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LAND USE AND OCCUPATIONAL CHANGE IN TRANS-YAMUNA DELHI

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ABSTRACT

In terms of dissolved oxygen (DO) and biochemical oxygen demand, the water quality of the Yamuna at the point where it enters Delhi is comparable to the requirements that have been established for that water (BOD). The BOD concentration in the Yamuna River has fluctuated between 12 and 51 mg/l during the past few years. The Chemical Oxygen Demand in Delhi ranged anywhere from 50 to 155 mg/l throughout the board. On the other hand, the water quality deteriorates to the point that it is no longer appropriate for any use. This research study presents an analysis of the current condition of the Yamuna River. In spite of the fact that research on land-cover and land-use patterns is still ongoing, there is still a requirement for the production of fundamental land-cover databases that provide quantitative and geographical land cover information. The pollution levels in Delhi have reached an all-time high and will continue to become increasingly harmful for the city's citizens as a result of the city's fast expanding population. It has been determined that Delhi is one of the top ten most polluted cities in the world and that it is susceptible to all types of pollution. The contamination of the Yamuna River has a wide range of negative effects on the natural environment of Delhi. In this study, the land use and cover (LULC) of the past, present, and future are analysed along the Yamuna River. Also, Land Use/Land Cover Change (LULCC) is evaluated based on socio-economic factors.

Key words: *Monitoring, Modelling, Biochemical Oxygen Demand*

INTRODUCTION

For a full comprehension of human ecology, a study of the utilisation of urban land is absolutely necessary. The variables that led to the land structuring assist to comprehend the land use pattern of the current scenario as well as the potential urban growth in the future. In order for humanity to be able to protect the environment for future generations, future planners will need to have an understanding of the inherent contradictions in the patterns of land use and will need to make an effort to stop the further mismanagement of land. The land consists of its geology, topography, hydrology, soils, and communities of plants and organisms, all of which are in constant interaction with one another while also being profoundly influenced by climate and by the actions of humans. Land that is used for urban or built-up purposes, land that is rural, land that is forest land, land that is water bodies, and land that is barren can all be categorised according to their land cover or land use. These categories are capable of being subdivided into even more specific groups. Changing how land is utilised is an extremely difficult and time-consuming task. At sizes ranging from the local to the global, there is a shift in land use and land cover that is both complicated and dynamic. Therefore,

Because of the fluidity and ongoing character of the LULCC issues, it opens up a plethora of doors for research on a variety of different levels. The Yamuna is the Ganges' most important tributary, and it serves a variety of purposes for the local population. It provides irrigation facilities, water supply for home use, water delivery in huge quantities for industrial usage, and a variety of other services. A significant amount of pollution is being released into the Yamuna River in Delhi and the areas surrounding it. The city of Delhi alone is responsible for almost 80% of the pollution that is found in the Yamuna River, making it India's second-most polluted river after the River Ganga. The Yamuna action plan has cost a significant amount of money, yet the attempts of the government to improve the river's water quality have been completely fruitless. It is also the primary supply of drinking water in the city, despite the fact that it is polluted with contaminants such as heavy metals, biological oxygen demand, and dissolved oxygen, etc., which, in the end, have an impact not only on human life but also on animal life.

The levels of pollution are quite high, and this continuing trend poses a significant threat to the people living in the city because the city's population is growing at an alarming rate. The city of Delhi is struggling with pollution on several fronts, including the air, the water, and the land. The whole section of the river in Delhi, from Wazirabad all the way down to Okhla, has very poor water quality. Between Delhi and Agra is a river whose water is so contaminated that it is given the nickname "green soup" due to the colour of the water. The wildlife and aquatic life in the area surrounding the Yamuna River in Delhi are put in a highly precarious position due to the pollution of the water. The Sal and Chir forests are both suffering from a decline in health as a direct result of pollution and a lack of water. If the current levels of water pollution and contamination are allowed to continue, the animal and plant life on earth will soon be on the edge of extinction.

A significant portion of the population places a high level of religious, social, and economic significance on the Yamuna River. The whole distance that the River Yamuna travels from where it begins in the Mountains in the state of Uttaranchal to where it meets the River Ganga at Sangam in the Allahabad district of the Indian state of Uttar Pradesh is about 1376 kilometres. The river enters Delhi at Palla village, which is located close to Wazirabad, and exits the city through Okhla barrage. One of the most fertile regions in the nation is traversed by the River Yamuna; this region is sometimes referred to as the granary of north India. This demonstrates the river's relevance to the local economy. The water that is used for drinking is drawn from the Yamuna River at the Wazirabad Barrage, which is located in the Delhi metropolitan area. Despite the fact that the river has a perennial nature, the water supply in the river is inadequate during the summer months, thus it cannot even meet the requirements of the city. The untreated waste water that is provided by major sewers in Delhi is processed at the Wazirabad water treatment facility. This water comes from Delhi. The National Capital Territory of Delhi is located in northern India at a latitude of 28o12'17" to 28o53'00" and an eastern longitude of 76o50'24" to 77o20'37. The city is at an elevation of around 200 metres above the mean sea level and is a component of the vast North Indian plain that spans the entirety of India. Over 22 kilometres of the Yamuna River flow through Delhi. In order to meet the requirements of a large number of people, Delhi is a megacity that is experiencing an alarmingly rapid population growth. As the Yamuna River is unable to meet Delhi's need for water supply on its own, the Ganga River is now being channelled into the city through a network of additional pipelines. The political, commercial, and cultural heart of the whole nation beats in the capital city of Delhi (Figure 1).

Figure 1. Map of the Study Area

The research is being carried out with the goals of evaluating land use and cover change (LULCC) on the basis of socio-economic parameters; quantifying and analysing the impact of LULCC on the basis of land, water, and air along the river; and establishing a Sustainable Socio- Economic Framework (SSEF) for better land use and cover practises in accordance with Delhi Vision 2021. The study is being carried out along the river Yamuna.

OBJECTIVES

1. To study land use and occupational change in trans-Yamuna Delhi
2. To study geology, topography, hydrology, soils, and communities

RESEARCH METHODOLOGY

The approach for doing the study that was ultimately chosen incorporates characteristics of teamwork as well as the identification of crucial milestones in the problem's comprehension. Methods of sampling that are purposeful, stratified, and random have been utilised in order to carry out the survey. Transformation of land into agricultural, cultivable, or commercial use is one of the parameters utilised in LULCC analysis. In the socio-economic impact study, parameters such as livelihood security and risk are taken into consideration. Temperature, NOx, SO2, CO2, RSPM, SPM, soil and water PH, dissolved oxygen (DO), biological oxygen demand (BOD), and chloride content are some of the parameters that are analysed in order to determine the quality of both the air and the water. On the basis of the Delhi Master Plan vision 2021, the parameters utilised for the Sustainable Socio-Economic Framework (SSEF) study include analysing assets such as forests, cultivable land, air and water, along with infrastructure assets.

LAND USE CHANGE DETECTION

The approach that was taken in the study consisted of several different phases in order to accomplish its multiple aims. The first goal has been accomplished by reading through the different accessible literature and identifying and analysing the elements that have an effect on the past, the present, and the potential future situations. For the second and third objectives, the factors that are affecting the socio-economic transformation, land, air, and water quality of the study area have been identified. As a result of this, different layers have been produced and prepared for this analysis, where the forecasting is done using Matlab programming. When the analysis is finished, numerous cartographic approaches are utilised in ERDAS 9.1, ArcGIS 10, and ArcView 3.2a. These techniques are used to depict the maps in a cartographically accurate manner. The facts have been represented in a clear and concise manner using a variety of figures, charts, and diagrams. On the basis of LISS III, Landsat TM/ETM, STRM-DEM, and SOI toposheet, collected from a wide variety of government agencies and organisations, the Land Use Land Cover data have been collected, classified, and analysed for more than a decade (2001-2012). The physical data came from sources such as Survey of India Publications, Topographical Map 1:50,000, the National Remote Sensing Agency (NRSA),

Hyderabad, and the Central Pollution Control Board (CPCB), New Delhi. The socio-economic data came from sources such as the Census of India Population Totals for Delhi, 1991 and 2001; District Statistical Handbooks; and other similar resources. The data and techniques of remote sensing, as well as geographic information systems (GIS), provided effective approaches to the study of land use concerns, as well as tools for the planning and modelling of land use.

Comparisons were made between the Land Use Land Cover (LULC) maps of 2001 and 2011. The LULC of the studied region had undergone significant transformations. As a result, the interpretation of the data and the analysis of the data are based on a comparison of LULC for various time periods during the course of the 10-year period. The population census and the built-up area were analysed in the first section of this study. In addition to this, the expansive character of the built-up region as well as the loss of both agricultural and forest areas is seen (Fig. 2 and 3).

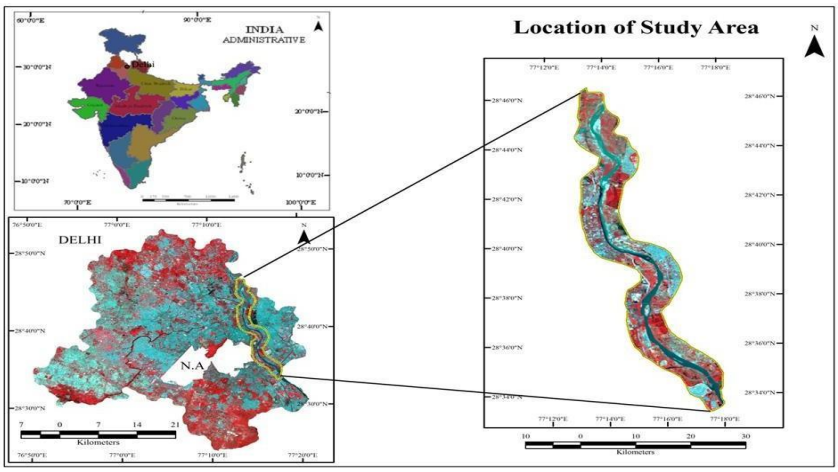

Figure 2. Location of the Study Area

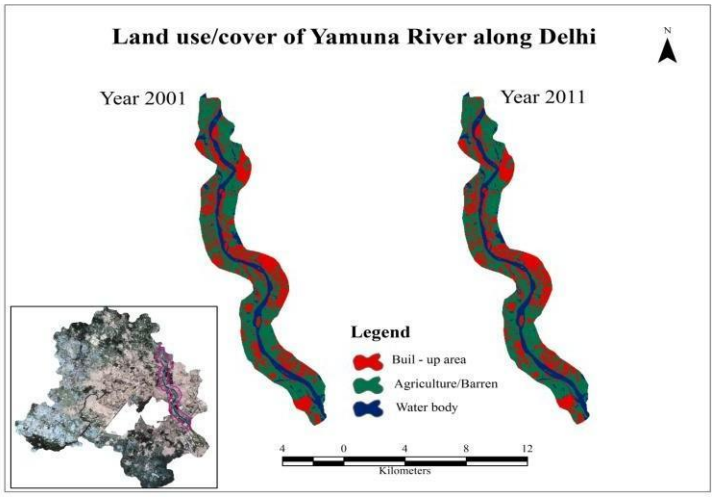

Figure 3. Land Use/Cover Change Yamuna

RIVER SOURCES OF POLLUTION

Waste from homes and businesses, as well as municipal solid waste, are the primary contributors to water contamination in the city. The most significant contributor to the overall level of water pollution in the city is

the household source, which accounts for around 80% of the total water pollution. The sewage that is produced by urban agglomerations is the primary contributor to the pollution caused by household sources. The high volume of sewage waste that is produced in Delhi is mostly attributable to the large number of illegal colonies that can be found in the city. Slums are home to about forty percent of Delhi's inhabitants, most of whom lack access to the city's most fundamental services. The most significant contributors to pollution in the river are both inorganic and organic sources. The solid trash that is produced in these colonies is discharged either directly or indirectly into the river through numerous drains and tributaries since there is no system in place to collect, transport, or dispose of it in an appropriate manner.

Industries, both big and medium scale, are a significant contributor to water pollution and are ranked as the second most major source of this pollution. They include oil refineries, thermal power plants, textile mills, and food processing facilities.

products, the paper industry, the sugar industry, the leather industry, and so forth. A significant number of these businesses are releasing their waste into the river without first having it treated. Prior to releasing wastewater into the Yamuna River, it is obligatory for these companies to treat the effluent to maintain set standards in order to comply with the environmental legislations. This is required in order for these enterprises to operate legally.

Although the Yamuna's stretch in Delhi only accounts for roughly 2% of the city's total area, it is responsible for approximately 80% of the city's pollution. The Yamuna receives approximately 3,684 MLD (million litres per day) of sewage from the city of Delhi, which is discharged through its 18 drains. Due to the fact that there are 143 illegal colonies, 1080 slums, and villages, the Yamuna continues to serve as a sewage canal, as stated by the Delhi Jal Board. This causes a difficulty for the collecting of sewage water, which then runs into the Yamuna untreated (CPCB). It has been seen that dead animals and people are dumped in the river, which both makes the water more contaminated and renders it unsafe for drinking purposes. Moreover, this practise raises the possibility of disease contamination in addition to having other bad effects on human beings.

STATUS OF WATER QUALITY

The biological oxygen demand (BOD) concentration of the Yamuna River, close to the village of Palla, is typically between 1-3 mg/l, with an annual average of not more than 4 mg/l. This is due to the fact that sewage and waste water are dumped into the river at the point where it enters the city, yet the water that flows downstream is clean and suitable for drinking. The Najafgarh drain is the largest drain in Delhi, and when it empties into the Yamuna River, there is a significant increase in the BOD level. This drain is responsible for about 70 percent of the pollution that is found in the river. The BOD level in the river jumped from 6 to 50 mg/l at the Nizamuddin Bridge; doesn't this indicate that Delhi is the only contributor to the problem? The BOD content was low in some locations; this might be because of the substantial rainfall that occurred in the River's catchment region. The Okhla Barrage is the location in the Delhi basin of the River where the water quality is the worst. In terms of the quantity of pollution that is introduced into the river, Delhi is the city that contributes the most amount, followed by Agra, Mathura, Panipat, Sonipat, Baghpat, and Etawah.

Between Wazirabad and the Okhla barrage, the concentration of dissolved oxygen (DO) in the Yamuna River is at an extremely high level. It also relies on the length of time that it takes for photosynthesis to take place and how long it takes for various animals, plants, and microbes to use it. In aquatic environments, the amount of dissolved oxygen is at its highest during the afternoon, and it is significantly lower during the night, when there is the least amount of sunshine. This difference might be attributable to differences in the sampling size

and the time period. During the dry season, the conductivity of the river was at an all-time high and reached its peak over its entire length; however, this value dropped when there was considerable rainfall. Up to the Hathnikund barrage, the average conductivity was lower than 300 micrograms/cm, but after that, it steadily grew to a level of 500 micrograms/cm all the way up to Palla. The average conductivity was somewhere in the range of around 600 to 1000 micrograms/cm between Wazirabad and Okhla, and Okhla was the location where the highest conductivity was measured. Conductivity was measured to be at its highest at Agra, where it varied from 450 to 2300 micrograms per centimetre. This indicates that there has been a dramatic decline in the quality of the water in the section of the Yamuna River in Delhi that extends from Palla village to Okhla Barrage.

The Yamuna is a river that flows year-round; nevertheless, the drainage basin and the amount of water that flows through the Yamuna River undergo substantial changes depending on the season and the amount of rainfall that is received. Due to this seasonal oscillation, it can be deduced that the level of dissolved oxygen is always higher than the permissible limit in neither of the seasons. At both non-monsoon and monsoon times, the level of biological oxygen demand in Palla is higher than the norms that have been established. There is a very modest rise in pH levels when one travels from Hathnikund to Nizamuddin Bridge. During the monsoon season, levels of ammonia and nitrogen dropped in a good number of the locations. At Nizamuddin Bridge, the BOD level was found to be at its highest point. The lowest levels of ammonia were found at Hathnikund Barriage, while the greatest levels were found close to Nizamuddin.

There were a few areas where DO levels remained high despite the presence of a high BOD concentration; this may be because both eutrophic and septic conditions remained. The standard deviation for COD (which ranged from 3.15 to 33.25), BOD (which ranged from 0.00 to 10.57), Ammonia (which ranged from 0.32 to 10.19) and TKN (which ranges from 0.79 to 11.06) was low at those locations that were relatively clean, whereas it was high at those locations that reflected a significant impact of pollution discharges. There was a wide range of possible values for the standard deviation of DO, from 1.0 to 4.2. Conductivity measurements with higher standard deviations (ranged from 47 to 533). The contribution of these characteristics along the Yamuna stretch fluctuated greatly depending on the space and weather conditions, which were primarily defined by the amount of rainfall.

On the basis of the percentile, the data for each monitoring station were divided into two distinct categories, namely the 90 percentile and the 10 percentile. The pH ranged from 7.74 to 8.96 for 90 percent of the samples, whereas the range was 6.70 to 7.52 for 10 percent of the samples. The concentrations of COD and BOD were found to be within the ranges of 6 to 107 mg/l and 1 to 34 mg/l, respectively. At the downstream location of Nizamuddin, the maximum value of the 90th percentile was found for both COD and BOD. The value of the 10 percentile was anywhere from 1 to 29 mg/l and anywhere from 1 to 7 mg/l, respectively, for each of these parameters. When it came to ammonia and TKN, the results for the 90th percentile ranged anywhere from 0.80 to 27.26 mg/l and 2.01 to 34.68 mg/l respectively. The values for the 10 percentile of ammonia and TKN ranged from below the detection limit (BDL) to 3.82 mg/l and from 0.16 to 7.06 mg/l, respectively. At Nizamuddin Bridge and Agra Canal, ninety percent of the data did not comply to the norm in terms of DO, and at three sites, ten percent of the data reflected that there was no occurrence of the parameter. In addition, data from additional three sites did not satisfy the necessary criteria for ten percent of the total. In terms of conductivity, the 90% and 10% values for the whole river stretch were below 154 to 1846 mhos/cm and 45 – omrr4ato 506 mhos/cm, respectively (CPCB, 2006).

POLLUTION AND HEALTH

The pollution of the river in Delhi has led to hazardous drinking water, which has contributed to an increase in the prevalence of water-borne illnesses in the city. As a result of the declining water quality and the general lack of hygiene, an increasing number of people are falling victim to infectious illnesses. Because dirty water from the surface percolates down into the ground, as well as the fact that filthy water is supplied by hand pumps in Delhi and the areas around the city, underground water in Delhi and the surrounding areas is likewise polluted.

Heavy metals, insecticides, pesticides, different chemicals, fertilisers, and micro particles are only some of the major pollutants that may be found in water; all of these things pose a significant threat to human health. The finest example of a water-borne sickness in Delhi may be found in the year 1055, when around 3000 individuals were infected with the hepatitis E virus and many people in Delhi suffered from its effects. Inadequate water quality is the primary factor contributing to the spread of water-borne illnesses like cholera in Delhi. According to the figures published by the Municipal Corporation of Delhi, around 15% of the water in Delhi is unfit for human consumption and should not be used for that purpose. The problem of contaminated water affects virtually the whole city of Delhi, although the regions immediately next to the River Yamuna are the most severely affected. This problem is particularly acute in the areas of Civil Lines, Karol Bagh, central sections, and many of the colonies in south Delhi. More than fifty percent of the samples were found to be filthy in the southern section of Delhi, making it the area with the greatest level of contamination.

A little less than half of those polled in Delhi stated that they had noticed a rise in the prevalence of water-related illnesses over the course of the past several years. The Nazafgarh drain is the largest of the city's many drains that contribute to water pollution in River Yamuna. This drain alone is responsible for almost 70 percent of the city's total sewage. The city has several drains that contribute to water pollution in River Yamuna.

RESULT

The study of how people see the world around them provides insight into the behaviours of society along with an explanation of the external environment. It is the process by which an individual or a community acquires knowledge about the world by receiving inputs from the environment through his senses and creating an image of that environment. This can happen either on an individual basis or on a collective level. People and organisations relate to their surroundings through their perception, and as a result, they make decisions within the context of the set of factors that they have in their perception. The typical image that he or she conjures up is simplified based on the reasons and experiences that he or she has had in the past. In recent years, geographers have exhibited a greater interest in the spatial pattern of behaviour as opposed to the process of behaviour itself (Davis, 1972). It is generally accepted that a person's personal perspectives, experiences, and preferences are the sources of their spatial behaviour.

The interviews were conducted in accordance with a well-structured questionnaire, which included questions about the respondents' personal characteristics, their level of concern regarding different types of land uses (such as residential, industrial, and commercial), their level of knowledge regarding the development of industries, the types of industries, and the pollution caused by industries, and their level of education regarding industrial pollution. People have been interviewed about the sources of water pollution, their perceptions of the problems and diseases caused due to deteriorating water quality, risk assessment, health hazards, the impact of land use change on human society, the role of government, the effectiveness of the recent water pollution control measures, and suggested penalties against the polluters, along with various prospects in the field of water pollution control. This has been done in order to gain a better understanding of the water quality.

The primary sources of data were used for the majority of this investigation. Individuals in the research region were questioned using a well-structured questionnaire in order to get information on the different socio-economic situations that exist in the area. In order to get a representative sample, residents of Chilla, Patparganj, and Wazirabad were questioned. It was determined that 50 respondents would be chosen from each hamlet, making the total number of respondents chosen 150. After performing the primary survey, stratified random sampling was determined to be the most appropriate method. A little under a third of respondents said that forest land had been turned into built-up areas, while around a third of respondents said that agricultural land had been turned into built-up areas. A response that was given by 10% of participants was that forest area is being turned into barren and waste land. Seven percent or so of respondents expressed concern that once-productive agricultural land was becoming unusable. A little less than 15 percent of respondents said that agricultural and forest land is becoming waterlogged. In addition, interviews were conducted with people to gather information on the altering agricultural seasons and patterns. These points of view are rather fascinating. A little over half of those who participated in the survey had the opinion that there had been a significant shift in the agricultural pattern. This suggests that individuals have an extremely high level of awareness of the shift in agricultural pattern.

About the flooding, individuals were questioned. More than half of those who responded to the survey stated that they believe the danger factor due to floods to be very high. It demonstrates that floods are a significant issue along the Yamuna River in Delhi. Every year, this region suffers the loss of a substantial amount of arable land. The floods in this region, according to the responses of two thirds of the residents, provide very little protection for people's means of subsistence. In this part of the Yamuna river basin, agriculture is quite precarious and based mostly on sustenance in the natural environment. There has been a significant shift in the land use and land cover in this region, which has led to an increase in a variety of different forms of social issues, such as unemployment and criminal activities, among other things. The Yamuna River's Delhi stretch has a worse water quality than the rest of the river. In this particular category, Delhi is alone responsible for roughly 80 percent of the pollution. The portion of the river Yamuna that passes through Delhi has an exceptionally high level of both dissolved oxygen and Biological Oxygen Demand. According to the responses of almost seventy percent of survey takers, the quality of the water in rivers is inadequate for human consumption. The release of sewage waste through drains, trash from industry and agriculture, and other sources are major contributors to pollution. The responses from the people showed that the involvement of the government in river cleanup is minimal. In the same vein, there is a lack of engagement from the community in the effort to fix the problem. Both the Yamuna Action Plan I and the Yamuna Action Plan II have been an abject failure.

MEASURES TO CONTROL POLLUTION

From 1993, the first phase of the Yamuna Action plan has been carried out with the support of financial resources provided by the Japan International Agency. To begin the process of cleaning up the Yamuna River, Phase I of the Yamuna Action Plan was initiated in 1993 at a cost of 682 crore Rs. The Yamuna Action Plan II was initiated in 2003, and its total cost was expected to be 624 crores of rupees. In accordance with these intentions, a great deal of action was made to clean up and make the River more environmentally friendly. On the banks of the river sit a number of water treatment plants that were built specifically for the purpose of treating sewage. Yamuna Action Plan III was initiated in 2011 at a total cost of 1656 crores of Indian rupees. This was due to the fact that the previous plans had been unsuccessful.

Because of an excessive amount of industrialization and urbanisation as well as an increase in the number of building operations, the river has been turned into a drain. It is imperative that the River Yamuna be cleaned up since it serves as a vital life support system for the city of Delhi and other cities around the country. It is imperative that there be widespread knowledge and education in order for government policies to be effectively implemented; only then will there be a chance that the river's water quality will improve. The following are some of the significant actions that need be taken in order to enhance the river's water quality.

CONCLUSION

It is possible, in the end, to draw the conclusion that the engagement of the people is required in order to prevent the pollution of the river Yamuna. The residents of Delhi need to be educated about the dangers of pollution in the Yamuna River and the effects that it has there. Individuals should be educated to become comfortable with the use of new technology. and plans for lowering the amount of pollutants that is being released into the River. It is possible to demonstrate that developing the river bed is the most effective solution to this problem. At the Yamuna Bridge, the government has installed wire fences that are 10 feet high in order to stop people from throwing different objects into the river. The participation of a wide variety of non-governmental organisations (NGOs) is particularly important to the process of raising public awareness. In order to preserve the river, raising public awareness may also be accomplished with the assistance of both electronic and print media.

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