culture	Immersion of idols	Immersion of idols is an important events related to some shrines and are considered as holy ones.
Safety	Fire extinguishing	In congested areas ponds are very useful as a source of water supply for extinguishing fire.

Table 4: Use of water bodies in South Dum Dum (ward no. 8 and 9)  
 Source: Primary survey, 2015

Ridit analysis has been used in the study to compare two or more sets of ordered qualitative data. The following factors have been selected for survey and to analyse people’s perception on use of water bodies. These are indicated below:

Parameters	Very high	High	Medium	Low	Very low	$\pi_i$
Bathing	79	72	89	62	98	400
Washing	153	87	61	65	34	400
Open space	93	92	161	46	8	400
Climate control	109	131	157	3	0	400
Fire extinguishing	194	133	73	0	0	400
Pisciculture	156	121	89	22	12	400
Aquatic ecology	173	147	78	2	0	400
Repository of rain water	77	137	128	47	11	400
Carbon sink	186	153	61	0	0	400
Immersion of idols	27	26	67	183	97	400
Community gathering	14	87	171	94	34	400
$F_j$	1261	1186	1135	524	294	4400
$1/2 f_j$	630.5	593	567.5	262	147	-
$F_j$	630.5	1854	3014.5	3844	4253	-
$R_j$	0.143295	0.421364	0.685114	0.873636	0.966591	-

Table 5: Calculation table for ridit analysis  
Source: Primary survey, 2015

Explanation:  $f_i$ =total summation of the individual attributes;  $\frac{1}{2} f_j$ =division of the individual  $f_j$  values by 2;  $F_j$ =summation of  $f_j$  of the first column and  $1/2 f_j$  of the second column;  $R_j$ =individual  $f_j$  divided by number of sample;  $\pi_i$ = total number of samples

Parameters	Very high	High	Medium	Low	Very low	$\sum \pi_i$
Bathing	0.028301	0.075846	0.152438	0.135414	0.236815	0.6288123
Washing	0.05481	0.091646	0.10448	0.141966	0.08216	0.4750626
Open space	0.033316	0.096913	0.275758	0.100468	0.019332	0.5257875
Climate control	0.039048	0.137996	0.268907	0.006552	0	0.4525034
Fire extinguishing	0.069498	0.140103	0.125033	0	0	0.3346344
Pisciculture	0.055885	0.127462	0.152438	0.04805	0.028998	0.4128327
Aquatic ecology	0.061975	0.154851	0.133597	0.04805	0	0.398473
Repository of rain water	0.027584	0.144317	0.219236	0.102652	0.026581	0.5203708
Carbon sink	0.066632	0.161171	0.10448	0	0	0.3322833
Immersion of idols	0.009672	0.027389	0.114756	0.399688	0.234398	0.7859042
Community gathering	0.005015	0.091646	0.292886	0.205304	0.08216	0.6770123

Table 6: Significance of parameters  
Source: Author’s own elaboration

A direct sorting of the mean ridit in terms of the probability of being in higher propensity gives the following sequence: Carbon sink (0.3322833)>fire extinguishing (0.3346344)>aquatic ecology(0.398473)> pisciculture (0.4128327) > climate control(0.4525034)>>washing(0.4750626)> repository of rain water (0.5203708) > open space (0.5257875) > bathing (0.6288123) > community gathering (0.6770123) > immersion of idols (0.7859042)

$\sum \pi_i$  values of washing, climate control, fire extinguishing, pisciculture, aquatic ecology and carbon sink are less than 0.5 which indicates that washing, climate control, fire extinguishing, pisciculture, aquatic ecology and carbon sink these parameters are more significant and the best according to people’s perception on use of water bodies as found out by Ridit Analysis.

Since, the Kruskal-Wallis (W) value i.e. 873.7465584 is significantly greater than  $\chi^2(11 - 1)$  i.e. 2.23, thus it can be inferred that the opinions about the scale items among the respondents are statistically different somehow.

### 5.3. Rapid Urbanization and Its Impact on Water Bodies

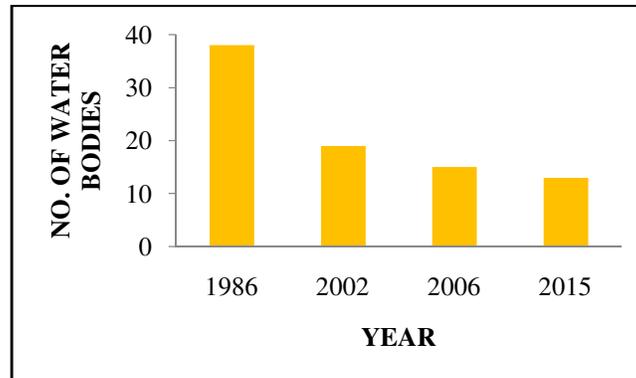


Figure 5: Changes in number of water bodies (1986-2015)  
Source: Google earth, KMDA, SDDM (1986-2015)

Most of the water bodies in South Dum Dum mainly in ward number 8 and 9 were filled up due to human activities like construction of buildings and along with that accumulation of various pollutants that are discharged and dumped into and near the water bodies. Large scale land transformation is presently witnessed in and around South Dum Dum Municipality due to increasing pressure of the human population, modified living standards and diverse economic activities.

The number of water bodies are decreasing at a faster rate with an increase in construction of residential buildings. In 1989 there were 36 water bodies in ward no.5 and 6 (presently ward no. 8 and 9). There was a significant decline in the number of water bodies in 2002, and the number was reduced to 19. In 2006 and 2015 the number of water bodies further reduced to 15 and then 13 respectively. Thus within 29 years 23 water bodies were filled up and are converted to residential areas.

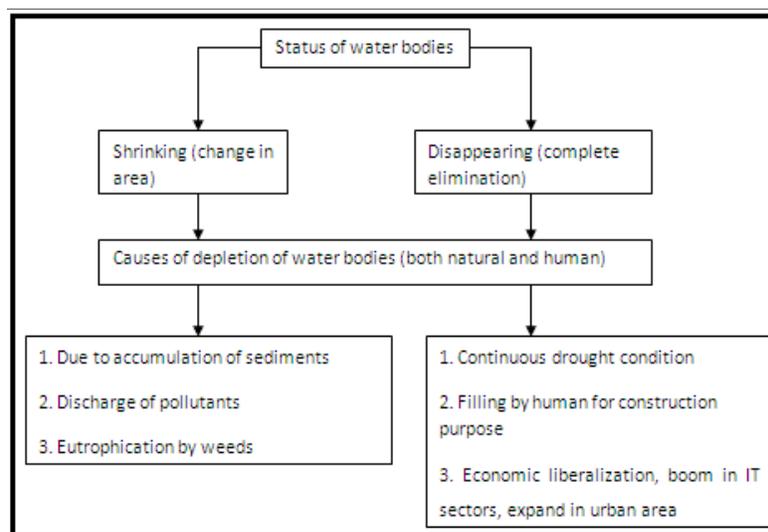


Figure 6: Land use and land cover drives responsible for shrinking, degrading and disappearing of water bodies  
Source: Primary survey, SDDM, 2015

Urbanization has become one of the main driving forces for drastic environmental changes. The important drivers such as growth of industrial, commercial and institutional activities have immense impact on the water bodies of the city. In order to meet the needs of urban population, water bodies were encroached in certain locations and in few areas shrinking of water bodies was also observed due to discharge of pollutants or dumping of wastes and garbage.

Depletion of water bodies in the study area due to urbanization had led to some negative impacts. Some parts of the present study area has become prone to water logging in monsoon season and the problem has aggravated further in recent years. As the population of the study area started growing uncontrollably between 1971 and 2011, the land use pattern also changed drastically. Due to filling up of water bodies for high rise buildings, dumping of wastes in water bodies and construction of metalled roads most of the area have become impervious and hence the problem of water logging is more. Some of the water bodies in South Dum Dum are mainly used for fishing which are of great economic importance as they are mainly sent to the local markets & other markets for sale and it provides alternative employment to the people. If these are filled up in the future, livelihood of those people depended on these ponds would be adversely affected. Some parts of South Dum Dum are very congested and if there is any fire outbreak in one residential

building, the others would also get affected within a short span of time. As mentioned above, these ponds can also be a very useful source of water supply during a fire outbreak. Hence conservation of the existing water bodies is essential.

#### 5.4. Strengths, Weaknesses, Opportunities and Threats of the Study Area

<p><b>STRENGTH</b></p> <ol style="list-style-type: none"> <li>1. Awareness of the people regarding the importance of water bodies have increased.</li> <li>2. Ongoing works for restoration of water bodies</li> <li>3. A deep knowledge of integrated water management amongst the residents</li> </ol>	<p><b>WEAKNESS</b></p> <ol style="list-style-type: none"> <li>1. A significant percentage of ponds and lakes are not at good ecological status/potential.</li> <li>2. Over exploitation of water resources</li> <li>3. Dumping of wastes in water bodies</li> </ol>
<p><b>OPPORTUNITY</b></p> <ol style="list-style-type: none"> <li>1. Deepening the water bodies up to its protecting/ impervious layer will lead to its optimal utilization.</li> <li>2. Adoption and implementation of stringent laws regarding conservation of water bodies</li> <li>3. Convincing the local residents about the proposed benefits of restoration approach</li> </ol>	<p><b>THREAT</b></p> <ol style="list-style-type: none"> <li>1. Continuous increase of domestic water demand and domestic water consumption, has more than doubled, due to increase in population. Depletion of water bodies would led to water scarcity in future.</li> <li>2. Further shrinkage may threaten the ecology and environment of the area.</li> </ol>

Figure 7: SWOT Analysis  
Source: Primary Survey, KMDA, SDDM

## 6. Discussion and Conclusion

The study shows a drastic shrinkage in number as well as areal extent of water bodies in the study area within a period of 29 years (1986-2015). Primarily, South Dum Dum area was a semi urban place with a large number of water bodies. But due to urban growth and development a large number of water bodies were filled up. With the increase in population and need for high rises, the decrease in water bodies have become a widespread feature of the area creating a number of environmental problems particularly water logging during the monsoon months.

### 6.1. Problem Management

The present study highlights the alarming condition of the status of water bodies and their probable causes. Hence to deal with this, appropriate restoration and management strategies need to be developed and the issues of concerns of the local community also need to be addressed. The existence of the water bodies in this region is needed for supporting the water demands of the area through surface water availability and ground water recharge. Efforts must be made to preserve these water bodies, to reduce or control the anthropogenic impacts, and to achieve a balance between the urbanization and environmental conditions. Proper enlistment and record keeping practices should be adopted for the local water bodies regarding their actual number, area, location, depth and uses in order to reduce their vulnerability to exploitation. Adoption and implementation of strict laws will facilitate conservation of the existing water bodies and also restoration of those partially filled up. The local people should be made aware of the need for conservation of urban water bodies and also about the adverse impacts of filling up of water bodies on the environment.

### 6.2. Measures Adopted

South Dum Dum Municipality has taken some initiatives for conservation and restoration of the existing water bodies. It has prepared an 'Environment Management Plan' which states that the existing water bodies should be conserved, those partially filled up should be restored and those with deteriorated water quality as a result of pollution should be treated. Pisciculture should be practised as it can act as a source of livelihood for the local poor apart from maintaining the aquatic ecosystem. The pond of Rastraguru Avenue, mainly used for immersion of idols and pisciculture was gradually shrinking in size as a result of idol immersion, disposal of flowers and other elements that are used for pujas. Besides, regular dumping of flowers and wastes was also affecting its water quality and hence practising pisciculture was becoming difficult. Therefore, in 2015 initiatives were taken by South Dum Dum Municipality and the pond was cleaned, guard walls were constructed along the bank of the pond to avoid further shrinking. 'Jheel Sanskar' program was enacted under Calcutta Sub-urban co-operative colony limited and Jawaharlal Nehru Urban Renewal Mission (JNNURM) by Kolkata Metropolitan Development Authority and South Dum Dum Municipality on 10<sup>th</sup> July, 2011 for Motijheel Lake. The lake was being gradually filled up due to discharge of wastes by local people, which polluted the lake as well. Hence initiatives were taken by South Dum Dum Municipality where piling and desiltation processes had been followed to remove the wastes and to make the lake clean. Not only that a guard wall had also been constructed to avoid further erosion of the banks and implementation of stringent laws was made to stop further dumping of waste materials and other effluents and pollutants in the jheel.

South Dum Dum area has experienced a change in urban landscape since early 1970's and this has led to the waning of a huge number of water bodies, which seemed to be the most vulnerable parts of the ward. The shrinkage of water bodies has resulted in severe water logging problem during the rainy months. But this problem can be taken care of with proper urban management plans for rejuvenating the natural drainage system of the area and the conscious participation of the local people.

## 7. References

- i. S.M.F. Costa, Metodologia alternativa para o estudo do espaçometropolitano, integrando as tecnologia de SIG e sensoriamento remoto –Aplicação à área metropolitana de Belo Horizonte. São Paulo. Dissertação de Doutorado – Escola Politécnica da Universidade de São Paulo, 179, 1996
- ii. A. K. Ghosh, Ecology and Environment of Calcutta, Calcutta's Urban Future, Government of West Bengal, 1991
- iii. C. Rakodi, "Global Forces, Urban Change, and Urban Management of in Africa", in Carole Rakodi (ed) The Urban Challenge in Africa: Growth and Management of Its Large Cities, (United Nations University Press, Tokyo), 1997, 17-73.
- iv. J. E. Hardoy, D. Mitlin, D. Satterthwaite, Environmental Problems in Third World Cities ( Earthscan Publication, London), 1997
- v. J. E. Hardoy, D. Mitlin, and D. Satterthwaite, Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia and Latin America.(London: Earthscan Publications), 2001
- vi. E. F. Lambin, B. L. Turner, H. J. Geist, S. B. Agbola, A. Angelsen, J.W. Bruce, O. T. Coomes, R. Dirzo, G. Fischer, C. Folke, The causes of land-use and land-cover change: moving beyond the myths, Global Environmental Change, 11(4), 2001, 261-269.
- vii. K. N. Joshi and C. R. Suthar, Changing urban land use and its impact on the environment -A case study of Jaipur City, Proceeding Asian Conference on Remote Sensing (ACRS), 2002.
- viii. D. L. Goyal, RS and GIS based methodology for the preparation of a sustainable development plan-A case study of Indore City, 2003.
- ix. M. E., Application of Landsat imagery to regional-scale assessments of lake clarity, Water Research, 36, 2002, 4330-4340.
- x. S. Maiti and P. K. Agrawal, Environmental Degradation in the Context of Growing Urbanization: A Focus on the Metropolitan Cities of India, J. Hum. Ecol., 17(4), 2005, 277-287.
- xi. A. Rahman, An integrated geo-spatial approach for monitoring urban environmental management issues and challenges in India, In (eds.), Urban Environmental Management, ( B. R. Publishers, New Delhi ,in press), 2007
- xii. A. Rahman, Application of remote sensing and GIS technique for urban environmental management and sustainable development of Delhi, India', In Applied Remote Sensing for Urban Planning, Governance and Sustainability, (eds.) (Netzband M. & Stefnow W. Springer-Verlag Publishes, New York ,in press), 2006
- xiii. A. Shalaby and R. Tateishi, Remote sensing and GIS for mapping and monitoring land cover and land -use changes in the Northwestern coastal zone of Egypt. Applied Geography, 27, 2007, 28- 41.
- xiv. M. Ray, M., Old Mirrors: Traditional Ponds of Kolkata, Kolkata Municipal Corporation, Kolkata, 2010
- xv. P. Thippaiah, Vanishing Lakes: A study of Bangalore city. Social and Economic Change Monographs, 17, 2009
- xvi. B. Rimal, Application of Remote sensing and GIS, Land Use/Land Cover Change in Kathmandu Metropolitan City, Nepal, Journal of Theoretical and Applied Information Technology, 23 (2), 2011, 80-86.
- xvii. A. Z. Khan, L. X. Quynh, F. Canters, E. Corijn, Environmental conflicts in coastal urban area. Towards a Strategic Assessment Framework for Sustainable Development, 2013
- xviii. B. Das, A. Bandyopadhyay, J. Sen, Industrial based migration in India- A case study of Dum Dum-Dunlop industrial zone, International Journal of Advancements in Research and Technology, 1(5), 2012