Reg.No. 307/81.

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To,
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Dear All,

Subject : Article on ILBM of Ujjani lake, Maharashtra, India.

Greetings from IAAB, Hyderabad. At the out set I would like to express my gratitude towards you for the guidance, information and help extended by you during the visit of ILEC team to the Upper Bhima Basin (UBB) in Sept. 2008. The workshop on ILBM of Ujjani lake was particularly very informative for us.

As a follow-up to the UBB visit by the ILEC-IAAB team, we have prepared the document for ILBM-G in Japan. In this context, I would like to request you to kindly go through the brief and give your valuable in puts. Particularly, it will be our effort to project Jal Dindi in a big way on International stage.

The finalized document will be sent to concerned authorities and insitutitons and civil society groups for follow up action. Your efforts will be duly recognized in the form of list of experts who have reviewed the ILBM on Upper Bhima Basin UBB - Ujjani reservoir.

Thanks in advance for your kind cooperation in this effort.

With best regards and good wishes

Dr. M S Kodarkar
Member, ILEC, Scientific Committee,
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ILBM GOVERNANCE PROJECT

INTEGRATED LAKE BASIN MANAGEMENT (ILBM) OF YESHWANTSAGAR (UJJANI LAKE), MAHARASHTRA, INDIA.

Ujjani reservoir, Maharashtra, India

CONTENTS

1. INTRODUCTION :

Water is the most basic natural resource essential for survival of life on the earth. It is also the powerful agent for socio-economic and cultural development of human society. With symptoms of stress already visible, future of man on the planet is closely linked with the way water will be managed in time to come. Fortunately, water is a renewable resource, however, its seasonal availability and wide 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..

In the recent past, the problem of sustained water supply was globally addressed through construction of small, medium and major reservoirs also referred to as man-made lakes across rivers, their tributaries and streams. Such storage reservoirs impound large volumes water for meeting year round demand of the same for competing uses. Although often criticized for their adverse environmental impacts, the lakes and reservoirs have transformed societies all over the world.

Management of natural lakes and man-made reservoirs is a very complex issue solution to which essentially require an integrating approach articulated in the Integrated Lake Basin Management (ILBM) and the World Lake Vision (WLV), by the International Lake Environment Committee (ILEC), Japan. Among the major problems, increased upstream water use, together with fast rate of siltation due to changes in land use pattern and deforestation, often leads to quantitative reduction and qualitative degradation of water in the lakes and reservoirs. Further, release of untreated or party-treated effluents from domestic & industrial sectors and pollutant load from chemical intensive agriculture, has over all negative environmental impact on the water resources. Unfortunately, there is lack of awareness about the long-term impacts of such de-gradative processes and their inherent potential to trigger social conflicts and economic losses. Further, it needs to be emphasized that tangible solutions to environmental problems are not possible simply by making enabling laws, acts and rules but what is needed is faithful implementation of the same in the face of vested interests, expediencies and lack of political will.

Ujjani lake, Maharashtra, India, is a classical case where all the concepts of ILBM can be put to test and in the following pages these issues will be analyzed for understanding different dimensions of ILBM and finding possible solutions for short and long term sustainability of the lake ecosystem.

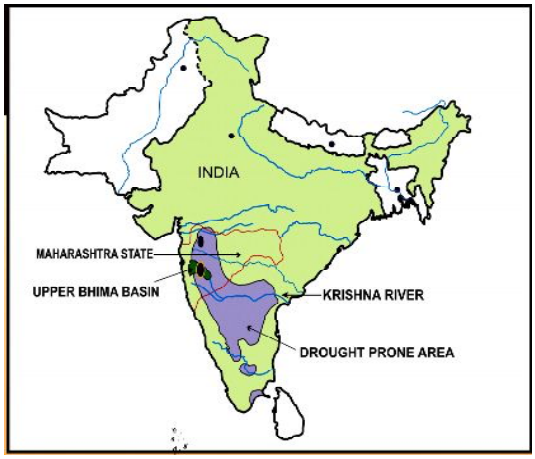


Fig.1A. Location of Upper Bhima Basin (UBB).

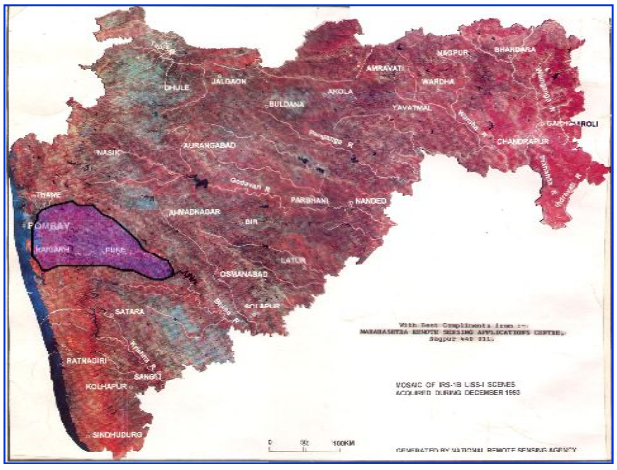


Fig. 1B. UBB deails of physiography.

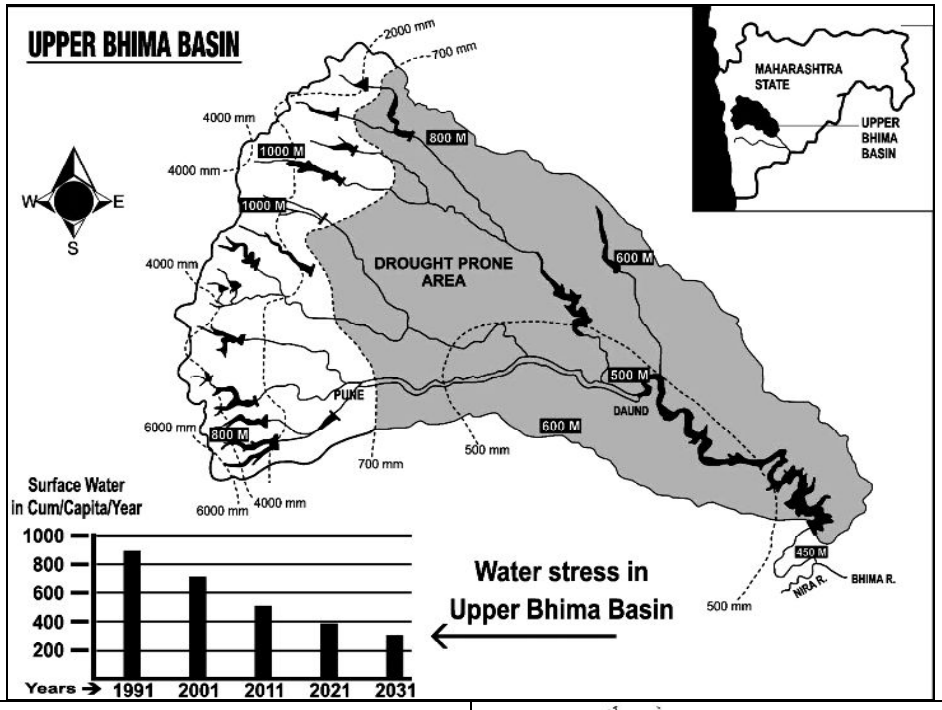
Ujjani lake is the terminal reservoir on the river Bhima the catchment of which lies in intensively developed Upper Bhima Basin (UBB) (Fig. 1and 2). The river basin sloping East (1000 M) to West (450 M) has extreme physiographic and agro-climatic variation. The average rain fall drastically diminishes as we move from East (4000 mm) to the West (500 mm). Historically, as a part of water management strategy, a number of reservoirs were built on the upper reaches of the basin with high rain fall and water from the same was mainly utilized for irrigation. However, in recent years, there is a significant shift in the water allocation from irrigation to ever expanding urban

areas. The down stream areas, on the other hand, are dependent on low quality waste water released in to the river for irrigated agriculture and other water uses. In the last 50 years accelerated pace of industrialization has added further stress on 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.

The lake is an important source of water for Pandharpur – the major pilgrimage centre situated down stream and visited by millions of people throughout the year. Particularly, every year on two occasions (Ashadhi and Kartiki) when pilgrims congregated in a very large number, the Ujjani lake is the major and reliable water source to meet water demands during these two important occasions. Thus, pollution of Ujjani lake has great consequences for downstream communities.

2. UJJANI RESERVOIR AND ITS BASIN, MAHARASHTRA, INDIA :

A. UPPER *BHIMA* BASIN (UBB) :



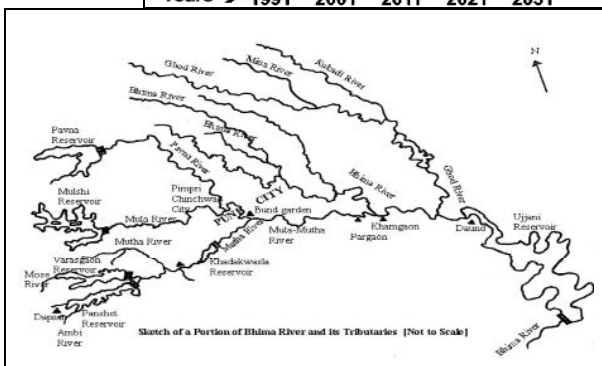


Fig. 2A. The river system in UBB. Major river is the Bhima on which Ujjani reservoir is present.

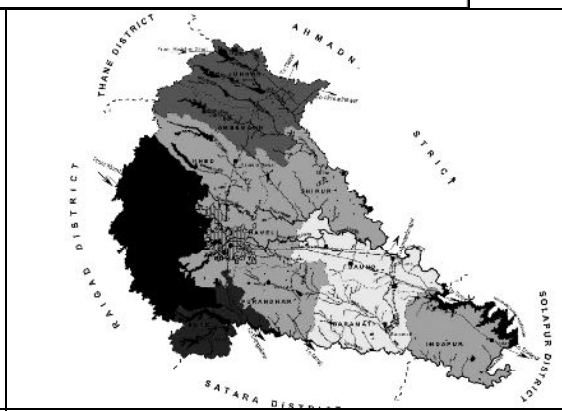


Fig. 2B. The precipitation pattern in UBB. Annual rain fall from 6000 (dark) to 500 mm (colourless).

I. Physiography :

The Upper *Bhima* Basin (UBB) has a catchment of 14,700 km^2 with altitude dropping from 1100 meters in the east to 450 meters towards the west. The important river in the basin is *Bhima*, a tributary of *Krishna* – one of the three major rivers in South India. River *Bhima* originates in *Sahyadri,* the mountain range running North to South along West coast of India and flows in eastern direction finally joining the *Krishna*. The river basin receives most of the rains from South-West monsoon that lasts for a period of four and half months (June to mid-October). The precipitation pattern in UBB is very un-even; while in the western ridge areas the annual rain fall is about 6000 mm and as we move eastwards it declines to 450 to 600 mm. This un-even precipitation coupled with impervious geology, poor ground water storage and evaporative water loss due to high temperature renders almost 60% area of UBB drought prone. The situation also provides an opportunity intra-basin storage and transfer technically feasible and economically viable option. In deed UBB is one of the intensively impounded basins in which irrigation potential to the extent of 63% is already tapped (Table 1).

Table 1. Irrigation potential of UBB.

Reservoirs	Irrigation potential	Number of schemes (completed & in progress)	Irrigation potential in ha	% cultivable area
Major	>10,000	19	3,51,500	31
Medium	2000 to 10,000	4	17,000	2
Minor	<2000	245	91,500	8
	Total	268	4,60,000	41
Ground water potential (recharge, canals, and watershed development)			2,46,000	22
Total			7,06,000	63

Taking advantage of the topography 5 large reservoirs are constructed in the rain intensive hilly region of UBB. They are Parana, Mulshi, Varasgaon, Panshet and Khadakwasla. The region also has a net work of small and big rivers, the main being Bhima on which is impounded the Ujjani lake at the terminal end of UBB.

The riverine environment of UBB can be divided in to three zones based on the topography as Northen, Middle and Southern (Fig. 2A). (A) The three rivers in the northern zone of UBB are Kurdi, Mina and Ghod which join Bhima near Dound city. (B) The middle zone has the major river of the basin – Bhima which joins Ujjani lake down Dound city. (C) The rain intensive southern zone is heavily impounded with 5 reservoirs mentioned above. From Pavna reservoir originates the river of the same name which joins with Mula near Pimpri-Chinchwad. River Mula originates from Mulshi reservoir and flows through Pune city and joins Mutha to form Mula-Mutha in the Pune city. This river finally joins with Bhima near Dound. River Mutha originates down stream of Varasgaon and Panshet reservoirs and is impounded down stream as the Khadakwasla reservoir. The river finally join Mula in the Pune city area. To summarise, the rivers of UBB are a result of characteristic topography of UBB and finally join Bhima with terminal Ujjani lake near Pandharpur. It is worth mentioning here that the names of rivers and reservoirs are bewildering for some one unfamiliar with the region, however, it needs to be understood in the context of ancient civilization that flourished in the region.

Most of rivers described above are perennial and except for rainy season carry and assimilate waste from urban areas. The situation is worst in the Southern zone where Mula-Mutha are highly degraded rivers and carry sewage and industrial waste generated by Pune and Pimri-Chnchwad urban areas finally polluting Ujjani lake. In this zone at present major quantum of the stored water in the reservoirs is supplied to *Pune* city and its adjourning *Pimpri-Chinchwad* industrialized townships. Further, faster 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.

II. Urbanization and industrialization in UBB :

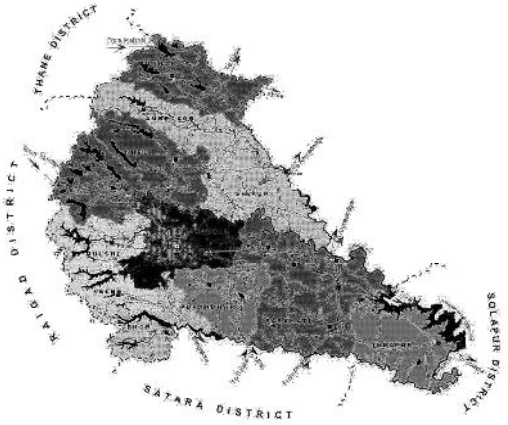


Fig. 3A. Population density in UBB.

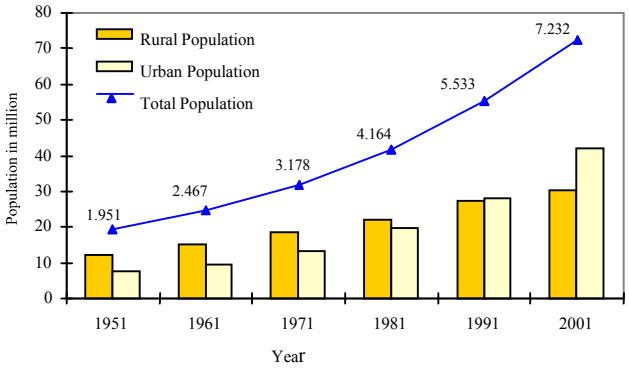


Fig. 3B. Population growth in the UBB.

Table 2. Population growth in Pune district, Maharashtra.

Year	Population in million	Water need in MLD		
I. Pune city under Pune Municipal Corporation (PMC) : Domestic		**Domestic Total**		
1961	0.49	61		
2001	3.00	890		
2021	6.49	1926		
II. Pinpri-Chinchawad Corporation : Domestic and Industrial		**Domestic**	**Industrial**	**Total**
1961	0.4	-	-	7.13
2001	1.0	376	90	466
2021	3.8	664	90	754

In the last 50 years phenomenal urbanization and industrialization is the major development in UBB (Fig. A and B. Table 2). For example, the population of Pune city, biggest in the region, grew from 0.4.95 million in 1961 to 3 million by the end of 2001 and is expected to double by 2021. The corresponding water consumption of the city increased from 61 MLD to 890 MLD and expected to go up to 1926 MLD by 2021. In mid 19th Century Pune city with limited population was dependent on local water resources like Katraj tank, wells and perennial river Mutha but with rising demand of water of the growing urban center, water from Khadakwasla dam was diverted. to augment water supply and further additional water resources were developed in the form of three major impoundments viz., Panshet, Warasgaon and Temghar. The water demand projections by 2021 suggests that almost all water from Khadakwasla complex will be needed for the urban areas in Pune district leaving agriculture sector high and dry.

The picture of second biggest urban agglomeration in UBB i.e. Pimpri-Chinahcwad is similar but with added factor of industrial liquid and solid waste generation. Like Pune, the water consumption of the twin cities also has gone up and is projected to be 724 MLD by 2021. In the last 50 years tremendous boost is given to the process of industrialization in this area (Table 3). Industrialization, no doubt, generates jobs and employment opportunities; its fall out for the environment is seldom given serous thought in the planning process. Nevertheless, with pollution situation getting worst, a number of initiatives are being implemented to mitigate the impact of pollution on the aquatic environment. Strengthening of pollution control laws, further empowerment of State Pollution control Board

(PCB), establishment of Sewage Treatment Plants (STP), Common Effluent Treatment Plants (CETP - Kurkumbh MIDC in Daund), water conservation/harvesting, zero discharge targets for the industries and Common hazardous Waste Treatment, Storage and Disposal facility (CHWTSDF facility - Ranjangaon, Taluka Shirur) are some of the major initiatives taken up in the recent years.

Table 3. Industries in Pune district (2004-05).

No	Industry Category	Type of industry			Total
		Large	Medium	Small	
1	Red	164	84	753	1001
2	Orange	21	54	569	644
3	Green	37	80	1840	1957
	Total	222	218	3162	3602

CREP Industries (MPCB, 2004) :

Paradoxically, the water demand in Upper Bhima Basin (UBB) is not stabilizing; and with increasing water supply to urban areas, volume of waste water generated is correspondingly increasing. For all practical purpose the UBB has reached a saturation point and can be described as water scare basin. On this back drop, failure of monsoon or a change in annual precipitation has explosive potential of conflicts and unrest in the water sector. **Sustainable supply of quality water in adequate quantity and in an equitable way is the real challenge of ILBM in UBB.** This will require better understanding of demands, prevention of losses, recycle and reuse, conservation measures essentially through an integrated approach. The task becomes more urgent with Global Climate Change and its un-predictable consequences for the water sector.

B. UJJANI RESERVOIR :

Ujjani is the terminal lake in the intensively developed Upper Bhima Basin (UBB) and source of water for irrigated agriculture, domestic use and generation of hydro-electricity (Table 4). It was constructed in 1980 and is considered as the boon for water scarce and drought prone plains of UBB (Fig 4). However, in the last few years the lake is facing the problems associated with eutrophication and the water quality has undergone significant deterioration

Table 4. Characteristics of Ujjani reservoir, Mahrashtra.

Land use pattern	
Attribute	**Area in Sq km / million hectors**
Name of the dam and year of construction	Ujjani dam, June 1980
Purpose of the reservoir	Irrigation, Drinking water and hydropower generation
Catchment	14,700 / 1.47
Forest cover	10.1% / 0.149
Uncultivated land	13.6%
Cultivable land	76.3 / 1.222
Land under plough	64.8 / 0.53
Larger picture of Irrigation infra-structure	
Major dams (19)	0.37
Medium/minor dams (214)	0. 09
Ground water	0. 25
Irrigation potential (63% of cultivable land)	0. 71

The hydrology of Ujjani is sustained by the river Bhima which carries heavy pollution load in the form of un-treated or partly treated sewage, industrial effluents and agriculture run off mainly from the southern zone of UBB. In recent years the lake is showing all the classical symptoms of eutrophication due to nutrient enrichment (Table 5).

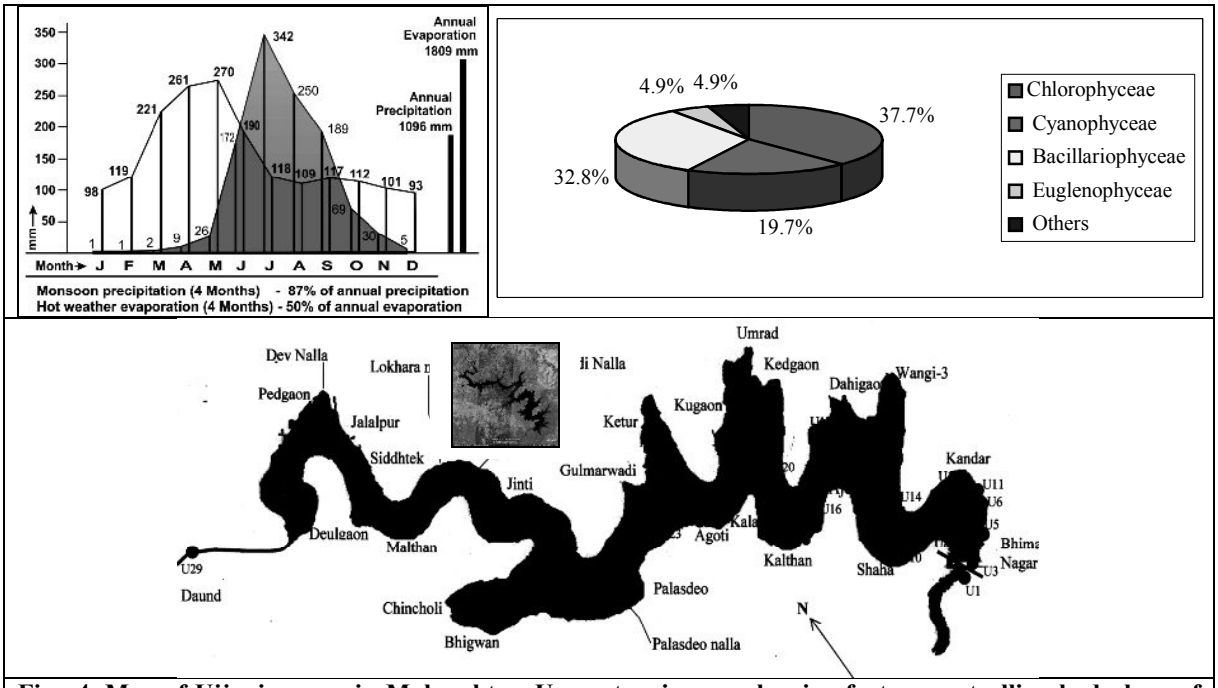


Fig. 4. Map of Ujjani reservoir, Mahrashtra. Upper two images showing factors controlling hydrology of the lake on left side, while composition of algae on the right.

Table 5. Orthophosphate level in Ujjani lake.

Seasons	Ortho-P mg/l				Secchi Depth (m)
	Upper Layer		Deeper Layer		
	Range	Avg	Range	Avg	Range
Early Summer	0.05 – 0.20	0.13	-	-	0.8-1.9
Summer	<0.1 – 0.87	0.10	<0.01 – 1.76	0.37	0.7-1.0
Monsoon/ Winter	<0.1 – 1.36 0.14 – 0.28	0.220.18	<0.04 – 0.31 0.11 – 0.38	0.13 0.19	0.8-2.0 1.5-2.9

A recent study on algae and macrophytes in the Ujjani reservoir has clearly indicated rising trend of cyano-bacteria commonly called as the blue green algae (Fig. 4 & 5). There is wild growth of weeds like *Ipomoea carnea* (Besharam), *Eichhornia crassipis* (water hyacinth) and *Potamogeton* along the bends, curves and broad fringed areas of the lake due to relative water stagnation and accumulation of nutrient rich sediments. It is estimated that more than 10% area of the lake is covered by the aquatic weeds.

3. MANAGEMENT OF THE LAKE AND ITS BASIN :

As far as water resources development and management is concerned Upper Bhima is one of the intensively developed river basins in the country. Almost all small and big rivers and their tributaries in the region are already

impounded and total water development has reached a saturation point. This situation also makes the basin vulnerable to water stress on account of failure of monsoon or alterations in raining pattern linked with global warming and climate change.

The water resources development to begin with was aimed at increasing area under irrigated agriculture in other wise drought prone areas. However, large scale growth of urban centers in the last 50 years with increasing population, expanding industrial sector and improving standards of living, the water allocation priority has shifted from agriculture to urban areas. This also added another dimension in the form waste water .

Today in many areas a point has reached where agriculture is dependent on the sewage and waste water generated by the cities and townships. In the recent past, while allocating higher quantum of water to urban areas, it was agreed that adequate sewage treatment will be carried out before releasing the waste water in to the river. However, this never happened for want of awareness, investments and lop sided socio-economic and political priorities. Thus pollution and environmental degradation of Ujjani lake is basically an issue linked with failure of good governance.

Urbanization is a world wide phenomenon and by 2025 majority of people will be living in urban centers. Further trend of urbanization will continue as people from country side will gravitate towards cities and mega-cities for livelihood and better standards of living. Globally, urban areas have become black holes for natural resources, in turn, only returning pollution to countryside devastating and impoverishing the rural communities. Thus, there is a need of reversing this trend and it can happen only when as advocated by former president of India, Dr A.P.J Abdul Kalam, infra-structure matching urbn standards is created in rural areas. Further, there is a need of rural-urban synergy.

An example of Pune city in UBB can further illustrate this issue. Up to middle of last centuary water need of the city was basically met from local resources like Katraj tank, wells and perennial river Mutha,. However, as the city started growing and existing resources were found to be inadequate, water from up-stream Khadakwasla dam was tapped. Further, rising demand of expanding city was augmented by developing three more reservoirs viz. Panshet, Warasgaon and Temghar. It is note worthy that the improved water supply to city was at the cost of quantum allocated to the agriculture sector. Water-wise Pune is one of the comfortable cities in the country with per capita water supply of more than 200 liters. This supply level is much higher when compared to the water supply ranging between 80 to 120 liters per capita per day in most of the mega-cities in the country. It is interesting to note that in small towns and rural areas in Maharashtra water availability ranges between 30 to 50 liters per capita per day. This marked inequity is the biggest challenge for water governance. Higher investment in infra-structure, recycle and reuse and actions like zero discharge and rain water harvesting could be some of the solutions for addressing present problems.

4. STAKE HOLDERS PARTICIPATION IN THE GOVERNANCE OF UBB – Major impact stories :

4.1. Introduction :

Water is a powerful agent that has profound influence on socio-economic development of a region and people inhabiting it. The role of civil society often referred to as the stake holders or grass root level communities and beneficiaries, in the developmental paradigm has been internationally recognized. It is based on the premise that the local communities know the best that is good for them. Moreover, over a period of time, it is these benefactors who determine long-term sustainability of any developmental arrangement. In the field of environmental conservation South Asia is the most advanced region where tradition and culture sustained by generations of its common people have demonstrated collective will to manage their immediate environment most effectively. Unfortunately in the

recent times most of these traditions have fallen victim to unprecedented challenges posed by population growth, urbanization and global climatic changes. The science & technology and globalization has further altered our way of thinking about and attitudes towards nature and its resources on which we depend for our survival.

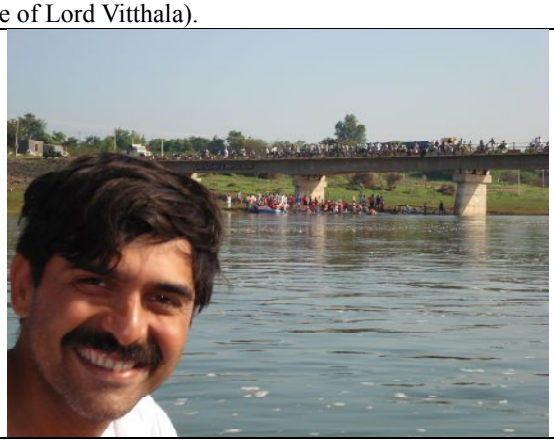
As a colonial legacy, in South Asia the process of decision making still continues to be centralized without much involvement of those who will be directly affected by such decisions. In response to such a predicament civil society has started to organize itself as specific purpose oriented voluntary organizations for asserting their role in the decision making and governance. In future involvement of local grass root communities in these processes will be a major shift in the management of natural resources.

4.2. *Jal Dindi* - Pilgrimage on water : An example how tradition and culture can be integrated in to a movement for conservation of water resources :

A. Introduction : The UBB is cradle of a great civilization that gave birth to *Bhakti* movement roots of which go back to thousands of years. *Bhakti* a spiritual term that can be translated as - single minded and total devotion to the Godhead with a form. In Indian philosophy it is considered as the easier path for self realization and communion with the God. The UBB has a number of cities/towns/villages where foot prints of this great spiritual movement are visible and alive in the form of thousands and thousands simple urban as well as rural people seeking salvation through this path of selfless devotion and service.

One of the interesting traditions of *Bhakti* movement in this part is annual pilgrimage to *Pandharpur* – the abode of lard *Vitthal* also named *Pandurang*, undertaken twice a year in *Ashadha* (July) and *Kartik* (November) months of Indian calendar. The pilgrimage (*Wari*) involves journey on foot from one's place of residence to *Pandharpur,* the pilgrimage destination situated down stream of the Ujjani reservoir. The pilgrimage has a great socio-religious significance for self discovery, social awareness and spiritual fulfillment.

B. The birth of Jal Dindi : On the lines of the foresaid tradition of journey on foot, a group of citizens from Pune city aggrieved by the highly degraded state of rivers in the region, had started a great movement of *Jal dindi* (pilgrimage on water). The annual event taking place since 2002 in the month of October involves voyage along the course of the river *Bhima* from *Alandi* (the small town on the river Indrayani that down streams is called Bhima where Dnyaneswar attained samadhi) to Pandhrapur (the abode of Lord Vitthala).

	
Jal Dindi – Voyage along the river	**Dr. Viswas Yeole, a gynecologist by profession, conceived the idea of Jal dindi**

C. Key organization : The Jal Dindi Pratisthan (Founsdation) : The key organization behind Jal Dindi movement is the *Jala Dindi Pratishthan* (Foundation)

Objectives :

1. Propagation of water literacy among the masses.

2. Study impacts of urbanization and modern agriculture on river, lake and groundwater quality considering river basin as a unit
3. Monitoring regularly the streams, rivers and lakes to access the ecological health. The assessment includes the physical surveys, sampling and testing samples for water quality parameters.
4. Execution of target oriented research programmes related to the riverine ecosystems, pollution, economics and culture
5. Designing and promotion of participatory programme to involve the society at large in preserving, conserving, developing and protecting the freshwater resources in Ujjani lake basin
6. To imbibe the environmental education with ethics with well designed courses and capacity building programmes at school and college levels.
7. To publish books, research papers, abstracts, manuals, newsletters related to rivers, lakes and human interactions with aquatic ecosystems.

Organizations associating with the Jal Dindi : Some of the prominent religious, social, environmental and Governmental organizations include the *Vishwasanskriti* (Global culture) Educational Initiatives (VEI), the *Kasba Ganpati Mandal, Alandi Devasthaan, Vitthal-Rakhumai Devasthaan, Srushti* Eco-Research Institute, Clean River Committee, University of Pune, COEP, and civic bodies like Pune Municipal Corporation (PMC) and Maharashtra Pollution Control Board (MPCB).

D. Route of Jal Dindi :

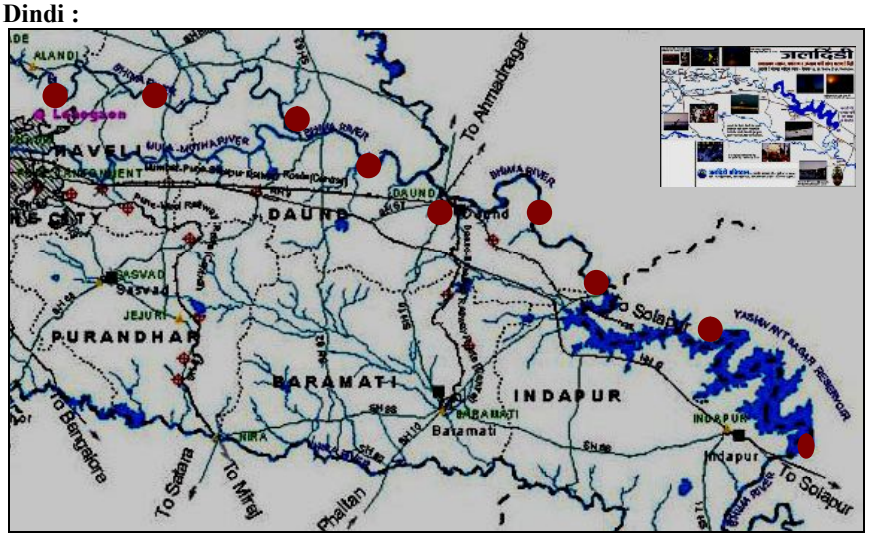


Fig. . The route of *Jal Dindi* along the course of stretche of the river *Bhima*, the major tributary of *Krishna*, a major peninsular river in Southern India.

The annual pilgrimage on water (Jal Dindi) covers a distance of 450 km up to Ujjani reservoir in about 12 days. Enroute the Dindi touches 70 villages on the bank of the river and in the last 7 years has transformed the lives of thousands of villagers. This great silent transformation has taken place through a number of activities undertaken to fulfill three basic objectives of the Jal Dindi foundation viz. health, environment and spiritual development.

E. Highlights of the symbolic and action programmes during Jal Dindi :

I. Kalash pujan (Worship of a sacred pot) :

In Indian culture *Kalash* – the sacred pot – has a special significance as it represents material prosperity and social well being and its worship is undertaken before beginning any socio-economic, religious or culture endeavor. The jal dindi begins from Alandi after representatives of major religions chant lines from sacred religious scriptures and perform Kalash puja (pot worship). Water brought from different resources from surrounding areas is poured in the river as a symbol of commitment to keep water resources clean and with this the Jal Dindi is flagged off. It is a great event and thousands and thousands of pilgrims and people lining on the bank of the river witness it with indelible impression on their minds about their responsibility towards nature and its resources.

II. Jal - Maitri Yatra (Voyage water friends) - It involves the journey from the origin of any river to the nearer village/town/city during which the participants spread awareness among the people about the importance of clean river. Mainly youth undertake kayaking, rowing, rafting and other water related sports during the journey. The Jal Mitra has caught imagination of younger generation and has become an adventure sporting event with socio-environmental context.

III. Establishment of Jal Mitra Mandals (River Eco-Clubs) : To sustain conservation momentum Eco-clubs are established in the villages along the course of the river. The members of these clubs undertake social service for maintaining the river clean and free from pollution. The members are also trained and encouraged to undertake water quality monitoring, awareness campaigns and related activities. Some of such activities include :

- An awareness on water borne diseases and development of low cost water filters.
- Tree plantation along the river for flood control and enrichment of the bio-diversity.
- Demonstration/training to local youth on rescue operations during floods and natural calamities as a part of disaster management.
- Promote water sports

IV. Jala Dindi Sanskar Shibir (Camp) : Moral values are crucial for order and peace in any society and this programme essentially addresses these issues. Youth in the age group of 6-14 yrs are trained in the role of values for leading materially prosperous, socially responsible and spiritually fulfilled life. The training is imparted by religious/spiritual teachers employing traditional techniques of mass communication through Bhajan (singing lyrics in praise of God), Kirtan (Communicating virtues through song and narrations), Pravchan (discourses involving intellectual analysis in the quest of supreme reality), Bharud and Gowlan etc (Singing songs that relate material realities with spiritual dimension embedded in every living being).

V. Camps :

Health check-up, advise and distribution of medicines : A group of expert physicians participating in the Jal Dindi organize such camps free of cost and thousands of villagers with out acess to even primary health care are benefited by these camps. Dr. Viswas Yeole who is a gynecologist by training and brain behid the idea of Jal Dindi himself is a key doctor in this process.

Water quality studies/assessment and guidance for avoiding water related health issues :

The Shrishti Eco-Research Institute SERI, a Pune based environmental organization undertakes studies on the health of riverine ecosystem and surrounding land environment. These surveys have brought out startling observations on impact of river pollution on every aspect of down stream population.

Some of these observations include (i) high microbial contamination of the river, high levels of nutrients – nitrates and phospahates and consequent high BOD of water make it unfit for consumption, (ii) the growth of the algae and aquatic plants is found along the course of the river, (iii) the river has self purification capacity with low nutrients and nil coliforms, the indicator organisms of organic pollution, (iv) the rivers get extremely polluted down stream of major urban locations (Pune, Pimpari-Chinchwad, Dound) mostly due to direct discharge of untreated domestic sewage. Thus sewage linked pollution is single largest factor in environmental degradation of the river and terminal Ujjani reservoir.

F. The way ahead :

Today, the Jal Dindi has emerged as an unprecedented environmental movement touching the lives of thousands of impoverished rural people who are victims of water pollution from up-stream urban centers like historic Pune, one of the fasted growing cities in Maharasthra and its twin, the Pimpri-Chchwad often described as Detroit of India. Perhaps in the environmental history of India, it is for the first time Jal Dindi has brought together thousands of environmental activists, professionals and institutions for a common cause of protection of rivers and lakes. It is also an example of how sound cultural traditions of a region could be sensibly interwoven in to a common cause of environmental protection. It could be compared with Dandi march, the famous Salt march (Satyagraha) undertaken by Mahatma Gandhi, the apostle of Non-Violence and Father of Nation, that kindled urge for freedom in the minds of thousands and thousands of Indians and shook the mighty British empire. The movement has potential to be global as basic issues of river pollution are crying for solution in all countries of the world. The mass movement is highly replicable and many such events are already happening all over the country. In deed in this lie the secret of its success.

4. 2. Water Users Associations (WUA) :

Generally irrigation schemes are operated by State irrigation departments and water-use efficiency did not cross 30 to 40% level. In 2005 Maharashtra State Assembly passes an act titled – **"Participatory Irrigation Management Act"** that has transferred irrigation management at supply end from concerned State department to Water User's Associations (WUA). The members of WUA are basically farmers using water for irrigated agriculture. This participatory approach is envisioned to meet irrigation water needs in terms of water volume and equity. This paradigm shift from State control to stake holders involvement in water management has not only improved water-use efficiency but also yielded spectacular results in terms of improved farm out put and socio-economic advancement of rural communities in many parts of the country and UBB.

4.3. Lifting of sewage for irrigation :

On the Mula Mutha river the severage water which is available through out the year is considered as a source for the Purandar Lift Irrigation Scheme. The scheme was designed and planned in the year 1993. The quality of the water was considerable good for irrigation purpose. However, subsequently in the last 15 years due to large increase in the population in the Pune and Pimpri Chinchwad area and also industrialization in the area of these Corporations has increased the pollution in the river water on large scale. This has resulted into large increase of DOD and COD of the water and which is ultimately resulted into quality of water which is not suitable for irrigation,even the scheme is ready, it is difficult to operate and function the scheme only because of the quality of water. It is expected that after completion of severage treatment plant by Pune Municipal Corporation and Pimpri Chinchwad Corporation there will be some improvement in the quality of the water.

Purandar Lift Irrigation scheme is on Mula Mutha river envisaged to supply 4 TMC of water to drought prone area of Purandar,Daund,Haveli and Baramati. It is observed that the raw water quality available near source is far below the acceptable limit for surface water irrigation.

The farmers are raising objections for supply of raw water for irrigation purpose. The main reason for the reluctance of the farmers in using available river water is undesirable organic and inorganic impurities, blackish green color and obnoxious smell of water. The Chemical analysis results indicate that BOD (Biological Oxidation Demand) and Chemical Oxidation Demand (COD) values of the raw water are ranging from 45 to 450 Mg/lit. The raw water is suporting profuse growth of plant and aquatic life. According to Maharashtra Pollution Control Board (MPCB) norms, treated sewage effluent discharged into inland water body must have BOD less than 20 Mg/lit. On this backdrop the BOD of supplied water is far in excess of tolerance limits. Considering the farmers strong demand it is inevitable to provide suitable treatment to this water.

Purandar Lift Irrigation Scheme is designed to irrigate 25100 Ha.land in 4 TMC of water. For optimum and efficient use of available water closed conduit system and drip irrigation system is proposed. For drip irrigation system water should be free from algae and suspended matter. This suspended matter in algae can chock up the nozzles provided in the laterals of the micro irrigation system.

The electrical conductivity of the sewage water is also high and hence the water can not be used for all types of crops which are proposed in cropping pattern of the Purandar LIft Irrigation Scheme. The E coli cound present in the water is also more than 16 which is also not desirable for controlling bacterial growth.

4.4. Upper Bhima Partnership (UBP) : Civil society initiative for sustainable management of (UBB) :

Under the aegis of IWP-GWP initiative an Area Water Partnership (AWP) called Upper Bhima Partnership was established in July 2001. The Non-Governmental organization NGO had undertaken an in-depth study to identify problems UBB and to formulate possible solutions. The out come of this civil society initiative was the document titled 'Vision for the development of Upper Bhima Basin by 2025'. The objective as per this document is - to establish a pollution free productive regime for the continued sustainable and equitable socio-economic development of the Upper Bhima Basin Area. It is proposed to be achieved through application of principles of Integrated Lake Basin Management (ILBM) and Integrated Water Resource Development and Management (IWRDM) as advocated by ILEC and GWP respectively.

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Salient findings of this study are as follows :

- There was total lack of awareness at all levels (policy makers, implementers, experts and water users), about water-related problems at micro-level in the basin.
- Not much efforts were taken to take a holistic approach while dealing with all problems in the water sector, by shedding the compartmentalized approach taken by different departments of the State Government.
- There was not much headway in changing the role of Govt. from that of a 'Provider & Manager' to a 'Facilitator & Regulator'.
- Management of surface irrigation through Water Users Associations (WUA) needs further boost.
- Apathy and myopic outlook (skewed priorities of developmental activities) of Municipal Corporations and Pollution Control Board, has resulted in very slow pace of treatment of urban sewage and industrial effluent, which has been degrading the water resources in UBB both quantitatively and qualitatively.
- The principle viz. 'User pays and polluter pays' has remained on paper, threatening the long term viability, sustainability and utility of the huge infrastructure to provide expected water services.

During the last five years, the partnership has undertaken following activities :

- To increase awareness amongst urban population about measures to economize on consumption of water for domestic use, a competition was held for school children of formative age group. The children, in turn, approached more than 1000 families who were representative of cross section of population from Pune city and apprised them of simple water saving measures which they could easily practice and could appreciably reduce daily water consumption in urban areas.
- Two workshops of representatives of women's organizations and women Cooperators from Pune city were organized to apprise them of the need to prevent wasteful use of domestic water.
- Poor quality of drinking water has been a chronic problem in rural area, which has been affecting health of the people. Hence similar activity for students from rural area was organized to promote adoption of Solar disinfection of drinking water (SODIS), by exposure of water filled plastic bottles for 6-8 hours to direct sunlight.
- To promote involvement of stakeholders in the watershed development works, a competition of best managed watershed developed village was held. 7000 copies a book in the Marathi, the local language, titled 'Watershed development-technique and technology' were distributed so far to stake holders in rural areas of UBB.

- A Poster on watershed development works was distributed in villages to increase awareness of this important activity amongst rural population.

4.5. Public Interest Litigation (PIL) :

Indian judiciary has played a very pro-active role in the matter of environmental protection which also gave birth to the concept of Public Interest Litigation (PIL). A citizen can approach a court for redressal of an issue of public interest and most of the environmental issues fall under this category.

5. MAJOR LAKE BASIN GOVERNANCE ISSUES :

5.1. The Maharashtra Water Resources Regulatory Act (2005) :

The Maharashtra Water Resources Regulatory Act (MWRRA) was passed in the year 2005, as a part of the Maharashtra Water Sector reform process which was initiated due to under-utilization of the created irrigation potential (In1999-2000, potential created was 3.500 million hectares and actual potential utilized was merely 1.286 million hectares), poor water tariff recovery and consequent financial losses, absence of coordination between concerned Government departments and extreme water pollution. To summarize, there was strong view that the water management system in Maharashtra was not conforming to the globally accepted norms of holistic and participatory management and to remedy it the Act was passed thus the State becoming the first to pass such an act of far reaching consequences.

Through MWRRA Law, MWRR Authority was constituted with the main functions as follows:

- To regulate the water tariff systems and water charges for the use of these resources.
- To ensure that water resource development and management within the State is carried out as per the Integrated State Water Plan prepared by the State Water Board and approved by State Water Council
- To review and ensure administration of water use entitlements (A) At the river basin / sub-basin, water using sectors such as Urban and Rural drinking water, Industries and Irrigation etc. and (B) At utility/project level between water using sectors, and also between various water users, within each sector, within the State.
- To assist and facilitate the development of a framework for the preservation and protection of the quality of surface and sub-surface water within the State
- To decide the criteria for trading rights of water so as to maximize the efficiency of the use of water.

Functions:

- To determine, regulate and enforce the distribution of entitlement for various categories of the users.
- The distribution of entitlement within each category
- To determine & regulate seasonal / annual water entitlements during scarcity.
- To establish water tariff system for various categories of water uses for stable & selfsustainable management of service delivery.
- To regulate water resource projects.
- To ensure development as per Integrated State Water Plan (ISWP),
- Economic, hydrological & environmental viability
- Statutory & other obligations for inter-state entitlements.
- To facilitate protection of water quality and its preservation.
- To promote ‘sound’ water conservation practices.
- To function as Appellate Authority for Dispute Resolution.

6. KEY LAKE BASIN GOVERNANCE CHALLENGES : Following are the key challenges for successful implementation of ILBM in UBB :

Challenge 1 : Equity in the face of variability and scarcity : Extreme variability of precipitation and water scarcity makes UBB, drought prone. The basin is intensively harvested by constructing 17 major dams in Western high rain fall zone and supplied to water scarce down-stream region. However, the demand supply situation has reached a saturation point and any change in this balance can lead to water conflicts. For example, in the part of UBB in Pune district, the available water in 5 up-stream reservoirs is estimated to be 1017 McuM of which 435 McuM is already being supplied to the urban zones (Pune, Pimpri and Chinachwad cities). The demand is expected to reach 972 McuM by 2021 leading to all the water being consumed by cities making them black holes of water consumption. Thus, down stream agriculture will be totally dependent on waste water released from urban areas. Finally, alterations in water cycle due to Global Climate Change will add another dimension to these complex cities. Thus, there is a need of better understanding of water balance of the region, preparation of models for water management, application of modern tools for prediction and management of water and finally if possible and environmentally feasible inter-basin transfer of water through linking of rivers in the region.

Challenge 2 : How to satisfy rapidly changing pattern of competing water demands : Unfortunately, the competing water demands in two key sectors viz., ever growing urban centers and agriculture, is not stabilizing. Population growth is leading to urbanization on the one hand and demand for more food is putting pressure on agriculture. The priority for policy makers is for supply of drinking water and with more water apportioned to it, particularly in the ever growing urban areas, there is corresponding increase in the generation of waste water (Sewage). Thus, **balancing the demands of these two key sectors is the biggest challenge in governance**. This could become possible only by effective treatment of sewage generated by the urban areas. There is a need of large scale investment on infra-structure and technology for sewage treatment. Such treated water could be effectively utilized in the down stream water intensive agriculture.

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 potential to compliment the technological interventions. As a matter of fact whole stretch of river Bhima can be effectively used for sewage treatment through 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 : How to tackle the problem of toxic industrial solid and liquid waste (Industrial effluents) : After independence in 1947 large scale industrialization was taken up basically to generate employment, goods and services and in the first phase pollution control was never given any priority with the view that nature will take care. However, today the effects of industrial pollution have reached an alarming proportion. Industrial waste, both solid and liquid, pose a special problem of toxicity depending on in-puts and processes. The waste water generated by industrial areas like Pimpri-Chinchawad in UBB is responsible for maing sewage un-fit for agriculture down stream. There is a need of new and un-graded technologies for effective treatment of toxic waste generated by increasingly complex industrial processes. Further, the concept of Green Industry need to be propagated with zero discharge and effective recycle and reuse to be the main goals. Industries need to be involved in a big way in environmental protection under the concept of Social Corporate Responsibility and Public Private Partnership (PPP).

Challnenge 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. In 1996 additional water was allocated to the urban areas in Pune district on the explicit condition the waste water generated will be adequately treated and will be utilized for irrigation purpose. Accordingly the water in the river is lifted by the seven weirs constructed across Bhima river along 105 km stretch from Pune to Ujjani reservoir. Unfortunately for want of adequate treatment polluted water is being used for growing seasonal crops and vegetables on large scale. For want of adequate monitoring and data the impact on the health of consumers remains a guess. 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. The situation has potential to develop in to urban-rural conflicts and its soulution is perhaps biggest challenge in UBB.

Challenge 7 : Mitigation of pollution impact on Ujjani reservoir and its command : The vast command area of Ujjani reservoir has very important piligriamge centre, Pamdharpur, annually visited by millions of people and pollution of Ujjani can have averse impact on the health and well being of people. The command has vast areas falling under two states viz. Maharashtra and Karnataka irrigated by water from Ujjani. Thus pollution of uajjani has potential of Inter-state dispute. 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 brid sanctuary : The reservoir has surface area of 29,000 ha and based on its high primary productivity is showing signs of eutrophication. Thus, there is a need of introduction of sustainable aquaculture. Further Ujjani is notified Bird sanctuary supporting more than 100 species of avian fauna that includes interesting species of spoon bills, ibis, Shovellers, flamingoes, spot billed ducks, pintails, cormorants and painted storks. Pollution of the reservoir will have devastating impact on the sanctuary.

Challenge 9 : Utilization of biological resources of the lake : The lake due to higher levels of nutrients (Nitrates and phosphates) reaching 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 need to be given training in modern techniques for maximization of fish production. Successful fishery not only help reversing eutrophication but also enhance protein availability to rural population. Same is the case with aquatic weeds which can be utilized in a variety of ways for value addition products through proper training and financial assistance.

Challenge 10 : Development of Eco-tourism, educational activities and awareness campaigns : The lake value can be enhanced through development of eco-tourism by promoting hiking and cycling pathways, developing recreational facilities. These developments have potential to generate jobs in service sector for livelihood of otherwise impoverished rural communities. A lake could be developed in great centre for education through establishment of Field station.

To summarize, in the context of ILBM in UBB sustainable supply of quality water in adequate quantity and in an equitable way is the real challenge. This will require better understanding of natural limits, impacts of Global Climate Change, sectoral water demands, prevention of losses, recycle and reuse, conservation measures and an integrated approach.

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