ENVIRONMENTAL DAMAGE COST ON URBAN INDIA

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ABSTRACT:

Urbanisation is considered as one of the indicators of economic growth. It is said that, greater the urbanisation then higher the economic growth and vice versa. It is a fact that we found the concentration of the economic growth in the urban areas, especially in the developing countries like India. Nevertheless, the centralisation of the economic growth along with the availability of economic and social infrastructures results in the rapid growth of the cities and metropolitan cities. There population growth coupled with migration of the population from rural and semi urban areas leads to urbanisation and thereby the rapid growth of cities and metropolitans, which over crowded them day by day. Urbanisation contributes in several ways to the environmental problems and consequently environmental damage. Urbanization is very closely related to environmental deterioration and put forth environmental bad effects and environmental damage cost, which is an important but less attention paid component in the Economics of Environment. This demands to examine the relationship between urbanisation and environmental degradation, and thereby the environmental damage cost to be borne by the society as a whole. We found rapidly growing urbanisation in general in India and Maharashtra in particular. The present study examines the extent of urban environmental problems in the state of Maharashtra in India, it calculates the cost of environmental damage taking into consideration some attributes of environmental degradation with special reference to Urban Maharashtra in India, which has industrially and agriculturally developed districts. The study brings forth the economic losses due to deterioration of the environment. It is against this backdrop, undertaking of the present study is very much essential and urgently needed. The foregoing analysis reveals that environmental damage cost on urban Maharashtra in India is

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huge, which is calculated by adopting both the methods, i. e. impact pathway approach, as well as the contingent valuation method. But the estimates of the contingent valuation method indicate higher environmental damage cost on Urban Maharashtra in India than that of impact pathway approach. Further it is higher for estimates based on willingness to accept than willingness to pay. It is of significant level in comparison with the GSDP of the Maharashtra state in India.

KEY WORDS: Environmental Pollution, Impact, Environmental Damage Cost, WTP, WTA

I) INTRODUCTION:

Urbanisation is considered as one of the indicators of economic growth. It is said that, greater the urbanisation then higher the economic growth and vice versa. It is a fact that we found the concentration of the economic growth in the urban areas, especially in the developing countries like India. Nevertheless, the centralisation of the economic growth along with the availability of economic and social infrastructures results in the rapid growth of the cities and metropolitan cities. There population growth coupled with migration of the population from rural and semi urban areas leads to urbanisation and thereby the rapid growth of cities and metropolitans, which over crowded them day by day. Urbanisation contributes in several ways to the environmental problems and consequently environmental damage. This disturbs the environmental balance and becomes responsible for the various evil consequences. Thus, urbanization is very closely related to environmental deterioration and put forth environmental bad effects and environmental damage cost, which is an important but less attention paid component in the Economics of Environment. This demands to examine the relationship between urbanisation and environmental degradation, and thereby the environmental damage cost to be borne by the society as a whole. We found the trend of rapidly growing urbanisation in general in India and Maharashtra in particular.

It is a fact that economic growth has been concentrated in urban areas or cities and metropolitan cities in the developing countries like India. Except agriculture, all other productive

sectors such as secondary, tertiary development is concentrated in the cities only. Likewise, socio-economic infrastructural facilities also have been centralised mainly in the urban areas. The noteworthy are roads, transport and communication, electricity, water supply, education, health and medical, entertainment, railways, and so on. Due to concentrated growth, the people prefer to stay in the cities to get employment opportunities. To derive the benefits of the social and economic infrastructures migration as well as population growth results in urbanisation and thereby over crowded cities. The concentrated economic growth materialised through the development of productive activities included in the secondary and tertiary sectors create the environmental problems like air pollution, water pollution, noise pollution, land degradation, problem of wastes etc. and contribute to environmental deterioration and damage. Population growth in the cities and migration of the population results in overcrowding of the cities as the result of which the development of slums, encroachments over footpaths take place that contributes environmental degradation by creating over pressures on socio-economic infrastructural facilities as well as air pollution, water pollution, problem of waste management as well as land degradation.

Environmental degradation in urban areas in the form of air pollution, water pollution, noise pollution, land degradation has severe consequences, which creates a significant environmental damage cost, which is to be borne by the society as a whole. The noteworthy evil effects of land degradation are unfavourable climatic conditions due to deforestation, salination of land, loss of cultivable land, decrease in fertile land, human diseases and health hazard, adverse effect on drinking water supplies, green house and global warming effects, fall in agricultural productivity, fall in rainfalls and drought conditions, starvation and malnutrition. Water pollution effects consist of water borne diseases such as dysentery, typhoid fever, cholera and hepatitis, reduction in utility for industry, fall in agricultural productivity, fall in availability of food resources, decline in aesthetic and recreational values, extermination of flora and fauna, teeth deformation, shifting of bones and paralysis, destroy of aquatic life etc. The major evil effects of air pollution include eye, throat, nose and irritation of respiratory tract, odour nuisance, increase in morality and morbidity rate, asthmatic attacks, bronchitis, cardiovascular and pulmonary disease, disease of bone (fluorsis) and mottling of teeth, damage of plant species, fluoride poisoning of animals, death of animals and paralysis, plant damages in the form of yellowing of leaves, death of plant tissues, necrosis,

adverse effect on buildings, fabrics, cars, green house effects and global warming etc. The evil effects of noise pollution consist of damage to hearing cells, sudden rupture of an eardrum, hearing loss, workers tire so on, fall in quality and efficiency, disturbance in oral communication, misunderstanding in information transmission, delayed action, circulatory problems, blood flow disturbances, irregularities in heart rate, lack of concentration, nausea, headache, insomnia loss of appetite, peptic ulcer, tumour, adverse effect on pregnant mother, constriction of smaller blood vessels in fingers and eyes. All these evil effects of environmental damage lead to environmental damage cost to be borne by the people or society. That environmental damage cost is necessary to study and calculate. Even it is difficult to study all the effects of environment degradation and their costing, it is possible to quantify some environmental evil effects and their social cost to the society. The major items of evil environmental effects that can be quantified and their costing is possible are cost of effects on human health, land degradation, materials, buildings and vehicles, flora etc. Therefore, they are prominently considered in this study.

The present study examines the extent of urban environmental problems in the state of Maharashtra in India. The very important point of its significance is, it calculates the cost of environmental damage taking into consideration some attributes of environmental degradation with special reference to Urban Maharashtra in India, which has industrially and agriculturally developed districts. This provides guidelines in estimating the intensity of the problem of environmental pollution. It provides a road map for government and decision-making authorities in taking due course of action so as to tackle environmental problems under area covered. The study brings forth the economic losses due to deterioration of the environment. It is against this backdrop, undertaking of the present study is very much essential and urgently needed.

II) RESEARCH METHODOLOGY:

The present study attempts to study the problem of urban environmental degradation with reference to Urban Maharashtra in India. It examines the nature, causes, consequences and extent of environmental pollution in the context of urban areas of Maharashtra state in India, which are headquarters of the Municipal Corporations. The total number of Municipal Corporations in the state of Maharashtra in India was 22 in the year 2010-11. The present research study makes use of both the secondary data as well as Primary data. The secondary data has been collected from the publications of concerned Municipal Corporations, State Pollution Control Board, Central Pollution Control Board, Socio Economic Survey of various districts, Economic Survey of

Maharashtra, Reports of Ministry of Environment and Forests, etc. The present research study covers the latest period from 2001-02 to 2011- 12.

The present study uses the primary data to identify nature and extent of evil consequences and estimate the environmental damage cost. The environmental damage cost is calculated by taking into consideration a few attributes of environmental damage such as human health, agriculture damage, industry damage, fishery loss, economic loss due to adverse effects on buildings and vehicles, fabrics. The use of Impact Pathway Approach, Contingent Valuation Method (CVM), Disability Adjusted Life Years (DALY) is made as per necessity and suitability. This part of the study brings about cross sectional analysis of the environmental damage cost for the period of one year. Likewise, the use of appropriate statistical techniques is made as per the need and suitability. The environmental damage cost is calculated in the context of Urban Maharashtra state in India taking in to consideration Municipal Corporation areas namely Kolhapur, Sangli-Miraj-Kupwad, Solapur, Pune and Pimpri-Chinchwad, which are industrially developed as well as socio-economic infrastructures concentrated.

The primary data for calculating the environmental damage cost in the context of Kolhapur, Sangli-Miraj-Kupwad, Solapur, Pimri-Chinchwad and Pune Municipal Corporations areas is collected through administering a well-structured questionnaire, conducting interviews, holding discussions and observations. The area under jurisdiction is divided into four categories (stratus) in accordance with the environmental problems such as air pollution, water pollution, noise pollution, and waste management in the area under study. Based on this stratus the purposive sample of 25 respondents from each strata consisting of in all 100 respondents from each selected Municipal Corporation area is taken, that stood at in all 500 respondents from five municipal corporations in the Maharashtra state in India. Besides this, the interviews of officers, experts, representatives, workers are conducted as per needs and requirements. The collected both the primary as well as secondary data is classified, tabulated, processed and analysed in the light of objectives of the study by employing appropriate statistical techniques like Simple Growth Rate, Compound Growth Rate (CGR), Ratio Analysis, Correlation, Regression, Standard Deviation, and so on, by using the computer software packages such as SPSS, Excel.

III) NATURE AND EXTENT OF ENVIRONMENTAL POLLUTION IN MAHARASHTRA STATE OF INDIA:

Environment means surroundings around us. It comprises of four segments, i. e. atmosphere, lithosphere, hydrosphere and biosphere. In simple words, environment means land, air, water and life. The activities to promote socio-economic development adversely affects environment and brings about environmental pollution and thereby environmental degradation. It is deterioration in the quality of the environment. Meeting the growing needs of a progressive state leads to a variety of adverse environmental issues, straining its natural resources and pollution all media such as air, water and land. Rivers in the state suffer from deteriorating water quality, the air is contaminated and industries add hazardous and e-waste to an already large waste stream of municipal solid waste, biomedical waste and plastic waste.

Water Pollution/Degradation in Maharashtra

One of the most crucial natural resources is water. Water resources are classified into two basic types – surface water and groundwater. In comparison to the established water quality standards in India, the water quality in both surface and groundwater sources in Maharashtra is of concern due to the pressures induced by driving forces such as industrialization and urbanisation. Increasing pollution lands of industrial effluents, municipal sewage discharges and minimal water flows maintained in surface water sources are the causes of severe contamination of surface water resources in the state. The over exploitation of groundwater application of chemical pesticides and fertilizers, and unscientific practices in groundwater execution result in contaminating, depleting and degrading the state's groundwater resources.

River Water Pollution

Rivers and their tributaries, and lakes are the two main surface water sources in the state. Maharashtra is endorsed with a number of rivers namely, the Godavari, Krishna, Bhima, Tapi-Purna, Wardhaa and Waintanga. The rivers Godavari and Krishna along with their tributaries flow eastwards irrigating most of central and eastern Maharashtra emptying into the Bay of Bengal. To the north of the state, the rivers Tapi and Narmada flow westwards, irrigating most of northern Maharashtra (MPCB, 2003-4).

Water quality monitoring at some of the major rivers in the state indicated that at 70% locations, water quality has deteriorated due to high levels of BOD. Along with the organic pollution, DO levels were also lower than the standard limit at some locations. The concentration

of total coliform (TC) increased at all stations except Pise dam on the Bhatsa river, Kurundwad on the Krishna river and the Gorapur and Jayakwadi dams on the Godavari river (MPCB, 2003-4).

Table No. 1: River Pollution in Maharashtra (2005-06)

River	pH	Parameters			
		BOD (mg/l)	COD (mg/l)	DO (mg/l)	Total Coliforms (MPL1 ml)
Bhima	7 – 8.3	5.4 – 46	25 – 33	0.8 – 7.2	15 – 1800
Godavari	7.2 – 8.7	1.5 – 15.5	4 – 320	3.3 – 8.7	6 – 1800
Kundalika	7.3 – 8.1	2.8 – 5	12 – 112	6 – 7	170 – 275
Patalganga	7 – 8	2 – 6.5	16 – 240	5.1 – 7.4	120 – 550
Purna	7.78 – 8.3	3 – 10	14 – 62	4.9 – 6	160 – 1600
Tapi	7.5 – 9.4	2 – 25	24 – 40	4 – 77	2 – 1800
Ulhas	7 – 7.7	3 – 6	16 – 64	5.3 – 7.4	95 – 350
Wainganga	7.33 – 9.08	3.4 – 11.5	6 – 82	5.7 – 6	300 – 1600
Wardha	7.6 – 8.7	3 – 14	61	5.2 – 6.5	110 – 1600

Source : Maharashtra Pollution Control Board

Water Pollution Due to Municipal Sewage

The deterioration quality of the waters in the state is often a direct result of domestic and industrial water pollution, as well as agricultural return waters. These activities pollute not only the surface water, but also groundwater and the coastal environment in the state. Given the larger than normal share of urban population in the state (4.24%) compared to all of India (27.8%), satisfying the basic needs of water and sanitation continue to pose a challenge for authorities water supply in urban areas is inadequate, as only 15.3% of ULBs satisfy the norms for per capita water consumption. Due to uneven distribution of water supply, the poor sections of society are worst hit. Non judicious use of water, subsidies and unaccounted for water all contribute to disparity in demand and supply and uniform distribution across masses. Bacterial contamination of water supplies is common, old supply systems add to the possibility of contamination because of physical damage to equipments. Additional problems such as irrational funding policies, budgeting without thought for proper operation and maintenance, deficient institutional arrangements, lack of accounting norms and illegal connections and thefts serve to compound the issue of water supply further (MPCB, 2003-04).

Sanitation facilities in both urban and rural areas are inadequate. About 46% of the state's population has access to sanitation facilities. About 84% of the urban population has access to these facilities, in contrast to the 20% people living in rural areas. Very few towns have properly planned sewage systems. In the Konkan and western regions of the state, about 45% of local bodies have underground drainage system, while in Marathwada and Vidharbha this number falls to 23.5%. Consequently about 60% of the sewage generated by municipal councils and over 50% sewage discharged by municipal corporations goes untreated. In 2005-06, the rate of effluent generation in corporation areas is only 76%, whereas in council areas it is 73%. Overall, the volume of effluent generated from municipal corporations is 5027 MLD. In many cases, Sewage Treatment Plants (STPs) constructed many years ago are currently overloaded. The possibility of untreated sewage discharged to rivers is very high. This in turn pollutes the drinking water downstream.

Groundwater Pollution

Another form of water pollution, especially because of land disposal of untreated and partially treated wastewater, and agricultural return water is groundwater pollution. Groundwater resources in Maharashtra are tapped substantially for domestic and agricultural uses. In time, over extraction and insufficient recharge have resulted in falling annual groundwater levels, which form a serious threat not only to its future availability but also to its quality. In the context of groundwater quality, analysis of groundwater monitoring results reveals that even though pH and DO values are within the prescribed limits the total hardness, chlorides, sulphates and nitrates exceed the limits at 64% of the locations.

Table No. 2: Parameter Exceedances in Maharashtra's Growth Groundwater

Region	No. of Locations Monitored	Locations with Parameters Exceeded Limits	Maximum Concentrations		
			Total Hardness (mg/l)	Chlorides (mg/l)	Sulphates (mg/l)
1. Amaravati	3	3	882	790	851
2. Aurangabad	8	5	1660	936	480
3. Kolhapur	12	1	1490	-	-
4. Nagpur	3	3	-	-	-
5. Nashik	66	56	6750	3175	1000
6. Pune	20	14	3100	-	-

7. Raigad	20	5	-	-	-
8. Thane	4	2	352	-	-
Total	13	-	-	-	-

Source : MPCB, Mumbai

It can be concluded that, there is a link between poor groundwater quality in a region and the corresponding inefficient performance or lacks of STP and deteriorating water quality in the rivers of the region. This fact is evidenced by the water quality observed in rivers Godavari, Tapi, Dharna and Girna all of which have deteriorated because of high levels of BOD and coliforms.

Coastal Water Pollution

The Maharashtra coast that stretches between Dahanu in the North and Terekhol in the South is about 720 km long and 30-50 kms. wide. There are about 18 prominent estuaries along the coast harbouring many mangrove floral and faunal species in varying densities. Of these, Ulhas in the North is the biggest estuary MPCB, 2005-06. In this region, the coastal districts Thane and Mumbai are heavily industrialized. Most industries located here are housed in large industrial clusters namely, Thane-Belapur belt, Kalyan-Ulhasnagar-Ambarnath belt, and along the western bank of the Thane Creek, around Patalganga and Amba rivers and Tarapur. Thus, Thane, Tarapur creeks and Ulhas, Patalganga and Amba estuaries are the recipients of a variety of wastes.

Table No. 3: Quality of Coastal Waters

Region	**No. of Locations Monitored**	**DO (mg/l)**	**BOD (mg/l)**	**Locations with Exceeded BOD Limits**	**Locations with DO lower than limit**
1.Kalyan	2	4.8	7.83	2	-
2. Kolhapur	3	6.2	2.43	1	-
3. Mumbai	12	4.7	14.2	12	2
4. Navi Mumbai	3	4.1	22.5	3	1
5. Raigad	7	5.2	15.2	7	1
6. Thane	12	4	90.4	12	5
Total	3			3	

Source : MPCB, Mumbai

It can be seen that the DO levels remained at fairly level. Similarly, the BOD levels were also comparable for most regions except Thane that saw a dramatic increase. The highest concentration of BOD (640 mg/l) was observed in Thane Creek at Kolshet. On the other hand, improvements in the BOD concentration levels can be seen in Kalyan, Kolhapur and Mumbai regions. The inshore waters of Maharashtra, particularly around cities and towns receive domestic waste water often untreated that has severely deteriorated the ecological quantity of these water bodies.

Lake Water Pollution

During the year, lake water samples were collected from the areas of Navi Mumbai, Nagpur, Chandrapur, Satara and Solapur to detect pollution levels. In all, a total of 12 lakes were monitored and 100 samples were analysed. The analysis indicates that lakes in Nagpur have a very high concentration of BOD and COD and the DO levels do not conform with the standards. The deterioration in water quality of the Digha Lake in Navi Mumbai was acute with the DO level at 3.3 mg/l. Sakhardara and Ambazari were found to be the most highly polluted in the current year.

Table No. 4 : Lake Water Pollution in Maharashtra

Area	No. of Lakes Monitored	Concentration of Pollutants in mg/l		
		BOD	COD	DO
Navi Mumbai	3	9 – 12.7	40 – 54	3.3 – 4.5
Satara	2	6.7 – 7.4	18 – 26	7.4 – 7.5
Solapur	2	10.8 – 14	28.8 – 37	5.5 – 6.1
Chandrapur	5	6.8 – 120	35.4 – 248	3.4 – 5.1

Source : MPCB, Mumbai

Air Pollution/Degradation

Along with water pollution, another important environmental medium is facing extreme deterioration in quality leading to poor health is air. Air pollution is the presence of unwanted substances in the atmosphere, which can be deteriorated to human health and the environment. Due to urbanisation, industrialization and the over increasing vehicular population in many cities, the problem of air pollution has become a serious issue. Chemical fertilizers and pesticide industries discharge toxic process emissions into the air. The burning of fuel in boilers adds to such air pollution. Other sources of air pollution include thermal power plants, sugar industries using bagasse as fuel, steel industries and rolling mills using either coal, LDO or FO as fuel.

Dust emissions from stone crushing activities, emissions from re-rolling mills and foundries, as well as coal mines, and the operation of DG sets also adds to air pollution. To safeguard the public from the most common and damaging pollutants, such as sulphur dioxide, nitrogen oxide, carbon monoxide, lead, suspended particulate matter and ground level ozone, ambient air quality standards have been notified by the Ministry of Environment and Forests (MPCB, 2005-06).

Table No. 5: Air Quality in Maharashtra (1993-94)

Region	No. of Locations Monitored	Concentration of Pollutants in µg/m^3			
		So_2	No_x	SPM	RSPM
Mumbai	15	5.9 – 33	30 – 292	157 – 522	89 – 977
Navi Mumbai	3	6 – 12.6	48 – 80	134 – 252	55 – 96
Raigad	7	2.8 – 31.5	8.2 – 39.3	60 – 145	33 – 141
Thane	5	6 – 48.5	6.5 – 27	201 – 3021	96.3
Kalyan	12	5.5 – 168.7	9 – 158	64 – 747	11 – 323
Pune	11	8.3 – 35	11.8 – 47.5	103 – 440	113 – 378
Kolhapur	9	2 – 67.9	6 – 32.1	70 – 1551	46 – 548
Nashik	11	17 – 60.2	16.6 – 55.8	163 – 839	37.1
Aurangabad	3	14 – 15	14.7 – 15.8	41 – 153	-
Amaravati	7	15.2 – 25.9	25 – 61	170 – 362	51 – 162
Nagpur	17	6 – 29.3	18.4 – 69.6	80 – 1114	35 – 208

Source : MPCB, Mumbai

In Mumbai, especially Sion and Mulund it is observed a significant reduction in concentration of So_2, No_x, but the values of PM 10 have increased. Some reduction has been observed in Co. Khar and Borivali remain polluted throughout the year. High concentrations of SPM found at Khar (430.88 µg/m^3) and Nair Hospital (522 µg/m^3). High levels of No_x and RPM use found at Mahim, Wadala, Andheri and Worli. In a survey, the values of RSPM found were beyond the limits and had increased very compared with the previous years. The ambient air quality monitoring carried out in Navi Mumbai and Raigad region indicates that pollutants are within limits. While in the Thane region the SPM levels found were to be for exceeding the limits. In the Kalyan region, at Ambernath and Ulhasnagar, No_x levels exceeded the limits, while in Dombivali area a high rise in RSPM was observed.

The So_2 level crossed the limit at MIDC Dombivali Phase-I, where it was found to be 168.75 µg/m^3. Testing in the Pune region, also indicated a high rise in SPM and RSPM

concentrations. While results from Kolhapur region showed SPM and RSPM levels far beyond the standards in Sangli city. An ambient air quality survey in Dhule city at nine locations revealed that except two locations, SPM values exceeded the limit. The ambient air quality testing in Aurangabad and Amravati regions indicated values were more or less within the limits except at Kotwali police station in Amravati. In the Nagpur region, most of the areas selected for monitoring air quality were industrial areas. So_2 and No_x were within the limits, but SPM levels exceeded the norms at five industrial locations and RSPM levels exceeded the norms at three locations. The highest SPM concentration (1114.28 µg/m^3 found in this region was at MIDC Umrer. The overall survey reveals that SPM and RSPM were the dominant air pollutants.

Air quality in the state is assessed through routine and specific monitoring. For the year 2005-06 it was noted that at more than 50% locations, levels of RSPM and SPM exceeded the standard. At some locations So_2 and No_x levels also exceeded the limit. These latter parameters exceedances can be attributed to source emissions and vehicular pollution. It was observed that for the parameters So_2, No_x, SPM and RSPM only 20% of the monitored locations were within limits.

Table No. 6: Air Quality in Maharashtra (2005-06)

Sr. No.	Monitoring Stations	So_2 (g/m^3)	No_x (g/m^3)	RSPM (g/m^3)
1	Kolshet (I) Thane	5.47	10.47	50.8
2	Balkum (I) Thane	5.05	10.88	50.48
3	Bavoada (I) Thane	4.9	10.59	50.3
4	Bhosari (I) Pune	29.13	48.38	155.4
5	VIP (I) Pune	30.39	27.43	93.37
6	CETP Dombivali (I) Kalyan	38.31	49.88	107.6
7	MIDC Office (I) Nagpur	9.76	34.94	39.94
8	MIDC (I) Chandrapur	26.4	37.39	134.8
9	Dabholkar Corner (C) Kolhapur	11.41	42.69	106.2
10	Nashik Municipal Corporation (C)	35.86	30.59	108.5
11	Ambernath Corporation (C)	34	52.19	79.97
12	Kalyan Kopri (R) Thane	4.89	3.87	50.4
13	RTO (R) Nashik	30.6	27.38	90.42
14	Chitale Clinic (R) Solapur	17.72	39.05	118.9
15	IT Campus (R) Solapur	16.84	37.5	37.71
16	Nagar Parishad (R) Chandrapur	20	30.1	129.2

17	Office MPCB (R) Chandrapur	20.83	31.06	129.7
18	Institute of Engineers (R) Nagpur	9.51	33.65	41.89
19	Government Polytechnic (R) Kolhapur	10.62	33.07	52.47
20	University Campus (R) Kolhapur	4.57	9.48	38.19
21	Mahadwar Road (R) Kolhapur	7.27	26.4	63.7

Source : MPCB, 2005-06

As per NAMP data for the last six years, it is observed that for Sion and Mulund, there does not seem to be any trend observed for So_2. However, there is a definite trend observed in the fluctuation levels of No_x and particulate matter. As expected, for both these contaminants, winter peaks and monsoon dips are observed. Also a surprising finding in the case of No_x was the decline in its concentrations over the last couple of years in comparison to the years of 2003 and 2004. Since vehicular traffic is a major source of No_x has not increased in this area, it has to be surprised that the MPCB made industries in the Sion and Mulund areas adopt a couple of years ago have been effective in bringing the No_x concentration levels in the area under control.

Noise Pollution/Degradation

Noise is the pressure of unwanted sounds that adversely affect the environment. These may come from a variety of sources, most of them man made. Industrial and vehicular sources are the primary ones in addition to music, air conditioners and other noisy equipments.

Now a days, due to modernization, urbanisation, increase in traffic and development activities, ambient noise levels especially in metro cities have increased significantly. These noise levels affect both the health and psychological well being of the public at large. Noise can affect human health, not only by damaging a person's hearing on extended exposure to loud decibels, but also increase blood pressure, adversely affecting the cardiovascular well being of an individual. During festivals, when loudspeakers blast music, animals can also be affected by noise and feeding patterns, breeding rituals and migratory paths may vary on account of noise pollution (2005-06). During 2005-06, noise was monitored at 254 locations by the MPCB, including 4 residential, 145 commercial, 11 industrial and 4 sensitive zone areas.

Table No. 7: Noise Level in Maharashtra

Region	Noise Level (dB)
Amaravati	60 – 120
Aurangabad	64 – 126

Kalyan	84 – 101
Kolhapur	52 – 125
Mumbai	53.2 – 112.6
Navi Mumbai	60 – 110
Nagpur	55 – 99.3
Nashik	60 – 97
Pune	50 – 114
Raigad	90 – 115
Thane	53 – 120

Source : MPCB, Mumbai

The overall observation reveals that noise levels exceeded the limit at 86% of the locations. Noise levels crossed the limit at all sensitive locations, and at 18% industrial, 86% commercial and 3% residential locations. Higher noise pollution levels were recorded in Kalyan, Raigad and Aurangabad. The highest noise level (126 dB) was recorded in Aurangabad and minimum noise level (50 dB) was recorded in Pune.

Municipal Solid Waste (MSW)

Waste is another category of environmental pollution that is straining precious natural resources as we create new dumping grounds for our growing waste management needs. Open dumping onto land that is not lined, waste piles that are not covered or secured, all lead to pollution of not only the land, but also of the ground water and surface water bodies through leachate and of air through burning. Solid waste management in Maharashtra mainly in major towns, is highly inefficient at all stages of the management cycle; collection, transportation, treatment and disposal. Local bodies are responsible for such management. There are a total of 253 ULBs including corporations, councils, cantonment boards and nagar panchaayts. However, of these 253 sites, a district level committee has so far finalized 223 locations for MSW landfill/waste processing sites. Remaining 27 sites are under review, admitting further necessary action. The major difficulties in identification of these sites are coastal regulation zones and their nearness to water bodies.

Table No.8: Municipal Solid Waste Generation in Maharashtra (Million Tonnes per Day)

Region	Corporation	A Class	B Class	C Class	Total
Amaravati	331	25	169.5	376.5	902
Aurangabad	492	188	118	216.2	1014.2
Kalyan	1959	75	-	52	2034

Kolhapur	170	252	62	118.8	602.8
Mumbai	7000	-	-	-	7000
Nagpur	770	203	127	186.5	1286.5
Nashik	625	65	203.24	146.04	1039.28
Navi Mumbai	450	-	-	8	458
Pune	1575	90.5	388.5	68.5	2122.5
Raigad	-	18	15	35.5	68.5
Thane	680	155	25	20	850
Total	12288	1071.50	1108.24	1198.04	17407.78

Source : MPCB, Mumbai

While the state as a whole generates about 18,000 MTPD of MSW, 50% of this total is generated in the Mumbai and Pune regions alone. The per capita MSW generation in urban areas of the state is between 0.4 to 0.5 per day. Compared to other states, MSW generation is higher in Mumbai city.

Bio Medical Waste Management (BMW)

Another waste stream that has gained importance over the last few years, because of the adverse impacts resulting from its mismanagement is BMW, with HCEs expanding their network to address the health needs of a booming population, the corresponding medical waste is generated has also exponentially increased. This waste is of particularly sensitive nature, considering its potential to spread illness and contamination and has to be given a high level of priority. BMW is any waste generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals.

The state of Maharashtra generates the largest share of BMW, about 31 MTPD, which is approximately 60% of the total BMW generated in the country. There is a steady increase in such amounts over the past three years, which is in keeping with the corresponding increase in coverage. Various agencies including MPCB and municipal corporations have taken steps for special handling of medical waste in different parts of the state. Through efforts of MPCB and pertaining institutions there are now 31 common BMW treatment facilities in the state, up from 17 facilities just two years ago. The treatment and disposal sites for BMW in Maharashtra are present in the cities of Ahmednagar, Amaravati, Aurangabad, Chandrapur, Kalyan, Kolhapur,

Miraj, Mumbai, Nagpur, Nashik, Palghar, Pune, Sangli, Solapur, Taloja, Thane and Pimpri-Chinchwad.

Plastic Waste Management

With a view to prevent the occurrence of problems like Mumbai (26th July 2005), the Government of Maharashtra has decided to declare the entire state of Maharashtra as a "Plastic Bag Free Area". To prevent the recurrable of the situation caused by the deluge of July 2005, the Government of Maharashtra appointed an expert committee to study the objections received and related problems and to submit its findings and recommendations. Notifications have previously been issued by the Government of India (Modification on Recycled Plastic Manufacture and Usage Rules, dated 22nd September 1999 and Amendment (2003) under E (P) Act 1986 and Government of Maharashtra (dated 8th March 1986 under E(P) Act 1986). However, during the year 2005-06, the Government of Maharashtra issued notification "Maharashtra Plastic Carry Bag (Manufacture and Usage) Rules 2006 on 3rd March 2006 under Maharashtra Non Biodegradable Garbage (Control) Ordinance, dated 27th February 2006.

Industrial Pollution

The air and water pollution and waste streams described above are all of a non industrial in nature. When industries dominate the landscape of a high profile state like Maharashtra, pollution from such establishments follows. This intensifies the already prevalent air and water pollution and contributes new waste streams to the mix, such as hazardous waste, lead acid battery waste, and electronic waste. As part of the manufacturing and production processes, industries generate a huge quantum of pollution of every possible environmental medium. The smoke stacks spew gases like sulphur dioxide and particulate matter into the air, the untreated waste water generated from the various processes add to the chemical and organic load of water bodies. The noise levels in industrial areas are extremely high and in addition they also generate a large volume of HW, battery waste and electronic waste depending on their kind of operation.

Maharashtra is rich in industry. The MIDC is responsible for the development of industry in the state. Cooperative industrial estates are also developed. Thane, Navi Mumbai, Kalyan, Nashik, Pune and Pimpri-Chinchwad all have a high density of industries. The industries in Maharashtra are growing at a tremendous rate and the levels of industrial pollution keep getting elevated alongside. There are approximately 60,000 industries in the state today, classified into "Red", "Orange" and "Green" categories of large scale, medium scale and small scale industries.

Table No. 9: Categorization of Industries in Maharashtra (2005-06)

Sr. No.	Region	Red			Orange			Green			Total
		LSI	MSI	SSI	LSI	MSI	SSI	LSI	MSI	SSI	
1	Amaravati	50	38	261	5	9	1937	1	-	2809	5110
2	Aurangabad	113	94	308	15	22	1178	5	6	4388	6129
3	Kalyan	29	45	857	4	4	371	6	5	1199	2518
4	Kolhapur	69	94	636	20	10	1356	1	5	6978	9169
5	Mumbai	56	36	505	28	43	307	2	36	3905	4918
6	Navi Mumbai	91	50	826	1	20	385	3	3	1192	2571
7	Nagpur	121	119	912	9	39	2093	3	7	3330	6633
8	Nashik	176	73	567	20	28	642	20	20	7336	8882
9	Pune	218	134	1249	32	101	1533	43	91	4327	7728
10	Raigad	79	55	92	4	13	195	1	3	373	815
11	Thane	85	75	780	5	15	317	6	12	3664	4929
	Total	1055	869	6993	143	304	10314	91	188	39503	59402

Source : MPCB, Mumbai

It is observed that a considerable proportion of industries belonging to the medium and large scale categories have a sizeable pollution potential. The MPCB listed 714 industries as major contributors to pollution. Of these, the Board has taken action against violating units this year. The Board has recognised industrial waste steams as one of the largest sources of pollution in the state overall and has strict policies in place to manage and control such contaminating activities. Consents and authorizations are awarded only after careful review of the application. Entire monitoring at industrial sites is performed and in addition, inspections are carried out to ensure compliable with the rules. The Board has collaborated with industries by encouraging the use of clean technology, and appreciating industries efforts to embrace policies on areas such as recycling and resource recovery and implement the same.

Industrial pollution occurs in all environmental media. The details of pollution and non pollution industries by media type are presented in table below.

Table No. 10: Media Specific Pollution in Industries

Sr. No.	Region	No. Of Pollution Industries			No. of Non Polluting Industries	Total Effluent (MLD)	
		Water	Air	H. W.		General	Treated
1	Amaravati	168	329	85	4080	1004	1001
2	Aurangabad	474	1079	222	4366	41	41
3	Kalyan	850	911	697	1210	105	105
4	Kolhapur	809	1125	304	7520	287	287
5	Mumbai	675	608	222	3943	4723	4723
6	Nagpur	991	1623	203	5060	955	955
7	Nashik	754	1309	388	6910	125	125
8	Navi Mumbai	885	742	495	1321	60	60
9	Pune	1345	1317	821	5157	110	110
10	Raigad	195	330	199	388	84	84
11	Thane	806	592	599	3682	18	18
	Total	7952	9965	4235	43637	7512	7509

Source : MPCB, Mumbai

In addressing industrial pollution, typically, industries, such as steel plants and thermal power plants have adopted treatment and disposal forms of technologies, whereas industries such as pharmaceuticals, pulp and paper and electroplating outfits are working towards zero discharge, and adoption clean treatment technologies. Despite the provision of common infrastructure for treatment of industrial waste water in the form of CETPs, history shows most of these do not comply with the prescribed standards in terms of effluent quality. Efficient functionality and operation are big issues in this context (MPCB, 2006-07).

Hazardous Waste Management

Hazardous wastes generated by industries are highly toxic and have serious repercussions on health. The state generates 14 lakh MTPA of hazardous waste, with Thane, Ratnagiri and Raigad generating the maximum amounts. The total amount of hazardous waste from Maharashtra amounts to about 50% of the total hazardous waste generated in the country, a large percentage by any account. In spite of corresponding regulation very few industries have bettered to dispose off their waste safely. It is dumped without proper treatment in nearby nallahs or land causing severe pollution and health concerns. Despite the commissioning of a sanitary landfill

and incineration facility at Taloja, industries are unwilling to pay for the cost of treatment and disposal.

Lead Acid Batteries Management

The Lead Acid Battery Management and Handling Rules, 2001 are applicable to battery manufacturers, assemblers, reconditioners, dealers, bulk consumers, auctioneers, importers and recyclers. These rules facilitate recycling of nickel, cadmium and lead acid rechargeable batteries. MPCB is the enforcing agency for this rule and submits an annual compliance status report to CPCB. Effective implementation of these rules in all its stages of collection, storage and transformation requires consultations with manufacturers and retailers as well as public education programmes to increase awareness and encourage participation. It is observed that while many batteries are being bent, not all of them are returned and the Bound reads to focus efforts in getting this ratio to unity. It is also revealed that, there is a disparity between information provided by the dealers and bulk consumers. Apart from production few new lead acid batteries are also imported. The percentage of batteries returned to the dealers continues to be poor as compared to the percentage of batteries auctioned by the bulk consumers.

Electronic Waste Management

Electronic waste is a mixture of almost 1000 different substances and chemicals many of which are highly toxic and can adversely affect human health and the environment if the waste is not handled properly. It also contains heavy metals like lead, cadmium, in addition to carcinogens such as polyvinyl chloride (PVC) in some of the components. Generally after separation of the components, the computer motherboards are smelted in open pits to extract copper and other metals. This process generates dangerous air emissions. The materials used in computers are complex and difficult to recycle in an environmentally sound manner. The recycling of computer waste requires sophisticated technologies and processes, which are not only very expensive, but also read specific skills and training for the operation and these are not present over in the developed nations as of today. Electronic waste or e-waste is the term used to describe old, end of life electronic appliances such as computers, laptops, TV, DVD players, mobile phones, and MP3 players that have been disposed of by their original users. It is estimated that 40 million components are being discarded every year which is likely to further grew phenomenally to 100 million by the year 2010. Initially the recycling of electronic and computer waste in India was mainly concentrated in Delhi, which is an illegal recycling. This

problem has spread its wings to cities like Mumbai, Chennai, Kolkatta, Bangalore and Hyderabad too. The stakeholders involved in this trade include scrap dealers, traders and the intermediaries before the computers and electronic goods land in the backyard recycling and smelting units. The processes employed in e-waste recycling are not environment friendly and capable of causing long terms damage to human health and environment.

Table No. 11: Status of Hazardous Waste, Biomedical Waste and Municipal Waste (2006-07)

Sr. No.	Particulars	RO Mumbai	RO Thane	RO Kalyan	RO Navi Mumbai	RO Raigad	RO Pune	RO Kolhapur	RO Aurangabad	RO Amaravati	RO Nashik	RO Nagpur
A)	No. of Hazardous Waste Units	222	515	693	512	212	814	265	263	103	414	347
1	No. of Authorisation Issued	222	615	676	512	208	558	246	263	97	413	164
2	Quantity of H. W. Generated in MT/M	262	2784	2615.5	3320.26	8453	3515.1	78103.33	1178.6	1130.32	5661	9918.87
3	Units having their own treatment and disposal facilities	0	0	0	0	1	358	72	71	10	192	61
4	Units joined to common facilities	222	616	643	512	138	538	144	81	17	356	74
B)	No. of Health Care Establishments	1354	499	442	143	240	1852	1338	928	896	1348	1046
1	No. of Authorisation Issued	1354	491	442	138	145	1633	827	847	579	1093	333
2	Quantity of BMW Generated in Kg/D	3500	480	989	534	813	5862	1589	26339.64	1927	4052	788.1
3	HCES joined to common facilities	1353	491	582	138	274	1210	1180	326	370	1616	672
4	HCES having their own treatment and disposal facilities	1	-	21	-	74	336	2	101	53	16	31
C)	No. of Local Bodies	1	9	5	2	10	34	24	54	40	43	31
1	No. of Authorisation Issued	-	9	2	2	9	33	23	52	39	40	15
2	Quantity of Solid Waste Generated in MT/M	24000	37920	1235	408	1263	25160	235.4	10139.5	20963.6	10952	10091.01
3	Local Bodies having their own treatment and disposal arrangement	No treatment disposal at Mulund & Devnar	-	0	1	2	1	15	9	1	4	11

		Dumping Ground										
4	Local Bodies joined to common facilities (if any)	-	-	0	-	0	-	-	0	0	0	0

Source : MPCB Report

IV) ENVIRONMANTALMAGE COST ON URBAN MAHARASHTRA OF INDIA:

The major objective of the present research study is to compute environmental damage cost in urban areas of Maharashtra state in India, along with its corporation wise scenario

Total Environmental Damage Cost on Kolhapur Municipal Corporation Area

Kolhapur Municipal Corporation is one of the municipal corporations in Western Maharashtra. It is famous on various grounds. The present research study has computed environmental damage cost in Kolhapur Municipal Corporation by applying both the impact pathway approach as well as contingent valuation method. It is presented in table below.

Table No. 12: Total Environmental Damage Cost on Kolhapur Municipal Corporation Area

Sr. No.	Factor	Damage cost (Rs.)	Percent	Study Period (Rs.)	Cost on Working Population	Cost on Total Population	Per Capita cost
1	Health Cost	508050	53	5080500	1459992000	2433320000	5080
2	Damage Cost of Agriculture	80200	8	802000	230494800	384158000	802
3	Damage Cost of Fisheries	95239	10	952390	273604800	456008000	952
4	Damage Cost of Plants & Trees	44940	5	449400	129042600	215071000	449
5	Damage Cost of Buildings , Cars, Fabrics	40212	4	402120	115534800	192558000	402

6	Damage Cost of Industry	188000	20	1880000	540312000	900520000	1880
7	Total	956641	100	9566410	2748981000	4581635000	1880
8	WTP	2637978		26379780	36657342288	61095570480	105519
9	WTA	4057200		40572000	56378851200	93964752000	162288

Source: Computed by the Researcher

From the data in above table, it is observed that as per impact pathway approach total environmental damage cost in Kolhapur Municipal Corporation stood at Rs. 9,56,641 for the respondents for a year, which was 3% of Kolhapur district income. It amounted to Rs. 9566410 for the total study period from 2001-02 to 2010-11, which is also 3% of Kolhapur district income. But total environmental damage cost for the total population of Kolhapur Municipal Corporation area is worth of Rs. 4581635000, which is 2% of Kolhapur district income, with Rs. 1880 per capita. Total environmental damage cost in Kolhapur Municipal Corporation was dominated by health damage cost (53%), which is followed by industry damage cost (20%), fishery damage cost (10%), agriculture damage cost (8%), plants & trees damage cost (5%), and buildings, cars & fabrics damage cost (4%).

The contingent valuation method (CVM) based on the willingness to pay (WTP) has estimated total environmental damage cost at Rs. 26,37,978 a year, and Rs. 2,63,79,780 for the total study period, which stands at 9% of Kolhapur district income. It is amounted to Rs. 61,09,55,70,480 for the total population of the Kolhapur Municipal Corporation area, and it is 20% of Kolhapur district income. The contingent valuation method by taking into consideration the willingness to accept (WTA) estimates total environmental damage cost worth of Rs. 40,57,200 a year for the respondents and Rs. 4,05,72,000 for the total study period, which is of the level of 2% of Kolhapur district income. It is for the total population of Kolhapur Municipal Corporation area amounted to Rs. 93,96,47,52,000, which is 31% of Kolhapur district income and Rs. 1,62,288 per capita. It is revealed that the citizens of Kolhapur have borne huge economic burden of environmental degradation is a thing of concern.

Total Environmental Damage Cost on Pimpri-Chinchwad Municipal Corporation Area

The Pimpri-Chinchwad Municipal Corporation is an industrially developed municipal corporation. It is found that the area under Pimpri-Chinchwad Municipal Corporation is environmentally degraded to the significant extent. Taking into account the extent of environmental degradation this study has computed environmental damage cost in Pimpri-

Chinchwad Municipal Corporation area in both the ways, i. e. impact pathway approach, as well as the contingent valuation method.

Table No. 13: Total Environmental Damage Cost on Pimpri-Chinchwad Municipal Corporation Area

Sr. No.	Factor	Damage Cost (Rs.)	Percent	Study Period (Rs.)	Cost on Working Population	Cost on Total Population	Per Capita Cost
1	Health Cost	493150	55	4931500	2976351600	4960586000	4931
2	Damage Cost of Agriculture	1500	.16	15000	9054000	15090000	15
3	Damage Cost of Fisheries	95212	11	952120	574627200	957712000	952
4	Damage Cost of Plants	80100	9	801000	483483600	805806000	801
5	Damage Cost of Buildings, Cars, Fabrics	135636	15	1356360	818481600	1364136000	1356
6	Damage Cost of Industry	89500	10	895000	540222000	900370000	895
7	Total	895098	100	8950980	5402220000	90033700000	8950
8	WTP	1129200		11292000	27263404800	45439008000	45168
9	WTA	3628400		36284000	87604089600	146006816000	145136

Source : Computed by the Researcher

According to impact pathway approach total environmental damage cost computed at Rs. 8,95,098 a year for the respondents, and Rs. 89,50,980 for the total study period. It is worth of 8% of Pune district income. For the total population of Pimpri-Chinchwad Municipal Corporation area, it stood at Rs. 90,03,37,00,000 and Rs. 8950 per capita. It stands at 47% of Pune district income. It is dominated by health cost (55%).

The contingent valuation method by considering the willingness to pay estimates total environmental damage cost at Rs. 11,24,200 a year and Rs. 1,12,92,000 for the total study period, which is 1.25% of Pune district income. But it arrives at Rs. 45,43,90,08,000 for the total population and Rs. 45,168, which is 4% of Pune district income. When the willingness to accept is considered, total environmental damage cost in Pimpri-Chinchwad Municipal Corporation amounts to Rs. 36,28,400 a year, and Rs. 3,62,84,000 for the total study period, is 3.46% of Pune district income. But it is worth of Rs. 146,00,68,16,000 for the total population of the Pimpri-

Chinchwad Municipal Corporation area, and Rs. 1,45,136 per capita, is 14% of Pune district income.

Total Environmental Damage Cost on Pune Municipal Corporation Area

Pune Municipal Corporation is the second municipal corporation after Pimpri-Chinchwad Municipal Corporation in Pune district. It is also a rapidly growing city along with the development of industry and service sector activities. The picture of environmental damage cost in Pune Municipal Corporation is shown in table below.

Table No. 14: Environmental Damage Cost on Pune Municipal Corporation Area

Sr. No.	Factor	Damage cost (Rs.)	Percent	Study Period (Rs.)	Cost on Working Population	Cost on Total Population	Per Capita cost
1	Health Cost	510650	70	5106500	10418280000	17363800000	5107
2	Damage Cost of Agriculture	4500	0.62	45000	91800000	153000000	45
3	Damage Cost of Fisheries	95212	13	952120	1942080000	3236800000	952
4	Damage Cost of Plants	29616	4	296160	603840000	1006400000	296
5	Damage Cost of Building, Cars, Fabrics	81780	11	817800	1668720000	2781200000	818
6	Damage Cost of Industry	2650	1	26500	55080000	91800000	27
7	Total	724408	100	7244080	14779800000	24633000000	7245
8	WTP	1206000		12060000	98409600000	164016000000	48240
9	WTA	2896800		28968000	236378880000	393964800000	115872

Source : Computed by the Researcher

The impact pathway approach estimates total environmental damage cost at Rs. 7,24,408 a year, and Rs. 72,44,080 for the total study period from 2001-02 to 2010-11, which is 7% of Pune district income. It is Rs. 24,63,30,00,000 for the total population in the area under Pune Municipal Corporation, and Rs. 7425 per capita, which is 2.36% of Pune district income. It is no doubt, a huge economic burden of environmental damage. It is dominated by health cost (70%), which is followed by fisheries damage cost (13%), buildings, cars & fabrics damage cost (11%), plants & trees (1%) and agriculture damage cost (0.62%).

The contingent valuation method based on willingness to pay of the respondents estimates total environmental damage cost at Rs. 12,06,000 a year and Rs. 1,20,60,000 for the total study period only for the respondents under study, which is 1.15% of total Pune district income. For total population of the Pune city, environmental damage cost stands at Rs. 164,01,60,00,000 with Rs. 48,240 per capita, is 16% of Pune district income. On the contrary, total environmental damage cost the contingent valuation method based on willingness to accept estimates at Rs. 28,96,800 a year, Rs. 2,89,68,000 for the total study period, which stands at 3% of Pune district income for the respondents only. When it is considered in the context of total population of the Pune city, environmental damage cost is worth of Rs. 393,96,48,00,000, and Rs. 1,15,872 per capita is of 38% level of Pune district income. It is a thing of serious concern, which demands due attention towards its control through appropriate measures.

Environmental Damage Cost on Sangli-Miraj-Kupwad Municipal Corporation Area

Sangli-Miraj-Kupwad Municipal Corporation is a recently originated municipal corporation in Sangli district of the Western Maharashtra. Total environmental damage cost and its breakup in Sangli-Miraj-Kupwad Municipal Corporation area is shown in table below.

Table No. 15: Environmental Damage Cost on Sangli-Miraj-Kupwad Municipal Corporation Area

Sr. No.	Factor	Damage Cost (Rs.)	Percent	Study Period (Rs.)	Cost on Working Population	Cost on Total Population	Per Capita Cost
1	Health Cost	519450	70	5194500	2265020000	2265020000	5195
2	Damage Cost of Agriculture	15560	2	155600	68016000	68016000	156
3	Damage Cost of Fisheries	95212	13	952120	415072000	415072000	952
4	Damage Cost of Plants	59436	8	594360	258984000	258984000	594
5	Damage Cost of Building, Cars, Fabrics	32664	4	326640	142572000	142572000	327
6	Damage Cost of Industry	20640	3	206400	89816000	89816000	206
7	Total	742962	100	7429620	3239480000	3239480000	7430
8	WTP	1050000		10500000	10987200000	18312000000	42000
9	WTA	4300800		43008000	45003571200	75005952000	172032

Source: Computed by the Researcher

It is observed that impact pathway approach computes total environmental damage cost at Rs. 7,42,962 a year, and Rs. 74,29,620 for the total study period from 2001-02 to 2010-11 only for the respondents into consideration, is 4% of Sangli district income. It is Rs. 323,94,80,000 for the total population of Sangli-Miraj-Kupwad Municipal Corporation area, and Rs. 7430 per capita, is 2% of Sangli district income. Total environmental damage cost in Sangli-Miraj-Kupwad Municipal Corporation area is dominated by health damage cost (70%), which is followed by fishery damage cost (13%), plants & trees damage cost (8%), buildings, cars & fabrics damage cost (4%), industry damage cost (3%), agriculture damage cost (2%) respectively.

The contingent valuation method by taking into account the willingness to pay of the respondents estimates total environmental damage cost in Sangli-Miraj-Kupwad Municipal Corporation area at Rs. 10,50,000 a year, and Rs. 1,05,00,000 for the total study period from 2001-02 to 2010-11 for only the respondents, which is 6% of Sangli district income. When willingness to pay is taken into account, then total environmental damage cost in Sangli-Miraj-Kupwad Municipal Corporation area is amounted to Rs. 18,31,20,00,000 with Rs. 42,000 per capita, is worth of 10% of Sangli district income. On the contrary, environmental damage cost on the basis of willingness to pay stands at Rs. 43,00,800 a year, and Rs. 4,30,08,000 for the total study period only for the respondents, is 2.36% of Sangli district income. It is for the total population arrives at Rs. 183,120,00,000 and Rs. 42,000 per capita is of the level of 10% of Sangli district income. The estimates of total environmental damage cost in the Sangli-Miraj-Kupwad Municipal Corporation area indicates that environmental degradation is economically highly burdensome for the society. The consideration of willingness to accept estimates total environmental damage cost at Rs. 43,00,800 a year, Rs. 4,30,08,000 for the study period only for the respondents, is at the level of 2.35% of Sangli district income. But it is worth of Rs. 75,00,59,52,000 for the total population, and Rs. 1,72,032 per capita, which stands at 41% of Sangli district income.

Environmental Damage Cost on Solapur Municipal Corporation Area

Solapur Municipal Corporation is a municipal corporation in Western Maharashtra. It is also highly populated with rapidly growing number of vehicles in the city. It is also suffering

from a significant extent environmental degradation, hence environmental damage cost. The details about its environmental damage cost are given in table below.

Table No. 16: Environmental Damage Cost on Solapur Municipal Corporation Area

Sr. No.	Factor	Damage Cost (Rs.)	Percent	Study Period (Rs.)	Cost on Working Population	Cost on Total Population	Per Capita Cost
1	Health Cost	398900	69	3989000	2089438200	3482397000	3989
2	Damage Cost of Agriculture	31140	5	311400	162901800	271503000	311
3	Damage Cost of Fisheries	95212	17	952120	498657600	831096000	952
4	Damage Cost of Plants	31140	5	311400	162901800	271503000	311
5	Damage Cost of Building, Cars, Fabrics	7560	2	75600	39808800	66348000	76
6	Damage Cost of Industry	10300	2	103000	53951400	89919000	103
7	Total	574252	100	5742520	3007659600	5012766000	5742
8	WTP	1160400		11604000	24312700800	40521168000	46416
9	WTA	2980800		29808000	62453721600	104089536000	119232

Source : Computed by the Researcher

According to impact pathway approach total environmental damage cost is amounted to Rs. 5,74,252 a year, and Rs. 57,42,520 for the study period from 2001-02 to 2010-11, which is 2% of Solapur district income. But in the context of total population of the Solapur Municipal Corporation environmental damage cost is amounted to Rs. 5,01,27,66,000 and Rs. 6742 per capital, is of the level of 2% of Solapur district income. Total environmental damage cost in Solapur Municipal Corporation is dominated by health damage cost (69%), which is followed by fishery damage cost (17%), agriculture damage cost (5%), plants & trees damage cost (5%), buildings, cars & fabrics damage cost (2%), and industry damage cost (2%) respectively.

The contingent valuation method based on willingness to pay estimates environmental damage cost in Solapur Municipal Corporation at Rs. 11,60,400 a year, and Rs. 1,16,04,000 for the total study period for the respondents, is 4.35% of Solapur district income. When it is applied to total population environmental damage cost amounts to Rs. 40,52,11,68,000, and Rs. 46,416 per capita, which is 16% of Solapur district income. Besides these, the consideration of willingness to accept computes environmental damage cost at Rs. 28,80,800 a year, and Rs.

2,88,08,000 for the total study period only for the respondents, is 1.10% of Solapur district income. Its application to total population of the Solapur city's environmental damage cost amounts to Rs. 104,08,95,36,000 with per capita of Rs.1,19,232, stands at 41% of Solapur district income. The foregoing analysis clearly reveals that the damage to the environment is significant in Solapur Municipal Corporation area, hence its environmental damage cost is also huge, is a thing of serious concern.

Total Environmental Damage Cost on Urban Maharashtra of India

Western Maharashtra is Pune revenue division of the state of Maharashtra. It comprises of in all five district namely Pune, Satara, Sangli, Solapur and Pune. Environmental damage cost in urban Western Maharashtra means sum total environmental damage costs in Pune Municipal Corporation (PMC), Pimpri-Chinchwad Municipal Corporation (PCMC), Solapur Municipal Corporation (SMC), Sangli-Miraj-Kupwad Municipal Corporation (SMKMC), and Kolhapur Municipal Corporation (KMC) area. Total environmental damage cost in urban Western Maharashtra is presented in table below.

Table No. 17: Total Environmental Damage Cost on Urban Maharashtra of India

Sr. No.	M. C.	Damage Cost (Rs.)	Percent	Study Period (Rs.)	Cost on Working Population	Cost on Total Population	Per Capita Cost
1	KMC	7651819	26	76518190	95785174488	159641957480	277372
	WTP	2637978		26379780	36657342288	61095570480	105519
	WTA	4057200		40572000	56378851200	93964752000	162288
2	PCMC	5652698	20	56526980	120269714400	200449524000	199254
	WTP	1129200		11292000	27263404800	45439008000	45168
	WTA	3628400		36284000	87604089600	146006816000	145136
3	PMC	4827208	17	48272080	349568280000	582613800000	171357
	WTP	1206000		12060000	98409600000	164016000000	48240
	WTA	2896800		28968000	236378880000	393964800000	115872
4	SMKMC	6093762	21	60937620	59230251200	96557432000	221462
	WTP	1050000		10500000	10987200000	183110000000	42000
	WTA	4300800		43008000	45003571200	75005952000	172032
5	SMC	4715452	16	47154520	89774082000	149623470000	171390
	WTP	1160400		11604000	34312700800	40521168000	46416
	WTA	2880800		28808000	62453721600	104089536000	119232
	Total	**26941818**	100	**269418180**	**739112042000**	**1229693750000**	**962717**
	WTP	**7183578**		**71835780**	**207630247888**	**494181746480**	**287343**
	WTA	**17764000**		**17764000**	**487819113600**	**813031856000**	**714560**

Source : Computed by the Researcher

It is revealed that impact pathway approach estimates total environmental damage cost in urban Western Maharashtra at Rs. 2,69,41,818 a year, Rs. 26,94,18,180 for the total study period from 2001-02 to 2010-11 for the respondents only, which is 1.35% of Western Maharashtra income. For the total population, it is Rs. 1229,69,37,50,000 and Rs. 9,62,717 per capita, which is of the level of 62% of Western Maharashtra income, and 14% of Gross State Domestic Product (GSDP), is a huge economic burden of environmental degradation. Total environmental damage cost for the total population of Western Maharashtra is dominated by Pune Municipal Corporation (PMC) (47%), which followed by Solapur Municipal Corporation (16%), Pimpri-Chinchwad Municipal Corporation (16%), Kolhapur Municipal Corporation (13%) and Sangli-Miraj-Kupwad Municipal Corporation (8%).

The contingent valuation method by taking into account willingness to pay estimates total environmental damage cost for Western Maharashtra at Rs. 71,83,578 for a year, Rs. 207,63,02,47,888 for the total study period only for the respondents, is of the level 4% of Western Maharashtra income, and 8% of GSDP. When it is calculated with reference to total population it stands at Rs. 494,18,17,46,480 and Rs. 2,87,343 per capita, is 25% of Western Maharashtra income, and 5.5% of GSDP of Maharashtra. On the contrary, when willingness to accept is taken into account total environmental damage cost in Western Maharashtra stands at Rs. 1,77,64,000 a year and Rs. 17,76,40,000 for respondents for the total study period, is of the level of 9% of Western Maharashtra income, and 2% of GSDP of Maharashtra. But when the willingness to accept is considered for the total population of the Western Maharashtra total environmental damage cost stands at Rs. 813,03,18,56,000, and Rs. 714,560 per capita, is of the level of 41% of Western Maharashtra income, and 9% of GSDP of Maharashtra. Total environmental damage cost based on willingness to pay for the total population is dominated by the Sangli-Miraj-Kupwad Municipal Corporation (37%), which is followed by the Pune Municipal Corporation (33%), Kolhapur Municipal Corporation (12%), Pimpri-Chinchwad Municipal Corporation (9%), Solapur Municipal Corporation (9%). Likewise, total environmental damage cost based on willingness to accept is dominated by the Pune Municipal Corporation (48%), which is followed by Pimpri-Chinchwad Municipal Corporation (18%), Solapur Municipal Corporation (13%), Kolhapur Municipal Corporation (12%), Sangli-Miraj-Kupwad Municipal Corporation (9%).

The foregoing analysis reveals that environmental damage cost in urban Western Maharashtra is huge calculated on the basis of both the method, i. e. impact pathway approach, as well as the contingent valuation methods. But the estimates of the contingent valuation method indicate higher environmental damage cost in Western Maharashtra than that of impact pathway approach. Further it is higher for estimates based on willingness to accept than willingness to pay. It is of significant level in comparison with both the income of Western Maharashtra, as well as GSDP of the Maharashtra.

V) CONCLUSION:

Environment is of vital importance for all the living things in general, and human beings in particular. Hence, its protection and conservation is of vital importance. Environment helps in the development of the economy, but development and human activities hamper and deteoriate the environment. Hence, it is of special importance to estimate environmental damage cost to recognize economic burden of the environmental degradation, and more importantly real development of the economy. The present study and its present chapter computes total environmental damage cost along with its components, records that it is significantly higher which demands due attention towards its control and preservation. This also states the polluting parties should be penalised to recover environmental degradation. The study is an eye opener to the polluters as well as to all the people, and consequently to the society as a whole. The estimation of environmental damage cost has the number of policy implications, hence, it is of pivotal significance.

VI) REFERENCES:

Maharashtra Pollution Control Board (MPCB) (2003-04), Annual Report : 2003-04, Mumbai

Maharashtra Pollution Control Board (MPCB) (2005-06), Annual Report : 2005-06, Mumbai

Maharashtra Pollution Control Board (MPCB) (2006-07), Statistics Report : 2006-07, Mumbai

Singh and Shishodia (2007), Environmental Economics : Theory and Applications, Sage Publications Pvt. Ltd., New Delhi

Bhattacharaya, R.N. (Ed.) (2006), Environmental Economics : An Indian Perspective, Oxford University Press, New Delhi

Shayar, U. (2006), Environmental Economics, Oxford University Press, New Delhi

Kolstad, Charles (2010), Environmental Economics, Oxford University Press, New Delhi

Murty, M. N. (2009), 'Water and Air Pollution Abatement : An Assessment Strategies', in Chopra & Dayal, "Handbook of Environmental Economics", Oxford University Press, New Delhi

Santra, S. C. (2006), Environmental Science, New Central Book Agency (P) Ltd., Kolkatta

Misra, Smita (2006), 'Accounting for Costs of Water Pollution Abatement', in "Economics of Water Pollution", Edited by Murty, James & Misra, Oxford University Press, New Delhi

Watkins, Holland, Hurley, Pye (1994), Damage Cots for Air Pollution, DEFRA Final Report, Didcot

Hanley & Spach (1998), Cost-Benefit Analysis and the Environment, Edward Elgar Publishing Limited, Northampton, Massachusetts (USA)

Dasgupta, Purnamita (2004), Valuing Health Damages from Water Pollution in Urban Delhi, Journal of Environment and Development, Cambridge University Press, UK