Ujjani Reservoir in Pune District, Maharashtra, India: A World Lake Vision Candidate Waiting for Ecological Restoration

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Abstract

Ujjani Reservoir is the terminal water body in the Upper Bhima River Basin. It has huge catchment of 14500 sq. km comprised of intense urban, rural, industrial and agricultural activities which has led to changes in its water quality over period of two decades after its completion about 3 decades ago. There are enough indications that urban discharges in the upstream of Ujjani Reservoir are contaminating the water body. It is noticed that 86% of the quantum of untreated wastewaters discharged into the tributaries of Bhima river is sewage from the twin industrialized cities – Pune and Pimpri Chinchwad having combined population more than 6 million. A strategy has to be developed for the 10 challenges indentified in the Catchment of Ujjani Reservoir based on Integrated Lentic and Lotic Basin Management (IL^2BM) and Citizens Paper on Concepts of Sustainable Development in River Basin.

Key words: Ujjani, urban discharges, eco-restoration, sustainability, ILBM

1. Introduction

Water is the most basic natural elixir of life. It is also the stimulator of the socio-economic and cultural development of humanity on Earth. Although it is a renewable resource, its seasonal availability, spatial and temporal variability calls for implementation of conservation and management strategies to meet challenges emerging out of rising water demands in developed, developing and under-developed countries (Kodarkar, M. S., 1995; World Bank, 2005).

The problem of sustained water supply was globally addressed through construction of small, medium and major reservoirs since the last few decades. These are man-made lakes across the rivers, their tributaries and streams. Management of natural and man-made lakes is a very complex issue owing to wide variations in their geo-climatic conditions. It essentially requires an integrating approach articulated in Integrated Lake Basin Management (ILBM) and the World Lake Vision (WLV), by the International Lake Environment Committee (ILEC), Japan. (Kodarkar, M. S., 2006a, 2006b, 2008).

Among the major problems, incessantly increasing water use in the catchment and enhanced siltation due to changes in land use pattern often lead to alteration of hydrology of the lakes and reservoirs. In addition to this, the release of untreated or partly-treated effluents from urban and industrial sectors together with pollution load from chemical-intensive agriculture has an overall negative environmental impact on water resources (Joshi, Sandeep, 2007a, b).

There is an austere lack of awareness and knowledge about the long-term impacts of such urban-industrial-agricultural processes and their innate impending effects to trigger social conflicts and economic losses. It is evident from many examples worldwide that tangible solutions to environmental problems are not possible simply by making laws, acts and rules; what is needed is the faithful implementation of ILBM in the face of vested interests, expediencies and lack of political will (Joshi, Sandeep, 2007c).

Ujjani Lake near Pune, Maharashtra, India, is a classic case where all the concepts of ILBM can be put to test and be analyzed for understanding different dimensions of ILBM and finding possible solutions for short and long term sustainability of the lake ecosystem.

2. Ujjani Reservoir: Merging of Lentic and Lotic Systems

Ujjani Lake is the terminal reservoir on the river Bhima, the catchment of which lies in the intensively urbanized and industrialized Upper Bhima Basin. The river basin has a slope west to east from High Ridge (Mountains of Sahyadri about 1000 m msl to plains of about 450 msl). Ujjani's catchment has extreme physiographic and agro-climatic variations. The major river is Bhima receiving waters from some major tributaries namely – Mula, Mutha, Indrayani, Ghod, Kukadi, Bhama, Pawana and Vel. The rainwater falling on Sahyadri's crest partly goes to Konkan (towards west) and partly flows to Desh (towards east). A total of 14,500 sq. km of Ujjani's catchment lies in Pune District only (Ranade, Vidyanand, 2007, and internet). The work of this dam was started in 1969 (http://solapur.gov.in/htmldocs/1977/agri_irrigation.html) and completed in June 1980.
Gross Storage of Ujjani Reservoir: 110 TMC
Live Storage of Ujjani Reservoir: 55 TMC
Area at FRL of Ujjani Reservoir: 32500 ha (about)
This lake is an important source of water for Pandharpur – the major pilgrimage centre situated downstream and visited by millions of people throughout the year. Particularly, every year, on two important occasions (Ashadhi and Kartiki) when pilgrims congregate in very large numbers, the Ujjani lake is the major and reliable water source to meet the water

demands. Thus, pollution of Ujjani lake has great consequences for downstream communities.

Fig. 1 Catchment of Ujjani Reservoir

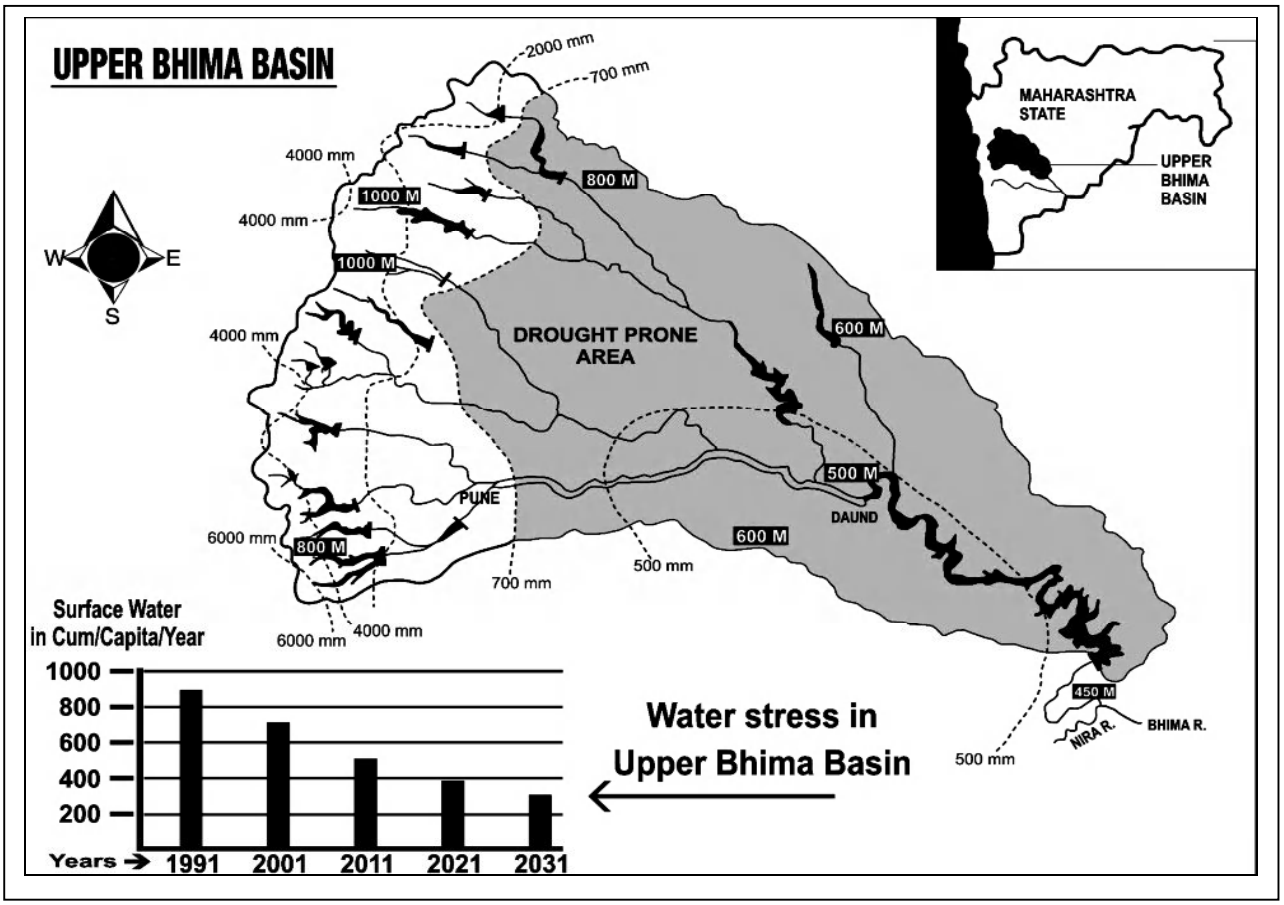
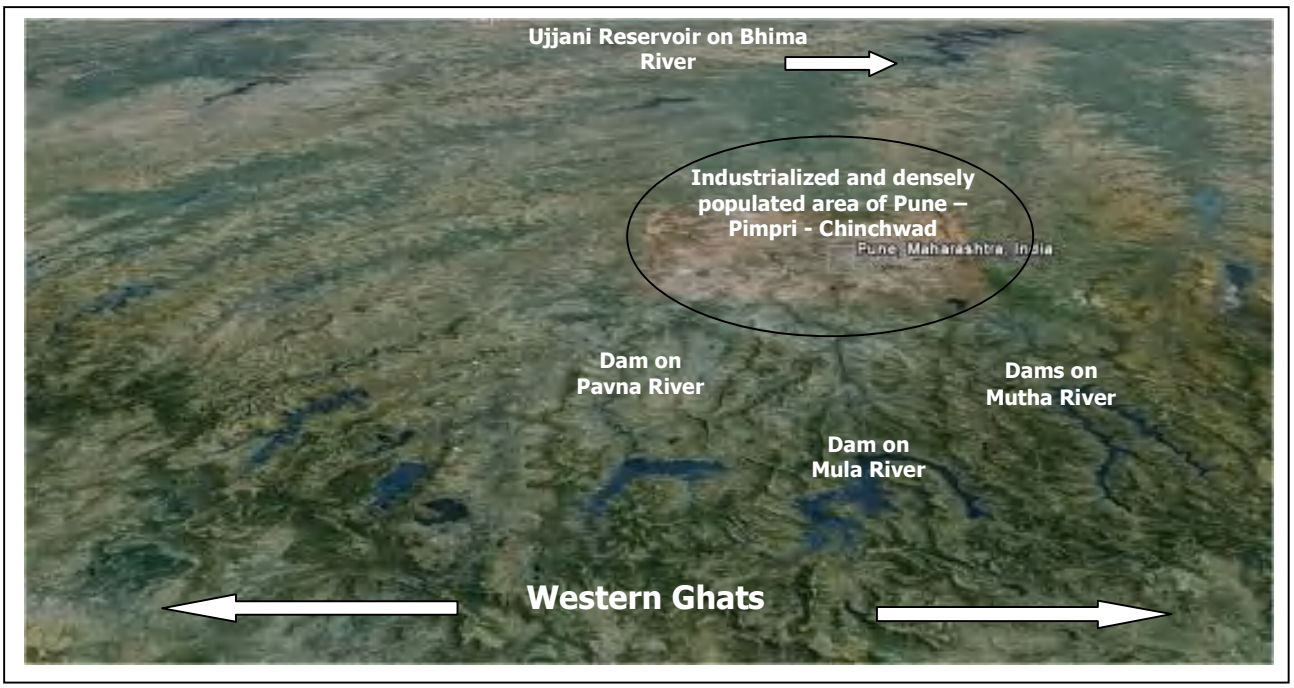


Fig. 2 Waste drains from the upstream urban systems to Ujjani Reservoir

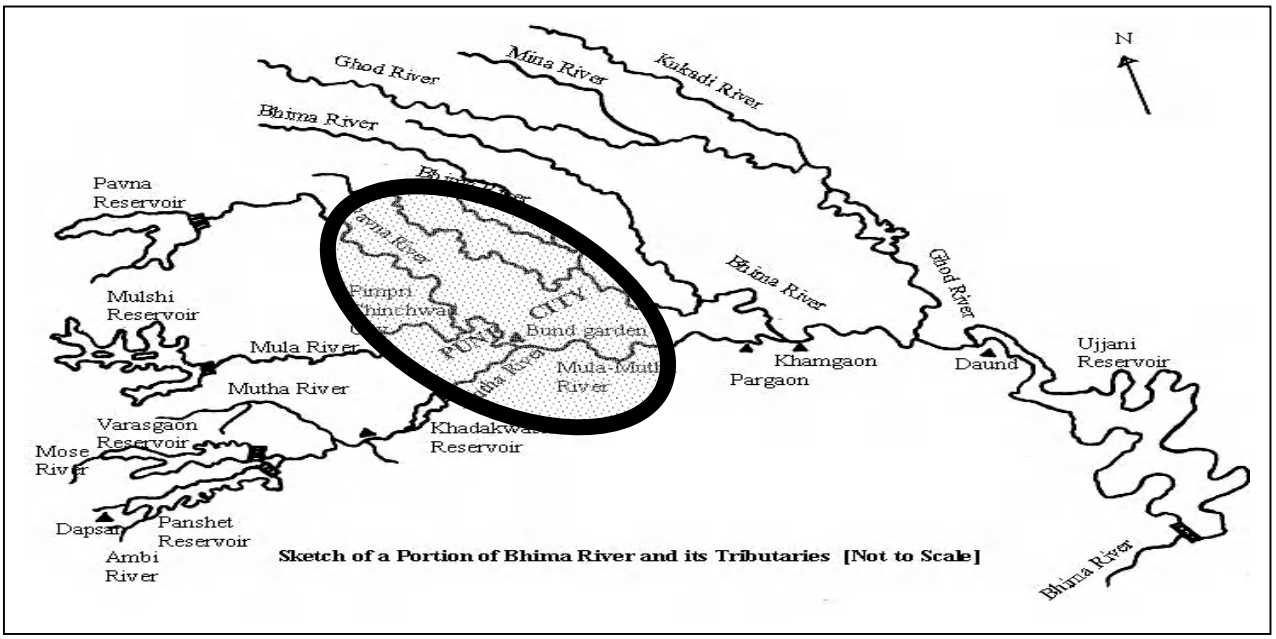


Average rain fall significantly lessens from west (4000 mm) to the east (500 mm). As a part of

water management strategy in Pune District, a number of reservoirs were built on the upper reaches of the basin. Water from the same was mainly allocated for irrigation. However, in recent years, there is a noteworthy swing in water allocation from irrigation to the ever-expanding urban areas.

Upper Bhima Basin can be divided into three zones based on the topography as Northern, Middle and Southern. Three rivers in the northern zone are Kukdi, Mina and Ghod which join Bhima near Dound city. Middle zone has the major river of the basin – Bhima which joins Ujjani lake down Dound city. Southern zone is heavily impounded with 5 reservoirs.

Fig. 3 River System of Ujjani Reservoir

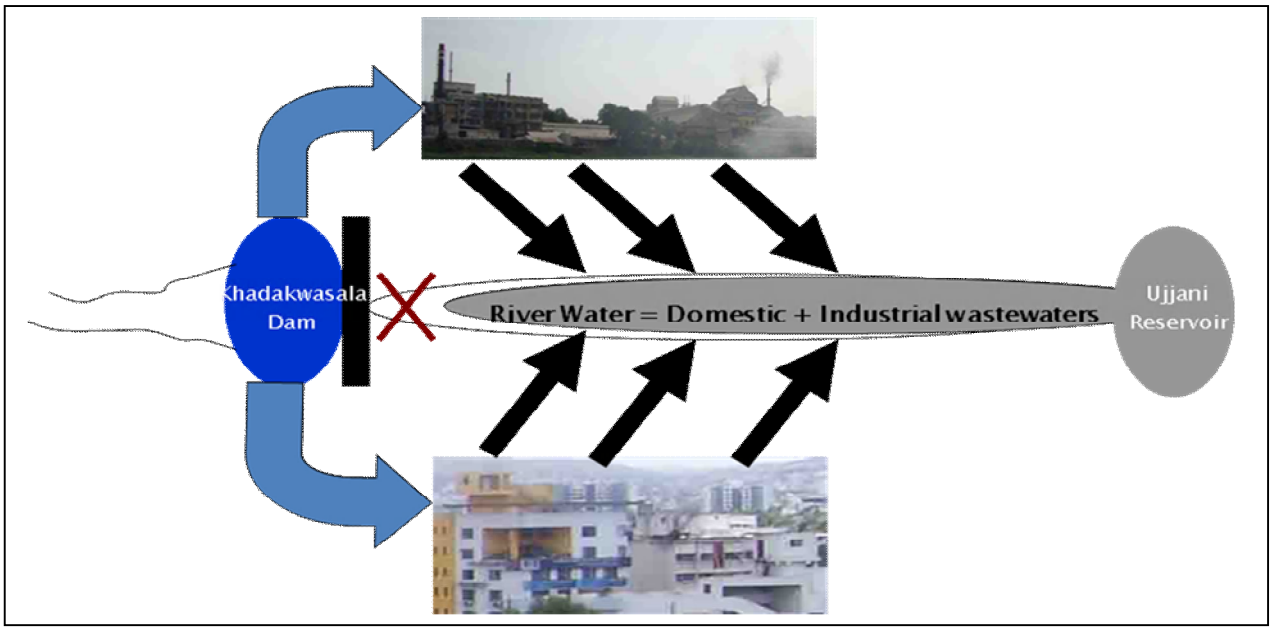


Pavna river having Pavna reservoir, River Mula having Mulshi reservoir and River Mutha having Panshet, Varasgaon, Temghar and Khadakwasla dams finally flow down to meet Bhima River before Daund. Rivers of Upper Bhima Basin are the result of its characteristic topography and they finally join Bhima with terminal Ujjani lake before Pandharpur – a famous pilgrimage centre.

Most of rivers described above are perennial and except for the rainy season carry and assimilate waste from urban areas. The situation is the worst in the Southern zone where Mula-Mutha, highly degraded rivers, carry sewage and industrial waste generated by Pune and Pimri-Chinchwad urban areas, finally polluting Ujjani lake (Joshi, Sayali & Joshi, Sandeep, 2009; Sinha, Pravir and Joshi, Sandeep, 2007).

In this zone at present, major quantum of the stored water in the reservoirs is supplied to *Pune* city and its adjoining *Pimpri-Chinchwad* industrialized townships having combined population moer than 6 million. Further, the fast pace of urbanization and industrialization is putting increasing pressure on available water resources and while share of water for urban areas is increasing year after year, the same is decreasing in the case of irrigation sector. Degradation of rivers due to unplanned growth with unprecedented patterns can be shown in following fig.

Fig. 3 River Pollution in the City and finally in the terminal reservoir



3. Development Vs. Pollution in Ujjani Catchment

Population explosion and industrialization could not be matched by civil systems and services in the Ujjani reservoir's huge catchment totalling about 14,500 sq. km where 56% of the population is residing on just 4% land. Wastes arising from such profusely populated areas finally finds it way down to Ujjani reservoir about 200 km downstream (Supate, A. R., 2008).

It is found that the waste streams from the residential, commercial and industrial establishments finally reach the Ujjani reservoir through the sewage-made perennial rivers and streams in the basin. The tributaries of Bhima River, Mula-Mutha are noted as ecologically ruinous rivers in various scientific and government reports. The reports noted that there were high concentrations of critical pollution and health parameters in the water bodies against the prescribed norms stated by regulatory agencies. In the urbanised areas, water consumption almost tripled in the last 20 years.

Presently it is about 1500 MLD as confirmed by authorities. About 80% of it is released into the urban natural streams as wastewater reaching the rivers. These huge mixed liquors of wastes are drained down to Ujjani reservoir every day in addition to the agricultural runoffs. Water use and wastewater generation has been reported by government agencies in a recently prepared report on Bhima River Pollution Control (Aug. 2010).

Downstream areas, on the other hand, are dependent on this low quality (waste) water released into the river for irrigated agriculture and other water uses. In the last 50 years, the accelerated pace of industrialization has added further stress onto the water quality making waste water un-suitable for any purpose. The polluted water also has an adverse impact on the health of the Ujjani Lake. In addition to human consumption, there is lot of water use for agriculture also. In this area, the sugarcane is major cash crop which dominates the farming practices with lot of use of chemical fertilizers and pesticides. These chemicals finally find their destination - the lakewater.

Their findings incorporating our studies are tabulated as –

Table no. 1 Water Use Balance sheet of Ujjani Basin

Water Availability	Basin Area: 14,500 sq. Km Rainfall: 1000 mm (average assumed considering variability) Total water availability: 14,500,000,000,000 lit./annum (About 40 years' total of requirement of Pune's present population) Net water availability: 7,250,000,000,000 lit./annum (considering the average runoff coefficient of 0.5)

Water-use and wastewater generation (in MLD)

Sector	Total Water Supply	% of Total Human use	Sewage / effluents generated	Treated	Untreated Released in the basin	Treatment claimed %
Pune City (Domestic)	1050	60.86	744	382	362	51.34
Pimpri Chinchwad (Domestic)	360	20.88	255	167	88	65.49
Municipal Councils	63.3	3.67	48.08	3.69	44.39	7.7
Villages	24.29	1.41	16.93	0	16.93	0
Large Scale industries	34.95	2.02	28.22	28.22	0	100
Industrial Areas	145.2	8.41	112.5	110.8	1.7	98.49
Private areas	47.44	2.75	34.9	6	28.9	17.2
Total	**1725.18**	-	**1239.63**	**697.71**	**541.92**	**56.28**

Conclusions

% Water use for modern agriculture annually with respect to net water availability in the basin (about 4,60,000 ha)	76.14
% Water for human activities excluding agriculture annually with respect to net water availability in the basin	8.7
% Wastewater generation = Wastewater/Water Supply x 100	71.86
% Wastewater Treatment = Treated water/wastewater generated x 100	56.28
% Claimed sewage treatment in urban sector of Ujjani Reservoir (With respect to total wastewater generated)	44.59
% Claimed industrial wastewater treatment in industrial sector of Ujjani Reservoir (With respect to total wastewater generated)	11.21
% of sewage in the untreated wastewater flowing into the rivers	86.38

Observations on the available data and water balance sheet

- No data on groundwater consumption for human activities is included due to unavailability.
- If safe drinking parameters (including faecal coliforms) to be considered, then the sewage needs at least 100 times dilution in the river. (Considering the simple disinfection techniques available in the rural areas of Ujjani Reservoir). This much dilution is not available in the Ujjani Basin.
- In the present calculations, the contaminated runoffs from agricultural fields are not considered.

(Modified from Anonymous, 2009 & 2010)

In our studies of Upper Bhima Basin and Pune City, we found that the most clean river stretch was at Temgharwadi and Khadakwasla dam on Mutha River and Kandalgaon on Bhima river. Here, organic matter content in the water was least and even coliforms – indicative organisms for pathogens - were nil. The most polluted locations were on Mutha river in Pune city viz. Vitthalwadi, Deccan, Kumbharwada, Bundgarden, Mundhwa, and Theur (COD in the range of 105 – 255 mg / L). Then, downstream of Theur, the organic

pollution reduces by half where the Mula-Mutha meets Bhima river (about 60 mg / L). Bacterial pollution in the river a result of direct discharge of sewage into the river was high near Vitthalwadi and increased till Theur through Kumbharwada, Bundgarden (more than 1600 no. per 100 ml) etc on Mutha and Mula rivers. Near Rohu on Mula-Mutha river, the bacterial pollution was still high (more than 200 no. per 100 ml). Downstream, the count gradually reduced but the water remained unfit for drinking bacteriologically (Joshi, Sandeep, 2003, 2005 & 2008; Joshi, Sayali & Joshi, Sandeep, 2009).

Fig. 4. Organic Pollution Upstream of Ujjani Reservoir

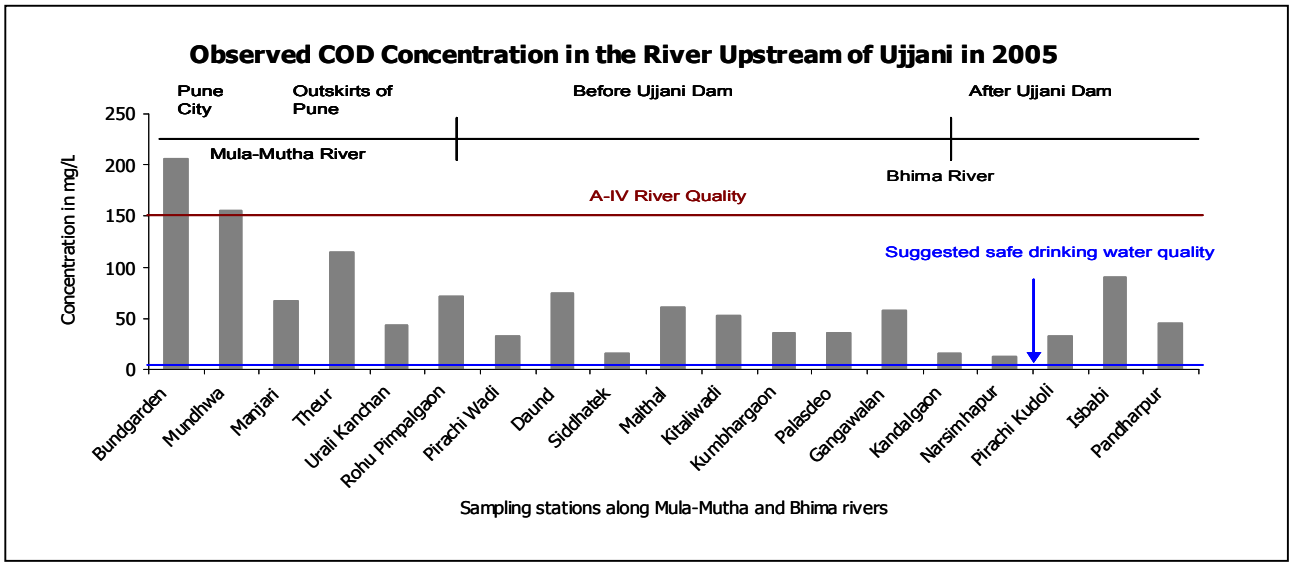
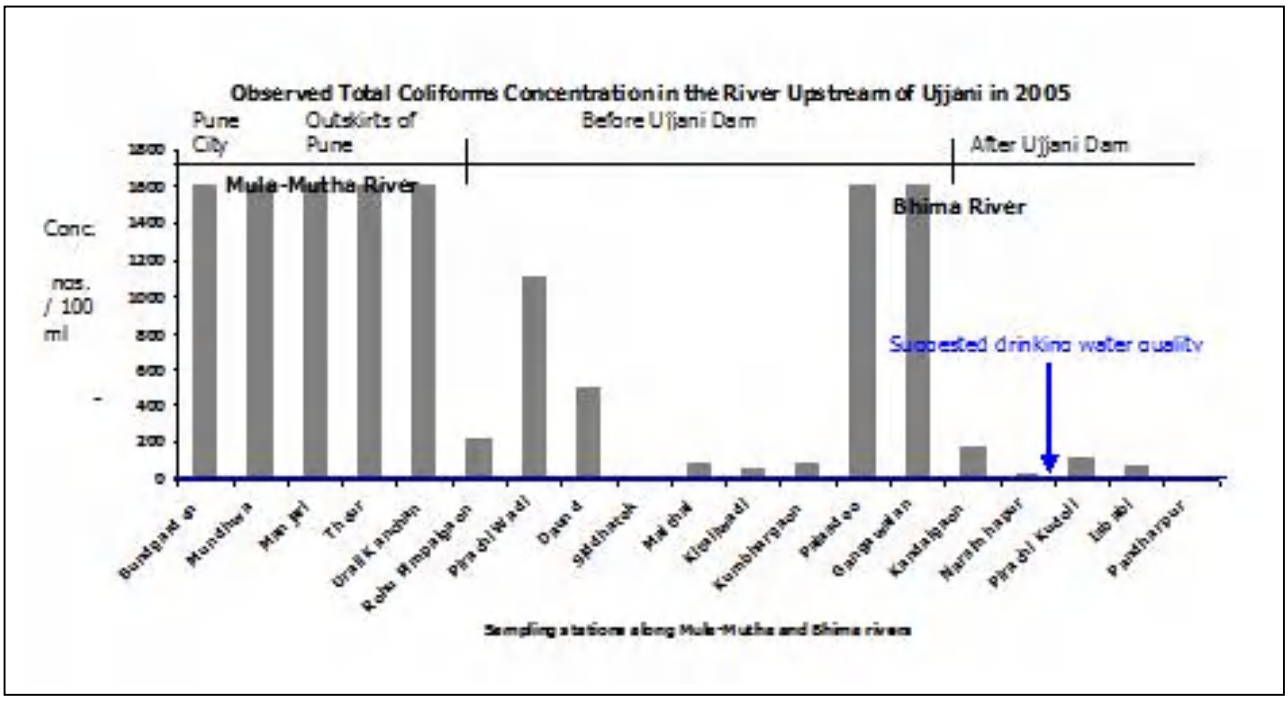


Fig. 5 Bacterial Pollution Upstream of Ujjani Reservoir



It can be stated that the restoration and sustainable maintenance of lake water bodies in and around urban centres need an innovative approach using ecosystem and ecological cycle principles in the modern urban systems. An Urban System with Ecological Security (USES) is

essential to ensure the good water quality downstream of the city. USES is a new concept evolved while studying the pollution of Pune's rivers to assure the ecologically live aquatic systems in the modernised city discharging waste streams into natural water bodies.

Pune's water footprint can be shown in following graph of COD and total coliforms concentration in the river water samples collected in 2005. The river stretch from the entry into Pune till Ujjani dam has been notified by Ministry of Environment and Forests till Ujjani dam (distance is about 200 km) & this means that the water is not suitable for human consumption. From Urali Kanchan, river water is lifted for Purandar Irrigation Scheme. Mula-Mutha river meets Bhima after Rohu. Then, the COD increases suddenly near big towns only.

4. Management of Ujjani Lake and Its Catchment

The water resources development and management in Upper Bhima Basin make it one of the rigorously developed river basins in the country. Most of the rivers and their tributaries in the region irrespective of their sizes have been impounded by now and total water sector development has reached a saturation point. This situation also makes the basin susceptible to water stress due to failure of monsoon or alterations in raining patterns linked with global warming and climate change.

Today, in many regions, it can be observed that agriculture sector receives the sewage and waste water generated by the cities and townships. While allocating higher quantum of water to urban areas, it was agreed that adequate sewage treatment would be carried out before discharging water into rivers. However, this never happened for want of awareness & investments and due to lopsided socio-economic and political priorities. Thus, pollution and environmental degradation of Ujjani lake is basically an issue linked with failure of good environmental governance.

Integrated Lake Basin Management (ILBM) attempts to assist lake basin managers and stakeholders in achieving sustainable management of lakes and their basins. It takes into account that lakes have a great variety of resource values whose sustainable development and use require special management considerations for their lentic (static) water properties.

Good basin management of a lake underlines continuous improvement of lake basin governance that integrates institutions, policy, participation, science, technology and funding. Improvement of the state of lakes can be realized by promoting ILBM, with long-term and strong political commitment.

5. Components of ILBM

As pointed out in the ILEC publication titled ILBM - the experiences learned from the GEF Project - good lake basin management requires:

A. **Institutions** to manage the lake and its basin for the benefit of all lake basin resource uses
B. **Policies** to govern people's use of lake resources and their impacts on lakes
C. **Involvement of people** central to lake basin management
D. **Technological possibilities** and limitations exist in almost all cases
E. **Knowledge** both of a traditional and scientific nature is valuable
F. **Sustainable finances** to fund all of the above activities are essential

6. Ujjani Lake Basin's Key Challenges of Sustainable Management

Challenge 1: Equity vs. Variability and Scarcity

Extreme variability of precipitation and water scarcity makes the UBB, drought-prone. The basin is intensively harvested by constructing 17 major dams in the Western high rain fall zone and this water is supplied to water-scarce downstream region. However, the demand-supply situation has reached a saturation point and any change in this balance can lead to water conflicts.

Challenge 2: Satisfying the changing pattern of competing water demands

Competing water demands in two key sectors viz., ever-growing urban centers and agriculture, have still not stabilized in the Ujjani Basin. Population growth is leading to urbanization on the one hand and demand for more food is putting pressure on agriculture. Balancing the demands of these two key sectors is the biggest challenge in governance.

Challenge 3: Investment for sewage treatment

With increasing water supply to urban areas the quantum of sewage generated is also increasing proportionately. The sewage, if properly treated can be a resource for down stream agriculture. This needs large scale investment in to the sewage treatment infra-structure and sustained budgetary allocation for running costs and maintenance.

Challenge 4: Integration of technologies with eco-technologies – A green approach

The cost-effective and eco-friendly eco-technologies have the potential to complement the technological interventions. As a matter of fact, the whole stretch of river Bhima can be effectively used for sewage treatment through the eco-technological approach. Such an integration of technology and eco-technology depends on change in the mindset of people managing the water resources.

Challenge 5: Tackling the issue of toxic industrial solid and liquid waste (Industrial effluents)

Industrial waste, both solid and liquid, poses a special problem of toxicity depending on in-puts and processes. The waste water generated by industrial areas like Pimpri-Chinchawad in the basin is responsible for making river water unfit for agriculture downstream. Propagation of the concept of Green Industry is essential with zero waste discharge and effective recycle and reuse of the resources.

Challenge 6: Resolution of urban-rural conflict

Increasing supply of water for urban and industrial use around ever growing Pune city has been at the cost of corresponding reduction of supply of water for irrigation. Inadequately treated polluted water is being used for growing seasonal crops and vegetables on large scale. It must be reflecting in the form of poor health and pressure on public health system and loss of productive man-hours and overall health of population.

Challenge 7: Mitigation of pollution impact on Ujjani reservoir and its command

The huge command area of Ujjani reservoir has in it, the very important piligriamge centre, Pandharpur, which is annually visited by millions of people. Pollution of Ujjani has adverse impacts on the health and well-being of those pilgrims and resident population. In the last few

years, farmers in the command have approached courts complaining against inadequate water-supply from the dam even for drinking purpose.

Challenge 8: Protection of Ujjani bird sanctuary

The reservoir has surface area of 29,000 ha and based on its high primary productivity, is showing sure signs of eutrophication. Thus, there is a need for the introduction of sustainable aquaculture. Further, Ujjani Lake is supporting more than 100 species of avian fauna including spoon bills, ibis, shovellers, flamingoes, spot billed ducks, pintails, cormorants, painted storks etc. Pollution of the reservoir is having devastating impacts on the sanctuary.

Challenge 9: Utilization of biological resources of the lake

The lake, due to higher levels of nutrients (Nitrates and phosphates) reaching it through sewage-rich water, is highly productive and this high productivity needs to be channelized for food productivity through scientific promotion of reservoir fishery. The traditional fisherman community associated with the lake needs to be given training in modern techniques for maximization of fish production.

Challenge 10: Development of Eco-tourism, educational activities and awareness campaigns

The lake value can be enhanced through development of eco-tourism by developing recreational facilities. These developments have potential to generate jobs in service sector for livelihood of the otherwise impoverished rural communities.

7. Restoration of Ujjani Reservoir

The Ecosystem approach, along with application of ecotechnological treatment systems, can rejuvenate the self-purification capacity of water bodies and wipe out the impact of water footprint. Government and non-government sectors along with the environmentally aware public can form a better network and institutional mechanism for the water and wastewater management sectors.

7.1. Ecoplanning for the treatment of Wastewater in Ujjani Basin

Presently, the wastewater generation from the Pune – Pimpri Chichwad urban and industrial sectors is estimated as to the tune of 1600 MLD. Development trend is that the cities would double up wastewater generation in next twenty years. Then the energy requirement would be 3000 MW just to treat wastewater with conventional systems.

With the energy crisis reaching new heights today, how would the required electricity be made available for the future waste-treatment systems? Hence, there is a need to look at waste management from the point of view of energy availability and to develop strategic action plans to use the ecosystem approach in the future. A comprehensive Basin Management document "Citizens Paper on Concepts of Sustainable Development in River Basin" can be referred to evolve strategy and action plan for Integrated Lentic and Lotic Basin Management (IL^2BM) (Joshi, Sandeep, Bodhankar, Vinod & Chugh, Narendra et al, 2009).

The issues of IL^2BM of Ujjani Reservoir are diagnosed as –

- Absence of holistic river basin vision resulting in inadequate plans, policies and implementation for catchment area development.
- Current "development-without-foresight" model of ad-hoc development based on limited lentic and lotic system vision ignoring the equitable sharing of benefits by entire population.
- Concentration of wealth by a few and deprivation of many in the lentic and lotic system catchment area due to non-inclusion of each individual as a resource consumer and/or resource dependent entity.
- Absence of integrated interstate catchment/reservoir management leads to disastrous floods and subsequent losses
- Neglecting, ignorance and failure by urban local bodies, corporations, municipal councils, and state governments in seriously implementing/updating policies, laws and development plans with respect to catchment area development.
- Selective implementation of catchment area protection instruments to blatantly serve partisan interests thereby catering to establishment-privatization and political interests.
- Inappropriate existing city and regional plans are unable to protect forests and streams, in the catchment.
- Ruthless destruction of forest tree cover in lentic and lotic catchment area results in heavy erosion and siltation in the rivers and dams thereby seriously compromising the carrying capacity of river and hydraulic volume of the dam. This is "hydro-ecological-imbalance of catchment area" without accountability and with continued incremental ecological and financial losses.
- Encroachment on urban watershed by governments and industries has resulted in severe impairment of ground water recharging processes.
- No honest efforts and support from government to the public initiatives against deforestation, encroachments in catchment area.
- Poor and marginalized communities are displaced from their ancestral lands and deprived of livelihood due to skewed catchment area development. The record and performance of their resettlement and rehabilitation is abysmal.

Following actions would be needed for effective IL^{2}BM -

- Scope of lentic and lotic catchment area development, policy and planning must include – river culture, river science, river engineering, river technology and objective evaluation of sustainable livelihood and growth of every stakeholder inclusive of man, ecosystem and lentic and lotic body.

- Demarcation of lentic and lotic catchment area using modern indigenous technologies and human resources with public participation for definitive mapping uniformly shared across every related ministry, departments, planning divisions, media and citizens' societies.

- Continued compilation, verification, and documentation of information about developmental processes significantly altering the lentic and lotic catchment area.

- Integrated water resources conservation and management for achieving the water balance by implementing afforestation, rainwater harvesting, water recharge, and pollution treatment to avoid inter basin transfers and linking of rivers.

- Efficient administrative and techno-professional institutional mechanism to involve the entire lentic and lotic catchment area populations and organizations in catchment-friendly lifestyle.

- Review and modify existing policies, definitions, laws, rules, regulations and guidelines for catchment conservation, protection and development measures with inputs from all affected stakeholders especially the women and poor, marginalized populations.

- In the wake of limited success of conventional technologies and chemical intervention in maintaining the river clean for sustainable development, the natural ecoremediation potential in the lentic and lotic catchment area must be harnessed and optimized.

- The central, state and local governments shall extend specific support and empowerment for the tasks/projects like – terrace-farming of hill slopes to check erosion and optimize landuse, control of encroachments of river lands, afforestation, protection of biodiversity hotspots in the catchment area, revival of ecological health of the lentic and lotic systems, sensitizing and awakening of river-basin populations to catchment-friendly life-styles and the rehabilitation of displaced and affected population's livelihood.

- Personnel discharging the above project duties of sustaining and protecting catchment area eco-logical health shall be publicly recognized and rewarded.

- Responsibility and accountability of existing state and local self governments in time bound implementation of industrial siting, township locations and agricultural cropping and pricing patterns to ensure intergenerational equity and sustainability.

- Strengthening of auditing system for evaluation of lentic and lotic -catchment area development projects/initiatives by ensuring involvement of societal wisdom and people's participation

- Local geo-cultural factors affecting the health of lentic and lotic catchment area unique to a river basin and identified by societal wisdom and local population must also be considered under the catchment-protection and development laws and rules.

- Violation of rules and regulations of notified and protected lentic and lotic -catchment-areas and components shall be treated as criminal offence. Laws, rules and regulations shall be framed and modified to include provisions to prosecute the violator as criminal attracting non-bailable warrants.

Solutions to achieve ecological health and water balance within the lentic and lotic catchment area, leading to protection of livelihood and to sustainable growth are given as below –

- A definitive shift, in the perceptions/planning, decisions/policy-making and actions/implementations of individuals, institutions and governments, from a limited view of catchment-components to a holistic, inclusive and integrated vision of entire river catchment area as a planning unit. This vision, based on effective publication and dissemination of developmental space-time maps of the catchment, must be seeded into the consciousness and conscience of the entire river-catchment area population through schools, colleges, cultural, general educational and media initiatives which are time-bound and include feedback mechanisms to check the actual impact on the health of the river catchment area under consideration. The general population must be thoroughly educated and alerted to the significance of above river-catchment-area maps as people's resource to immediately report disruption or disturbance of river-catchment eco-system.

- Evolution of stringent legal instruments and accountability audits to precisely implement plans and policies which are intended to ensure the holistic development of the river-catchment area.

- The choice of technology and planning tools should be governed by a study of the natural self-restoration potential of the river-catchment area, the societal memory and wisdom of the local inhabitants and an openness to experienced innovative field-implementation of the above in the light of current local circumstances.

7.2. Treatment of sewage from Residential, Commercial and Institutional Complexes

Urban residential and commercial complexes like apartments, colonies, hotels, shopping malls, multiplexes, hospitals and institutions like schools, colleges, government offices etc can avail the advantages of green channels in and around the premises. Sewage ecotreatment units – vertical ecofiltration systems as green channels along the city roads can be developed. Then it will ease the problem of energy required for sewage conveyance to the outskirts of city for the centralized treatment. It will resolve the issues like rehabilitation of communities affected due to excavation for and construction of sewage pipelines.

Advantages of this scheme in the cities and settlements will be - minimum electricity requirement for pollution treatment and treated wastewater can be use for fountains in the squares, recharging of groundwater, and rivers and at the same time, the plants in it will help in reducing dust and gaseous pollution due to vehicular exhausts. The scheme can be summarized as –

7.3. Basic Principles of Ecological Restoration of Water Body

- Catchment area treatment using Ecosystem Approach – Decentralised treatment of point sources of pollution using Ecotechnological systems.
- All the existing residential and commercial complexes will use zero electricity and low maintenance natural systems to treat their liquid wastes.
- Ecotechnological processes – like bioremediation with phytoremediation, bio-oxygenation and treatment units will be comprised of horizontal filtration – Green Bridge – proprietary technology of SERI, metal screens if required and bio-cells etc.
- The treatment scheme will comprise removal of plastics in addition to what is being done presently. (Screening of floatables).
- Use of floating materials to convert into floating gardens – green plants and their root systems are used as living systems for pollution absorption (Phytofiltration, phytoextraction and phytooxygenation).

7.3.1. Advantages

- Availability of pollution-free water for non-consumptive use
- Clean water for agriculture reducing the accumulation of toxic metals into crops and grains, thereby improving the production efficiency, quality and price
- May reduce the necessity of fertilizers to some extent leading to reduction in farmers' expenses
- Increased biodiversity establishing the agricultural ecosystem for quality production
- Improvement in groundwater quality over a period of time
- Improvement in Air quality in and around the Green Bridge System
- Control of nuisance insects and odour
- Improvement in healthy environmental conditions for the population in the adjacent areas
- No failure of system due to breakdowns and non-availability of electricity
- Site for the ecological tourism and education

7.4. Project Stages

1. Project Conceptualization
2. Project Preliminery Survey
3. Project Gist
4. Identification of Project Stakeholders
5. Project Proposal, Feasibility Report with block cost estimates
6. Detailed site survey of selected treatment stretch, detailed project report with cost estimates for all project activities
7. Budget sanction
8. Indentification of contractors for various activities
9. Cleaning, training and bank stabilization of treatment stretch
10. Installation of screen, green bridges and plantation
11. Review

7.5. Project Components

1. Site identification, land use change notifications/NOCs
2. Development of approach roads if needed
3. Shifting of trees to suitable locations if required
4. Thorough cleaning of nallah stretch selected for treatment
5. Training and bank stablization of treatment stretch
6. Installation of metal screen as per design and instructions
7. Installation of green bridges as per design and instructions
8. Three tier plantation as per instructions
9. Rountine maintenance
10. Reviews

7.6. Rural and Urban Water Resources Management

World is moving ahead with great pace in this 21st millennium towards sustainable development while coping with climate change, having objectives of pure water supply for everybody and complete sanitation to protect environment from pollution.

The corporations, municipal councils of cities and towns, panchayats and local administration of villages with co-operative societies of farmers can be updated, trained and educated for using ecofriendly techniques for their effective waste management – including liquid and solid wastes.

7.6.1 Action Plan shall involve –

- To identify the critically polluted stretches of rivers, streams and lakes
- To undertake water body pollution control projects anywhere in India without any administrative restrictions
- To keep water body under observation till it gets thoroughly cleaned
- To implement innovative techniques in combination with judicious selection of other environmental technologies in removing pollution from the water bodies and ensuring their continued improved ecological health in future
- To develop constantly new techniques best suited to the local conditions, instead of applying monoculture approach
- To guide pollution-monitoring authorities in their respective projects to improve their performance in pollution control activities

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