A Review Paper On Study Of Purification Of Holy River Kshipra In Ujjain

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Abstract- *Kshipra is Holy River that originates from the Kakri-Badi (Indore) of Madhya Pradesh and flows across Ujjain city (23°18' N, 75°77' E) which is considered to be geographically, historically, geologically, astronomically and astrologically important. Unlike other river of our country the life line of Ujjain is also facing the consequences of various anthropogenic activities that are leading to its quality deterioration. The present study was carried out to assess the quality status of Kshipra water, so as to have a baseline data for future studies and to plan a management strategy. Water quality was assessed in terms of physical, chemical and microbiological parameters. Physical parameters included pH, temperature, conductivity and opacity, while chemical parameters assessed were Total Dissolved Solid, Total Suspended Solid, hardness (Ca++andMg++) Dissolved Oxygen and BOD. Total coli forms, fecal coliforms, fecal strep to cocci and Total Viable Count (TVC) were taken as microbial parameters. All parameters were studied following standard protocols. Results reveal that value of all the parameters were above the permissible limits laid by WHO/CPCB. Present study brings out the urgency and need for the sustainable management of river Kshipra and there by maintaining sustainability of our society and culture*

I. INTRODUCTION

Water is one of the prime elements responsible for life on the earth and fresh non contaminated water can be a finite resource (Silvia et al., 2012). Clean, safe and adequate freshwater is vital for the survival of all living organisms and functioning of ecosystems, communities and economies (Judite et al., 2012). A river is a natural watercourse in which usually freshwater flows towards an ocean, a lake, a sea or another river. Rivers generally start at a source, like a snow melt (such as a glacier) or a natural spring or the overflow of a lake. A river is a part of the hydrological cycle. Water within a river is generally collected from precipitation through surface run-off, ground water recharge, springs and release of stored water in natural ice and snow packs.

Kshipra River is considered as a Holy River like Ganga by Hindus and the word Kshipra is used as a symbol of purity or sanctity. Holy city of Ujjain is situated on the right of the bank of the river where Simhasta (Kumbh Mela) is held in every 12 years. Simhasta is the religious gathering of Hindus where they worship the river goddess Kshipra and take holy dip in the river water to clean their souls. The Puranas, or ancient Hindu texts, also point that the Shipra river originated from the heart of Varaha, Lord Vishnu's incarnation as a boar. (K.Satish Kumar, 2015) [2]. Shipra is also known as Kshipra or Avanthinadi. The river originates at Kakri Bardi hill of Vindhya Range, 20 km South-East of Indore city near a small village Ujjani 220 31'North and 760East. It flows north across the Malwa Plateau through Dewas, Indore and Gwalior districts of the state and joins Chambal river near Kalu-Kher village (23o53' N and 75o31"E). The overall course of the Shipra river is 190 Km with a catchment area of 5600 km2. Main tributaries of Shipra are Khan River near Ujjain and Gambhir River near Mahidpur. (K. Satish Kumar 2015).

Nowadays river has lost its perennial nature and now runs dry for a period of 5 to 6 months per year. Water of Shipra river is used for drinking, industrial and irrigation purpose and the main land use along the river is agriculture. There are three small dams on Shipra River with total irrigation area of 3703 Km2. (K. Satish Kumar, 2015) [2]. The Kumbh Mela is the Great Religious Bathing Festival of India, celebrated in a cycle of 12 years in the four cities of Prayag (Allahabad), Haridwar, Ujjain and Nashik. The Kumbh Mela in these cities is celebrated as per the specific configuration of the planets. The Kumbh mela in Ujjain is popularly known as Sinhastha due to its special significance since a rare configuration of planets takes place in twelve years with the Sun in the Aries and the Jupiter in the Leo- Sinha Rashi (Arpita Bansal, 2013) [1]. At least 30 million visitors are expected to visit Ujjain during the fair and the government is leaving nothing to chance. Over a span of one month over a 100 million people are estimated to take a dip in Ujjain's Shipra river. Most people pay their respects at the Ram Ghat is Ujjain.

II. THE STUDY AREA

River Kshipra is one of the sacred rivers of India. The river is not perennial now a days and flows only during monsoon months. In the initial stages of the river, its basin is

of dendritic drainage pattern in which there happens to be maximum possibility of water recharging. All the sources of water and geographical continuity of its basin were responsible for continuous flow in the river (Gupta and Gupta, 2009). According to survey of India (1971), there were 178 reservoirs in the Kshipra basin. These reservoirs were constructed on both the slopes of the water distribution lines and parallel to the contour lines thereby supplying water to the tributaries by way of percolation. Due to all these reasons, the river Kshipra was perennial till 1971. Due to the green revolution after 1970, there generated a huge demand of water from irrigation side. That demand was met by underground water leading to drop in ground water table. In the year 2004, an amount equal to 1, 35,369 hectare-metre was drawn from underground storages which exceeded by 834 hectare-metre from its yearly recharge. It seems that the whole basin has come under over-exploited category. During the course of the river from the origin to just 52 before the Ujjain city i. e. up to a distance of about 70 km, some small villages are situated along the bank of the river and two nallahs namely Ashamati and Jijavanti meets it leading to normal additions and abstractions of water. The quality of river water is medium in this stretch. River enters the city at Triveni ghat. Three other important ghats namely Gaughat, Ramghat and Siddhvat ghat are situated on the river before it leaves the city at Kaliyadeh stop dam. After Kaliyadeh stop dam, there are no major inputs of wastewater up to its confluence with River Chambal. The real problem with the river starts as soon as it enters the territory of Ujjain city having a population over five lacs. River Khan is the biggest source of contamination to the River Kshipra carrying high organic content, chemicals and heavy metals generated from Indore city. Eight drains (single/combined) carrying domestic wastewater of Ujjain city also joins it at various locations in this stretch. About half of 110 MLD of wastewater generated is discharged directly into the river. Thus about 20 Km stretch of the river is most critical from pollution point of view and even unsuitable for bathing and therefore needs to be addressed properly. Many of the important ghats like Triveni ghat, Ramghat and Siddhvat ghat are situated in this stretch where hundreds of pilgrims take a holy dip daily. During Simhastha fair, which is organized after every twelve years, about two crores of pilgrims visit Ujjain in a month's time to take a holy dip in the river. Thus about 20 km stretch of the river in the vicinity of the Ujjain city has been chosen under study because of its religious importance

THE SOURCES OF POLLUTION

The sources of pollution in a watercourse may be: Point Sources: It refers to contaminants that enter a waterway through a discrete 53 conveyance, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory or a city storm drain. Non Point Sources: It refers to sources of contamination that does not originate from a single discrete source. It is often the cumulative effect of small amounts of contaminants gathered from a large area. The leaching out of Nitrogen compounds from agriculture land and nutrient runoff in storm water from sheet flow over an agricultural field are examples in this category. The sources of pollution to the River Kshipra are: 1. 'River Khan' joins river Kshipra just upstream of the town near Triveni temple carries industrial sewage and domestic sewage of Indore which is a big industrial town and is only about 55 Kms. from Ujjain. River Khan thus pollutes River Kshipra quite intensely. (Point source) 2. Lakhs of devotees come to take a dip in the sacred river all the year round. As flow recedes after monsoon, every year the quality of river water deteriorates appreciably. (Non point source) 3. Eight main drains meet the River Kshipra during its traverse through Ujjain town. All drains carry mainly domestic sewage generated in the city. (Point source) 4. River water is polluted further directly or indirectly as there are no regular dhobhi ghats. Cremation is done in riverbed itself and ashes are left in the river. People throw flowers, ashes and bones directly in the river after pooja. (Point source) 5. Further, the run-off from the agricultural areas of Indore, Dewas, and Ujjain district within the catchments further aggravates the problem. (Non point source)

MONITORING OF KSHIPRA RIVER AND ITS SOURCES OF POLLUTION

Monitoring of Drains Eight drains (single/combined) carrying domestic wastewater of Ujjain city and merging at different locations are the potential source of contamination to Kshipra River. Therefore, it is essential to monitor the drains qualitatively and quantitatively. For the present analysis, the discharge, pH, DO, BOD and FC data are required. Public Health Engineering Deptt. Ujjain monitors the drains as per their schedule. Some of the data was procured from the deptt. and some data was analyzed as per requirement. Discharge was measured with the help of a V notch while other parameters were analyzed through standard analytical procedures. Monitoring of Kshipra and Khan River The monthly discharge measurement of Kshipra River is done by Central Water Commission, New Delhi. Similarly discharge measurement of Khan River is done by Hydrometerological Department of Govt. of M.P. The discharge data of these two rivers were procured from these departments. It was required to determine values of the parameters prescribed by CPCB for maintaining bathing standard as well as other parameters for assessment of overall water quality of Kshipra and Khan Rivers for summer, monsoon and winter seasons. The

parameters considered are pH, Temp., Turbidity, Total solids, DO, BOD, Phosphate, Ammonia, and FC.

Data Analysis through Water Quality Index Primary data As discussed earlier, the values of individual parameters of pollution do not depict the clear picture of the level of pollution. Whereas, water monitoring for different purposes is well defined, the overall water quality is sometimes difficult to evaluate from a large number of samples and parameters. To overcome these difficulties, a water quality index was developed which is a numeric expression transforming large quantities of water characterization data into a single number representing water quality level (Sanchez et al.2006

(1) A close look at the water quality data of Kshipra River at all ghats indicates that except pH, other parameters like DO, BOD & F C do not satisfy the class 'B' water quality standards as prescribed by CPCB (pH = 6-8.5, DO >5 mg/l, BOD < 3 mg/l & MPN/100ml < 500). Hence river water in territory of Ujjain city is unsuitable even for bathing.
(2) Water quality at station 2 is of medium quality because in that stretch there is no heavy input of waste water. Water quality at stations is of bad quality indicating sudden deteriotion. This is due to merging of River Khan at Triveni sangam whose water is of bad quality. At stations there is further input of domestic waste water from Ujjain city.
(3) Water quality at station slightly deteriotes during winter season. At station water quality is poor in summer. It improves significantly during monsoon and then again deteriotes during winter.
(4) Phosphate is responsible for algal formation. The effect of phosphate is more or less constant at all stations and during all seasons in Kshipra River. Water quality gets lowered to the extent of 5-10% due to the presence of phosphate. However, Phosphate effect is 64 more predominant in Khan River. Hence remedial action should be taken to control phosphate input.

III. RIVER ACTION PLAN

A River action plan is the process to establish policies, procedures, and standards which, wherever attainable, help to restore, enhance and maintain the chemical, physical and biological integrity of the river water and the public trust therein to protect public health, to safeguard fish and aquatic life and scenic and ecological values and to enhance the domestic, municipal, recreational, industrial and other uses of water. The main purpose of an action plan is to ensure that the quality of water covered under the plan is maintained so that existing and future beneficial uses are protected. The plan outlines a programme of action which will ensure the survival of a river. The Kshipra River water is primarily used for bathing purposes. The river water is so polluted that its quality does not even confirm to the bathing standard. The main causes of deteriotion of this river are

(1) Severely reduced flow
(2) BOD load (more than 600% of its assimilative capacity) entering into the river through point and non-point sources
(3) bathing activity of thousands of people daily and
(4) various other miscellaneous sources. Therefore, the interventions proposed should be able to combat with all such problems. The ways to restore river quality is either by a considerable decrease in pollution load from incoming drains or maintaining a substantial flow of water in the river. Artificial aeration and flow augmentation must be incorporated to achieve the standards (Sharma and Singh, 2009).

The water quality of Kshipra River has been continuously degraded all along its Ujjain stretch. The management for restoration of water quality and quantity may include the Proactive approaches i. e. augmenting the 78 river's assimilative capacity of pollutants and Defensive approaches i.e. reducing the concentration of the pollutants. For control and management of water quality, an appropriate analysis and strategy is required to choose the best alternatives.

Usual methods for control and management of water quality in a river, which depends upon the "purposes" and "resources" available, are:

(i) Augmentation of flow from the different upstream sources,
(ii) Controlling of wastewaters,
(iii) Artificial aeration through different devices,
(iv) Treatment of wastewaters before they are actually discharged into the river water,
(v) Combinations of (i) through (iv)

The "purpose" means why the restoration of river water quality is necessary, whether to restore the ecological degradation of the river or the river waters are going to be used for different beneficial purposes. The "resource" means availability of water at the upstream for flow augmentation and economic aspects for treatment of wastewaters.

IV. FLOW AUGMENTATION

Flow augmentation in another term means 'dilution of wastewater', which can be achieved by additional flow to the river from an external source. The additional flow decreases the critical DO concentration in the river by

increasing the flow and the reaction rates and reducing temperature etc. which finally reduces the treatment costs. The external sources could be an upstream storage or an aquifer. The pollutants could also be diluted by increasing the base flow in the river by watershed management. However, as discussed in Chapter 2, the main emphasis is being given on the use of QUAL-2Kw water quality model for calculation of TMDL, dilution flow requirement etc.

Water quality scenario generation: For controlling water quality in a river, the usual alternatives are:

(i) limiting the amount of wastewater discharged into the river;
(ii) Augmentation of flow;
(iii) treatment of effluents before discharging into the river;
(iv) combination of flow augmentation and effluent treatment; and
(v) combination of flow augmentation and artificial aeration through devices, if required.

Keeping the above alternatives in mind the model in this study was applied to frame strategies that would help to keep the water quality of the River Kshipra within acceptable limits. The simulations were done in a stepwise manner to explore how the water quality would change with change in loads as well as environmental modifications, i.e. flow augmentation to the river. Looking to the presence of two major sources of pollution i. e. Khan River and drains, the simulation was done considering four management options: (I) Both Khan River and drains merge with parent channel (Base Case), (II) Only Khan River merge with parent channel and diversion of all drains, (III) Only drains merge with parent channel and divert Khan River and (IV) Complete diversion of both Khan River and drains. All these options were also simulated for limited dilution and artificial aeration. These options are coupled with wastewater reduction as well as flow augmentation and aeration.

Dilution flow requirement during festival days According to Hindu Panchang, one or two festival days are often seen occurring in a month. Bathing in Kshipra on those days is considered to be very auspicious by Hindu people specially villagers. About 50000 to 100000 extra population is reported to be gathering on those days (CDP, Ujjain 2006). Bathing activity of these people will enhance the BOD and FC level in the river to the extent of 10 -20% (CPCB, 1998). The model was run to calculate the dilution requirement to cope up with the extra burden on the river. It was found that it will require about 10 - 20% more dilution water as compared to the normal dilution requirement. The problem may be handled either by flowing this additional dilution water or by chlorination of river water (CPCB, 1988).

Dilution Flow Requirement During Simhasta (Kumbh) Days As described earlier, Simhastha (Kumbh) fair is organized every twelve years at Ujjain. Its duration generally falls in the months of April and May. The next fair will be organized in the year 2016. About 2 to 3 crores of devotees come to Ujjain to have a holy dip in the River Kshipra and to worship Lord Mahakal (CDP, Ujjain, 2006). A CPCB report (1988) related to effects of mass bathing in Ganga River during Kumbh Mela, 1986, narrates that BOD and FC count increases significantly during mass bathing. Pilgrims contribute organic matter and FC by washing their bodies, offering milk, sweets, ghee, flowers, leaves and other materials to the river as a part of worshiping. Also a, large number of pilgrims defecate on the banks of the river. The report states that BOD and FC increases to the extent of 50% and 100% respectively. Adopting these figures for Simhastha fair, dilution flow requirement increases to the extent of about 50%. During 1980 Ardha Kumbh Mela at Haridwar,colifirm density reduced drastically on peak bathing days despite of huge contribution of coliform on that day, even lower than the upstream concentration. This was due to massive chlorination done by the health authorities for the fear of any epidemic during such mass gathering. This proves the effectiveness of chlorination in rivers during mass bathing. Reduction of extra pollutants by way of extra dilution will require a huge amount of water. Such amount of water is not available in the Kshipra basin. Else, a reservoir may be created on the River Gambhir, but it will prove to be very costly. The study suggests chlorination by diffusing bleaching powder at the specified rate in the days of mass bathing which is a simple and economical alternative.

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