SUSTAINABLE WATER RESOURCES FOR THE FUTURE GENERATIONS: A CASE STUDY OF KANPUR

Pradeep Kumar[1] and Rashmi Ashtt[2]
Professor, Civil Engg. Deptt., HBTI Kanpur[1]
Professor, Hindu College, Sonepat[2]

ABSTRACT

Kanpur is a metropolitan city, sprawling over an area of 260 sq km. being the biggest city of the State of Uttar Pradesh it is also the centre of commercial and industrial and educational activities. Need is felt to decongest the inner core area to improve the quality of life. Water supply is one of the basic needs of an area and the status of water supply can be taken as the basic index of quality of life of the residents. Water supply of Kanpur city is one of the major concerns in the urbanization of Kanpur city. The paper brings forward the status of water supply in Kanpur and the gap on the basis of research .It also suggests various reforms to improve the water supply conditions in Kanpur so as to prove upon QOL index in the city as well as adjoining areas.

INTRODUCTION

Kanpur is a metropolitan city, sprawling over an area of 260 sq km. being the biggest city of the State of Uttar Pradesh it is also the centre of commercial and industrial and educational activities [Singh, Harihar 1972, 31]. Following the census 2001, Kanpur has a population of 25.51 lakhs. Administratively it is divided into 6 zones and 110 wards with an average ward population range of 19000 to 26000.The average annual growth of population was 3.5 percent during 1991-2001 as compared to the average annual growth rate of 2.6 percent in the previous decade (1981-91). One of the factors for this growth can be higher in-migration to Kanpur City. The Proposed population is 48 lakhs in 2031 which means that another Kanpur will be added in next 25 years as per the master plan of Kanpur (2021) . The average population density in Kanpur is 97.56 persons per hectare.

The density in core area is six times higher than the outer area. Therefore, need is felt to decongest the inner core area to improve the quality of life. Water supply is one of the basic needs of an area and the status of water supply can be taken as the basic index of quality of life of the residents. Water supply of Kanpur city is one of the major concerns in the urbanization of Kanpur city. The paper brings forward the status of water supply in Kanpur and the gap on the basis of research .It also suggests various reforms to improve the water supply conditions in Kanpur so as I prove upon QOL index in the city as well as adjoining areas.

The main source of surface water in the city is from the catchments of Ganga River [Ganga Action Plan 1986, 1993, 30] and Pandu River. The total water supply requirement is 600 mld but only 385 mld of potable water is being supplied as per KJN [Singh, B.B. Chief Engineer (Ramganga), (1995-1997), 30]. The total supply from treatment plants is about 255 mld water (210 mld raw water

from Bhaironghat pumping station and 45 mld from Lower Ganga Canal) .[Ganga Barrage Kanpur Report, 30] and approximately 130 mld water is drawn from groundwater comprising of 80 mld from tube wells(about 135) and 50 mld from hand pumps.

The water available in the area is adequate but distribution system needs to be improved. Main issues being the number of connections increasing not due to excess use of ground water, low pressure and unreliable service or low utilization but due to old and leaky system and inadequate funds for O&M. The need is felt to expand distribution system as in coming future the demand of 464 mld of water shall rise to 860 mld by 2031. The emphasis shall be on improving water supply distribution for the inner core in the initial phase. This shall comprise of replacing old and leaky pipes in inner core area, renovation of the zonal pumping stations and improving capacity, providing for inter-connection of various water treatment plants to balance shortfall in capacities. Additional Water Treatment Plants and feeder mains to connect to outer colonies shall be considered subsequently.[Ganga Barrage Kanpur Report, **30**].

In Kanpur, 35 percent which is a steep growth in population from 1991-2001 has put tremendous pressure on urban infrastructure such as water supply, sewerage, solid waste etc. The primary responsibility of providing water supply and sanitation rests with state government and more specifically with municipal government. Kanpur Jal Sansthan (KJS) [A2Z Infra Ink Pact, 16] deals with water supply and sewerage system while Kanpur Nagar Nigam (KNN) deals with social infrastructure such as Education, Health and Medical services. The paper further reveals the present status, gaps and future requirement for water supply services and focuses on strategies and investment required by different agencies to meet the gap.

KANPUR WATER SUPPLY SYSTEM [Singh, B.B. Chief Engineer (Ramganga), (1995-1997), **30]**

Kanpur which is the biggest and most important industrial city of Uttar Pradesh (India) is situated on the right bank of river Ganga and rests on a relatively flat alluvial plain. It has the biggest water supply system of Uttar Pradesh. The capital works are carried out by U.P. Jal Nigam (UPJN) whereas the operation and maintenance is carried out by Kanpur Jal Sansthan (KJS).

KANPUR JAL SANSTHAN [Singh, B.B. Chief Engineer (Ramganga), (1995-1997), **30]**

Kanpur Jal Sansthan (KJS) was constituted as a specialized body under the U.P. Water Supply & Sewerage Act in 1975, and was entrusted with the work of operation and maintenance of water supply and sewerage system. Prior to the creation of KJS, Water supply and sewerage services were looked after by Municipal Corporation.The working of Jal Sansthan is decentralized. . The entire city has been divided into four service districts namely **city service, west service, south service and east service** districts for the management of water supply system. There are 6 Zones to manage the water supply. Each zone is headed by an Executive Engineer who is vested with drawing and disbursing power, is responsible for Water Supply and Sewerage and also for revenue collection.

FEATURES OF WATER SUPPLY IN KANPUR

In 1982 the piped water supply system started in Kanpur City. The Kanpur water works which is more than a hundred year old serves the city service district and part of south service district. Water works was established with a designed capacity of 4 million gall1ons per day to serve a population of about 2 lac. It was started with three Settling Tanks, fiveSlow Sand Filters; two Clear Water Reservoirs (1.14 million gallons each) with steam operated filtered water pumping plants at Benajhabar. Distribution system was served by two balancing tanks of 3 lakh gallons capacity each. The source of intake was river Ganga and the Ganga water was pumped from Bhaironghat Raw Water Pumping Station which was about two kilometers away from Benajhabar Treatment Works.

River Ganga started receding towards Unnao due to which raw water supply started reducing. To meet the water demand, Kutcha Nala (5.4 Km.) was constructed from lower Ganga canal as raw water channel in 1920. Electrification of K a n p u r Water Works was done in 1927. Major re organization works were carried out in 1937- 42, 1951- 56, 1977-81 and 1986-97.Construction of Ganga Barrage was a permanent and reliable source for the water supply is available to provide 1600 mld raw water. This is sufficient to cater the needs of the town up to 2031.

WATER PURIFICATIONS MEASURES

Conventional methods of water purification [Helmer, Richard and Hespanol, Ivanildo (1997, 14)], viz, coagulation, filtration and, disinfection are used to treat surface water from the river Ganga and Lower Ganga Canal. There are 16 Slow Sand and 30 Rapid Gravity Filters in KJS[Singh, B.B. Chief Engineer (Ramganga), (1995-1997), **30]**.

Rate of filtration in slow sand filters is comparatively very low. I n the beginning, it was 9- 11 litres per square foot per hour, which has gradually decreased with the increase in head loss. After attaining a head loss of normally 36 inches, the filter is closed. Periodical recouping of sand is done. These filters are not functioning due to need for rehabilitation.
In Rapid Gravity Filters, filtration rate is much higher as compared to slow sand filters. Conventionally, 400 - 550 litres per square foot per hour rate are met. However, two conventional Rapid Gravity Filters have been converted into bituminous coal- sand dual media filter in which the rate of filtration was four times of the conventional rate.

CURRENT SCENARIO

Source of Supply

The main source of surface water in the city is from the catchment of following:

- Ganga River
- Pandu River

The water flow in the Ganga varies between a mean minimum of 72.6 m^3/s and a mean maximum of 8.860 m3/s. After tapping water from upper and lower Ganga canals, minimum water flow of 6m^3 /s is maintained in the river Ganga near Kanpur. The quality of water intake point has been satisfactory between the year 1997 and 2001 with DO ranging from 7.5 mg/l to 9.1 mg/l. In 2006, quality of water intake point is DO ranging from 4.5 mg/l to 7.0 mg/l

SERVICE COVERAGE

The total water supply requirement is 600 MLD but only 385 MLD of potable water is being supplied. The total supply from treatment plants is about 255 mld water (210 mld raw water from Bhaironghat pumping station and 45 mld from Lower Ganga Canal) and approximately 130 mld water is drawn from groundwater comprising of 80 mld from tube wells (about 135) and 50 mld from hand pumps thereby making a total present water supply of 385 mld. In addition, there are large numbers of private bore wells in residential and industrial areas which are unaccounted.

The present status of water supply source and capacity of KJS is given in table 1.

Table 1 Source and Supply of Water

Source of Raw Water	Installed Capacity (mld)	Actual Supply in mld.	Remarks
Ganga Channel at Bhairongat	310	210	Contaminated; Needs treatment.
Lower Ganga Canal	130	45	Contaminated; Needs treatment.
Other Sources			
Tube- wells - 135	110	80	Good for use
Hand Pumps- 9830	50	50	Good for use
Total	**600 mld.**	**385 mld.**	

Source: KJS

HOUSE CONNECTIONS

As mentioned earlier, there are 2.84 lakh accesses and 4.2 lakh properties in Kanpur city. However, the coverage of KJS is only 1.8 lakh connect ions. This is woefully inadequate, especially considering that the distribution network covers 80% of the city area. The total metered residential connections are 1,77,009 whereas un-metered residential/commercial/ industrial connections are 1500.

EXISTING DISTRIBUTION AND STORAGE CAPACITIES

The surface water from different intakes is being treated at the Benajhabar Treatment Works from where it is supplied to 28 zonal pumping stations. From these Zonal Pumping Stations water is further distributed to the different localities of the town. Benajhabar facility has been

augmented by two new intake units. Ganga Barrage [Singh, B.B. Chief Engineer (Ramganga), (1995-1997), 30], main unit was commissioned in 2005. Thus there is an installed treatment capacity/ storage capacity (OHT) of 540 mld of surface water, besides the tube wells and hand pumps. However, against installed capacity of 540 mld, presently only 255 mld of water is treated and supplied.

Table 2 Treatment Capacity

Location	Installed Capacity	Running Capacity
Benajhaber	310 mld	210 mld
Gujaini (established in 2005)	30 mld	20 mld
Ganga Barrage (established in 2005)	200 mld	25 mld
Total	**540 mld.**	**255 mld.**

The water treatment plant at Barrage unit is presently operated and maintained by U.P. Jal Nigam. Its capacity of utilization will increase when more households and industries falling within its supply zone will take connections.

At the site of Barrage, 1600 MLD raw water is available whereas present installed capacity is 200 mld of water treatment. For the next five years, this provides sufficient intake and treatment capacity. Keeping the potential for increasing the capacity up to 1600 MLD, another 7 units of 200 MLD can be added.

SERVICE LEVELS (UNACCOUNTED – FOR – WATER (UFW)

The supply per capita is 92 litres per capita per day (lpcd) with an estimated current population of 27 lakhs. This is less than the prescribed per capita consumption of 150 lpcd. The leakage (UFW - unaccounted- for water) from Benajhaber works is estimated to be 30 percent due to old and leaky pipelines. The most significant drawback of Kanpur water supply is the huge amount of water wastage and negligible revenue collection from public utilities (for example parks and fire fighting etc.) and stand posts which takes away about 10 percent of water.

Table 3 Future Requirement and strategies

Year	2006	2016	2031
Estimated Population in Lakhs	27.00	34.00	50.00
Demand for Water Supply mld	464	585	860

Source: KNN

STAKEHOLDER'S CONSULTATIONS

Stakeholders reveal that the water supply in inner core area may be much less than the 92 lpcd, as the pipes there are leaky and often supply contaminated water.

- It is not unusual to find water supply in these areas being augmented by local community based tube wells or hand pumps. Many MLA and corporates have spent their discretionary funds to set up such localized schemes.
- Secondly there is unequal distribution of available water in the city. The assessment of consumers as assessed by KNN and KJS is 2.84 Lakhs of which only 1.8 lakhs are currently connected. Water meters are either not installed or not working. Hence the total water supply cannot be measured at user's point.
- Thirdly, the water pressure is not maintained adequately all over the city. This is both because of old and leaky pipes and due to ad hoc style of working in giving connections from water main lines without first checking feasibility and availability of water.
- The existing three water treatment plant locations are not inter-connected and as such, there is disparity in supply/demand position in various localities. The clear water reservoirs at Benajhaber have storage capacity of 35 ml (million litres) and this water is pumped to 28 zonal pumping stations spread all over the city. The water supply is provided for 4 to 5 hours per day, which is not adequate as compared to the requirement of water supply round the clock.
- The citizens also complain of unreliability of supply hours, which often become erratic because of erratic water supply. This forces consumers to depend on their own sources of water i.e. tube wells or hand pumps. The tube wells and Hand pumps also cater to those areas, which are not covered by water distribution lines from water works.

KEY ISSUES

1. The water supply level in the city is around 90 lpcd. The ideal water supply indicators suggest that the service level is well below the minimum prescribed norm of 172 lpcd (150 +15% waste). This is so, even though there is sufficient intake and treatment capacityin the city.
2. The water supply system in inner core area is very old. This has resulted in water scarcity in core areas such as Chamanganj, Baeongamjek etc. from where KJS[Singh, B.B. Chief Engineer (Ramganga), (1995-1997), 30]. is facing complaints quite often. It is estimated that 30 percent of water is lost in the distribution due to old system. This needs to be rehabilitated in inner core areas.
3. There are frequent complaints of consumers getting dirty water and contaminated water declares water unsafe for drinking.
4. The minimum requirement of gross per capita supply is 135 lpcd; however equitable distribution is an issue to be examined and corrective measures need to be taken to rectify the situation.
5. If the installed capacity of 540 mld is fully utilized, the supply from water works alone could give service level of 199 lcpd, which is well above the minimum prescribed level.

6. It is observed that the supply is limited to 5 hours per day due to in- adequate storage and pressure.
7. In earlier years, there used to shortage of water at intake at Bhaironghat and dredging wascarried out to bring flow of Ganges towards city. Now with the construction of Barrage, the priorities have changed and to maintain water level at Barrage, down flow of river getsreduced, thereby all pumps do not work at Bhaironghat.
8. The shortage of water at Bhaironghat will reduce the water supply at Behajhaber water works, which needs to be supplemented from Lower Ganges Canal, which can supply up to 130 mld.
9. In order to get better quality raw water, pipe line of proper size is suggested to be laid for drawing water from lower Ganga Canal at Armapore estate. Bejahaber water works will keep on functioning if proper provisions are made to draw raw water from both Bhaironghat pumping station as well as lower Ganga Canal. Laying raw water pipe will also stop pollution of raw water, which flows in open canal through city area, wherein rubbish is thrown in the incoming water stream.

A CASE OF SINGAPORE [Dastur, A., Maruyama, H., Moffatt, S., Suzuki H., & Yabuki, N., 2010, 8]

Singapore has taken some relevant steps to combat the added pressures on its water resources caused by various reasons like climate change, rapid urbanization etc. The tiny city-state of Singapore (with its 4.8 million people) integrated its water efficiency objectives with other public and private sectors‟ activities to create comprehensive water management strategy. To control use, Singapore implemented tariffs based on usage (but subsidized use by the poor). The city-state requires rainwater collection systems for new developments and incentivizes rain catchment installation, desalinization, and waste water recycling on existing buildings.

The city-state also integrated its transportation and land use planning with its energy policies. To lower automobile use and emissions, Singaporean drivers pay as they drive, where they drive, and when they drive. A vehicle quota system was established that limits newly registered cars to only 3 to 6 percent yearly [23]. Finally, to incentivize lower use, electricity is not subsidized.

Due in part to its small land area, Singapore already supports a dense population; however, its island locale also makes it more susceptible to the less subtle effects of climate change[68] (such sea level rise). Therefore, it is in Singapore's best interests to institute water and energy saving programs to be better prepared for the future. Like Stockholm and Curitiba, Singapore successfully integrated its urban planning efforts across municipal departments while including community and business stakeholders in the process to create truly locally supported solutions.

STRATEGIES F OR IMPROVING WATER SUPPLY

Intake and Treatment

Additional units of 200 MLD may need to constructed and commissioned with enhancement in water supply to meet the demand after 2016.

The 200 MLD treatment plant at Ganga Barrage is under utilized to the extent of 175 MLD.

- On the other hand the core area of Kanpur inner city is experiencing shortage of water. To meet this shortage, water mains need to be laid from Barrage site to Benajhaber. An estimate forlaying the conduit pipe line with a pumping station at Armapore estate needs to be drawn.

Transmission and Distribution

1. The three already existing water treatment units should be connected, so that shortage in one system can be made up from surplus of the other system.
2. The old and leaky pipes, especially in the old inner city which have expired need to be replaced. This will improve pressure, reduce losses and hence reduce pumping costs and most importantly reduce contamination
3. The reliability of water supply needs to be improved by either arranging direct electricity connections to the zonal pumping stations or by providing standby diesel generating sets.
4. KJS needs to improve its image by being more responsive to complaints and by setting up an efficient grievance handling cell. Such image makeover will help it in getting more consumers to opt for water connections.
5. KJS should also experiment with introduction of metering of water. With the availability ofnew smart meters, their reliability and life has gone up many fold, and they provide a viable method of metering even where the supply is intermittent. Other cities like Hyderabad, Bangalore etc. have switched tometering
6. Since billing by metering differentiates between a heavy and lighter user, experience in other cities have shown that it encourages poor and slum dwellers to take to piped water supply, thereby improving both the basic services to the poor as also improving the viability of the service provider.

Improving Viability of Kjs

- One of the problems of KJS is management of works b y staff. It has more staff than other comparable cities like Allahabad etc. As the system has inertia, drastic changes are not possible due to resistance from staff and unions.
- Private participation can be experimented by giving O & M for certain zones initially and then if found successful, it could be extended to the entire area.
- KJS has an advantage of possessing prime land in the heart of city. The existing slow sand filters are out of use and it is not economically viable to renovate and rejuvenate them. This land can be better utilized in view of the fact that no further treatment plants are likely to be constructed in Benajhaber area.KJS can have a good source of by leveraging this land or could even use it as an incentive forP PP.

VISION

The vision of a „Resurgent Kanpur" is to build on its twin strengths of industrial base and knowledge base. This base combined with plans to build new world class townships around the old city, would act as a magnet to attract fresh investments and spur economic development. The leveraging of emotional ties is only possible if it is combined with good and healthy living conditions and an environment that is conducive to economic growth. The overall vision is to make Kanpur a clean and healthy city with high quality infrastructure such as better roads, airport, and basic services so that it is recognized as a premier city of U.P. and an environment which attracts people and develops business. And above all the main focus is improving the water supply conditions which shall reflect in the economy and quality of life index (QOL) of Kanpur residents. The government machinery should be efficient, effective, accountable and transparent by adopting customer oriented approach to improve confidence of entrepreneurs and encourage them to come forward for P -P -P scheme.

Also removing the current bottlenecks which are leading to deterioration in the city management, by way of infrastructure improvements and bringing reforms in urban management by making policy level changes in the form of following Strategies -

- Reducing transmission and distribution losses with identification of illegal water connection anddiscourage public stand posts.
- Refurbish the old distribution system and leak detection study and UFW
- Upgrading the storage capacity of drinking water.
- Providing 100% house service connections and metered supply to all houses.Plan of action being
- Carry out a study on sample basis and establish actual T&D losses, with steps to reduce losses.
- The leaky and old pipes in inner core area, which have outlived their life, should be replaced.
- Inter- connect the three treatment plants so that surplus capacity of one can balance the shortfallin another system.
- Improve reliability of supply by providing larger storage at zonal pumping stations

CONCLUSION

Kanpur City needs to be developed on a long-term planning framework to cope up with this problem. All previous efforts in city planning have been limited by "a narrow -focused project approach". The cities are often facing problems of inadequate service levels and inadequate infrastructure, Water supply being the most important of all, inadequate investment and the non- availability of adequate land and housing. The legal systems, lengthy procedures and the inability of local bodies to perform effectively make it difficult to deal with the problems which cities face. The Planning Commission and the Ministries, in consultation with States, have to develop an agenda of reform to persuade urban local bodies to look ahead and plan for growth in a sustainable manner.

Against this background, the central government has come out with the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), which is a city-based programme, to build the capacity of cities for better urban management. Development Scheme for Small and Medium Towns (UIDSSMT) and Integrated Housing and Slum Development Programme (IHSDP).

The paper is an attempt to addresses the problems created by outdated laws, systems and procedures and aims to align them to the contemporary needs of Kanpur. Also it is an effort to create a City development plan through research for Kanpur City So as to provide a status of world class city to Kanpur.

REFERENCES

[1] *Bhargava, Gopal K. (Ed.), Shankarlal C. Bhatt (2005) "Environment and Health Improvement in Jaj Mau Area, Kanpur: Lessons and Experiences for Wider Replication Author: Ministry of Environment and Forests. Land and People of Indian States and Union Territories,(28), Uttar Pradesh", Gyan Publishing House, ISBN 8178353849.*

[2] *Bhargava, Gopal K. (Ed.); Shankarlal C. Bhatt (2005), "Land and People of Indian States and Union Territories (28)., Uttar Pradesh", Gyan Publishing House, ISBN 8178353849.*

[3] *Biswas, S. K. (1987), "Hydrocarbon exploration in western offshore basins of India".*

[4] *Brees G. (1969), "Urbanization in Newly Developing Countries", Prentice-Hall, New Delhi.*

[5] *C. Caruso, A. Colorni and M. Paruccini, "The Regional Urban Solid Waste Management System: A Modeling Approach CISE S.P.A., Milan, Italy", Dept of Electronics, Polytechnic of Milan, Milan, Italy CEC, Joint Research Centre, Ispra, Italy*

[6] *City Development Plan (2005) for Nanded, River Front Development"*

[7] *Curitiba (n.d.) our parks are our „beaches"." Retrieved July 2011 from: http://www.curitiba.pr.gov.br/idioma/ingles/nossosparques*

[8] *Dastur, A., Maruyama, H., Moffatt, S., Suzuki, H., & Yabuki, N. (2010), "Eco^2 cities: Ecological Cities as Economic Cities". Washington, DC: The World Bank.*

[9] *Dastur, A., Maruyama, H., Moffatt, S., Suzuki, H., & Yabuki, N. (2010), "Eco^2 cities: Ecological Cities as Economic Cities". Washington, DC: The World Bank.*

[10] *Dastur, A., Maruyama, H., Moffatt, S., Suzuki, H., & Yabuki, N. (2010), "Eco^2 cities: Ecological cities as Economic Cities."*

[11] *Dastur, A., Maruyama, H., Moffatt, S., Suzuki, H., & Yabuki, N. (2010), "Eco^2 cities: Ecological cities as economic Cities", Washington, DC: The World Bank.*

[12] *Discover India by Rail", Sterling Publishers*

[13] *Dr. K.R. Thooyavan, "Urban Planning and Real Estate Development, Institute of Town Planners, India Journal" Vol. 8, No.-1, Page No. 90-94, January - March 2011*

[14] *Helmer, Richard and Hespanol, Ivanildo (1997), "Water Pollution Control –A guide to the use of Water Quality Management Principles, Published on Behalf of the United Nations Environment Programme, the Water Supply & Sanitation Collaborative Council and the World Health Organization".*

[15] *Indrasini Devi (1989), "Infra Guide: Innovations and Best Practices", Developing a Water Distribution systemnational Guide to Sustainable Municipal Infrastructure.*

[16] *Kanpur Nagar Nigam, A2Z Infra Ink Pact.*

[17] *Kohatsu, Silvia Melendez, Fovida, Ana Granados Soledvilla, Cortez, Victor Carrasco*

[18] *Master Plan Kanpur, 2021, TCPO Kanpur.*

[19] *Nirmita Mehrotra, "Disaster Management: Need of Revival in Policy FrameworkInstitute of Town Planners, India Journal" Vol. 7, No.2, Page No. 98-102, April-June 2010*

[20] *Prof. Kavas Kapadia,"Temporal Transition of Global Space:Cities in Transition,Institute of Town Planners, India Journal" Vol. 8, No.-1, Page No. 65-72, January-March 2011*

[21] *Prof. Subir Paul, "Merging Challenges in „Water and Sanitation" Problems andthe Need for Appropriate Human Resource Development, Institute of Town Planners, India Journal" Vol. 8, No.-1, Page No. 73-89, January-March 2011*

[22] *Purushottam Kesar and Prof. S Chattopadhyay, "Forecasting Regional Economic Potentials for Economic Regions - Special Economic Zones and Investment Regions, Institute of Town Planners, India Journal" Vol. 8, No.-1, Page No. 41-55, January - March 2011*

[23] *Ramakrishna Nallathiga, "Redevelopment of Industrial Land in Urban Areas: A Case Study of Textile Mill Land Redevelopment in Mumbai, Institute of Town Planners, India Journal" Vol. 8, No.-1, Page No. 95-106, January - March 2011*

[24] *Rashmi ashtt (2009), "Impact of Mehrauli- Gurgaon MRT Corridor and Strategies of Development, Institute of Town Planners, India Journal", Vol. 6, No.-4, Page No.-82.*

[25] *Report from Central Leather Research Institute in Kanpur"*

[26] *Report from UPPCB on Leather Industries in Kanpur"*

[27] *Report on Indo-Dutch Environmental and Sanitary Engineering Project, Jajmau, Kanpur: Ganga Pollution"*

[28] *Sabarmati Riverfront Development Project Wikipedia, the free encyclopedia". Htm*

[29] *Silas, Sandeep (2005). "Manchester of the East: Kanpur".*

IJRST

[30] Singh, B.B. Chief Engineer (Ramganga), (1995-1997), "Kanpur Water Supply Scheme through Ganga Barrage, Detail Project Report", Vol. I, Uttar Pradesh Jal Nigam.

[31] Singh, Harihar (1972), "Kanpur: A Study in Urban Geography".

[32] Singh, Surendra Nath (1999), "Planning & Development of an Industrial Town: A Study of Kanpur", Mittal Publications, ISBN 8170992419.

[33] Smit, B. Pilifosova, O. Huq, S. Challenger, B. Burton I., "Adaptation to Climate Change in the Context of Sustainable Development"

[34] South Asia Sustainable Development Unit, the World Bank", 13-14 September, 2006, Avari Towers, Karachi.

[35] Tibbalds, Francis, (2005) "Making People-Friendly Towns: Improving the Public Environment in Towns and Cities", Spon Press, London.

[36] UN Habitat, „Urban World: Harmonious cities India and China in focus"."

[37] Urban Environmental Management: A report from Human Settlements Management Institute, HUDCO".

[38] Usha Mahavir, "Planning For Inclusive and Harmonious Cities", Spatio-Economic Development Record, Vol.16, No.6, Nov.-Dec 2009.

[39] Wahba, Sameh, Serageldin, Mona, Kim, Suzanne, "Decentralization and Urban Infrastructure Management Capacity"