SUSTAINABILITY OF WATER RESOURCE SYSTEMS IN INDIA: ROLE OF VALUE IN URBAN LAKE GOVERNANCE IN AHMEDABAD

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Abstract

One of the ongoing discussions in water resource governance in India is on the revival of the river and lake systems. The new water-system as infrastructures are proving to be the connectors in the current societal (urban) development as they did in the times of traditional water management and old settlement pattern. Rivers and lakes have different social, ecological and economical demands made on them at different periods of societal development and that made them vulnerable to change. One of the core challenges documented in the governance of rivers and lakes in India is addressing the rapid changes in these value systems. Effectively addressing the change (or priority) in the values of water systems and urban systems linked to the governance can be a major step towards sustainability of these systems. There is still limited understanding of how the values of water resource systems are progressively linked to changing urban systems and how upward and downward causation linkages occur within the systems as well as across diverse sectors and scales of governance. The PhD research on 'Sustainability of urban lake systems in India' is an attempt to look at the interactions and outcomes of the spatial and temporal dynamics of urban systems and lake systems especially the values that sustain the institutional and ecological memory. The paper highlights the relationship and the role of values between urban lakes systems (ecological systems) and governance (social systems) and identifies that sustainability of both the systems is the key towards sustainable cities. The multitier framework for analyzing the social-ecological systems is used as the foundation to elaborate the link of the values with urban lake systems and governance in the context of Ahmedabad city. Then Vastrapur lake development in Ahmedabad is studied to elaborate the role of values.

Keywords
Sustainability, urban system, lake system, india, values, governance

I. INTRODUCTION

Traditionally, water resources like rivers and lakes have provided many important functions for societal developments. Rivers and lakes have different social, ecological and economical demands made on them at different periods of societal development and that made them vulnerable to change. In modern times many economical, social and ecological demands are met by these water resources. One of the ongoing discussions in water resource governance in India is the revival of the once degraded river and lake systems to fulfil the social, ecological and economical values of the urban infrastructure. The new water-system based infrastructures are

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proving to be the connectors in the current societal (urban) developments as they did in the time of traditional water management and old settlement pattern.

In the following we analyse water resource governance with respect to urban lake systems in India by looking at how values of water resources have influenced urban development and vice versa. The paper is part of the literature review and desk case study analysis of the PhD research. The research poses broader questions on the current governance approach and the sustainability of urban systems and urban water systems such as, which role do values play in the governance of urban water systems? Which values are responsible for the revival of lakes and rivers in many urban areas today? What is different in the old and new water governance? Where could governance lead to when urban population density is at increase? What is the role of the individuals/society in relation to the governance of these urban water resources? Which institutional surroundings can we expect to be established? Which values determine decisions for more privately or more publicly owned urban water resources? Some of these questions are touched upon in this paper.

The paper is on the changes at the interface of social and ecological system dynamics, more specifically between urban lake systems and the urbanisation processes. Firstly, urban lake systems, value, sustainability, and governance are discussed. Secondly, values are looked at different spatial and temporal level of societal development in the context of India. Thirdly, the multitier framework for analyzing the social-ecological systems (Ostrom, 2007) is used to elaborate the link of values with the urban lake systems and governance approach. A case study is drawn from 'interlinking of lakes' initiative in Ahmedabad. Fourthly, the role of values is looked upon in detail in specific 'Vastrapur lake development' in Ahmedabad. It is realised that values play an important role in sustainability of urban lake systems. The paper concludes with observations on the role of values in relation to the changing concepts of urban water governance. For social scientists and sustainability researchers, it is an interesting challenge to address the many values of social (urban)-ecological (water) systems over time and specifically capture the influence these values have on these systems.

2.i. URBAN LAKE SYSTEMS

With no specific definition for urban lakes, the commonly perceived classifications of urban lakes are geographical, liminological, functional, water quality oriented, and management based (Reddy and Chhar, 2004). In the management classification they are generally categorised as: urban lakes, non-urban lakes, coastal estuarine lakes, ephemeral lakes, etc. Reddy and Chhar (2004) define urban lakes as the subset of all fresh water bodies such as reservoirs, lakes, ponds, tanks, etc. those are surrounded by land on all sides and located in urban situations (Refer Figure 1). Some known examples of urban lakes in India are Upper lake in Bhopal, Mansagar lake in Jaipur, Bellandur lake in Bengaluru, Hussainsagar lake in Hyderabad, Dal lake in Srinagar, Fatehsagar lake in Udaipur. The lakes that are located outside urban areas, such as Loktak lake in Imphal, Sakhyasagar in Shivpuri; or the lakes that are part of river/ sea/ ocean, such as Chilika lake in Orissa are not considered as urban lakes and therefore are kept outside the scope of this research. Since, every lake is part of a larger hydrological system that normally comprises of

catchment areas, inlet and outlet of the lake and the associated ecosystems and biodiversity, lake is referred as the lake systems.

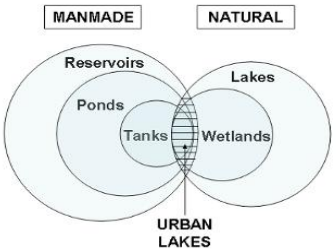


Figure 1: Urban Lake Systems
Source: Reddy and Chhar, 2004

The social, economical, political, and cultural association of the lake in urban areas is referred to the 'urban' systems. Researchers justify the values of the urban lakes linked to ecological, economical, social, cultural and even political values to be the driving force behind lake sustainability. These urban components add aspects such as appraisal or neglect towards the lake systems which directly or indirectly affects the lake sustainability of the lake (Bal, 2006).

2.ii. THE GENERAL CONCEPT OF VALUE

The concept of values has different interpretations for individuals and disciplines. For individuals, 'the value of water' at first instance may be the monetary value or the cost that the individuals pay for water to consume, or the social-economical value that covers all the benefits of water, or the psychological value that water is 'price-less'. Metaphorically, 'value-less' can be referred to either as 'useless' which is close to meaning waste or 'price-less' which is close to meaning so precious that it is difficult to measure'. When it comes to the value of the water resource such as 'the lake', it is often hard for individuals to quote a monetary value. Individuals then usually refer value to the benefits attributed by the river/lake.

In economics, discussions on values of water resources are oriented towards the value of environment, or valuing the environment, since environment offers 'goods' and services' to the society and affects the society's welfare. Non-economists regard putting prices on environmental 'goods and services' as mis-conceived notion since society is continuously affecting the environment, which in turns affects the actual and perceived value of the environment. While economists advocate the desirability of valuation, there is a disagreement over the prospects of actually doing valuation in a satisfactory way amongst economists (Perman et.al., 2003).

To understand the relationship between value and the environment, it is important to understand the 'goods and services' offered by the environment, or in other words the functions attributed by the environment to the society. How does it affect society's welfare? For example in case of lake systems, values of lakes may be interpreted from the Total Economic Value (TEV) framework developed by Kolstad (2000) (Refer Figure 2). The TEV framework is made up of instrumental value (or use value) and intrinsic or passive (or non use value). The instrumental value is subdivided into direct use value, indirect use value and option value; and the intrinsic value is subdivided into existence value and bequest value. In case of lakes, drinking water, ground water recharge, bathing and washing are the direct use value.

Experiencing the water, the landscape, the fauna and the flora are examples of the indirect use value, while settlement development (or urban real estate) belongs to the option value. Conserving it for its very being/identity is called the existence value, and conserving the lake for future generations is the bequest value. Interestingly, the use and non use values combined are similar to the definition of sustainability as posed by WCED (1987), making 'sustainability' a value.

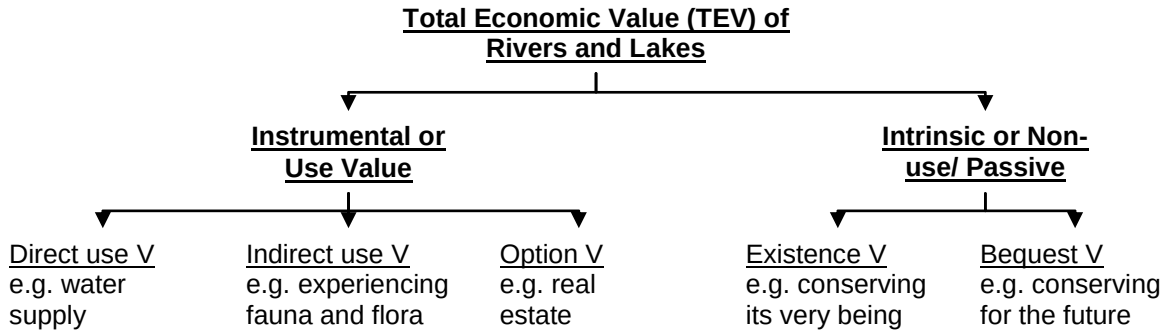


Figure 2: Total Economic Value (TEV) of Rivers and Lakes
Source: Interpretation from Kolstad, 2000

In main stream sociology, values refer to social-cultural behaviour linked to ethics, customs, beliefs and traditions in society, for example the way society behaves towards the water environs. At an individual level people say, "I have certain values" and at a societal level it is said: the society has certain values. Here, value is linked to a system or behaviour or belief that is institutionalized, called value systems. An example of belief is the holy dip at Pushkar Lake in Ajmer, India as 'a dip to cleanse self'. In the study on analysis of institutions Ostrom (1990), norms, customs, and traditions are used as a referent to values and attributes to the society.

2.iii. VALUES IN THE CONCEPT OF SUSTAINABILITY

The fundamental tenets of the concept of sustainability came from the traditional wisdom of living in harmony with nature and in society. Sustainability has its base in the notion of ecological sustainability (Meadows et.al., 1992; Gottlieb, 1996). The concept of sustainability originated in the context of discussions about harvesting and managing renewable resources, such as forest and fisheries in such a way as not to damage future supplies (Lele, 1991). Most proponents of sustainability take it to mean the maintenance of the existence of ecological conditions necessary to support human life at a specific level of well being through future generations. The World Commission on Environment and Development report (WCED, also known as Brundtland Commission), 'Our Common Future', holds the most common definition of sustainable development or sustainability: *development that meets the needs of the present without compromising the ability of future generations to meet their own needs".* (WCED,1987). According to Berkes et.al. (2003) sustainability is the maintenance of the capacity (functions) of an ecological system to support social and economic systems over time. By bringing the element of time directly into the environment and development debate, the strategy of 'eco-development' has discovered a truly synthesizing factor in sustainability (Khosla, 1995). Sustainability is certainly referred to 'time' such as longevity, sustenance and existence, the challenge is: how long to sustain?

Major development in the concept of sustainability is the realisation that in conjunction with the need to maintain the ecological conditions, there are economical, social, political and cultural conditions that seek sustainability. These conditions, in addition to the ecological, are viewed as the basic values/ principles/ pillars of sustainability. The issues such as equity, health, education, awareness, security, and demographic pattern are social values; land, water, bio diversity, and environmental health are ecological values; and economic performance, benefits, production and consumption, waste generation and management are economic values. The balance between social equity, ecological effectiveness, economic efficiency, political will, and cultural context are vital to sustainability (Mitlin and Satterthwaite, 1994). In actual, the divergent priorities create conflict and stress on certain values, e.g. economic and environment priorities generate a development conflict; social and economic priorities generate a property conflict; and social and environment priorities generate a resource conflict (Campbell, 1996). Mitlin and Satterthwaite (1994), therefore argue that political will and cultural context are important values to achieve ecological and social sustainability in modern times. Baker et.al. (1997) add by saying that sustainability is a process of change in which the exploitation of resources, the direction of investment, orientation of technological development and institutional change are to be made consistent with future as well as present need. The new concepts that are used in environmental science and social science, such as resilient system (Folke, 2006; Milman and Short, 2008; Berkes et.al., 2003) and robust system (Anderies, Janssen and Ostrom, 2004) and adaptive systems (Folke et.al., 2005; Olsson et.al., 2006; Scholz and Stiftel, 2005) some way depict the notion of sustainability.

With the values diverging and converging in similar and different situations, some common ambiguities that arise in the discussion on sustainability are:
- what is to be sustained- status quo, characteristic, quantity, quality etc.?
- how much to be sustained- quantity, quality?
- what is most important to sustain- ecology, economy, culture?

2.iv. VALUES IN THE CONCEPT OF GOVERNANCE

In recent decades there have been many changes in how governance is understood. Governance is a broad term, making it suitable for all purposes; but it is also a confusing term as it is used in many different ways (Peters & Pierre 1998; Lynn et. al., 2000; Toole, 2000). The concept of governance has changed due to a growing recognition that government alone does not determine the future development of sectors in the society, but that this is shaped through the interaction of many stakeholders, with the government being one of them (Bressers and Rosenbaum, 2000). The ‘governance’ pattern consists of the consequences of the interplay between attempts to intervene by all the stakeholders involved (Kooiman, 1993).

There is also a growing acceptance in the fact that sectors in society are not governed on one level, or on a number of separate levels, but through interaction between these levels. These levels may reflect the various tiers of government or other stakeholders or a combination of both. This is termed as *‘multi-level governance’* (Bressers and Kuks, 2010). Ostrom, Anderies, Janssen, Mchiggins, Teisman and also referred as *‘poly-centricity’*. A reason for this is the

acknowledgement that a resource (environment/ natural) situation itself contains various interacting levels. Issues such as boundary definition, choices about decision-making arrangements, accountability and sustainability arise in the governance of resource systems. This explains why most natural resource governance often takes poly-centric institutional forms composing of individual interests of various institutions Ostrom (2007). The term *'multi-level'* relates not only to its multiple nature but particularly to the mutual interdependence between the levels (Smith 1997). Lundqvist (2001) in the context of challenge of 'environmental governance' argues that for problems like sustainability issues, a more encompassing multi-level view of governance is needed: 'multi-faceted'. Sustainability issue 'require different scales (or variables or parameters) and the interactions between the scales require multi-level coordination'.

In addition, Milward and Provan (1999) argue that 'the essence of governance is its focus on governing mechanisms: grants, contracts, agreements. Toole (2000) treats governance in the context of studies of the implementation of policy strategies and highlight the 'multivariate' character of governance. Governance refers to the different mechanisms that are embedded in the institutions such as policy, planning, acts, rules (formal-informal), laws, norms, sanctions, agreement, international conventions and activities. Interestingly, most of these mechanisms can be argued as the values of the society and the stakeholder organisations.

2.v. VALUES IN THE CONCEPT OF SOCIO-ECOLOGICAL SYSTEMS

In Ostrom (2007, 2008, and 2009) and other scholars' study on socio-ecological systems (such as urban lake systems) from governance perspective, value is widely referred in the sub-variables of the multitier framework (commonly called the SES framework) for analyzing social-ecological systems. The main variables of the multitier framework are:

1. Socio- economic, political settings (S)
2. Related Ecosystem (ECO)
3. Resource System (RS)
4. Resource Units (RU)
5. Governance System (GS)
6. Users (U)
7. Interactions (I) and
8. Outcomes (O)

Ostrom (2007) presents the framework for systematic diagnosis of the structure and outcomes of complex, multitier social-ecological systems such as urban lake systems to understand the processes that lead to improvements in or deterioration of social-ecological systems (Refer Figure 3). To use the SES multitier framework, the resource system (RS) and its resource units (RU) relevant to the research is basic. Identifying the variables that are important in deteriorating/ alleviating or change in the resource system and its resource unit is the starting point. The socio-economic, political settings (S) are important in affecting the patterns of relationship amongst variables within a region. The related ecosystems (ECO) affect or get affected by the resource system and the resource unit. All of the resource system characteristics combined with key users (U) and governance system (GS) variables generate a diverse set of interactions (I) and outcomes (O). Many patterns of interactions and outcomes among the users (international corporations, governments, local private firms and local users) within the institutions created by national and local governance systems can be found.

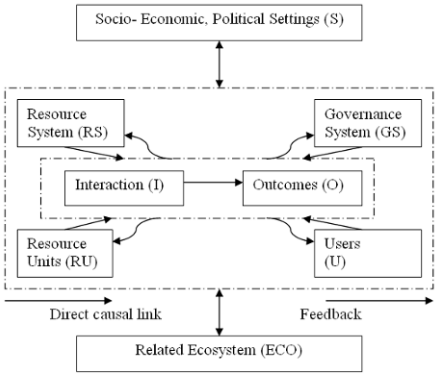


Figure 3: Main variables in the multitier framework for analyzing social-ecological systems
Source: Ostrom, 2007

To diagnose the causal patterns that affect outcomes, a set of 'second tier' variables or sub-variables that are contained within the main tiers are needed. Each core system is made up of multiple sub-level variables which can be further composed of deeper-level variables. The most elaborate set of fifty sub-variables developed by Ostrom (2008) are presented in the Table 1. Ostrom (2009) warns that to understand a particular puzzle related to the sustainability of SESs, one does not need to look at all the variables. One can even go to third, fourth, fifth level of variables depending on the depth of the problem the researcher aim to address. In a study of the variable performances of user groups for canal irrigation in India, Meinzen-Dick and Ostrom (2007) illustrate the critical factors affecting irrigation institutions can lead to sustainable approaches that are adapted to specific contextual attributes. They constructed the sub-variables into 2nd level and 3rd level.

Table 1: Second- tier variables in framework for analyzing an SES

Socio- Economic, Political Settings (S)
S1- Economic Development, S2- Demographic Trends, S3- Political Stability, S4- Government Settlement policies, S5- Market Incentives, S6- Media Organisation.

Resource System (RS)
RS1- Sector (water, forest, pasture, fish)
RS2- Clarity of System Boundaries
RS3- Size of resource system
RS4- Human- constructed facilities
RS5- Productivity of the system
RS6- Equilibrium properties
RS7- Predictability of system dynamics
RS8- Storage characteristics
RS9- Location

Governance System (GS)
GS1- Government Organisation
GS2- Non- Government Organisation
GS3- Network structures
GS4- Property- rights system
GS5- Operational Rules
GS6- Collective- choice Rules
GS7- Constitutional Rules
GS8- Monitoring and sanctioning processes

Resource Units (RU)
RU1- Resource unit mobility
RU2- Growth of replacement rate
RU3- Interaction among resource units
RU4- Economic Value
RU5- Size
RU6- Distinctive markings
RU7- Spatial and temporal distribution

Users (U)
U1- Number of users
U2- Socio- economic attributes of users
U3- History of use
U4- Location
U5- Leadership/ Entrepreneurship
U6- Norms/ Social Capital
U7- Knowledge of SES/ mental models
U8- Dependence on resource
U9- Technology used

Interaction (I)
I1- Harvesting level of diverse users
I2- Information sharing among users
I3- Deliberation processes
I4- Conflicts among users
I5- Investment activities
I6- lobbying activities

Outcomes (O)
O1- Social Performance measures (e.g. efficiency, equity, accountability)
O2- Ecological performance measures (e.g. overharvested, resilience, diversity)
O3- Externalities to other SES

Related Ecosystem (ECO)
ECO1- Climate patterns, ECO2- Pollution patterns, ECO3- flows into and out of focal SES

Source: Ostrom, 2008

Considering urban lake system as a social-ecological system, the multitier framework clarifies how different concepts of values are embedded in the sub-variables (Bal, 2009). Sub-variables such as productivity of the system, equilibrium properties, location, predictability of system dynamics, and storage characteristics are categorised under resource systems. Economic value is one of the sub-variables of the resource units. Sub-variables such as mobility, availability, spatial and temporal distribution, replacement rate and hydrological interaction are also categorised under resource units. The sub-variables of the resource system and the resource units in the SES can be broadly refered to characteristics of the resource system. The sub-variables such as property-right, collective-choice rules, constitutional rules, formal regulation, and operational rules are categorised under governance systems. The sub-variables such as socio- economic attributes of users, history of use, leadership/ entrepreneurship, norms/ social capital, dependence on resource, technology used are categorised under users.

The interactions between these variables produce outcomes. It is a challenge to many policy makers to capture the different stakes and values of stakeholders in the process of formulating water governance strategies, in order to deal with potential conflicting value-concepts of actors and the costs and benefits incurrent in a particular context at a particular period of time. These sub-variables are further analysed in the case study of Ahmedabad lake systems.

3. SUSTAINABILITY OF WATER RESOURCE GOVERNANCE IN INDIA

Since antiquity in India, water enjoys a respectable and unique status amongst all the natural resources. The first reference to the hydrological cycle in the world comes from the *Chandogya*, which is part of one of the principle philosophical texts of Hindu religion called *the Upanishads*[2]*;* in which attempts were being made to interpret and explain recurrent natural phenomena of the water (Agarwal and Narain, 2001). Water had both to be managed and exploited for the survival. Hydro-technical installations are thus amongst the earlier technical achievements and innovations of mankind. The prima facie agenda of water management till the mid twentieth century was on one hand linked to the demand of water for domestic and irrigation and on the other hand was primarily the protection against floods and droughts (Bansil, 1991). Since agriculture became a part of civilization, land management interlinked with the water management was in the forefront. The planning of the settlements and the agricultural land followed the water systems (Bal, 1999). With water as deciding factor for growth and prosperity, indigenous practices of water conservation, water harvesting, and transportation of water from remote areas ensured meeting of water needs. These practices were given shades of ritualistic overtones and woven into the religious and social-cultural rituals to ensure widespread practice at community level.

An important aspect of rivers and lakes in reference to socio-cultural values is that they are still considered sacred in India. Religious and ceremonial occasions have association with rivers and lakes in India (Agarwal, Narain and Khurana, 2001). Rivers are referred by the names of female goddess, such as the five main holy rivers of the country are called by *Ganga, Jamuna, Godavari, Narmada and Kaveri.* It

[2] The Upanishads are philosophical texts (written in Sanskrit) of the Hindu religion. More than 200 are known, of which the first twelve, the oldest and most important are variously referred as the principal, main (*mukhya in sanskrit*). *Chandogya* was composed during the pre-Buddhist era of India.

is believed that a dip in any of these five holy rivers washes ones sins away. Even today thousands of pilgrims perform holy pilgrimage of Circumbulation (called *Parikrama*) of the rivers every year. Similarly, many small rivers and lakes also enjoy this holy status. Traditional fairs like *Kumbh Mela*[3] at the banks of river Ganges and *Pushkar Mela* at Pushkar lake are still very popular across the country. The social processes followed the water resources systems in early days. Since, values of water resources were directly linked to the community in the past; management of rivers and lakes was inherently integrated in the community life. Although the property rights remained with the state; formal and informal rules were usually crafted by the community for water usage, maintenance, sanctions etc. (Ostrom, 1990). The hydrological cycle, the water balance principles and the community water management systems were known to the community through wisdom and experience that was passed from one generation to the other (Bansil, 1991).

Traditional economic values of water were fishing, transportation and irrigation. Although pilgrimage to sacred rivers and lakes were socio-cultural events, they involved many economic activities such as religious fairs, trade fairs, animal fairs and even bride/groom fairs. Tourism linked to recreation, ecotourism and water sports are more of recent origin. In many cities they are even the main economic drivers of the city, e.g. tourism in Udaipur. Popular traditional water sports and events are still organised on many rivers and lakes and at their banks around the country. Apart from the traditional values of water, the use of water in hydropower, industry and municipal consumption gained prominence in modern developments. Technological developments such as large dams and small dams linked to the rivers and lakes developed as common water reservoirs. The water reservoirs for energy generation and irrigation became key economic drivers. Interlinking of water bodies through canals across several cities and states are big investments made for developments. Water governance involved scientific and sophisticated tools aimed at optimal utilisation and management of the water resources and to make the development more complimentary to the environment and the vice versa.

Water resource has always been politically contested at city level, state level, national level and even international level. With rise in development activity, many rivers and lakes are engulfed within the cities. Reclamation of land from the rivers and lakes for urban development activity is common at city level. Urban development and planning dominated over the existence of the water systems (Bal, 1999). Trans-boundary water governance between the states is a political issue among many states such as the Narmada between Gujarat and Madhya Pradesh. The idea of inter-linking of rivers project at the national level known as the National Water Grid was high on agenda in the beginning of this century. The aim of the Inter-linking of rivers project is to distribute the water to different rivers in the country to counter the recurring droughts and floods in different rivers flowing at different regions. Doubts about financial viability, technological capability, ecological sustainability and political feasibility are stopping the project to start (Bansil, 1991).

Traditionally, ecological values linked to the water resources were veiled behind the socio-economic and cultural values. Water received significant ecological concern by the end of last century in terms of its availability and accessibility which started

[3] Kumbha Mela is a pilgrimage celebrated every 4,12 and 144 years in which Hindus worship rivers.

affecting the balance of human life and also the growth. The state of rivers and lakes, the community and also the water management systems changed. This was primarily attributed to the urbanization pattern, modernization of infrastructure services and the governance approach. Water governance became a government affair only with market usually reluctant to indulge into governance activities. Government became the provider of the water related services and the community and the industry became the end users. The growing demand and competition between municipal consumption and industry due to the rapid urbanization made water a scarce resource in the cities. The uncontrolled access to surface water and groundwater and the lack of proper institutional arrangements led to pollution and degradation of surface water and ground water sources. The water exploitation indiscriminately affected the health of rivers and lakes; droughts and floods became common in many cities. The river and lake beds turned into large cesspools and became the recipient of industrial and domestic wastes generated from the cities. In addition, land encroachment and squatting by the residents, industries and sometimes even by the state institutions affected the rivers and lakes in the cities. A realization of threat to existence of rivers and lakes became strong.

Several institutions are involved in governing the river and lake systems in India to meet the varied values involved in the water resource systems. Water governance involves different sectors (thus ministries and organizations) such as, resource management, supply management and demand management, surface water management, ground water management and inter-basin water resources management. Other related sectors such as pollution boards, urban development, environment etc. are also influential. In challenges of governance in India's water crisis, Narain (2000) presents mapping of organizations at several levels and various policies linked to water management. Reddy and Chhar (2004) present similar illustration of organizations and policies with respect to lake/river management. They present a grave concern over the fragmentation of responsibilities and coordination amongst the organisations and policy implementations. According to World Bank (1998), the separation between surface and ground water functions and their responsibilities discourages unitary analysis of water and its use as a single resource. The fragmentation creates ambiguity and duplications and it also makes it difficult to fix responsibility and accountability. The fragmentation also hinders inter-sectoral water allocation, e.g. from agriculture to industry to domestic consumption.

Narain (2000) advocates institutional reforms in India's water sector in three ways: by securing greater coordination and integration within the water management organizations; restructuring water bureaucracies as inter-disciplinary, financially autonomous organizations; well-defined water rights and dual accountability between user groups and the bureaucracy. Reddy and Chhar (2004) call for similar approach and promote Integrated River Basin Management model as way to manage rivers and lakes in India. They also highlight the role of international organisations and the local users for effective management of the water resources. The revised National Water Policy of 2002 emphasizes on integrated water resource development and management for optimal and sustainable utilization of available surface and ground water resources, creation of well developed information systems, use of traditional methods of water conservation, non-conventional method for water utilization and demand management; and to have a synergy between the government and non-governmental organisation for water conservation and utilization (GOI, 2002).

Experts express the need for integration of surface and ground water management, integration of upstream and downstream water related interests and integration of quantity and quality of water management. Technologists perceive effective management of water as managing both the water supply management and the demand management of water. Supply side is more linked to the ecological aspect of the water bodies, since the lakes and rivers are invariably the main source of water supply. Demand side is more linked to the social aspect of the water bodies since there is a heavy need and dependence on the lakes and rivers.

The growing awareness that sector based water management will not solve the water problems in India, led to the acceptance of the concept of integrated water resource management (IWRM). IWRM system is seen as a process to promote coordinated development and management of water to maximize economic and social welfare in an equitable manner, without compromising the sustainability of vital eco-system i.e. the water system (Bansil, 1991). There was an overtone of socio-economic values being dominant when IWRM system was conceptualized. There was stress on the developing the IWRM model in such a way that all the stakeholders participate at all levels. Still the mindset that water is a government's business prevailed. This was the time when the slogan of 'access to water was considered a fundamental right of every citizen' and the state being the authority was obliged to take care of it. The state saw 'water as a good' and the citizens as end users. This situation is still realised as an undercurrent in the country.

In the last few decades, privatization and public-private partnership (PPP) came into the Indian water governance. They were advocated based on the market forces. International organizations such as World Bank, International Finance Corporation, Asian Development Bank promoted private sector-led growth in water works and services. PPPs were being promoted as a key, if not the main, vehicle to achieve the required growth in most infrastructures, including water sector. Soon serious criticisms and disapproval were shown from civil society groups and grass-root movements in India regarding priorities and strategies of the private sectors. PPPs further crumpled with the global recession when government finances were used to bail out many PPP projects (Dwivedi, 2010). However, scholars and experts believe that PPPs are there to stay; only their nature and approach may change over time.

Things changed in last decade when sustainability of water resources like lakes and rivers became high on policy agenda. After the dominance of socio-economic value of water for decades, depleting natural resources and climate change issues brought the ecological value of water back as a top-priority. Water gained more focus on environmental grounds when the concepts of climate change and global warming came in the forefront of global environmental agendas. The year 2003 declared as the 'International Year of Freshwater' led water to become the subject of much environmental and developmental discourses in India too. National and international water initiatives also became very active in India, such as the formation of National Lake Conservation Plan (NLCP in 2003); promoting River Basin Organisations (RBO in the line of integrated river basing management); 23 sites declared as Ramsar (2000) sites for wetland conservation; the revised National Water Policy; and many other initiatives are ongoing. The legal institutions and community based organizations are also more active than before with respect to environmental concern over water.

River and lake managements are now seen more as a land management issue than water management in the cities (Bal, 2006) since water is again considered to have a strong link with urban development and planning. One of the prominent ways in which change in the water systems are observed is the current spatial development. Plans and projects like river and lake revivals and redevelopments; rehabilitation of slums encroaching the river/lake beds; waste water treatments; and rain water harvestings became common in every city to revitalize the lost values of the rivers and lakes. Since, developing new sources of water is costly; the logic of re-using the waste water generated from municipal consumption and industry also rose as a new domain in water management in recent decades, as an alternative source of water. Such initiatives are underway within the Jawahar lal Nehru National Urban Renewal Mission (JnNURM, 2005) under which many cities are tacking river and lake management under the infrastructure development regime.

The concept of sustainable water management is common in the policy and research domain now in India. The catch here is who uses it and how do they interpret it. Sustainability of rivers and lakes are linked to the sustainability of cities. It is also the time when bringing people back into the issue of water governance got its prominence. Water Users Association (WUA) formation for managing canals, ponds, portion of rivers, irrigation systems is considered efficient way to get better outputs in water management (Narain, 2000). The WUA concept is effective in many rural areas but it is still facing problems to take-off in urban areas as it was expected.

Experts describe three issues that limit the sustainable management of water resources namely: the policy failures and institutional weaknesses; competition for water; health and environmental needs and effects. At grassroot people give a fundamental argument that the urban lifestyle and occupation keeps the people away from direct interaction to the water resources where rivers and lakes are just perceived as places of recreation and water as a ‘service’. People consider their job done after paying taxes for the services and user charges for the recreation. When traditional communities managed their fresh water resources, they also managed other natural resources such as forests and water basins, improve sanitation and reduce diseases as an integrated approach. Such concepts and practices are now back in practice and are embedded in the larger domain of water governance and further complimented by stronger technology and policy tools. With the changed values of water and the different management systems, the following years will show outcome of the current water governance approach.

4. SUSTAINABILITY OF URBAN LAKE GOVERNANCE IN AHMEDABAD

Case study of urban lake system in Ahmedabad is discussed here to analyse the functioning of urban lake governance. The ongoing initiative in Ahmedabad namely, ‘Interlinking of Lakes (IOL)’ is used as a reference of analyses. The IOL initiative started in 2004. It is conceptualised and initiated by the local urban body namely Ahmedabad Urban Development Authority (AUDA). AUDA identified 630 lakes in its jurisdiction and notified 79 lakes as urban lakes. Out of the 79 urban lakes, 33 lakes are identified as strategic for storm water networking. These lakes are identified for development under ‘Interlinking of Lakes’ project. As part of comprehensive infrastructure development strategy, the project evolved categorically into two

developmental components: related development outside the lake area and development within the lake area (Jagani, 2004). They are further elaborated below:

- **Related development project outside lake area:** Provision of sewerage system in surrounding housing colonies on all sides of the lake; Laying of rain water line in the surrounding catchment area and to divert rain water to the lake; Relocation and rehabilitation of the slum dwellers present in lake area; Widening of all the roads and developing new linkages with rest of the city.
- **Development project within lake area:** De-silting work and excavation of lake for achieving better percolation; constructing percolation bore-well at the bottom surface of lake; Evacuation of encroachment on periphery of lake area; Reclamation of land adjoining the lake; Development of amusement park, garden, parking, hawkers' zone and community spaces (AUDA, 2004).

The project is partly funded by the National Government under the policy namely, Jawaharlal Nehru National Urban Renewal Mission (AMC and AUDA, 2005). The lake developments are perceived as a 'success' by the local bodies and people at large have welcomed the initiative. The initiative is seen as a 'model lake development' across the cities in the state of Gujarat (Bal, 2006). This gives a good impetus to analyse the lake governance approach in Ahmedabad. The variables and sub variables of the SES framework by Ostrom (2007) is hypothesized to explain how the lake system and the governance actually function.

4.i. Socio-Economic, Political Settings (S)

Ahmedabad is an important trade and commerce hub and an urban centre at the western part of India. 10% of the state (Gujarat) population is from Ahmedabad contributing to 20% of the State Domestic product (SDP) (***S1- Economic Development)***. The urbanised population is more than 5 million with a growth rate of 2.42% ***(S2- Demographic Trend)*** (Official Gujarat state portal, 2009). Apart from high birth rates, vibrant economic activities generate employment and result in huge in-migration. The city is comprised of (***S3- Urban Development)*** Ahmedabad Urban Development Authority (AUDA) area or Greater Ahmedabad with area measuring 1294.65 sq. kms. that includes Ahmedabad Municipal Corporation (AMC) area of 500 sq. kms. (Refer Figure 4.1.). The annual physical growth of the city is around 4.68% (AUDA, 1997). The city planning happens at two levels: the 'Development Plan' is a broad land use plan for regional and city level visions and decisions; and the 'Town Planning Scheme' is a detailed land use plan covering 100-150 hectares in each scheme for the implementation (Bal, 2006).

The steering committee (***S4- Political Stability)*** of both AUDA and AMC are elected. There are different political parties at AMC and AUDA and the state government (AUDA comes under state government). Both AMC and AUDA have received several awards for innovative developmental works, one of which is the IOL initiative. The recent expansion of AMC area to brought many of the lake development activities which are initiated by AUDA into the AMC administration. There is a tension between AUDA and AMC over tax issues, infrastructure development, resource sharing and coordination that are complex and difficult to resolve.

There is plethora of policies, acts, rules and laws in the Water Resources, Environment, Forest, Agriculture, Fisheries and Social sectors, directly or indirectly related ***(S5- Government Settlement policies)*** to lake management in India (Reddy and Char, 2004). The Constitution empowers urban local bodies with functions and responsibilities, as relevant to Lakes Environment: "The State as the trustee of all natural resources meant for public use, including lakes and ponds, is under a legal duty to protect them" (MoUD, 2006). The National Water Policy 2002 gives importance to institutional mechanism to the planning and management of the water resources on a hydrological unit basis (MoWR, 2006). The legal framework for protection of lakes and reservoirs (wetlands) deals with environmental protection, pollution control, specific natural resources protection acts, hazardous waste management and handling rules, tribunal act for providing strict liability for any damages arising out of any accident. International organisations such as the WWF, UNDP, UNEP, ADB, WB and many other funding agencies are all involved in providing technical and financial assistance to the Ministry of Environment & Forests and State organizations that are responsible for the wetland restoration. In this effort, the wetland restoration national policy is a key factor as it encompasses lakes and reservoirs (Reddy and Char, 2004). There are no direct policies to address the issues of urban lakes. The closest is the policy guidelines under the National Lake Conservation Plan (NLCP). NLCP envisages a comprehensive and holistic approach for lake conservation by integrating socio-economic development of the people who are dependent on the lake ecology (MoEF, 2008).

The earlier mismanagement and inefficient use of urban lakes may be traced to malfunctioning, distorted or totally absent market (***S6- Market Mechanisms)*** (Stiglitz, 2000). Economists believe that an important cause of market failure was the fact that the lakes were un-priced. Prices do not reflect the true social costs/ benefits of its use; they convey misleading information about its scarcity and provide inadequate incentives for management, efficient use, and conservation, e.g. extraction of ground water was not accounted for since it was considered as unlimited which led to the drying of the lake beds.

Externalities are endemic to urban areas and a classic case of market failure (Evans, 2004). The market does not signal the cost of externalities back to the perpetrator, who has no incentive to curb his behaviour (unless there are regulations and fines governing anti-social actions). Since, individuals do not bear the full cost of negative externalities they generate; they generate such activities in excess, e.g. squatting, garbage and waste water disposals on the lakes became a normal activity (Bal, 2006). The function of the market is to signal the emerging scarcities of the resources. The problem arises because environmental processes and changes are not clearly understood by the people. People do not perceive the implications of their activities over a long period or at a point remote from them (Pearce and Turner, 1990), e.g. the fact that bore-well may cause extinction of ground water in 40-50 years or waste disposal may result in filling of lakes in 25-30 years does not weigh much in most people's decisions (Bal, 2006).

Ecosystem externalities also capture indirect impacts over time and show up as an unexpected surprise (Hanley and Spash, 1998). A change in the market approach happened since the initiative. Private sectors and individuals see an added value and are willing to contribute to the lake development and management (Bal, 2006).

4.ii. Related Ecosystems (ECO)

The hot arid climate ***(ECO1- Climate patterns)*** around Ahmedabad has an impact on the lakes**.** High evaporation rate and in addition high percolation affects the containment of water in the lakes. Therefore, lining of the lake bed is a necessary part of in-lake treatment. It is adapted from traditional water structures like tanks and step-wells. Climate change also has its impact on the lakes, e.g. sudden outburst of rain has become a regular feature in last decade which made the lakes and the (almost) lost catchment area incapable to contain and absorb storm water, resulting in flooding in the city (Jagani, 2004). Most of the lakes and low lying areas are usually squatted illegally; resulting in soil pollution, surface and ground water pollution, air pollution and loss of vegetation ***(ECO2- Pollution patterns).*** Poor living conditions on the lake beds result in health issues in the area, e.g. malaria is common during monsoon. Solid waste dumping and air pollution are also the key causes of pollution. Although, flooding in monsoon still remains an issue, nevertheless, some pollution issues are improved after the IOL initiative.

Urban development particularly housing and infrastructure ***(ECO3- Housing and Infrastructure)*** also affect the lake systems. Illegal squatting over lakes and their clearance during lake development is recognized by AUDA as the biggest challenge, e.g. seventy percent of the declared project cost in one of the lake (Vastrapur) development projects was spent on relocation and rehabilitation of slum dwellers who squatted over Vastrapur lake for years (AUDA, 2004). Fund allocations for lake development and slum development fall within different government organizations that have their own priorities and therefore fail to coordinate in development process. (Bal, 2006). Infrastructures such as roads obstruct water flow to the lakes. In addition, hard surfacing of roads and building premises make percolation of storm water difficult. Therefore, even in the smallest spell of monsoon, the surface water that should generally flow into the lakes gets diverted into unintended areas causing water logging and flooding. Days of water logging makes it a breeding ground for mosquitoes and other insects, therefore resulting in health hazards (Bal, 1999). It was observed during Vastrapur lake development that the second big share of the cost was on surrounding road networking and storm water design (AUDA, 2004).

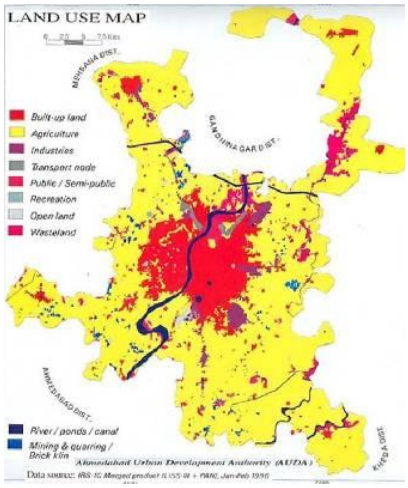
Lake systems compliment the open space system of urban development. The open spaces designation within AUDA area (3.56% open space and 0.89 % of recreation spaces) is ambiguous between open/ vacant land and recreation and public/ semi-public areas. Even if, all are accumulated, still the open space provision in Ahmedabad is 0.36sq.mt. per capita which is far below the national standard, Urban Development Plans Formulation Guidelines (UDPFI 1996), of 8.00sq.mts. per capita (MoUAE, 1996).Under these circumstances, lakes are realized as potential public open spaces in the midst of dense urban development (Bal, 1999).

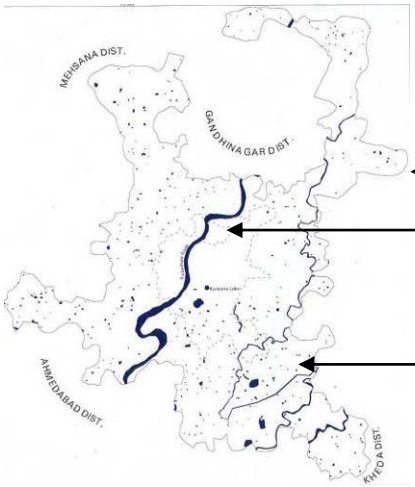
4.iii. Resource System (RS)

Even though they are located within dense urban fabric ***(RS1- Location)***, urban lakes, like other lakes, are not stand- alone entities. They are part of a larger ecosystem of land and water ***(RS2- Sector)****.* Every lake has an inlet, outlet, natural drainage course and a catchment area, normally referred as micro- water shed of

lakes (Bhargava, 1995). Traditionally, retention of outflow to resist erosion and in-lake treatment was integral to lake maintenance. Not much was done to link different lakes, since natural drainage courses and the vast catchment areas existed naturally (Agarwal and Narain, 2001). Today, lake development includes both in- lake development (pitching, deepening, cleaning) and development outside the lake area ***(RS3- Human- constructed facilities)***. In addition, lakes are now considered as part of overall storm water drainage system. Besides storm water networking, other infrastructure up-gradation around the lakes such as, slum rehabilitation, road networking, development of garden and other facilities etc., are considered necessary for overall lake development (Jagani, 2004).

This brings the argument that urban lakes are not just part of a hydrological system but they are also part of the land system, particularly in the context of urban development. Today, urban development is constantly chasing the rising demand for more resources, one of which is the need for land within the dense urban fabric. Natural resources such as rivers, lakes and forests and other public designated amenity spaces often fall prey to the demand for more land. Land use allocation ***(RS4- Land use)*** for lakes and their preservation is therefore an issue in urban development. Within the Development Plan Framework, the land-use 'water bodies' represent both the rivers and the lakes ***(RS5- Clarity of System Boundaries).*** The total coverage of water bodies in AUDA area is 4.46 percent out of which half of the area is covered by lakes, AUDA identified 630 lakes ***(RS6- Size of resource system)*** in its jurisdiction and notified 79 lakes as urban lakes (AUDA, 1997) (Refer Figure 4.2). Out of the 79 urban lakes, 33 lakes are identified as strategic for storm water networking (AMC and AUDA, 2005).





Note: all the dots in the picture represent lakes

AUDA Boundary

Sabarmati River

Lakes

Figure 4.1: AUDA area: red is urbanised area and yellow is open land for future urbanisation.
Figure 4.2: Lakes/ water bodies identified within AUDA, 2004
Source: AUDA, 1997

With substantial coverage of area in AUDA and their water collection capacity, the lakes have a vital role in urban development (Jagani, 2004).The productivity of urban lakes is dependent on their status ***(RS7- Productivity of the system)***. Bal (2006) identify that in case the lakes and their surroundings are not developed and maintained, the lakes attribute to the values such as lack of potential pollution absorbent and micro-bio diversity, development of informal activities and negative affect on property prices, encroachment by wastes, shacks and illegal activities and demean quality of outdoor social activity. In contrast, if the lakes and their

surroundings are developed and maintained, the lakes attribute to the values such as water harvesting systems, micro- climate and bio-diversity regulator, sub-centres of economic activity, property price regulator and open space and recreation hub.

Their importance in recent urban development is more crucial than ever because today they are realised as potential public open spaces in the midst of dense urban development. Experts believe that the key driving force behind the current lake development and management in Ahmedabad is the revival of public open and green spaces. In addition, the threats due to urban lakes such as risk of drying and lowering of water table or flooding and water stagnancy which lead to many environmental, economical and health issues are also a concern of sustainability of urban developments (Bal, 1999). Therefore, the impact of/on lake system on/by the urban development is crucial ***(RS8- Equilibrium properties)***. Only bio-remedial measures may fail to achieve lake equilibrium. Technological approach alone may also not be sufficient (Reddy and Char, 2004), e.g. although storm water drainage is laid out in the related areas of the lakes, flooding still occurs in those areas.

4.iv. Resource Units (RU)

The sizes of urban lakes in Ahmedabad vary from 2 hectares to 20 hectares ***(RU1- Size)***. Traditionally, lakes and ponds were determinants of many settlements due to the availability and access to water. Attention to lakes was from utilitarian and ritual necessity, e.g. farming and important religious places were located ***(RU2- Distinctive markings)*** strategically at the inlet and outlet of the lakes (Bal, 2006). Urbanisation and modernization brought ***(RU3- Growth of replacement rate)*** new water systems and modes of social interactions. Lakes were less priority in urban development until they were integrated with storm water infrastructure development. Therefore, urban lakes became important as physical and social infrastructure ***(RU4- Economic Value)*** (Jagani, 2004).

The spatial distribution of the lakes in the city offer opportunities to adhere to the values of public open spaces ***(RU5- Spatial and temporal distribution)***. The spatial distribution offers the opportunity to plan neighbourhoods with lakes as core of development. If all the identified lakes are developed as public open spaces in Ahmedabad, it is likely that Ahmedabad may become a ‘city of lakes’ (Bal, 1999). In addition, the storm water networking is an attempt to interlink the lakes ***(RU6- Interaction among resource units)*** in terms of water flow, water (flood) level and ground water recharge etc. This networking is planned to up-scale through planning green network in Ahmedabad (AMC and AUDA, 2005).

4. v. Users (U)

Often more people come into contact ***(U1- Number of users)*** with urban lakes than with the rural or natural lakes. Every individual ***(U2- Socio- economic attributes)*** experiences the existence of lakes in Ahmedabad directly or indirectly, e.g. visitors to the lakes and associated facilities or those who just pass through the lakes. The squatters are generally considered as negative users by citizen since they are mainly responsible for lake degradation. There are many government organisations that are directly and indirectly related to lake-environment. There are also non-governmental organisations directly and indirectly involved in the governance of lakes. The people

who live ***(U3- Location)*** in the vicinity of lakes directly harvest the positive (rise in property prices and good outdoor environment) or negative (low property prices and poor outdoor environment) impacts of the lakes (Bal, 2006).

Traditionally, attention to lakes derived from a utilitarian and ritual necessity and they were considered as integral part of the society ***(U4- History of use)*** (Agarwal and Narain, 2001). This changed over time as cities extended their boundaries and agglomerated many villages within them. The major water demand activity of farming disappeared. Eventually the lakes became dispensable entities ***(U5- Dependence on resource)*** until recently when its value in recreation and ecology was realised.

4.vi. Governance System (GS)

There are different views in India on governance of water resources such as lakes, i.e. strong government intervention or community led governance. Community-led traditional water governance has changed in last few decades to more government-led affair (Agarwal and Narain, 2001). The Constitution also empowers (***GS1- Constitutional Rules)*** only the government with functions and responsibilities, as relevant to lake's environment (Reddy and Char, 2004). There are many government organisations **(*GS2- Organisations)*** that are directly and indirectly related to lake-environment. Since coordination (horizontal/vertical) and allocation of funds and powers are not clearly defined among the government organisations, an ambiguous situation arise, e.g. conflict in priorities of the environment department and the slum development board is evident in Ahmedabad. Researchers believe it to be the main reason for the neglected state of lakes (Jagani, 2004; Reddy and Char, 2004; Bal, 2006). In addition, lack of understanding of functioning of the lakes among those responsible for their management is also an issue. Local government officers, who are responsible for managing urban lakes, inherit the lake simply as part of an overall responsibility for park management (Birch and McCaskie, 1999). To address the coordination and functioning of the lake governance, an advisory board namely, Gujarat Lake Development Cell is created which is still far from being effective since the board lack statutory powers over various responsible organisations.

The NGOs focus on awareness creation, whereas few are actively involved in the decision making process, e.g. Center for Environment and Education Ahmedabad. Patterns of collaboration (***GS3- Network structures)*** between the government, private sector and the community are also witnessed in many cases. The collaboration is usually based on responsibilities *(**GS4- Operational Rules)*** such as, development, operation and maintenance, e.g. development is mostly done by the government, maintenance of activities around the lakes such as the garden, the fun park or other utilities are taken up by the private firms; operation (lake water and basin management) is done by the government; the community often volunteers for policing for cleanliness and safety (AUDA, 2004).

Property rights are usually a debate in common pool resource governance ***(GS5- Property- rights system)***. It is noteworthy that during the traditional community-led governance the lakes were the property of the government (or ruler) like they are today. Lakes are the property of national government under The Forest (Conservation) Act 1980, amended in 1988 (MoEF, 1990). Since, bureaucracy is known to slow down the decision making process, it made the local government

reluctant for many years to intervene in the upkeep and development. AUDA raised the issue of national government's inability to manage the lakes and negotiated with them to transfer the development and management rights to them (Jagani, 2004).In the period when lakes were 'open access' resource, cases of illegal possession of lakes by individuals, private sectors and even local government initiatives of lake reclamation for development happened. The 'open access nature' of lakes are transformed to user charges, taxes, fees, physical boundaries, fines, (***GS6- Monitoring and sanctioning processes)***. The way society perceives the lakes has an impact on the lake governance. Transformation from community-led governance to the participation of people only as a user is an example of this ***(GS7- Entrepreneurship)***. Modern life style and urban occupation has changed society's direct involvement in urban issues. Today people of Ahmedabad are willing to pay for the development and maintenance of lakes through development taxes, betterment charges or user charges or fees (field report of Bal, 2010).

Awareness and knowledge about the lake environment is growing. Awareness about deterioration of lakes and its direct and indirect impact made the society active ***(GS9- Knowledge of SES)*** on lake issues, e.g. depleting water table and regular floods during the monsoon has made people aware that lakes. The awareness is used to pressurize the government to perform, e.g. the civil society made a public interest litigation against the government in the High Court in 2000 about the maintenance of the urban lakes and the High Court judgment eventually made AUDA to prepare a comprehensive lake development plan and the 'interlinking of lakes' was conceptualised (Jagani, 2004). There is public interest litigation now on entry fees to the lake premises. The judgement on entry fees is yet to come (Bal, 2010).

Technology play a big role in the way lakes are developed, managed and maintained now ***(GS8- Technology used)***. Geographical Information System is used in planning of lakes in order to understand the lakes, the urban topography and record pre and post monsoon data. Hydraulic systems for the flow of water between the lakes, monitoring systems etc. are also used the latest technology available (AUDA, 1997).

4.vii. Interactions (I) and Outcomes (O)

All of the resource system characteristics combined with key users and governance system variables generate a diverse set of interactions and outcomes (Ostrom, 2009). Hardin's (1968) argument on overharvesting ***(I1- Harvesting level of diverse users)*** of resources is quite appropriate in case of urban lakes. Ground water extraction, squatting over lakes, landfill with solid waste and reclamation of land for development etc. contribute to the exploitation of the capacity of the lakes. The situation remains similar today, since much of the lake bed is reclaimed for development of ancillary activities like recreation and park. In addition, conflict of various users groups such as squatters, developers, local people and even the government ***(I2- Conflicts among users)*** often delay the decision making process and the implementation. There is also a concern that natural processes are not well understood. Change in natural systems and their implications are now perceived ***(I3- Uncertainty)*** by the society. Society was ignorant about the results of its activities over a long period or at a point remote from them (Pearce and Turner, 1990) e.g. people were unable to weigh that bore-wells cause extinction of ground water in 40-50 years and waste disposal results in filling of lake in 25-30 years. Dissemination of

information about the complexity of the lake systems is vital to change in individual's perception and behaviour ***(I4- Information sharing among users).*** Many NGOs such as CEE are active in spreading awareness and knowledge about the lake systems. Experts believe that it is also important to take a sustainable view of lake systems and its value chain ***(I5- Deliberation processes).*** Attempts to protect the city from flooding, to recharge the ground water and most importantly to preserve the lakes for its existence in future are being made in IOL (Bal, 2006).

One of the incentives that have changed society's behaviour towards lake systems in recent time is the investment opportunities ***(I6- Investment activities)***. The activities around the lakes promote formal and informal commercial activities. Recreational activities also generate financial profits. The main incentive has been the property price index before and after lake development. When there are investment opportunities and profits involved, lobbying is natural to occur ***(I7- Lobbying activities)***. Private sectors lobby for buy and sale of adjoining properties; the squatters lobby for their right to live in the city and squat; and the NGOs lobby for environment protection, law implementation, and the government to act. They also lobby for the rights of the poor who are not rehabilitated. Government is supposed to take a longer view on behalf of their constituents, but electoral considerations often dictate otherwise (Evans, 2004). Even the governments lobby for the benefits ripened from the resources, e.g. 'vote bank politics' was often linked to illegal urban settlements particularly provision of basic services in the squatters just during the election. This is changing mainly because of the civil society's demand for the positive outcomes that the lakes and their surroundings offer (Bal, 2006). Now, the both local and state governments are more inclined in building image towards the clean and green city environment that is inductive to larger economic investments.

The development of lakes and their surroundings have positive social outcomes ***(O1- Social Performance measures)***. It is observed that such places promote social equity, a place where people at large wish to go. For poor people, this is important since they cannot afford other modes of recreation (Bal, 2006). The efficiency of the lakes from its land-use capacity is also vital. Lake systems offer recreation places, better outdoor environment in the locality, technical solutions for infrastructure, regulate property price and many more. However, many lakes are still encroached by illegal activities and waste dumping (Bal, 1999). The ecological performance of lake systems has also changed over time. Micro water-shed development criteria have changed ***(O2- Ecological performance measures)*** towards micro climate regulator, localized pollution absorbent, storm water sink and networking. It is observed that ground water depletion has reversed since the lakes are developed and the vegetation has increased in the vicinity areas (AMC and AUDA, 2005).

Lakes bring externalities to other SES, ***(O3- Externalities to other SES)*** e.g. the IOL is one component of the overall storm water networking in the city. Similarly, lake development triggered planning of roads, parking, street lighting, landscaping and other public amenities in the vicinity. In the past, lakes and ponds were interconnected by natural drainage courses. After the natural drainage courses were disturbed, they are now re-connected by storm water drainage network (Jagani, 2004). The water in the lakes is not the result of natural accumulation. The water to the lakes come from a larger water supply network, under the project namely, Sardar Sarovar Project (SSP) (state led water canal system to bring water to many cities of

Gujarat in order to address the water scarcity of the state) (AUDA, 2007). It is a concern to many ecologists, since the lakes are dependent on the SSP system for their existence which also stresses on the coordination and integration of different infrastructures core to urban development process today (Bal, 2006).

From a common pool resource to a public good and further moving to almost private good, the sustainability of urban lakes in Ahmedabad is a future challenge.

5. GOVERNANCE AND VALUES OF AN URBAN LAKE SYSTEM IN VASTRAPUR

The following empirical work is aimed at understanding in depth about the economic, social and environmental values arising from a case of lake development namely, Vastrapur Lake Development Project (VLDP) in Ahmedabad, India. The VLDP was the pilot lake development initiative in Ahmedabad. Later the development model was modified and used to conceptualise the interlinking of lakes initiative in the city. The empirical work involved a questionnaire survey to different stakeholder groups who were impacted by VLDP in 2006 and a revisit to the site to conduct expert interviews. The main assumption for the empirical work was framed as: higher quality amenity space provides wider values to the local community and business and these values are attributed to an improvement in the society's welfare.

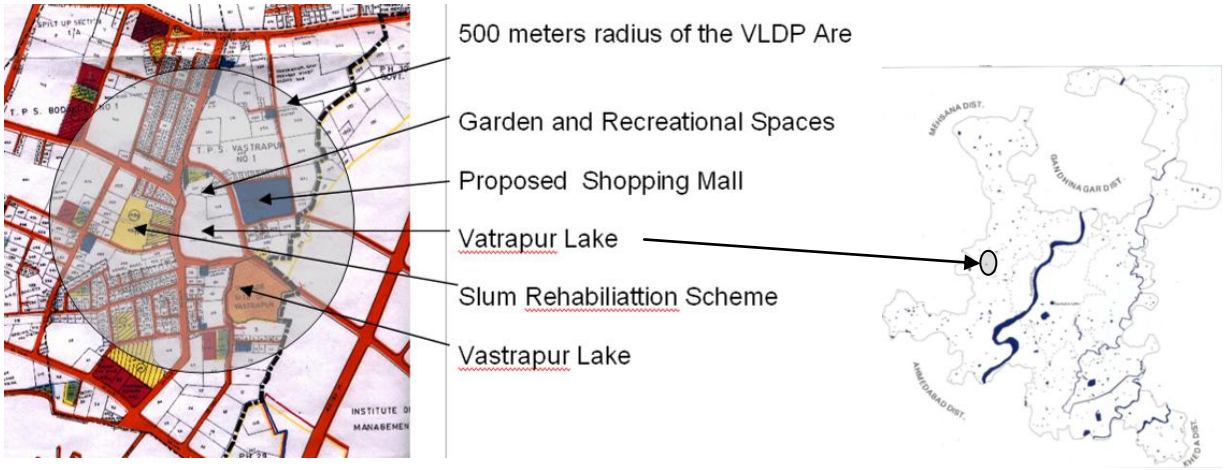


Figure 5: Vastrapur lake development area in detail and in Ahmedabad city
Source: AUDA, 2004

The sampling frame for the survey was the target population of 40,000 who are residing within a 500 meters radius of the VLDP area. Figure 5 shows the Vastrapur area and its environs, the circle representing the 500 meters radius. The survey was carried out face to face on site with the local residents and for the direct users. 120 respondents randomly selected from the area completed the survey questionnaire. The respondents were divided into four groups – people from residential and commercial area, squatters who are rehabilitated, and visitors to the lake. Thirty respondents from each group were surveyed. The respondents from residential groups were subdivided into two categories- those who live in flats and those who live in bungalows. The respondents from commercial groups were subdivided into two categories- those own/ work in shops and those own/ work in offices. Visitors to the lake were chosen at three different times of the day, morning, noon and evening; to help understand the usage of the area and to get a mix of all kinds of users. Figure 6 represents the sampling procedure.

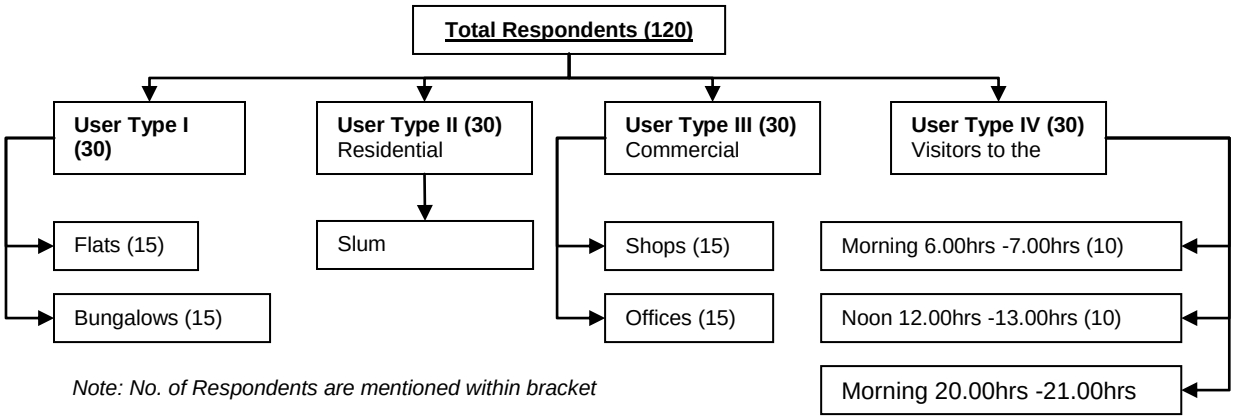
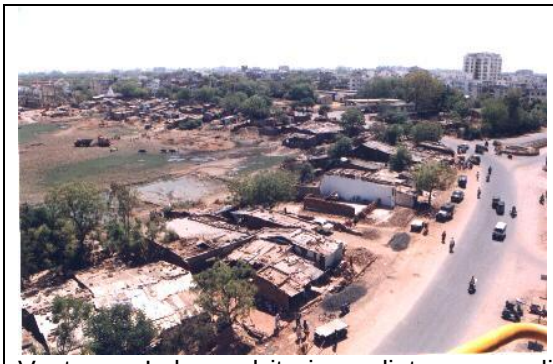


Figure 6. Sampling Procedure

The questionnaire in all the four groups is broadly divided into four sections. The questionnaire starts with a general information about the respondents like the house type- rented or owned; occupation; income etc. to build the case and involvement of the respondent. Then the respondents were explained about the lake development and were showed the pictures of Vastrapur lake before and after the VLDP (Refer Figure 7). In the second section, the respondents were asked about their view on the change in property prices in last five years and the change, if mentioned, was then cross checked whether the respondents attribute this change in price to the lake development project. In the third section, the respondents were asked about their willingness to pay (WTP) for the VLDP. If WTP, the respondents were asked about the mode of payment they would prefer. The respondents were also asked some questions on general environment and attributes to define better lake environment. The last section retested the ethics and validity of the responses with the respondents to see whether the respondents understood the purpose of the survey. The questionnaire was one page only.



Vastrapur Lake and its immediate surroundings- Before the Vastrapur Lake Development Project.

Vastrapur Lake and its immediate surroundings- After the Vastrapur Lake Development Project

Figure 7: Pictures that were shown to the respondents
Photo Source: AUDA, 2004.

The economic values are looked at by the analyses of change in the property price and people's willingness to pay (WTP) for the lake development activity. The mode of payment and people's preference to maintain the lake is also measured. The social values are looked at by the direct use such as recreation and indirect use such as existence. The social benefits are also looked at in terms of number of visits and purpose of visit and their attributes to define good environment. The environmental

benefits are looked at by physical aspect such as aesthetics and hygiene. The findings from the survey are discussed below:

5.i. Economic values are categorised into: direct benefits, e.g. recreation; indirect or spill over benefits, e.g. business activity; non- uses values; and include:

- Upgradation of existing commercial and residential complexes and new ventures in the vicinity commenced immediately after the VLDP initiative was declared.
- Vacant flats and bungalows facing the lake were occupied soon after the VLDP.
- Residential property value in the vicinity raised by 24.33% after VLDP (Table 2).
- The local real estate agents commented that the commercial buildings surrounding the lake have attracted higher value and more prestigious business since the VLDP. The commercial property value in the vicinity raised by 17.90% after VLDP. The business in the area generally raised by 15.23%.

Table 2: Analysis of change in Property Price since VLDP

	Present Property Price per Sq. Yd. in INR	% Rise in Property Price
User Type I	11133.33	31.33
User Type II	7181.82	13.46
User Type IV	11250.00	28.20
Mean of I, II and IV	**9855.05**	**24.33**
User Type III	**61050.00** (converted from 6783.33 INR per Sq. Ft.)	**17.90**

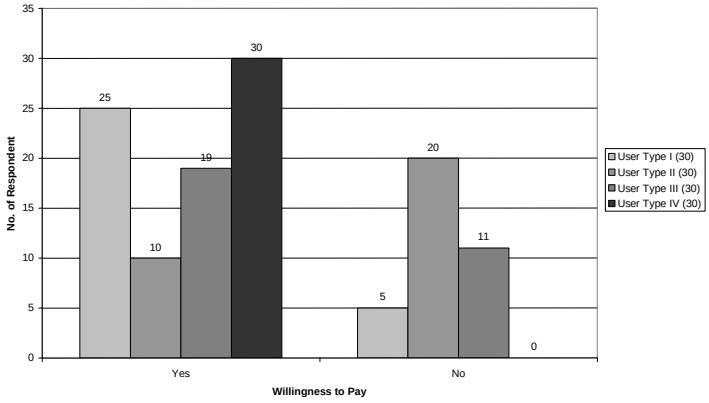


Figure 8: Graph showing respondents willingness to pay (WTP)

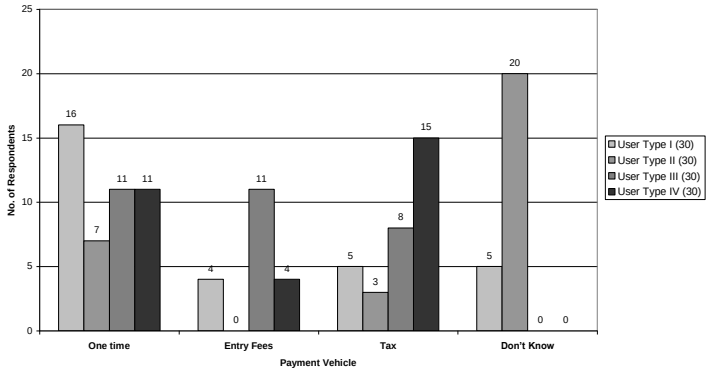


Figure 9: Graph showing the preferred Mode of Payment for VLDP

- 86 respondents are willing to pay WTP for the VLDP. It was noticed that all the 30 respondents who were visitors to the lake/ park are WTP (Figure 8).

- Out of those WTP, 45 respondents are willing to make 'One Time Payment' i.e. a donation and 31 respondents preferred some form of 'Tax' (Figure 9).
- 75 respondents believe that they should not be charged for the maintenance, i.e. it should be free. This view was predominantly from the residential groups and they had the opinion that the fee should be covered under the annual infrastructure charge which they have to pay in any case (Figure 10). A comparative tabulation of WTP, the preferred mode of payment for the VLDP and the maintenance of lake is presented in Table 3.

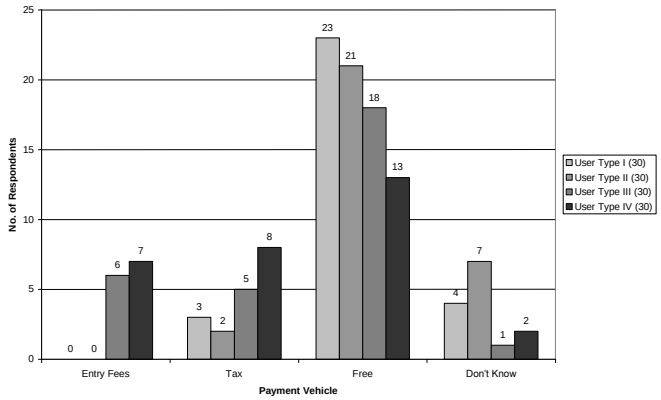


Figure 10: Graph showing the preferred Mode of Payment for Maintenance

Table 3: Analysis of Willingness to pay, the Mode of Payment and the Mode of Maintenance

Respondents	WTP		Payment Vehicle				Mode of Maintenance			
	Yes	No	One Time	Entry Fees	Tax	Don't Know	Entry Fees	Tax	Free	Don't Know
User Type I (30)	25	5	16	4	5	5	0	3	23	4
User Type II (30)	10	20	7	0	3	20	0	2	21	7
User Type III (30)	19	11	11	11	8	0	6	5	18	1
User Type IV (30)	30	0	11	4	15	0	7	8	13	2
Total (120)	**84**	**36**	**45**	**19**	**31**	**25**	**13**	**18**	**75**	**14**

- There is a significant shift in the use from residential to commercial in the ground floor and first floor and offices in the upper floor in the buildings facing the lake.
- AUDA generated surplus income from leasing the adjacent plot designated for a neighbourhood centre which is ongoing developments as a shopping mall.
- AUDA lends the amphitheatre, the lake water and recreations spaces to local contractors on annual rental basis which supports to cover the maintenance of the rest of lake area. AUDA developed a corpus fund from the profits for the future maintenance and for other uncertainties with the lake activity.
- In/ direct investments in provision of various facilities generated employment.
- Increase in time spent on the lakefront by local residents and commuters visiting the area have benefited the local businesses.
- The footpath around the lake is now used by organised hawkers and vendors which supports the poor (mostly the early squatters) economy.

5.ii. Environmental values linked to quantity and qualities of lake environs are not covered. They can be only analysed after a certain period. Environmental values identified are based on individual experiences and preferences:

- Percolation wells dug at the lake bed has helped to percolate ground water and helped in ground water recharge.

- Storm water drainage improved the flood situation of the locality by 70%.
- Lake water attracted many migratory birds to the site which will rejuvenate the lake ecology.
- Greenery in the lake area improved the aesthetic value of the space.
- Lake water throughout the year has improved the microclimate of the area.

5.iii. Social values mainly finds the distributional impacts of VDLP and include:

The local residents have an open space which they can use in many ways such as jogging, lunch time outings, and evening outings. On the frequency of visit, there are almost an equal number of visitors on a daily, weekly and monthly basis (Table 4).

Table 4: Table showing frequency of visit to the lake

Respondents	**Visit to Lake**		
	Daily	**Weekly**	**Monthly**
User Type I (30)	2	17	11
User Type II (30)	9	12	9
User Type III (30)	NA	NA	NA
User Type IV (30)	15	4	11
Total Respondents (120)	**26**	**31**	**31**

- Slums rehabilitation provided better living conditions to squatters. Easier access to housing loans was acknowledged as a benefit by respondents.
- Widening of roads and the allocation and organization of parking all around the lake has improved the traffic flow in the locality.
- It has changed people's choice with respect to the use of the space. The park around the lake with amenities such as children's play area, public toilets, and pockets of public and private spaces etc. has increased usage for people of all age, class and caste. Note that the same play area is now used by the children living in flats/ bungalows and poors.
- Fountains, boating and Fun-park attracts people from distant parts of the city.
- Raised people's awareness of the lake existence and hence its conservation.

5.iv. Use of VLDP area changed:
- Park is used by visitors on a daily routine for health, sports and congregation.
- Various social events and workshops are held in the park and amphitheatre.
- Boating and Fun-park are big success especially on weekends and holidays.
- Commuters now prefer to stop by for local shopping and social meets.
- VLDP is a model lake development for the city as well the state.

Economists pointed out limitations and issues which are helpful for future lake development initiatives. Sixty six percent of the total cost was spent on housing rehabilitation of the squatters. This was recognized by AUDA as a possible setback to initiate any lake development project because slum rehabilitation is not covered under AUDA's scope of work; it is difficult and time consuming to remove encroachments under the current institutional constraints. However, the VLDP model helped to draft the 'interlinking of lakes' initiative and seek funding through the national infrastructure development program of JNnURM. Partnerships with private sector for maintenance and management are also developed now.

Social activists believe that the loan burden on the rehabilitated squatters needs to be more resolved. The payment conditions and allocation should be looked into more carefully. It was found that the purchase price of the rehabilitation dwellings were different. This can be mainly due to the time of buying and resale. It was noticed that some of the dwellings are illegally resold and rented out. The rehabilitated dwellings became an alternate source of income for the squatters. The calculation goes like this: 550 INR is the average net loan repayment per month and if the place is rented, it may fetch around 1000-1500 INR so there is a profit of around 1000 INR per month which is a big amount of money for poor people. Unfortunately, the squatters squat in other part of the city after the rent out their place. This is a great cause of worry. Interestingly, most of the rehabilitated respondents are not willing to pay for the provision of VLDP which suggests that either they cannot afford to pay or they are potential 'free-riders'.

Social workers and employees of the VLDP believe that the nuisance and vandalism in the public space reduced after VLDP. Families, especially ladies and senior citizens are flocking to visit the area. However, they warn that the presence of the deep lake water encourages fatalities such as suicide.

Ecologists are concerned that the source of water to fill the lake is from the Narmada canal water supply network which is itself an ongoing project. In light to this, if the lake development is dependent then how far it can be sustainable is a critical issue. Experts also say that the lake development is an eye wash to lure business and investment opportunities to the city in the name of 'clean green and city'.

Urban designers and planners warn about the user capacity with respect to traffic, parking, informal and formal shopping. The development of more malls and increase in commercial activities may generate high density and congestion. It may de-value benefits if land use development in the surrounding are not controlled and planned.

DISCUSSIONS

Over centuries there has been a strong relation between the value of water resources such as rivers and lakes and how the rivers and lakes are managed and governed. The case of India discussed at all spatial levels highlight the link between value systems and water resource governance. Several values are associated to rivers and lakes since history till date such as, socio-cultural values, economic values, ecological values and political values. The discussion also brings forth the paradox of value systems linked to the current state of urban lakes in India. Mostly, the values of the lakes vary from case to case and are the derivable of functions that the lakes perform which determinant of the lake environs, either they are developed and maintained or un-developed and non-maintained.

Considering the values on temporal scale, a strong correlation with modernisation processes can be observed. With the transition to modern times, societies started to exploit water systems in a way that they reached their ecological limits. The emphasis changed to co-evolution between ecological and economic values. In the sustainability transition at the end of modernisation, a trend can be observed to ground human use on the limits of the water resource system. It leads to practices like adaptation, participation and strengthening of resilience.

Table 5: Developments in the concept of water management

Phase	Concept	Value
1 historic	flood control drinking water supply water quantity management	human health land use/food production
2 modernisation	sectoral water management integrated water management	human use water system health
3 recent times	sustainable water management	sustainability (long term) (interaction, adaptation, resilience)

Source: Ast, Bouma and Bal, 2010

Considering a paradigm transition in water resource governance, an overview of conceptual changes can be identified. In Table 5, the important features related to the changes from traditional to modern thinking in water governance are mentioned.

Table 2: Changes in water management

FROM	TO
- Sectoral water management	- Integrated water system management
- Effective and efficient	- Sustainable: long term responsibility
- Supply Management	- Demand Management
- Social processes follow water systems	- Water systems follow social processes
- Water follows spatial development	- Spatial development follows water
- Ecosystem based: support resilience	- Technocratic: build and maintain
- National	- Local
- Command and control water policy	- Participative water management

Source: Ast, Bouma and Bal, 2010

These changes are mainly the outcome of the value pattern that is generally attributed to water resource systems, for example, ‘aethetics’ and ‘nature’ are predominant values in the post-modern times. In this way, the transition corresponds with the change from exploiting the nature for human use to seeing the nature as an independent value that can upgrade the society in an aesthetical way. The awareness that society depends on large ecosystems of which they are part of made a contribution to the increase of the value of nature. It resulted in planning practices that take the characteristics of the ecosystem into account. It also leads to a broader view on trans-boundary issues. The democratic view on equity value where water is considered to be a basic human right influenced the mechanisms on the decisions about the water resource systems. It brought back the importance of the value of participation of individuals and stakeholders in water governance. The values can be considered to be responsible for the revival of water bodies in many urban areas.

Values related to nature and ecosystems are influenced by interaction with the urban system. Understanding of values is extremely important for the sustainable management of water resources in urban areas. Facing the rapid urbanisation in Indian cities and assessing the values of urban lakes systems, it can be stated that urban lake systems are vital to the health of the cities and therefore the sustainability of urban lake systems is directly linked to the sustainability of the cities. The question is where would this lead to in the future when urban population density is increasing in leaps and bounds. The answer depends mainly on the values that will lead human behaviour. It can be expected that with the continuing scarcity, the ecological value

will increase in its importance. Societies have to get acquainted to the fact that lake systems bring conditions for humans to make use of them. Sustainability or other terms that refer to the protection of the health of natural systems, will be rise in strength. Institutions that will take care of long enduring high scale ecosystems are expected to develop. These institutions can at least make guidelines for the way societies can deal with ecosystems. We hope that the current approach to urban lake governance may accelerate the transition towards sustainability; and lake systems again prove to be connectors of societal development today as it did in the times of ancient and traditional water management practices.

REFERENCES

Agarwal, A. and Narain, S. 2001. Dying Wisdom. Centre for Science and Environment, CSE Delhi.

Agarwal, A., Narain, S., and Khurana, I. 2001. Making Water Everybody's Business, Practice and Policy of Water Harvesting. Centre for Science and Environment, CSE Delhi.

Allen, T.F.H., Bandurski B.L., King A.W. 1992. The ecosystem approach: theory and ecosystem integrity. International Joint Commission United States and Canada, Washington D.C. (USA).

AMC, and AUDA. 2005. City Development Plan, Ahmedabad: 2006-2012 for Jawaharlal Nehru National Urban Renewal Mission. Ahmedabad Municipal Corporation and Ahmedabad Urban Development Authority.

Anderies, J.M., Janssen, M.A., and Ostrom E. 2004. A Framework to Analyze the Robustness of Social-ecological Systems from an Institutional Perspective. *Ecology and Society, vol. 9 (1), pp.18*.

AUDA. 1997. Revised development plan of A.U.D.A. Area: 2011. Ahmedabad Urban Development Authority, Part.1, vol.1 and vol.2, Part.2, vol.1 and vol.2,

AUDA. 2004. Project Report on Vastrapur Lake Development Project. Ahmedabad Urban Development Authority, Ahmedabad.

AUDA. Official portal of AUDA. http://www.auda.org.in/Environment. AUDA, Ahmedabad.

Bal, M. 1999. *Open spaces in the urban context- lakes as an opportunity*. Unpublished Thesis for Post Graduate Diploma in Urban Design, School of Architecture, CEPT University, Ahmedabad, India.

Bal, M. 2006. An assessment of the case for increase in public amenity and space. Unpublished Thesis for MPhil Planning, Growth and Regeneration, Department of Land Economics, Cambridge University, Cambridge, UK.

Bal, M. 2009. Sustainable Urban Lake System Governance: Looking at Ostrom's Social-Ecological Systems Framework as a starting point. Proceedings of The AUC-EUR Sustainable Development Workshop, Oct. 27–29, 2009, American University in Cairo, Egypt.

Bansil, P.C. 2004. *Water Management in India*. Concept Publishing Company, New Delhi.

Bhargava, A. 1995. Land Water Mediation. Unpublished Thesis for Post Graduate Diploma in Landscape Architecture, School of Architecture, CEPT University, Ahmedabad, India.

Birch, S., and McCaskie, J. 1999. Shallow urban lakes: a challenge for lake management. In: Harper DM, Brierley B, Ferguson AJD, & Phillips G (eds). The Ecological Bases for Lake and Reservoir Management. Kluwer Academic Publishers; Hydrobiologia, vol. 395/396, pp. 365–377.

Braungart, M., MacDonough, W., and Bollinger, A. 2007. Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design. *Journal of Cleaner Production*, vol. 15, pp.1337-1348.

Bressers H.Th.A., and Kuks S.M.M. 2009. What does governance mean? From conception to elaboration. Draft Paper

Campbell, S. and Feinstein, S. 2003, Readings in Planning Theory, Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable, Blackwell Publication.

Chandrasekharan, H. et. al. 2004. *Water resources development and management,* Mittal Publication, Delhi.

Daly H.E., and Farley J. 2004. Ecological Economics: Principles and Applications. Island Press.

Daly, H.E., and Farley, J. 2004. *Ecological Economics, Principles and Applications.* Island Press.

Dave, A.M. 1997. *Water mission for Gujarat: proceedings of the national workshop on "Water Resources Management of Gujarat"* at GSFC training institute, GSFC Science Foundation, Vadodara.

Doolette, J. B. ed. 1994. *Watershed development in Asia: strategies and technologies,* World Bank International Bank for Reconstruction & Development, Washington, D.C.

Dwivedi, G. 2010. *Public-Private Partnerships in Water Sector: Partnerships or Privatisation*? Manthan Adhyayan Kendra, Badwani, India

Evans, A.W. 2004. Economics and land use planning. Blackwell Publishing, Oxford, UK.
Foster, J. 1997. *Valuing nature: Ethics, economics and the environment.* London, Routledge.
GOI. 2002. *National Water Policy*. Government of India, New Delhi.
Gujarat State. 2009. Official Gujarat State Portal. http://www.gujaratindia.com.
Hambleton Robin and How Thomas, 1995, *Urban Policy Evaluation, Challenges and Change,* Paul Chapman Publishing Ltd.
Hanley, N., and Spash. 1998. *Cost Benefit Analysis and the Environment.* Edward Elgar.
Hanley, N., Shogren J.F. 2001. Introduction to Environmental Economics. Ben White, OUP
Hardin, G., 1968. The tragedy of the commons. Science 162, pp.1243-1248.
Hoekstra, A.Y. 2008. Human appropriation of natural capital: A comparison of ecological footprint and water footprint analysis. *Journal of Ecological Economics*, Elsevier.
Hooper, B.P. 2005. *Integrated River basin Governance*, Learning from International experience. IWM Publishing, London, Seattle.
ICWE. 1992. International Conference on Water and the Environment, *Development Issues for the 21st century.* The Dublin Statement Report of the Conference, ICWE Conference January 26-31, Dublin Ireland, ICWE, Dublin.
Jagani, A. 2004. Techno planning solution for water resources conservation through interlinking the lakes of peri-urban area: a case study of AUDA. Ahemdabad: PG Diploma Thesis in Planning, School of Planning, CEPT University, Ahmedabad,
Jong, J.D., Rooy, P.T.J.C. V., and Hosper, S.H. 1995. Living with water: At the cross-roads of change. *Water Science and Technology*, vol. 31, issue 8, pp.393-400.
Jongejan, R.B. 2008. How safe is safe enough? The government's response to industrial and flood risks, Dissertation Delft University of Technology, Delft University Press, Delft.
Kerr, J. M., and Swarup, R. 1997. *Natural resource Policy and Management problems in India in Natural Resource Economics: theory and Application in India.* Oxford & IBH publishing, New Delhi.
Kohli, K. 2004. *An impacted assessment process,* http://indiatogether.org/2004/dec/env-nepolicy.htm
Kolstad C.D. 2000. Environmental Economics. Oxford University Press, Oxford.
Kontoleon, S.M. 2002. Individual Preference-Based Values and Environmental Decision Making: Should Valuation Have Its Day in Court? Research in Law and Economics, Vol. 20, pp.179–216.
Lélé*, S. M. 1991, Sustainable development: A critical review. World Development, Vol.19, issue 6, pp. 607-621
Mcharg, I. 1969. Design with Nature. New York: John Wiley & Sons.
Meinzen-Dick., R. 2007. Beyond panaceas in water institutions. PNAS, vol. 104(39), pp.15200-15205.
MO&EF. 1990. Wetlands of India -A Directory. Ministry of Environment and Forests, Government of India, New Delhi, India.
MO&EF. 2008. Guidelines for National Lake Conservation Plan (NLCP). National River Conservation Directorate, Government of India, New Delhi, India.
MOUAF. 1996. Urban Development Plan Formulation and Implementation Guidelines, UDPFI. Ministry of Urban Affairs and Employment, Government of India, New Delhi, vol. 1.
MOUD. Official portal of Ministry of Urban Development, Government of India. http://www.urbanindia.nic.in.
MOWR. Official portal of Ministry of Water Resources, Government of India. http://www.wrmin.nic.in
Narain, V. 1998. Towards a new Ground Water Institution for India. *Water Policy, vol.1, issue 3*, pp.357-365.
Narain, V. 2000. India's water crisis: the challenges of Governance. *Water Policy 2, pp.433-444 .*
North, D.C. 1990. *Institutions, institutional change and economic growth.* CUP, *Cambridge*.
Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, New York, USA.
Ostrom, E. 2001. Reformulating the commons. In: Berger J, Ostrom, E., Norgraad, R.B., Policansky D, Goldstein B.D., (eds). Protecting the Commons, A Framework for Resource Management in the Americas. Washington DC: Island Press 2001. pp. 17-41.
Ostrom, E. 2007. A diagnostic approach for going beyond panaceas. Proceedings of the National Academy of Sciences (PNAS) of the United States of America, USA, vol. 104 no. 39, pp. 15181-15187.
Ostrom, E. 2008. Frameworks and theories of environmental change. Global Environment Change, vol. 18, pp.249-252.
Ostrom, E. 2008. Institutions and the Environment. Institute of the economic affairs, Blackwell Publishing, Oxford
Ostrom, E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. Science, vol. 325, no. 5939, pp. 419 – 422.

Ostrom, E. Janssen, M.A., and Andries J.M. 2007. Going beyond panaceas. Proceedings of the National Academy of Sciences (PNAS) of the United States of America, USA, vol. 104, no. 39, pp. 15176-15178.
Ostrom, E., Gardner, R., and Walker, J. 1994. Rules, Games and Common- Pool Resources. University of Michigan Press.
Ostrom, E., Schroeder, L. and Wynne, S. 1993. Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective. Boulder, CO: Westview Press.
Pearce D.W., and Turner R.K. 1990. Economics of Natural Resource Environment. Harvester Wheatsheaf.
Pearce, D. W. 2000, *Cost-Benefit Analysis and Environmental Policy"* In: D. Helm (Ed.), *Environmental Policy: Objectives, Instruments, and Implementatio*n. OUP, Oxford, vol.38.
Perman, R., Ma Y., Mcgilvary, J., and Common, M. 2003. Natural Resource and Environmental Economics. 3rd ed. Pearson Education Limited, pp. 399-400
Reddy, M.S. & Chhar N.V.V. 2004. Management of Lakes in India: Detailed Project Report (DPR) - Conservation and Management Plan for Dal and Nagin Lakes, Roorkee. India: Ministry of Water Resources, Government of India.
Rudel T.K. 2005. Forests: Regional paths of Destruction and Regeneration in the Late Twentieth Century. Columbia University Press, New York.
Schueler, T., and Simpson, J. 2001. Introduction: Why Urban Lakes Are Different. In: Urban Lake Management. Watershed Protection Techniques, vol. 3, no. 4, pp.747-750.
Upadhyay, V. 2003. *Urban Water: Judicial recipes falling short,* http://indiatogether.org/2004/oct/env-nepolicy.htm#continue
Van Ast, J.A. 1998. Trends Towards Interactive Water Management; Developments in International River Basin Management, in: *Physics and Chemistry of the Earth (B), vol. 24, Nno 6,* Elsevier Science, Oxford, pp. 597-602.
Van Ast, J.A. and Bouma, J.J. 2008. Value chains in water cycles, Innovations in water governance. In: Auger J.F., Bouma, J.J. and Kunneke. R. ed. 2009. Internationalization of Infrastructures, Proceedings of the 12th Annual International Conference on Economics of Infrastructures. Delft: Delft University of Technology, Chapter 14, pp.187-200.
Van Ast, J.A. and Bouma, J.J. 2008. Value Chains in Water Cycles: Innovations in Water Governance. *CRNI*, vol. 9, no. 4, Intersentia, pp. 341-360.
Van Ast, J.A. and Bouma, J.J. and Bal, M. 2010. Governance Values of Water Systems in The Netherlands and India. Proceedings of The Netherlands Institute of Government (NIG) seventh Annual Work Conference, 25-26 Nov. 2010, Maastricht, NL.
WCED. 1987. World Commission on Environment and Development, *Our Common Future*, Oxford University Press, Oxford, UK.
Williamson, O.E. 1979. Transaction costs economics: the governance of contractual relations. *Journal of Law and Economics*, vol.22, pp.3-61.
Williamson, O.E. 1996.The Mechanisms of Governance. Oxford University Press,
Williamson, O.E. 1998. Transaction costs economics: how it works, where is it headed. *The Economist*, *Vol. 146, No.1*, pp.23-58
World Bank, 1998. India. Water Resources Management Sector Review: Report on inter-sectoral water allocation, planning and management, World Bank, New York, UN.