CHAPTER – 2
REVIEW OF LITERATURE

Water management and consumption pattern has invited the attention of scientists, economists, administrators, environmentalists, sociologists and even non-governmental organizations. A lot of fragmented and piecemeal studies on urban water situation have been conducted and these studies largely focus upon the following issues:

- Scarcity of water and its reasons;
- Depletion of water resources both surface as well as groundwater;
- Equity considerations in urban water supply;
- Pollution and quality of water;
- Water education and users participation;
- Water pricing;
- Demand side management through economic incentives and disincentives.

Aijaz (2010) in his paper on, “Water for Indian cities: Government practices and policy concerns”, noted that the demand for basic infrastructure and services in Indian cities has increased due to rapidly growing population. Such increasing demands often adversely affect the quality of urban life, the economic productivity, as well as sustainable development. The main purpose in paper was to highlight the problems involved in improving access to water supply in Indian cities faced with a severe water shortage crisis. A case study approach was followed, and the status of water supply service was described for three large cities of India, namely, Delhi, Mumbai and Kolkata. It was proposed that there exists an immediate need to build up the water infrastructure and institutions, and pointed out that the challenge for stakeholder’s lies in speeding up the reform process and in the implementation of efficient water governance practices.

Amiraly et al (2004) in their paper on, “Rainwater harvesting, alternative to the water supply in Indian urban areas” calculated that water scarcity is a main feature of north-western states of India. The continuous increase in the population and the financial, administrative and technical deficiencies in the new supply system have led to the deterioration of the water supply service in Ahmadabad city. The water
demand has increased due to the improvement in the standards of living of the masses. This has resulted in an ever increasing pressure on underground water resources, which has lead to an alarming depletion of aquifers. The objective of the research to evaluate to what extent the traditional system might constitute an additional source of water within the old city of Ahmadabad and locally reduce the pressure on water demand, assuming that the existing supply system was not fulfilling the needs of the users. The results of this exploratory field study conducted in the old city in 2001-02, which combined quantitative and qualitative aspects, give an outlook on people’s opinions and behaviors regarding both systems. Finally, the rehabilitation of rainwater harvesting structures in the old city of Ahmadabad suggests the necessity of empowering local structures of water management in semi-arid urban areas to create the conditions for a sustainable implementation.

Araral (2010) in his paper on, "Urban water demand management in ASEAN countries: Challenges and solutions", pointed that communities face challenges in managing urban water demand when populations are rising, looming water scarcity is on high speed and urbanization is on rising trend. Depending on country’s circumstances, both short term and long term solutions including tariff solutions, management solutions, technical / engineering solutions, institutional / regulatory solutions and leadership, public education and community involvement were suggested. Short term solutions include reducing commercial losses, checking on meter accuracy and reducing pressure. Long term solutions include pipe placement programs, shifting towards economic valuation of water service, performance and process benchmarking and 100 percent metering. Other effective long term institutional solutions include more effective regulation, private sector participation and financial restructuring of water utilities. These solutions can only be applied if formal training is provided to the staff, advisory services can be enhanced and leadership qualities can be developed.

Arlosorof (2007) in his paper on, “Water demand management – A strategy to deal with water scarcity in Israel: A case study”, found that to combat water scarcities in The Middle East, a condition which might accompany the Middle East socio-economic policies for many years to come is ‘Water Demand Management’, and/or ‘Water Conservation’ as well as the ‘Increase of Water Use Efficiency’. These three

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terms have become a major shift of paradigm from the conventional supply side management of water to the management of the demand side, producing additional quantities of water for the immediate needs of the society, through the creation of “Virtual” quantities of water, whether by conservation strategies or by increased agricultural and industrial production per unit of water, as well as the import of water intensive agricultural products and decreasing exports of such products.

Bathla (1999) in her paper on, “Water resource potential in Northern India: Constraints and analysis of price and non-price solutions”, examined the linkages between water depletion, continuous population growth and economic development. The consequent fall in water table may lead to constraints in the use of water. This has strong inequity implications in the resource use. It was revealed that a mix of interventions based on price solutions, non-price solutions and institutional set up are decisive in bringing a sustainable development and use of resource.

Bhandari and Khare (2006) in their study, “Poor provision of household water in India: How entrepreneurs respond to artificial scarcity”, observed that though water is not strictly a ‘public good’, in most countries it has been a convention that water supply and provision is the government’s realm. In India too this is the case. India has blessed with some of the best natural water resources in the world. It has perennial rivers that are spread fairly evenly across the country, a large coastline, and (generally) high rainfall levels. The study analyses the problems with urban water supply in Delhi and other regions of India. It examined the adverse human and environmental impacts of unpriced water which is supplied inefficiently by the public sector.

Boland and Whittington (2000) in their research paper on, “Water tariff design in developing countries” showed that increasing block tariffs (IBTs), were widely used in the developing world, discourage wasteful use of water, promote economic efficiency, and assure access to sufficient water for basic sanitation. In fact, these claims are incorrect. In practice, IBTs are likely to promote inefficiency, inequity, unfairness, net revenue instability, and other negative consequences. An alternative tariff design, a uniform price with rebate (UPR), was presented. A revenue-neutral comparison, using developing country data, shows the UPR to outperform the IBT on all counts, while avoiding certain undesirable aspects of IBTs.
Bouselly et al (2006) in their working paper on, “Water and urban poor” studied that rapid urbanization was responsible for increased urban poverty and greater demand for many utility services in India. The pressure on public water utilities becomes immense, which to a great extent are not able to provide services of good quality for all. The urban poor suffer the most because of the inadequate water supply as they cannot afford the payments that have to be made as coping strategies and neither can they afford to spend time standing in lines. Among the various factors responsible for the poor service delivery the most important is the meager pricing of the water, which discourages investments in the system and prevents the municipalities from adopting any water saving schemes. Since the Governments are either unwilling or unable to raise tariffs and improve cost recovery, the only solution is allowing private participation in the sector. Privatization along with improving cost recovery and encouraging quality and cost innovations will also ensure a more efficient and accountable service delivery system. As for the arguments against privatization of the water sector: the perceived inability and unwillingness of the poor to pay the charges under the privatized system, both are proven to be baseless. The poor do pay and often pay a lot more per liter than the well off even while they do not consume as much as the rest of the population do. Experience has shown that the poor would be willing to pay higher user charges if they were ensured a more adequate and efficient supply. Thus we have privatization as the model means to counter the deficiencies of the current water supply system.

Central Public Health and Environmental Engineering Organization (CPHEEO) (2005) study on, "Status of water supply, sanitation and solid waste management in urban areas", found that the urban population of India is growing rapidly and is putting considerable pressure on urban services. Urban infrastructure has been unable to keep pace with the growing population. A great challenge for Indian cities is to make cities to provide every citizen with basic services. Urban local governments are entrusted with the task of providing these basic services but they are often short of funds and unable to discharge their duties satisfactorily. In order to understand what needs to be done to improve the provision of basic services, we need to know the level of provision of these services. The objective was to assess the status of water supply, sanitation and solid waste management in 300 selected
cities and towns and to estimate the requirement of funds for full coverage of population by these services in the urban areas of the country.

Chaudhary et al (2002) in their paper on, “An analysis of groundwater vulnerability and water policy reform in India” established that water is a basic human need, a finite life support system and a key to prosperity. Unplanned industrialization, urbanization and impact of liberalized import of wastes intended for recycling have adversely affected the water environments in India. This is further exaggerated by lack of discipline and a weak obligation towards conservation and pollution prevention. Measures have to be especially taken to resolve the groundwater problems. While groundwater resources are quite well assessed, overexploitation still occurs frequently. There has been a considerable lack in implementing existing policies as well as developing new laws and policies.

Dwarakanath (2006) in his paper on, “Rain water harvesting in urban areas and its impact” pointed out that urban centers in Indian cities have been facing acute water shortages now-a-days. On one hand there is acute water scarcity and on the other the streets are often flooded during the monsoons. This has led to serious problems with depletion of water table on one side, deterioration of chemical quality of ground water on the other side. Most of the traditional water harvesting structures in cities have been neglected and fallen into disuse, worsening the urban water scenario. One of the solutions to the urban water crisis is rainwater harvesting-capturing the run off.

Emoabino and Alayande (2007) in their paper on, “Water demand management, problems and prospects of implementations in Nigeria”, pointed out that water supply in Nigeria was facing serious challenges and supply-oriented indefinite expansion of water supply infrastructures was stressing the available budgetary allocations to the sector to the limit. Governments have been pursuing water supply programmes and donor agencies also have been making efforts to expand water supply infrastructures. Despite these efforts still a substantial number of people are not covered with safe drinking water and sanitation.

Fox and Kelly (2000) analyzed that expansion and improvement of public services is essential for improving the quality of life and productivity in all developing countries. It was found that some of the African countries have been diligent in expanding the infrastructure necessary to provide public services, but unfortunately,
most have not done a very good job of paying for it. They presented a case study of water supply services in Egypt, where they emphasizes the significance of user charges in enabling expansion of coverage of water supply services.

Franceys and Sansom (1999) in their paper on, “The role of government in adjusting economies”, based on information from 35 urban centers in India, represent that 15 percent of India's population, have noticed that private sector participation is unlikely to have a significant impact on delivery of public services such as water supply in the medium term, because of too many vested interests in the existing institutional patterns. Until there is demand for institutional development from municipalities, which is, in turn, generated by demand for better service from customers, there can be no sustainable advances in service delivery.

Gidey (2006) in his research on, "Managing a scarce resource: Demand side management (DSM) in urban water governance”, noted that to fulfill public water supply needs efficiently and in sustainable manner in a rapidly urbanizing world is becoming a challenge to governments and utilities. Past experiences have shown that the supply side management to water governance has proven to be inadequate in meeting water demands of urban areas in a sustainable manner and protecting the environment. New water sources are not available. Moreover, environmental constraints, political as well as socio-economic realities have presented new planning scenarios. Water conservation has therefore becoming the need of hour.

When it comes to meeting urban water demand and ensuring efficient and sustainable use of resources, demand side management is appealing as a complimentary solution and is currently being promoted as an appropriate measure to ensure water use efficiency. Water conservation objectives in urban areas can be achieved through demand side management practices. The empirical analysis aims at investigating primarily whether water conservation has occurred in Copenhagen as a result of demand side management strategies. It also tries to explore the extent to which these measures have been employed and the challenges and constraints faced in the process. The study concludes by stating that there is a significant potential in the demand side management approach as a complimentary effort to the supply side management to ensure adequate supply of water to urban areas in a sustainable way.
Gulyani et al (2005) in their discussion paper on, “Water for the urban poor” discussed that urban poor were served inadequate water by the public utilities and small-scale private water providers. Based on a survey of 674 households, this paper examined current water use and unit costs in three Kenyan cities and also tested the willingness of the unconnected to pay for piped water, yard connections, or standpipe service. By examining water-use behavior of poor and non-poor households, the study brought into question a long-standing notion in the literature—that the poor are underserved, use small quantities of water, and pay a higher unit price for it. The study opined that water should be priced and water markets should be created so that service delivery options can be improved without appropriate institutional arrangements, technical solutions such as water kiosks may not succeed in delivering an affordable service to the poor.

Gupta et al (2006) in their working paper on, “Measuring the performance of water service providers in urban India: Implications for managing water utilities”, assessed that data envelopment analysis (DEA) is an analytical tool for measuring technical efficiency. Cities were categorized into two groups (e.g. Municipal Corporations and Government, and Municipal Corporations and parastatal) according to the management structures of their water utilities. The efficiency of urban water supply system in select 27 Indian cities for the year 2004-05 was assessed. The results showed that although the average technical efficiency scorings between these two groups were not significantly different, but the decomposition of this total efficiency indicated that the utilities managed by Municipalities in collaboration with parastatal were relatively scale efficient in comparison to the other group. Moreover, the results also have implications for urban domestic water pricing. Most of the water utilities were operating under decreasing returns to scale (DRS) implying that water should be priced at marginal cost of supply.

Hoffmann et al (2006) in their paper on, “Urban water demand with fixed volumetric charging in a large municipality: The case of Brisbane, Australia”, asserted that residential consumption is charged using a fixed annual service fee with no water entitlement followed by a fixed volumetric charge per kilolitre. Water demand is specified as average quarterly household water consumption and the demand characteristics include the marginal price of water, household income and size, and the number of rainy and warm days. The findings not only confirm
residential water as price and income inelastic, but also that the price and income elasticity of demand in owner-occupied households is higher than in rented households. The results also show that weather, particularly summer months and the number of rainy days, exerts a strong influence on residential water consumption.

Howard and Bartram (2005) in their paper on, "Effective water supply surveillance in urban areas of developing countries” highlighted that the quantity of water delivered and used for households is an important aspect of domestic water supplies, which influences hygiene and therefore public health. To date, World Health Organization (WHO) has not provided guidance on the quantity of domestic water that is required for good health. Based on estimates of requirements of lactating women who engage in moderate physical activity in above-average temperatures, a minimum of 7.5 liters per capita per day will meet the requirements of most people under most of conditions. This volume does not account for health and well-being-related demands outside normal domestic use such as water use in health care facilities, food production, economic activity or amenity use. The basic need for water includes water used for personal hygiene, but defining a minimum has limited significance as the volume of water used by households depends on accessibility as determined primarily by distance and time, reliability and cost.

Jethoo and Poonia (2011) in their paper on, “Water consumption pattern of Jaipur city” found that in past few years, ground water level in India as a whole and in Rajasthan, in particular is going down. The State is facing a drought like situation. Ninety nine percent dams of Rajasthan are completely or are at the verge of drying. Major cities like Jaipur are facing a grave problem of drinking water. In the last few years, the population of Jaipur city has been increasing exponentially, leading to acute shortage of drinking water. Unfortunately, with diminishing resources of drinking water, the human behavior towards water conservation is not changing. The study examined the different income group consumer’s behavior with respect to the dwindling water supply. It was observed that in ignorance of depleting water tables and acute shortage of drinking water due to little awareness, people were using much more water than it is needed. This needs to be addressed immediately by changing public perception towards water use through media and by organizing public awareness programs.
Jha (2010) in his working paper on, “Access of the poor to water supply and sanitation in India” calculated that access to safe drinking water is necessary for livelihoods. In India, a mid-term assessment reveals that the country has already met its Millennium Development Goals (MDG) in terms of expanding access to water infrastructure although in sanitation progress is short of its aims. In reality, most basic observations indicate that water supply coverage is not as good as the figures show while national sanitation continues to be poor even after almost six decades of efforts to stop open defecation. Economic, technical, institutional as well as social factors constrain access to safe drinking water and proper sanitation in India for both the urban and rural poor, and that figures do not reflect this restricted access. Communities are being required to manage their own water and sanitation schemes, not just in rural areas but in urban areas as well. There are definite advantages to such an institutional arrangement if the transition to community management is carried out smoothly. The chances of success of community management are vitiated because policy makers misunderstand and misapply three interlinked concepts that are important for the success of community-managed water and sanitation schemes—participation; water and sanitation burden; and project ownership.

Kayaga and Smout (2007) in their paper on, “Water demand management: A key Building block for integrated resource planning for the city of the future”, studied that looming water scarcity along with adverse environmental impact compels water sector policy makers to rethink the way they manage the water resources. Urban water managers should not only pay attention to supply side options, but also water demand management (WDM) tools should be applied. They could adopt integrated resource planning (IRP) approach which was successfully applied in the energy sector to manage demand. IRP approach is based on the phenomenon that consumers could be offered the same or even better service levels by using water more efficiently.

Khitoliya et al (2006) in his paper on, “Water management in intermittent supplies” reported that 1/6th world population does not have access to safe drinking water. Most of this unserved population lives in the urban areas. Rapid population growth and migration from rural areas are further worsening the situation by imposing extra burden on the water bodies. The foremost task of water utilities is to deliver drinking
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water in required quantity and quality to consumers. This task entails the need to understand the technical aspects. The system of water supply adopted in most of the developing nations is of intermittent nature, India being one of them. Due to financial and revenue availability constraints it is not possible to operate water supply systems for twenty-hours a day. Therefore intermittent nature of supply over a period of eight hours or less is considered adequate to supply the drinking water.

Kumar and Harada (2002) in their paper on, "Field survey on water supply, sanitation and associated health impacts in urban poor communities” reported that the availability of water through a field survey for slum dwellers, squatters and pavement dweller communities of Mumbai City, India, with a total sample size of 1,070 households. Study revealed extremely low water consumption averaging merely 30 lpcd, no sewerage and safe excreta disposal facilities manifested by high occurrence of water-borne diseases. The annual diarrheal, typhoid and malaria cases were estimated to be 614, 68 and 126 per thousand populations respectively. At point prevalence scale, at least 30 percent of all morbidity can be accounted for by water-related infections. Analysis of variance also revealed intra-poor variations both in living standards and health conditions.

Kumar et al (2006) in their paper titled, “Rain water harnessing and harvesting”, assessed that water resources are limited and water is becoming a scarce commodity due to ever-increasing demand in proportion to the increasing population. Now it is the time when we should concentrate on the conservation of this natural resource. For conservation of water resources, rain-water harvesting from roof-top catchments should be done in the form of ground water recharging be made mandatory in the urban areas. The sustainability of water resources has been endangered by vagaries of rainfall and uneven development. An optimum development can be achieved by the conjunctive use of surface and ground waters.

Landge et al (2006) in their paper titled, “A solution to water scarcity for Narkhed town”, pointed that drinking water is the very basic need of the human being. It can be made available either from ground water or from surface water resources available in rivers, dams and tanks. For villages and small towns, generally ground water is extracted for drinking and other purposes. Continuous withdrawal of ground water results in substantial depletion of ground water. Therefore the need of the hour is to replenish the depleted aquifers by arresting surface runoff in monsoon and
allow it to percolate to the needy aquifers. The Government of India and almost all the state Governments have geared up to face the grave situation that has cropped up and further going to deteriorate in respect of water supplies for various reasons. The present situation of water is alarming and serious steps should be taken for the equitable management of water resources.

Maria (2008) in her paper on, “Urban water crisis in Delhi: Stakeholders responses and potential scenarios of evolution”, found that an inadequate piped water supply from the public utility, featured by intermittence and unreliability, and supplemented by private uncontrolled groundwater extraction, is a common feature of most Indian cities as well as other developing cities in the world along with the high level of pollution of urban aquifers, the usual diagnosis consists in considering private groundwater extraction as an undesirable consequence of the mismanagement of the public utility, one which is bound to disappear when proper reforms are implemented in order to extend the reach and enhance the level of service provided by the municipal water supply network. The scenario of convergence towards universal access to drinking water supply through a centralized public network is not the only long term scenario that can take place in developing cities similar to Delhi. Private coping systems play a role in shaping the long term technical trajectory of the urban water management system; allow the highlighting of certain important policy tools in achieving the sustainability of water management in developing cities.

Mathur and Thakur (2003) in their study, "Urban water pricing: Setting the stage for reforms”, assessed that appropriate prices are necessary to supply adequate drinking water to India’s ever growing urban population. Water in most Indian cities and towns is underpriced, with ruining long-run consequences for households who have limited and poor quality water services and for water supplying entities that are unable to invest and expand water coverage. Most water utilities run at a loss, and they cover the loss from government subsidies. The result is a low-level equilibrium: low tariff, poor services, and constraints on access, especially of poor households. While the need for an appropriate pricing of urban water has been long stressed and is widely recognized as necessary for urban sector reforms, what constitutes water price reform remains an elusive issue. Moreover, the goals and objectives of water pricing are often conflicting ones. Using city-level experiences of water pricing,
particularly in respect of the size of the consumer base, multiple instruments of charging, price discrimination between different water user groups, and price-cost linkages, provides a framework that spells out key areas of reform, objectives that may govern water pricing, and parameters of tariff rationalization.

Mathur et al (2007) in their working paper on, “Norms and standards of municipal basic services in India” reported that at the prevailing level of infrastructure, urban services rates are at crossroads. There is an improvement in the level of basic services such as water supply, sanitation and solid waste management but the quality and quantity of these services are still below the norms prescribed by various commissions and committees. A number of agencies and expert groups committees have provided a range of standards of basic infrastructure and services in India. The resource gaps and further to bridge the gap and improve the level of basic services in the country were analyzed.

McKenzie and Ray (2009) in their paper on, "Urban water supply in India", noted that large numbers of households in cities around the developing world do not have access to and safe drinking water. India experienced the problem of access to water in urban areas and the various options available for reform. Using two sets of data from the National Family Health Survey (NFHS), as well as published and unpublished secondary sources, the status of access to drinking water in urban India, the performance of India's urban water sector as compared to other Asian metropolitan regions, and the reform efforts that are under way in several Indian cities is the stress point. A review of these ongoing reforms illustrates some of the political economy challenges involved in reforming the water sector. Each country faces challenges and opportunities, the scope and range of the Indian experience provides insights and caveats for many low-income nations.

Mithra et al (2010), in their paper on, "Drinking water in an urban areas in South India", showed that globally, 1.1 billion people lack access to improved drinking water supply and drink water that is contaminated. Hence, study of water treatment assumes utmost importance in order to ensure the safety of the water consumed especially in fast developing cities. This study provides information of drinking water management practices in the study area. The study examined the sources, the treatment and storage facilities of drinking water in households and also assessed the free chlorine levels in the drinking water.
Molden (1997) in his paper on, “Accounting for water use and productivity” noted that with growing population and limited water resources, there is an urgent need worldwide to manage water resources. All water resources are allocated to various uses. Effective strategies for obtaining more productivity while improving the environment must be formulated. Wastes and non-productive uses must be carefully scrutinized to identify potential savings. To accomplish these tasks, improved procedures to account for water resources use and productivity are required.

Monteiro (2010) in his research paper on, “Residential water demand in Portugal”, hypothesized that the increasing block tariffs (IBTs) for water were widely used in Portugal. IBTs are good tool for achieving the objectives of equity, water conservation and revenue sufficiency. IBTs are second-best pricing mechanism practices under water scarcity and budget balancing constraints, when consumers are heterogeneous and the fixed charge is only allowed to cover fixed costs. Because, in these conditions, the choice of tariff schedule design is dependent on the price-elasticity of demand and the way it varies with consumption levels.

Naik et al (2006) in their paper on, “Water resources management in Solapur city”, examined the impact of urbanization and the exploding population on the ground water regime in a fast growing city, Solapur, in central India, giving special emphasis on the management of the present and ultimate demand of water in 2020 AD. Pollution threat to the ground water regime has also been studied. The objective was to appraise the city planners and administrators of the effects of urbanization on the ground water regime in a fast growing medium-sized city where the infrastructure developments are not in conformity with the rapid growth in population. The areal extent of Solapur increased fivefold from 33.03 km2 to 178.57 km2 in the year 1992 with the inclusion of 13 adjoining villages within the city limits. With such major expansion, Solapur was soon identified as one of the fast growing cities in India in the decade 1990-2000. With a population of 907,400 (2003), it is the 37th most populous city in the country and 8th in the State of Maharashtra.

Nallathiga (2006) in his report on, “Reforming water sector governance and institutions for improving efficiency: The case of Mumbai”, assessed that in India, the progress of the urban water supply sector has been very slow because of inadequate reforms in the urban local bodies. Even large cities like Mumbai are yet
to undertake reforms for improving the efficiency of water service provision. Mumbai’s future requirements of water resources could be met through only if the water supply system can be expanded in an incremental manner. However, such a course of action has now come under scanner due to a rapid rise in water demand on one hand and snags in supply on the other. As such, there has hardly been any focus on ‘demand management’ and on improving the efficiency in supply sector. No reforms have been undertaken in urban water resources management as the utilities refuse to acknowledge the water deficit situation in Mumbai.

National Water Commission (2008) in its occasional paper on," Approaches to urban water pricing", highlighted that water shortages in major cities and the reliance on mandatory restrictions have signaled a question mark on the pricing of urban water services. Three broad alternative approaches to charging for urban water services were suggested. These approaches were the current arrangements or status quo, scarcity pricing, and urban user trading or a tradable entitlement regime. These approaches were assessed in the light of economic efficiency, revenue adequacy, flexibility, ease of operation and administrative simplicity, transparency, and equity. Olivier (2006) research paper titled, “Water tariff increase in Manaus (Brazil): An evaluation of the impact on households”, found that increasing block tariffs seek a cross-subsidy mechanism between the water network users, based on the common assumption of a low water price elasticity. In Manaus most of the 1.6 million dwellers are supplied through the municipal water network. The tariffs were hiked in 2004 and there was substantial drop in the consumption pattern of the households. This drop questions the cross-subsidy capacity of the current structure. The 31.51 percent tariff increase as a natural experiment applied to the whole network user population of Manaus and has the impact on monthly consumption of metered households, using month-on-month differences between years 2003 and 2004.

Padwal (2003) in his working paper on, "Issues of pricing urban water", studied that with urban expansion and the growth of population, Indian cities are unable to supply water services that are adequate both quantitatively and qualitatively. Most urban water supply authorities prefer to respond to this demand deficit problem by increasing existing supply via tapping new distant and often costlier water resources. It cannot be a permanent solution because it cannot be sustainable in the long run. Supply augmentation ignores the role of pricing in water demand management.
Water pricing is a complex problem because water is a merit good. The pricing policy, therefore, intends to achieve number of objectives, which are often inconsistent of to each other. The objective of this to paper was to focus on the issues that are crucial for determining appropriate price policy and the need to initiate reforms therein.

Palnisami (2003) in his paper on, “Sustainable management of tank irrigation system in India” reviewed that Tank irrigation systems of India are century old. Most of the tanks have, degraded into open access resource due to weak property relations. Encroachments, privatization and government appropriation of the tanks have been the main outcomes of the failure of local authority system to enforce the institutional arrangement under common property resources management regime.

Perry et al (1997) in their research report on, “Water as an economic good: A solution, or a problem?” calculated that there are contradictions on idea of treating water as an economic good. However, the role of water—as a basic need, a merit good, and a social, economic, financial, and environmental resource— makes the selection of an appropriate set of prices difficult. The application of price-based instruments is particularly difficult in the case of water. This is so because the flow of water through a basin is complex, and provides wide scope for externalities, market failure, and high transaction costs. If market tools were applied judiciously they can certainly bring benefits. Appropriate prices can give high returns.

Rahman (2006) in his paper titled, “Searching of an alternative source for drinking purpose”, noted that Bangladesh has been suffering from adequate drinking water crisis, since 1980’s. This may be due to the environmental degradations such as decreasing patterns of river flow, extraction of excessive amount of ground water, use of pesticides and fertilizers and other anthropogenic activities. Arsenic in ground water contamination has increased various health problems. In urban areas, piped water supply is available to some extent although that is again supplied to the recipients without being treated properly. As a result, people have to suffer from different water borne diseases. Although urban population has limited access to the piped water supply, but the people living in the villages don’t have any access to even that. This problem is even severe in the villages, where rural poor as well as primitive races are living. They have to solely depend on local ponds and distantly located tube-wells.
Raju et al (2004) in their paper on, “Abatement in water- A case study of Kolar city” highlighted that in Kolar city, although 66 percent of the households had piped water supply, 68 percent of them had unauthorized connections, thus depriving the utilities of its revenue. The per capita water that is being supplied to them was only one-third of the urban water supply norms; also the city is completely dependent on groundwater, which is contaminated. Nitrate and fluoride contents are beyond the acceptable limits, which forces households to rely on private water vendors. Most of the households were forced to spend $2.26- $11.28 per month for drinking water, while public water fee was just $1.02 per house per month, thus putting a great monetary burden on the households.

Raju et al (2007) in their working paper on, “Increasing groundwater dependency and declining water quality in urban water supply”, examined that the extent of groundwater dependency and quality status in Hubli, Dharwad, Belgaum and Kolar cities has been increasing. Household survey indicated dependency of 30, 51, 37 and 100 percent while the quality analysis indicated 45, 42, 22 and 97 percent as non-potable in the above cities respectively. Water markets captured a turnover of Rs. 50 crore in Hubli, Dharwad and Belgaum whereas in Bagepalli taluk, Kolar district alone, was Rs. 120 million/annum.

Ramachandriah (2001) in his paper on, “Drinking water as a fundamental right” highlighted the recent landmark judgement by the Supreme Court, placing drinking water in the list of fundamental rights. The study emphasizes that the concern of the judiciary should serve as a stern warning to the politician-bureaucrats nexus that have, in recent years, turned a blind eye to the growing pollution in Indian rivers. The court too has favored people, and has helped in initiating a debate on a crucial issue that has serious implications for the continued health and well-being of most citizens.

Ramachandraiah and Prasad (2004) in their paper on, “Impact of urban growth on water bodies: The case of Hyderabad”, asserted that Hyderabad City has been dotted with a number of lakes, which formed very important component of its physical environment. State and private agencies control, and rapid urban sprawl of the city, made many of the water utilities totally dysfunctional. Many have been shrunk in size while the waters of several lakes got polluted with the discharge of untreated domestic and industrial wastewater. The adverse consequences of the loss of water
bodies are felt in the steep decline in water table and the resultant water crisis in several areas. The severity of flooding that was witnessed in August 2000 was also due to a reduction in the carrying capacity of lakes and water channels. The state has not bothered to either implement the existing laws or pay attention to the suggestions of environmental organization in this regard.

Rao (2007) in his discussion paper on, "Access to drinking water and sanitation in Asia", hypothesized that inclusive growth in Asia will make little practical sense unless targets are set and policies, programmes, and projects are formulated to achieve universal water and sanitation access. Composite indicators like the Human Development Index (HDI) are of great help in highlighting the areas where action is needed. An Index of Drinking Water Adequacy (IDWA) is proposed which is simple to interpret. Its components indicate directions for policy, programme, and project actions. However, there is a need to re-examine how water and sanitation access data are collected and how a fair degree of accuracy and cross country comparability can be assured. At present, half way through the Millennium Development Goals (MDGs) timeframe, fine-tuning the goals on water and sanitation may be considered by developing member countries of the Asian Development Bank (ADB), with a view to achieving universal house connections by an appropriate date.

Ray (2007) in her paper on, “Women, water, and development”, highlighted that the women play central role in the management and safeguarding of water. Water management is especially important for the developing world where millions of women lack access to water for their basic needs. The lack of gender-disaggregated data on the impacts of water policies, and the underlying disagreements on how gender and development should be theorized, makes it difficult to reach conclusions on which policies can best assure poor women reliable access to water for their lives and livelihoods.

Ruet et al (2002) in their paper on, “The water and sanitation scenario in Indian metropolitan cities: Resources and Management in Delhi, Calcutta, Chennai, Mumbai”, justified that like other infrastructure in India, the urban water supply and sanitation sector (UWSS) is not on right track. Faced with increasing demand and growing pollution problems, Indian cities are not able to provide services to the people at large. New investments are required in addition to a change in the
management of the water supply and sanitation so as to provide adequate supply to all. The paper reviewed the urban water and sanitation scenario in metropolitan cities; it chooses to leave aside some questions such as the use of performance indicators of the water corporations to assess supply efficiency or questions regarding demand analysis. The main emphasis was put on the institutional and organizational structure of the service providers by looking at technical and managerial level of these four cities. The development of conservation based strategy and the need for a more participative approach by involving the civil society should be the main priority. This would mean a paradigm shift for the water supply and sanitation sector. Indeed, demand side solutions are rarely considered and the problem of water supply is mostly addressed by the supply angle.

Saleth and Dinar (1997) in their technical paper titled, “Satisfying urban thirst: Water supply augmentation and pricing policy in Hyderabad city, India”, justified that the urban water deficit can be met through supply augmentation by tapping distant and multiple-use water sources often disturbs prevailing sectoral allocation and causes inter-sectoral water conflicts. To resolve these conflicts market-based approach to inter-sectoral water allocation can be made in uneconomic rate structure and pervasive use inefficiency and wastage in the urban water sector, inter-sectoral water transfers are likely to conceal inefficiency, damage incentive structure, and dampen the urge to explore supply augmentation options. Utilizing primary and secondary information pertaining to the water sector of Hyderabad city, India, policy changes and institutional conditions necessary to ensure the economic viability of market-based solution to intersectoral allocation problems in an urban context. External as well as internal, structured and unstructured supply augmentation options should be applied so as to bridge the gap between demand and supply sectors.

Sampath et al (2004), in their paper on, "Water privatization and implications in India", reported that due to increasing consumption patterns, water is becoming scarce and this scarcity is an emerging threat to the world population. Global consumption of water is doubling every 20 years, more than twice the rate of human population growth. At present more than one billion people on earth lack access to fresh drinking water. By the year 2025 the demand for freshwater is expected to rise to 56 percent above what currently available water can deliver, if current trends
Persist. To solve the growing water crisis, the solution that is proposed by World Trade Organization (WTO) and International Monetary Fund (IMF) through international agreements such as General Agreement on Tariff and Services (GATS) is privatization of water. Water privatization will promote conservation. This commodification of water has already happened in several developed countries and is being pushed in many developing countries through structural adjustment policies. The control of water by private companies takes away this resource from the public and puts it in private control.

Shaban and Sharma (2007) in their paper on, “Population dynamics, water availability and consumption patterns in Indian cities”, pointed out that the per capita availability of fresh water in the country, in general, and in cities, in particular, have declined rapidly in the recent years due to rapid growth of population. The increased population has led to the increased demand of food, resulting in changing agricultural patterns and practices which need higher amount of water. Also, the changing structure of the economy has resulted in increased environmental pollutants – affecting the quality of fresh water.

Shao (2002) in his research paper on, “Water pricing towards sustainability of water resources: A case study in Beijing”, discussed that role of water pricing for managing water resources is important as the looming scarcity of water resources. To enhance the sustainability of water resources the principle of full cost pricing in which the cost should include supply cost, opportunity cost and externalities was proposed as a means to achieve the sustainability of water resources. Low water price was one reason for unsustainable water consumption in Beijing. Thus water pricing is necessary. It was proposed to impose water price in phased manner and eventually towards full cost pricing. The assessment of impacts on water resources by raising water price shows water pricing could eliminate the conflict between water supply and demand.

Sridhar (2006) in their paper titled, “Costs of urban infrastructure: Evidence from India’s cities”, pointed out that the marginal costs of providing water supply in several Indian cities are much more than the price that is charged from them. A few large cities are under-pricing their water, so closing the cities to migration to households might not be the solution. They found that the marginal operating cost of
providing one kilolitre of water in several Indian cities ranged from $0.06 to $0.11 and that many cities are undercharging their water, based on marginal cost estimates. Sridhar (2007) in his paper on, "Reforming delivery of urban services in developing countries", hypothesized that urban infrastructure attracts firm location, increasing employment and facilitating economic growth. Public service delivery in Ludhiana needs reforms when judged against national benchmarks. The city’s financial performance and its delivery of urban services are much less than the national standards prescribed by various agencies. The potential bottlenecks to reform in service delivery, and the triggers for reform in service delivery were analyzed. Several measures such as the growth of population and land area, service delivery, and its current finances, suggested a need for reforming public services in this city. The general decline in the service level of water supply and sewerage in the city was attributed to a decline in its capital expenditures on these services. Further, user charges did not adequately covered the production costs of supplying water. The major bottlenecks to reforming public service delivery in this city were financial and institutional, as they pertain to existing arrangements for water, sewerage and land use. Major triggers that could make the reform happen in this city pertain to changes in institutional arrangements for service delivery and public participation.

Western Resource Advocates (2003) study on, “Smart Water: A comparative study of urban water use across the Southwest”, pointed out that low-density development and inefficient urban landscape design can result in wasteful water use, primarily due to comparatively large amounts of water used for outdoor landscape irrigation. With urban populations continuing to grow throughout the Southwest and water supply remaining finite, careful urban planning is becoming more and more critical. Although per capita water consumption and even per capita land area development are decreasing in some urban areas, the overall effect of population growth on sprawl and total water consumption continues. However, even if population growth continues in the Southwest, we have a choice about how we develop our urban landscapes. Urban design strategies, including infill development and higher-density mixed-use development, help maximize water efficiency. Incorporating other water efficiency measures into such developments augments the potential water savings. Developments that incorporate design strategies similar to
that of the Civano development in Tucson illustrate how smart development can yield significant water savings.

Whittington (2003) in his paper on, “Municipal water pricing and tariff design: A reform agenda for South Asia”, noted that the water tariffs in use in most cities in South Asia were not accomplishing their aims. They are not generating sufficient revenues so that utilities can recover their financial costs. They were not sending the correct economic signals to households, i.e., that water is scarce and must be treated as a commodity. They were not helping the majority of the poor households, many of whom were not connected to the piped distribution system. The reforms should be made in the South Asia utilities so that they can expand consumer base; connections can be metered, pricing policies can be executed, policies to protect poor households to be put up, water bill calculation for households, commercial customers etc. should be changed. The pro-poor policies that suggested were to ensure that poor households can have a private water connection when they want it, providing public taps as a water source of last resort for the very poor, legalizing water selling by neighbors’ and it is to be ensured that private operators in no way exploit the poor households by charging excess prices.

Wild et al (2010) in their study on, "Water: A market of future", showed that supplying water of adequate quality and in sufficient quantities is one of the major challenges facing modern society. In many countries the available water resources are now being overexploited to such an extent that the negative consequences have been occurring. Countries located in arid regions are finding it difficult to irrigate the crops. At the same time many people still do not have access to safe drinking water, because water resources are limited or polluted by domestic and industrial wastewater. Global population growth has made the situation graver. Demand for water is increasing, along with the personal needs of individuals. In the coming years even more water will be needed to produce food for the world’s increasing population. In many countries the infrastructure for supplying the population with drinking water and wastewater treatment is out of order. Major investments will be required in the short term to upgrade water mains and sewer systems in particular. Solutions also need to be found to meet the fresh challenges arising from new micro pollutants that are becoming a problem in industrialized countries especially.
Climate change will cause significant variations in the hydrological regime in many regions, culminating in a water crisis in some areas.

Wolf (2007) in his paper titled, “Shared waters: Conflict and cooperation”, examined the state of conflict and cooperation over transboundary water resources from an environmental, political and human development perspective. Although the potential for outright war between countries over water is low, cooperation is often missing in disputes over transboundary resources. The nature of conflict and experiences of cooperation over transboundary resources and a conceptual basis for understanding cooperation and the costs of noncooperation over water are the thrust areas. The paper indicates the possible triggers for conflict over water sharing and the implications on the livelihoods of ordinary communities. It offers evidence on the potential costs of noncooperation or even conflict over water resources and analyze power asymmetries between riparian states and they affect the outcomes of negotiations.

Worthington and Hoffman (2007) in their working paper on, “A state of the art review of residential water demand modeling” reported that the increased reliance on demand-side management policies as an urban water consumption management tool has stimulated considerable debate among economists, water utility managers, regulators, consumer interest groups and policymakers. This has fostered an increasing volume of literature aimed at providing best-practice estimates of price and income elasticity, quantifying the impact of non-price water restrictions and gauging the impact of nondiscretionary environmental factors affecting residential water demand. This paper provides a synoptic survey of empirical residential water demand analysis conducted in the last twenty-five years. Both model specification and estimation and the outcomes of the analysis are discussed.

Zerah (2002) in his research paper on, “Water supply and sanitation in Vijayawada: Analysis of households’ situation towards modes and cost of access, consumption and level of satisfaction”, pointed out that in his study in Vijayawada that 77 percent of the households considered water to be cheap or very cheap. In case of connections or monthly charges the households’ willingness to pay was more than one and a half the average, thus testifying for the sustainability of water charges as a means of financing investment in that area.
The above given review of literature shows that although a large number of studies on urban water supply management have been conducted by various researchers, organizations and the institutions yet these studies are fragmented, piecemeal and by and large address one or two special aspects of the urban domestic water supply. A comprehensive study taking into account all the issues related to urban water supply of a particular city was conspicuous by its absence. More importantly there is a dearth of studies on urban water supply situation in Punjab. This study will be an effort in this direction and will be able to fill this research gap.