Working Paper for India Water Week 2012

Policy

Incentives & Disincentives

For

Wastewater Reuse

A Case of Gujarat State, India

Kinnari Panchal




Working Paper

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Policy Incentives & Disincentives For Wastewater Reuse[*]

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Abstract

Given the current rate of urbanization in India, the stress on basic facilities like clean water supply and hygienic sanitary conditions are of a huge concern. Groundwater has always been of major importance in providing water supply, and is intensively exploited for private, domestic and industrial use in many urban centers.

The research is focused on reducing the stress on water supply by utilizing the most of untapped sources through reuse and recycle of wastewater. Wastewater reuse has become increasingly important in water resource management for both environmental and economic reasons.

The paper attempts to understand the present scenario of sanitation in India and the wastewater potential in Gujarat State, India. The study identifies the challenges faced in terms of institutional, technical, financial, and social acceptance perspectives of the current users (farmers and industries) through selection of two case cities (Ahmedabad and Kalol) in Gujarat State. It explores the incentives or disincentives the present legal and institutional system offers to wastewater reuse /recycle and the inter-play of various factors influencing utilization of treated wastewater.

The paper also explores wastewater as a growing resource and the concerns in reusing wastewater in irrigation and industries. It reviews the wastewater reuse patterns in various countries like Israel, Tunisia, Jordan, UK, Malta, Ghana, Canada and India differentiated on the basis on presence or absence of guidelines and regulations to identify factors leading to successful and safe reuse.

It is essential that the issues of depleting groundwater and scarce water availability are addressed simultaneously since practices like reuse and recycle are possible only when the

availability of free sources of water like groundwater is regulated in India. The factors affecting wastewater reuse were explored by applying a top down and bottom up approach on Gujarat State – reviewing policies and legislations of wastewater and groundwater at national level as well as understanding the user's perspective (farmers and industries) at city level.

The research provides detailed understanding of the wastewater legal framework in India by reviewing acts and policy like Water Act, Environment Protection Act, National Urban Sanitation Policy, etc. and identifies the loopholes in Groundwater Governance by reviewing the Model Bills for groundwater extraction in India. The paper provides a brief overview of wastewater reuse in India and the direct/indirect factors effecting wastewater reuse and thereby identifying the policy incentives and disincentives offered by the framework.

It can be concluded from the legal frameworks and the responses of various industries from Kalol and Ahmedabad that the reuse of wastewater has not yet been accepted as a measure to decipher water crisis in India. The factors influencing wastewater reuse in India can be classified into internal factors (factors which directly influence wastewater reuse) and external factors (factors which indirectly influence wastewater reuse).

It finds that only internal factors like mitigating the higher costs of treated wastewater, or increasing public awareness to reuse, or educating the ULB's towards water conservation does not ensure wastewater reuse in absence of mandates and penalties for utilizing ground and surface water. Overall, factors like building capacity and defining institutional framework, policy and legal framework, formulating standards and guidelines, increasing public awareness and appropriate pricing of fresh water are some of the measures whose combined results would be safe and successful reuse of wastewater.

Keywords: *Wastewater Reuse, Groundwater governance, Legal frameworks, India, Ahmedabad, Kalol*

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Certificate

I, ***Kinnari Panchal***, hereby certify that the paper entitled ***"Policy Incentives and Disincentives for Wastewater Reuse – A case of Gujarat State"*** submitted for consideration for conference on ***"India Water Week"*** to be held in New Delhi from 10-14 April, 2012 is in original and has not been published or presented at any other forum.

Kinnari Panchal

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BACKGROUND

'Sanitation' is defined as safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices. The sanitation sector therefore encompasses everything from investment in large infrastructure such as trunk sewers, simple 'on-site' toilets for individual households, to provision of 'soft' items, e.g. support for women's groups seeking to change defecation practices in their community. The term Sanitation chain, widely used by various authors, consists of five components, namely Access, Storage, Conveyance, Treatment and Reuse.

In order to improve the sanitation facilities in urban areas of the country, the Government of India has launched ***National Urban Sanitation Policy (NUSP)*** in 2008. Various initiatives like Nirmal Shahar Puraskar, which will rate cities according to various sanitation-related parameters and present awards for excellence in performance; proposing a National Level Communication Campaign to increase awareness on sanitation among households and service providers and formulation of service-level benchmarks in four core areas (water supply, sanitation, solid waste management and storm water drainage) have been undertaken by the Ministry to ensure sanitation for all.

Sanitation Scenario in India:

Even though India has been on track for the targets set by Millennium **Development Goal (MGD)**, 55 per cent of all Indians, or close to 600 million people, still do not have access to any kind of toilet. According to the recent **Central Pollution Control Board (CPCB)** report, discharge of untreated sewage in water courses both surface and ground waters is the most important water polluting source in India and total sewage treatment capacity in class-II towns mostly located in Andhra Pradesh, Maharashtra, Tamilnadu, Uttar Pradesh and Gujarat is only 8 per cent of the total sewage generated. Despite of such critical treatment scenario, MGD like many other programs focuses on the demand creation and collection part (Access, Storage and Transport) of the Sanitation Value chain, while treatment and the reuse part which are of more environmental concerns get less attention. These programs focus mainly on access to toilets by provision of individual toilets, community toilets etc through various government schemes.

Inadequate treatment facilities and discharge of improperly treated wastewater into water bodies cause various health hazards at consumer end and also pollutes the already depleting ground water table of region. **Central Ground Water Board (CGWB)** has estimated that states of Haryana, Punjab and Rajasthan, the stage of groundwater development is more than 85 per cent and in Haryana and Punjab, heavy groundwater withdrawal have likewise resulted in high stage of groundwater development. The falling water table due to over extraction from ground aquifers, and rivers and other water bodies are increasingly getting polluted, encroached, built upon, and commonly used as defecation grounds or simply outlets for sewage.

Inadequate treatment facilities and discharge of improperly treated wastewater into water bodies cause various health hazards at consumer end and also pollutes the already depleting ground water table of region. Groundwater is of major importance in providing the mains water supply, and is intensively exploited for private, domestic and industrial use in many urban centers of the developing world.

Need and Approach to the Study:

The research focuses on utilizing the untapped sources through wastewater reuse/recycle of the various water conservation techniques of utilizing untapped sources, enhancing storage, efficient supply and reducing usage. Water conservation through wastewater recycling and desalination plants due to its considerable potential, have received priority in the **Vibrant Gujarat 5th summit**, an initiative by **Government of Gujarat (GoG)**. The reuse of wastewater is practiced in some Indian cities like Hyderabad (reusing untreated WW for agriculture), Kolkata (reuse through aquaculture in wetlands), Nagpur (reusing treated WW for agriculture at experimental basis), and many more at informal levels.

The research aims to explore the possibilities of reuse of wastewater in industries and agriculture and the policy framework or formal mechanism required for the same. The research also aims to explore the challenges it would face in the utilization of treated wastewater focuses on identification of incentives and disincentives for reuse of wastewater. The objective of the research is to analyze the factors influencing the utilization of wastewater in India and thereafter Gujarat State. The aim and objective of the research are as stated below:

Aim: To identify the Policy Incentives and Disincentives for utilizing treated domestic wastewater.

Objectives of the research:

- To understand the Wastewater Reuse potential
  - To understand the WW reuse approaches adopted globally and in India
  - To review the Policy and Regulatory framework that influence the utilizing treated wastewater and case studies for the same
- To review the Wastewater reuse status in Gujarat state
- To identify the challenges faced in terms of institutional, technical, financial, and social acceptance perspectives of the current users (farmers and industries) in the chosen city
- To understand the inter-play of various factors influencing utilization of treated wastewater

The proposed study is aimed to answer the following research questions:

- What are the various government policies, acts and regulations promoting the utilization of treated wastewater? (National & International)
- What are the schemes and programs supporting the utilization of treated wastewater? (Central and State)
- What are the various challenges to utilization of treated wastewater in terms of institutional, technical, financial, and social acceptance perspectives?

The research has been divided into three levels as follows:

National Level - to understand the policies, acts, and regulation directly or indirectly affecting the utilization of treated WW

- Policy framework is essential for facilitation of any mechanism at national level as it formulates a vision for the country to move ahead. Various countries have adopted formal reuse mechanisms with dedicated authorities defining their own wastewater quality standards and regulatory bodies monitoring them specifically for wastewater reuse. Reuse has also been practiced in countries, who haven't yet adopted defined reuse mechanisms though unsuccessfully. The research aims to identify the various aspects of reuse mechanism taking examples of various countries and study of Indian provisions for facilitation of reuse of wastewater. The outcome of this study is to identify what provisions in Indian framework promote/demote wastewater reuse through secondary data and literature review.
- The study includes provisions directly influencing wastewater reuse like National Sanitation Policy and the standards defined for disposal by CPCB as well as indirect factors like National Water Policy and Groundwater Extraction Rules.

State Level - to understand the present wastewater reuse potential in Gujarat State

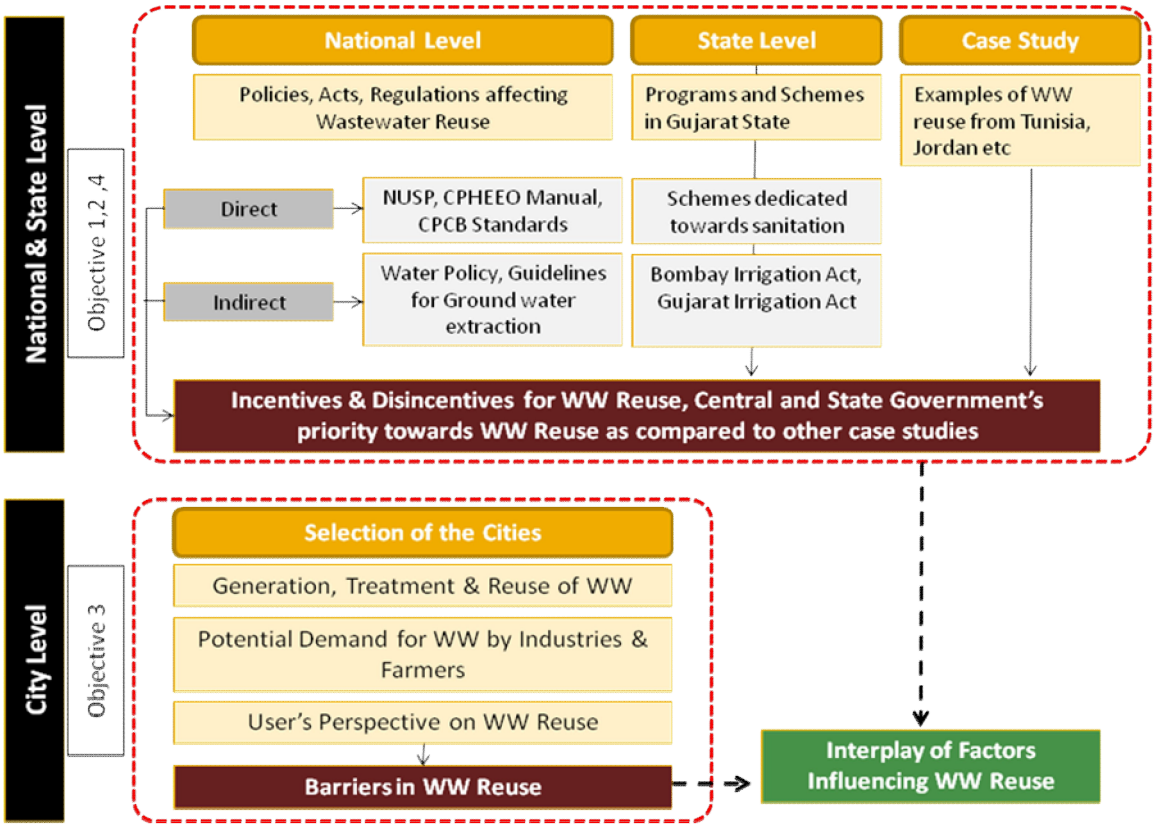
- The study extends to provisions in Gujarat State directly influencing wastewater reuse like programs and schemes dedicated for sanitation and the standards defined for disposal by GPCB as well as indirect factors Gujarat's take on Groundwater Extraction Rules.

City Level - to understand the various challenges that a city would face in utilization of WW

- As discussed earlier various countries have defined reuse mechanisms to facilitate reuse of wastewater. The study of the challenges faced by a city in utilization of treated wastewater in terms of institutional capabilities, technologies available, financial viability, social acceptance as well demand for wastewater by the probable users (farmers and industries). The study also aims to understand the users (farmers and industries) perspectives and issues faced in wastewater reuse through primary surveys of industries and discussions with concerned authorities like Industrial Associations, CETP Operators etc.
- The identified issues would define the areas of improvement towards successful reuse mechanism and the probable approach to reuse wastewater.

The table below describes the various steps in the methodology adopted:

Research Methodology:



WASTEWATER – *A Growing Resource*

The term '**wastewater**' means any water that is no longer wanted, as no further benefits can be derived out of it. About 99 per cent of wastewater is water, and only one per cent is solid wastes and '**reuse'** of wastewater is to utilize it in its present form without making many alterations. The collected wastewater must be treated to adjust its quality to any of the following end-users uses: (i) irrigation, (ii) artificial recharge, (iii) potable water supply, (iv) toilet flushing, and (v) industrial water supply. Reuse of wastewater has been practiced in many areas worldwide for thousands of years.

Wastewater Reuse Options:

Of the three types of wastewater reuse, indirect potable reuse (groundwater recharge and discharge into water body) and non potable reuse (irrigation of crops, vegetable, landscape; industrial; flushing uses) are the most commonly used options. Reuse of wastewater in agriculture has been a widespread option for many developing countries to reduce the usage of fertilizers and nutrients. Only some extremely water scarce countries who could afford to treat wastewater to tertiary levels through reverse osmosis, membrane technology and UV radiations, have utilized wastewater for potable purposes.

Importance of Wastewater Reuse Guidelines:

The constituents, that largely determine the suitability of a wastewater for agricultural or landscape irrigation are the dissolved inorganic solids or minerals. Municipal wastewater may contain pathogens of fecal origin including bacteria, viruses, protozoa, and parasitic worms. To address these concerns, almost all the guidelines and standards for wastewater reuse deal mainly with the reuse of wastewater for irrigation purpose. Generalized guidelines were formulated by **World Health Organization (WHO)** in 1973 to protect public health and facilitate rational use of wastewater and excreta in agriculture and aquaculture. Later guidelines were also formulated independently by countries and cities like US, Florida, Australia, Canada, Japan, Jordan etc.

Wastewater Recycling and Reuse in various Countries

Countries practicing reusing wastewater can be differentiated on the basis of presence of Reuse Guidelines, those still contemplating Reuse Guideline and without Reuse Guidelines.

The comparison of the reuse applications and provisions made for reuse mechanism shows that countries like Israel, Jordan, Tunisia, and Korea with guidelines and regulations for wastewater reuse/recycle have been successful in reusing wastewater due to supportive Policy framework, defined Reuse Programs and Institutional Mechanisms (both at central and state level), strict Monitoring and adherence to Quality standards either defined by own or WHO and tax as well as water charges Incentivized by the National Government.

Countries contemplating guidelines and regulations for wastewater reuse/recycle like UK, Malta and Canada have been reusing wastewater on experimental basis and have realized the importance of the reuse guidelines and are in the process of formulating them.

On the other hand, countries without guidelines and regulations for wastewater reuse/recycle have also been reusing wastewater at informal levels but reuse of wastewater hasn’t become popular measure for water conservation due to insufficient organizational capacity to implement and monitor the rules, poor water and sewerage pricing system, insufficient attention and budget towards environmental issues of water pollution and lack of awareness among people. With large number of developing as well as developed countries opting for wastewater reuse it has become extremely essential to understand the importance of safe reuse and adhere to the safe reuse standards as it can jeopardize public health at large.

In India, wastewater is used either raw or partially treated due to high treatment costs, whereas in other developed regions treated wastewater is recycled in agriculture and other sectors in water scarce areas and regions with severe restrictions on disposal of treated wastewater effluents. Though no documented evidences exist wastewater is reused in India informal levels in various cities and towns at petite levels. These cities have attempted to reuse wastewater mainly in agriculture but the concerns of health hazards due to use of untreated water prevails. Cities like Hyderabad and Calcutta have been reusing wastewater (partially treated) since many decades in agriculture and aquaculture respectively while projects in cities like Nagpur and Rajkot are in pipeline for industrial reuse of wastewater. Chennai is one city in India which has been reusing wastewater since many decades in industries though at smaller scale.

Policy Framework for Wastewater in India:

The utilization of treated wastewater is influenced by some direct factors like the Sanitation Policy and some indirect factors like availability of fresh water at lower rates. Indian framework does not provide any Guidelines or Policy to address wastewater reuse. In absence of such a Policy, ***National Urban Sanitation Policy*** (NUSP) formulated in 2008 by **Ministry of Urban Development** (MoUD), GoI, and the ***National Water Policy*** (NWP), 2002 plays an important role in addressing the importance of wastewater as an essential resource. The NUSP addresses reuse of wastewater as an important factor helping to meet the environmental outcomes of the city while the Water Policy addresses it as one of the potential source for meting water demands and reducing pollutions. NUSP recommends the Service Level Benchmarks (SLB's) defined by MoUD and recommends a minimum of 20 per cent reuse of wastewater in every city. Though NWP does not provide service levels for various defined conservation techniques, it recommends strict control over Groundwater development. Control on Groundwater development prevents further deterioration of already exploitation zones and indirectly promotes the alternative conservation techniques like wastewater reuse. While both the Policies fail to define a proper institutional and financial framework for the reuse mechanism, they do define specific environmental criteria's defined by the Pollution Control Boards. Other then NUSP and NWP, **Jawaharlal Nehru National Urban Reforms** (JNNURM) has included the reuse of wastewater as one of the optional reforms and MoUD, GoI has defined the **Service Level Benchmarks** (SLB) which gives a set of indicators to assess the performance of the ULB in wastewater management sector.

Legal Framework for Wastewater in India:

After the Bhopal Gas Tragedy, the 42nd Constitution Amendment Act (CAA), 1976, inserted specific provisions for environmental protection in the form of **Directive Principles of State Policy** (DPSP) and Fundamental Duties. Article 48A (Directive Principles) enunciates that ***"the state shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country"***. Article 51A (g) (Fundamental Duties) says ***"To protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures".*** Sanitation, in general, has been looked within the framework of environmental protection within the Constitution of India. Sanitation comes under the jurisdiction of local bodies viz, municipalities and panchayats and until 1992 they were not given the necessary powers to deal with these subjects. Part IV (DPSP), Article 40 provides that "***The State shall take steps to organize village panchayats and endow them with such power and authority as may be necessary to enable them to function as units of self government".***

The Water (Prevention and Control of Pollution) Act, 1974:

This Act contains specific provision for prohibiting the use of stream or well for disposal of polluting matter, prescribing restrictions on new outlets and new discharges, laying down rules regarding existing discharge of sewerage or trade effluents, emergency measures in case of pollution of stream or well and power of the Board to make application to courts for restraining apprehended pollution of water in streams or wells. The said Act also incorporates provisions for creating Central and State Pollution Control Boards and prescribing powers and functions of these Boards to take various steps and measures for regulating the prohibition, prevention and control of water pollution. Some states have also enacted separate water pollution Acts, e.g. Orissa River Pollution Prevention Act, 1953 and Maharashtra Prevention of Water Pollution Act, 1969.

The Tiwari Committee, 1980:

The Government of India set up a Committee in January 1980, under the Chairmanship of N.D. Tiwari, then Deputy Chairman of the Planning Commission, to review the existing environmental legislation and to recommend legislative measures and administrative machinery for environmental protection. Department of Environment was constituted in 1980 under this committee, which was transferred to the newly created Ministry of Environment & Forests (MoEF) in 1985. Fiscal incentives such as rebates on excise/customs duties for pollution control equipments, accelerated depreciation allowance on selected pollution control equipments, financial and technical assistance to small scale units in industrial clusters to set up common

effluent treatment plants are now available. EIA has become mandatory for highly polluting industries since 1994.

The Environment (Protection) Act (EPA), 1986:

Environmental (Protection) Act (EPA), 1986 enacted in the aftermath of the Bhopal gas tragedy in 1984 includes ***"water, air and land and the interrelationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro organism and property"***. Under Rule 14 of the E.P. Rules 1986, the government evolved guidelines for submission of yearly environmental audit/statement by units requiring consent under the Water Act, Air Act and authorization under Hazardous Wastes (Management and Handling) Rules

Policy Statement for Abatement of Pollution, 1992:

The ***Policy Statement for Abatement of Pollution*** issued by the MoEF in February 1992 identifies the environment problems and admits that ***"the state of the environment continues to deteriorate"***. It favors a mix of instruments in the form of legislation and regulation, fiscal incentives, voluntary agreements, educational programs and information campaigns. It recommends the polluter pays principle, involvement of the public in decision making and new approaches for considering market choices ***"to give industries and consumer clear signals about the cost of using environmental and natural resources".***

Issues in Legal Framework for Wastewater in India:

As per the 74th CAA and municipal legislations defining the roles and responsibilities of ULB, the wastewater treatment facility provision is a discretionary function of the Urban Local Body (ULB). Thus to provide treatment facility is left to the ULB to decide depending upon the availability of funds. This results in assigning low priority to wastewater treatment by the ULBs. The nodal agency for implementing various legislations relating to environmental protection at the centre is the **Ministry of Environment and Forest** (MoEF). Besides giving directions to the CPCB on matters relating to prevention and control of pollution, the MoEF is responsible for designing and implementing a wide range of programs relating to environmental protection. In the absence of metres which can record the quantities of and concentrations of pollutants in the effluents, the SPCBs can monitor only by inspection and sampling.

Legal Framework for Groundwater in India:

The basic objective of understanding the groundwater governance in India is to understand the legal framework abiding the groundwater usage and its indirect effect on reuse of wastewater.

In the Constitution of India, water as a whole is included in Schedule VII in Entry 17 of list II (State List) which states ***"Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List I", "Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union, is declared by Parliament by law to be expedient in the public interest".*** Directive Principles of State Policy [Article 39 (b)] of the Indian Constitution has made it incumbent on the state to ensure that the ownership and control of the material resources of the community are so distributed as to subserve the common good in the best possible manner.

It can be seen from the above that ground water is not mentioned in any of the lists in the VII schedule of the Constitution of India. Though not mentioned separately in any of the three lists, ground water can be understood to be a part of the generic category of "water supplies" as well as "irrigation".

Unlike several countries, India does not have any separate and exclusive water law dealing with all water resources and covering all aspects nor explicit legal framework specifying water rights. Instead the water related legal provisions are dispersed across various irrigation acts, central and state laws, orders/decrees of the courts, customary laws and various penal and criminal procedure codes.

The Indian Easement Act, 1882:

Section 7(g) the ***Indian Easement Act, 1882*** which came into force in July 1982, states ***"The right of every owner of land to collect and dispose within his own limits of all water under the land which does not pass in a defined channel and all water on its surface which does not pass in a defined channel"***. This clause explicitly relates to ground water and is the basis for prevailing thinking that land owners have absolute rights over water underneath their land. The provision has been based on the common English law under which ground water is viewed as an easement connected to land. This Act made all rivers and lakes the absolute right of the state. But as per the provisions of the Act as usually understood and the ***Transfer of the Property Act*** of 1882, a land owner is supposed to have a right to ground water beneath his land as it is considered as an easement of the land. So, the land owners own the ground water on their lands. There is no limitation on how much ground water a particular land owner may draw.

The Water (Prevention and Control of Pollution) Act, 1974:

Water (Prevention and Control of Pollution) Act, 1974 as discussed before was passed for prevention of pollution of water due to discharge of liquid effluents from industries but does not cover groundwater contamination. Municipalities which are primarily responsible for treating residential wastes remain free from direct liability as it allows the government agencies too much flexibility. For example the Act states that the head of a polluting unit would not be punished ***"if he proves that the offence was committed without his knowledge or that he exercised all due diligence to prevent it".*** The penalties for non-compliance with the standards or directions are independent of the extent of violations.

The Environment (Protection) Act (EPA), 1986:

Environmental (Protection) Act (EPA), 1986 as discussed earlier was formed to cover different areas of "environment" including water as well as items interrelated to water. The ***Central Ground Water Authority***, constituted under this Act has been a major institution created for regulating over-exploitation of ground water. For the protection of coastal environment in India, including ground water resources, a Coastal Regulation Zone Notification (CRZ), 1991 has been issued. National Coastal Zone Management Authority and State Costal Management Authorities constituted under Environment Protection Act are other legal bodies for overall protection of costal environment including ground water.

The Model Bill:

The Draft Model Bill was circulated to all States by Government of India, Ministry of Agriculture as early as in 1970 restricting excessive exploitation of ground. The bill envisaged empowering the state governments to acquire powers to restrict installation of new ground water structures like bore wells, tube wells and even dug wells by private individuals or groups for purpose other than drinking water. The Bill was revised thrice, once in 1992, second in 1996 and then in 2005 by the Ministry of Water Resources (MoWR)

The salient features of the Bill were to State Governments were to acquire powers to restrict the construction of ground water abstraction structures (including wells, bore wells, tube wells etc.) by individuals or communities for all uses except that of drinking water, Constituting a State Ground Water Authority (SGWA) for discharging the various functions to be acquired by the Government under the legislation, Persons/organizations desirous of taking up the business of sinking of wells/tube wells were required to register with the Ground Water Authority, and to provide the Authority with complete legal support to enforce the various provisions of the legislation. The Bill was revised in 1992 and 1996 and exempted the small and marginal farmers from obtaining prior permission of the proposed Ground Water Authority for the construction of ground water abstraction structures, provided these were for their personal use (not commercial). However till now out of 30 States and 5 UTs of the country, only 7 had enacted and implemented the legislation and three had passed the Bill.

Issues in Legal Framework for Groundwater in India:

The main thrust of all versions of the Draft Model Bill were constitution of **State Ground Water Authority** (SGWA) which would identify the critical areas that are over-exploited (where exploitation is much more than natural recharge to ground water and depletion is quite high) and would notify such areas as "Notified Areas". Owners of ground water structures in such areas would be required to get themselves registered with such Authority. For installation of any tube wells in such Notified Areas, a permit would be required from such Authority and penalties can also be imposed for failure to comply with provisions of the Act. Implementation of the Model Bill in its present form does not fully take care of the problem of over exploitation of ground water as it has no provision for restricting the extent of ground water extracted by the existing users.

The review of National Level Policies and Guidelines confirm that they promote the recycle and reuse of wastewater through inclusion in various policies and adoption of new techniques but they do not give Institutional & Financial Clarity for Reuse Mechanism. The State level study shows that they do promote the Reuse of WW through SSLB Guidelines (for domestic use) but do not mandate the Industries & farmers to use it. Various Central level provisions have not yet been adopted by states (for example the model bill) which make the governance ineffective. The summary of the incentives and disincentives offered in context of wastewater reuse by the above discussed policies, acts and regulations is as follows.

The above summary of the National Level Policies and Guidelines confirm that they promote the recycle and reuse of wastewater through inclusion in various policies and adoption of new techniques but they do not give Institutional & Financial Clarity for Reuse Mechanism. The State level study shows that they do promote the Reuse of WW through SSLB Guidelines (for domestic use) but do not mandate the Industries & farmers to use it. Various Central level provisions have not yet been adopted by states (for example the model bill) which make the governance ineffective. The summary of the incentives and disincentives offered in context of wastewater reuse by the above discussed policies, acts and regulations is as follows:

Incentives & Disincentives offered by Center & State for WW Reuse

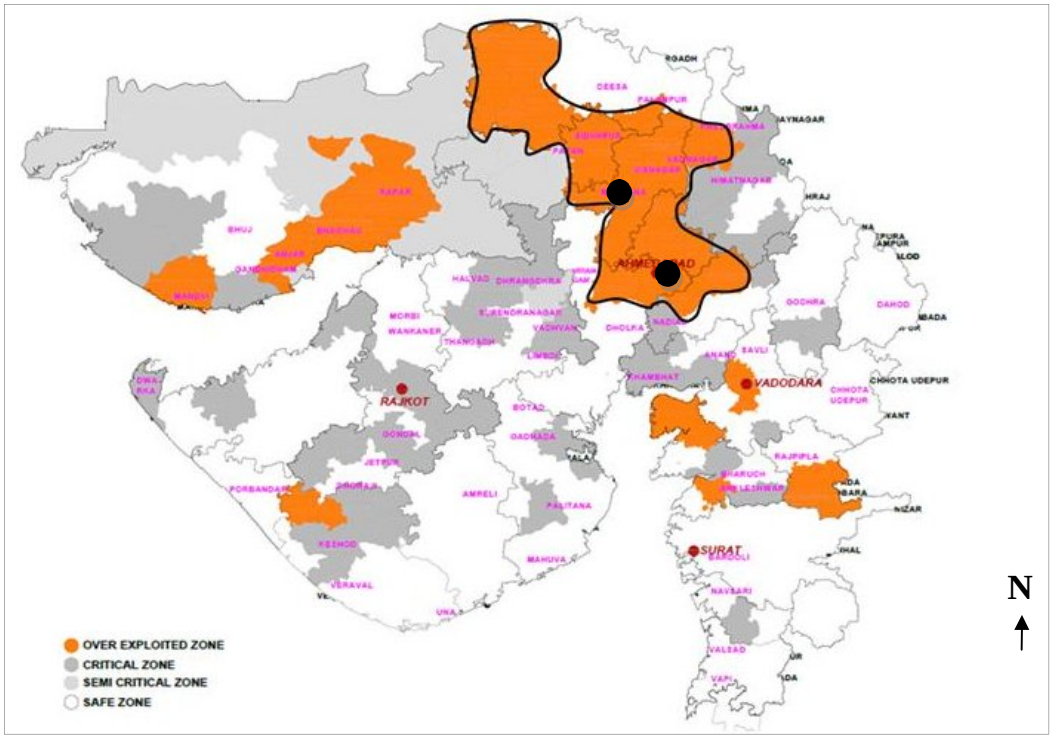
Components	Incentives	Disincentives
Overall approach	Comprehensive and inclusive	Not reflected in mandates
Reuse as a component of target group	**NUSP & NWP:** reuse of treated waste water for non potable applications	Not supported by **Acts and Regulations (Ground water abstraction rules, GIDC regulations, etc)**
Level of service/ use of technology	Promotes the service provider to reuse through **SLB**	Not a mandate to reuse for the service receiver
Institutional roles & responsibility		No **formal mechanism** available to implement reuse
Environmental considerations caused due to unsafe disposal of WW	Mandates through **CPCB Standards**, promotes through **SLB**	Regulations or Guidelines for reuse defined. Leading to unsafe reuse of untreated WW.
Financial pattern	-	No **Dedicated schemes** for treatment, disposal and reuse
Water Tariffs	-	Low Industrial and subsidized Agricultural water tariffs

WASTEWATER REUSE IN GUJARAT:

Gujarat has 166 Urban Local Bodies, categorized on the basis of population. This ULB's are classified as Class A, Class B, Class C, Class D and Municipal Corporations (MC).

Cities	Total Nos.	With Sewerage Network	No. of STP's	Functional STP's	Quantity of Sewage Generated	Quantity of Sewage Collected	Quantity of Sewage Reused*
Municipal Corporations	8	7	18	17	2,563	1168	1**
Class A	18	10	3	2	1,332	18	0
Class B	33	19	3	2	1,137	0	0
Class C	44	17	3	0	821	9	0
Class D	64	13	1	0	679	0	0
Total	166	66	28	21	6532	1195	1

***** Only formal and documented reuse taken into consideration. Various cities & towns reuse WW in agriculture by pumping WW directly from nallas.
** 1 MLD Reuse Plant based in Ahmedabad
Source: PAS for UWSS, 2009; UMC 2009



Source: GWDA, G

With the 74th CAA, 1992, all the elected bodies of the state are governed under the Gujarat Municipalities Act, 1963 which is administered and supervised by the Directorate of Municipalities (DoM). The Municipal Corporations are empowered under Bombay Provincial Municipal Corporation (BPMC) Act, 1949. The wastewater reused at formal levels is marginal and on pilot project basis.

Water Pollution due to untreated wastewater:

The Municipal Corporations of state release about 933 MLD of wastewater into rivers, while the other towns release about 1400 MLD. In addition, nine coastal towns dispose an average of about 77 MLD, which is dumped into ponds and lakes. As per survey conducted by Gujarat Pollution Board (2004-05), there are 5270 water polluting industries in the state, having effluent treatment plants. They belong to the industrial categories of textile, organic chemicals, petrochemicals etc located along the region of Golden Corridor, between Mehsana and Valsad.

Selection of Cities:

The city selection id done on basis of Class of the cities, Presence of Treatment Plant, Availability of water and Industries located nearby. Treatment of wastewater is considered a pre-requisite for reuse of wastewater. Treatment facilities, its O & M, and funds available for provision of this infrastructure depend on the size of the city. The two cities of different sizes are chosen for the research i.e. a Municipal Corporation and Class A Municipality having relatively better treatment facilities for wastewater provisions are selected. Among the Municipal corporations, Ahmedabad, Rajkot, Surat and Vadodara possesses Sewerage treatment plants and Ahmedabad is said to be the highest treating efficiency (more than 94 per cent).

Gujarat has, at present, water availability of 1000 cubic meters which is likely to go down to 600 cubic meters by 2050. The total utilizable groundwater was 17365 million cubic meters in 1984, which declined to 12365 million cubic meters in 1997 registering a drop of 26 percent. As groundwater exploitation is more than 65 percent of the recharged water, the whole state falls into the '**grey'** category. The whole of Gujarat falls into the "**water stressed**" category. The study areas for this research are selected from the over exploited zone of northern Gujarat. Industries have been located mostly in the Golden Corridor comprising of Ahmedabad and Gandhinagar districts in Northern Gujarat. Ahmedabad city in Ahmedabad district and Kalol city within Gandhinagar district have the highest registered industries.

Hence, Ahmedabad city from Ahmedabad district and Kalol from Gandhinagar district have the maximum industrial units and are chosen as study areas for the research.

Case of Kalol Nagarpalika, Gujarat:

In terms of water availability, total water supplied at source is 17.3 MLD while the water loses accounts for about 46 per cent (7.9 MLD). Thus, only 9.4 MLD reaches the end user. About 26 per cent (4.5 MLD) water is supplied through ground water sources. The total discharge from Kalol city is 8.7 MLD. Sintex industry and Kalol GIDC discharge secondary treated effluent of 2.5 MLD and 0.2 MLD respectively into the sewerage lines near the ULB limits. The city has an oxidation pond located just outside the municipal limits which presently is in a poorly maintained condition. The sewage from 17,000 HH's are given secondary treatment in 2 Oxidation ponds of 6.8 MLD capacities each. According to the discussions with authorities in ULB, Kalol was earlier reusing 1 MLD of wastewater in agriculture in 2003-06 but had stopped due to lack of manpower. The rates charged to the farmers were Rs.150/Season/Farmer regardless of quantity of water consumed.

The whole textile unit of Sintex and a sample size of 23 units (50 per cent) in Kalol GIDC were surveyed to understand the factors influencing the reuse of wastewater in industries. These selected units including Sintex industry were surveyed and the components of the survey questionnaire were water consumption for various purposes (for processes, landscape, domestic etc.), water tariffs, quality of water desired for industrial purposes, willingness to pay for treated wastewater, barriers in utilizing treated wastewater.

Both Sintex and Kalol GIDC have their private bore wells and water supply is trough a piped network is supplied to different units for various processes. The water charge of Kalol GIDC is about Rs. 13/KL which includes labor charges, O & M of pumps, and electricity charges while Sintex industries account for Rs. 8/KL due to relatively newer pumps. Sintex Industries consists of require softened water of potable quality for some processes and raw water for remaining processes. Kalol GIDC consists of chemicals, rolling mills, medical cotton, and intermediate units which require water for different kind of processes. It can be concluded from the survey that the willingness to pay for desired quality ranged from Rs.10 to Rs.15/KL is low was due to the availability and the lower rates of freshwater. According to the survey conducted, the barriers faced by Sintex and Kalol GIDC were higher cost of treated wastewater, quality of treated wastewater, shortage of land for treating wastewater within industrial premises, lower rates and availability of freshwater, no incentive/mandate/penalty to reuse wastewater.

A focused group discussion was conducted to understand the perspective of farmers of adjoining areas of Kalol city towards reuse of wastewater in irrigation. The major points of discussion were present water charges quality of water desired for irrigation purposes, willingness to pay for wastewater, barriers in utilizing treated wastewater.

The grampanchayat owned bore wells are insufficient in numbers and hence farmers are made to rely on private bore wells owned by rich farmers charging Rs.100/hour for drawing water. This higher cost of water increases the overall cost of production. Discussions with farmers led that though ULB is not willing to provide wastewater for irrigation formally, they are using wastewater for irrigation by pumping untreated wastewater directly from the nalla leading to Borsai Lake. The quality of untreated wastewater being used for irrigation is a concern though no records of health hazards have been reported till now.

Looking at the existing scenario of wastewater reuse, the challenges are faced in reusing wastewater from the ULB side are inadequate manpower, lack of funds, and decreasing demand of wastewater due to the poor condition of oxidation pond.

Recently, Kalol GIDC and Sintex industries had shown willingness to establish, fund and maintain a common effluent treatment plant (CETP) and support reuse mechanism for irrigation. However this proposal for CETP was rejected by the ULB as JnNURM funds were to be made available in a short term for establishing a new treatment plant. The new treatment plant proposals do not take the reuse of wastewater into consideration. The willingness of these industries to participate to facilitate the reuse mechanism can be considered as an excellent opportunity to implement reuse mechanism at formal levels.

8.7 MLD wastewater (including 2.7 MLD of treated effluent) is not adequately treated as the oxidation pond is properly maintained. Adequate treatment of wastewater is a pre-requisite for wastewater reuse and use of untreated wastewater can jeopardize public health at large. The untreated sewage used by farmers of Kalol for irrigation and the discharge of the same into Borsai lake should be considered as a potential concern requiring immediate attention. Improved public health and environmental protection can be the basis for initiating safe wastewater reuse. The untreated sewage used by farmers for irrigation due to the higher cost of water from private bore wells (Rs.100/hour) and the nutrient value of sewage attracts the farmers to reuse wastewater for irrigation.

Willingness of industrial associations to setup and maintain a CETP and make wastewater available for irrigation and also to the same for their units (provided potable quality standards are matched) should be considered as driving factors for implementing reuse mechanism. However, the lower consumption of water in these industries (3.5 MLD in Sintex and 0.4 MLD in Kalol GIDC) might not make treating of wastewater to potable levels financially viable but reuse of wastewater for irrigation is definitely a sustainable solution both for ULB and farmers (ULB gets nominal amount on sale of sewage which can be used for O & M of pond and reduced environmental pollution and farmers get nutrient contained sewage which is safe for reuse).

Case of Ahmedabad Municipal Corporation, Gujarat:

Ahmedabad presently receives a total supply of 950 MLD consisting of 818 MLD of surface water from Narmada and 132 MLD of groundwater. The water treatment plants are located at Dudheshwar, Kotarpur & Jaspur and the ground water is supplied through 450 bore wells. At present, Ahmedabad generates about 760 MLD of sewage of which about 168 MLD is discharged into River Sabarmati without treatment through storm water outlets. In the newly merged areas of 92 sq.km of extended east Ahmedabad, sewerage facilities are provided in 44 sq.km area. The city is divided into five sewerage zones. There are about 43 sewage pumping stations in the city of which 9 are main sewage pumping stations, which pump sewage into the terminal pumping stations at Vasna and Pirana before the inlet chambers of the sewage treatment plants. Of these 9 STP's, 4 STP's at Vasana and Pirana of 180 MLD, 76MLD, 106 MLD and 126 MLD are operated by Ahmedabad Municipal Council, while 3 new STP's of 35 MLD, 60 MLD, 180 MLD were constructed under JNNURM and 2 STP's are currently ready for being inaugurated. The STP constructed under JNNURM are on BOOT basis. No formal reuse of wastewater is done in Ahmedabad city. However, a small 1 MLD tertiary treatment plant is setup in the premises of 180 MLD STP which treats the wastewater to potable standards and is reused for landscaping the premises.

A sample size of 30 units (5 per cent) in Vatwa Industrial cluster, Ahmedabad was taken to understand the factors influencing the reuse of wastewater in industries. These selected units in Vatwa GIDC were surveyed and the components of the survey questionnaire were water consumption, water tariffs, quality of water desired for industrial purposes, willingness to pay for treated wastewater and barriers in utilizing treated wastewater.

Vatwa GIDC has 10 bore wells and water supply is trough a piped network is supplied to different units for various processes. However there are also 40 private bore wells within the estate which are unaccounted (unmetered). The water charge of Vatwa GIDC is about Rs. 12/KL which includes labor charges, O & M of pumps, and electricity charges while the water drawn from private bore wells is unmetered. Vatwa GIDC consists mainly of dyes, textile processing, ice factories and intermediate units which require water for different kind of processes. Of these, dyes and intermediates require water for intermediate products manufacturing and hence donot require higher quality water. Remaining units of textile processing and ice factories require potable quality water for their processes as they manufacture finished goods. It can be concluded from the survey that the willingness to pay for desired quality ranged from Rs.10 to Rs.12/KL. Presently water is available at Rs. 12/KL at Vatwa GIDC. The willingness to pay for treated wastewater was very low due to the presence of 40 private bore wells and availability of free groundwater.

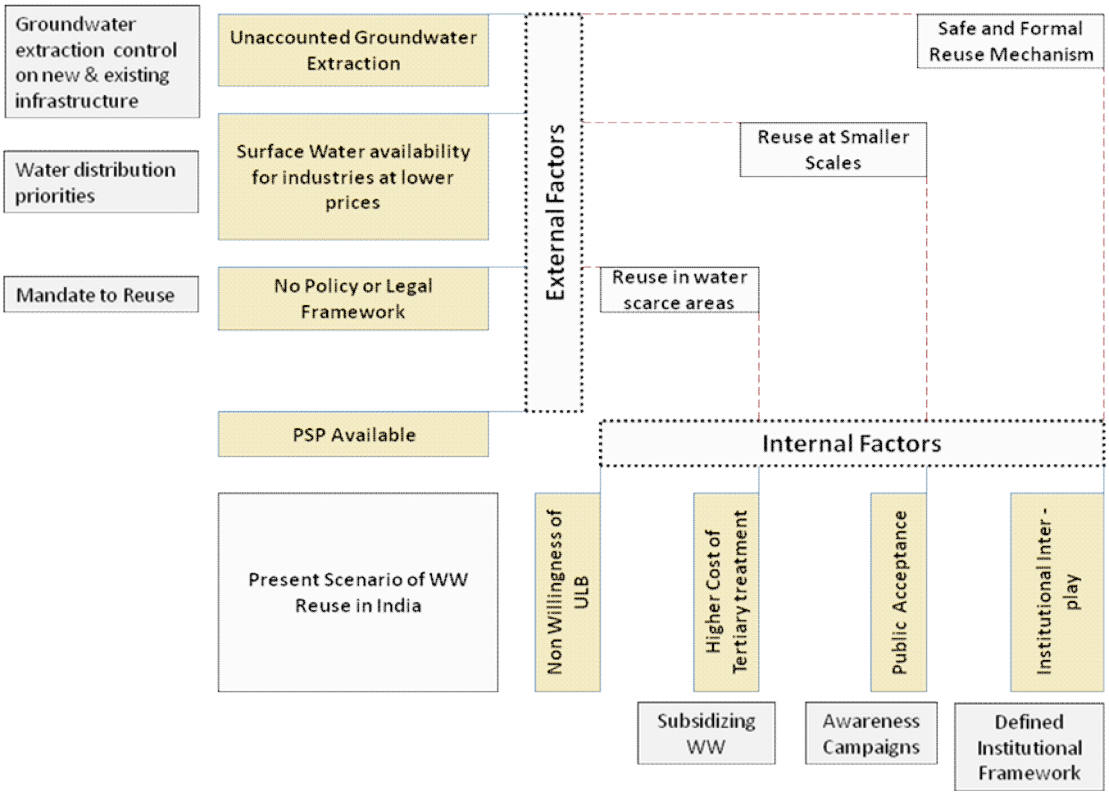
Private operates like JITF Aquasource Ltd., Doshion Ltd. etc, are willing to participate in the reuse mechanism process by operating STP's on a BOOT basis. The ULB is also willing and trying to convert such initiates into projects but the unwillingness of the industries to reuse wastewater has been a major drawback till now. Despite of Ahmedabad being in the 'Overexploited zone' of groundwater development, the presence of private bore wells providing unmetered water in industrial clusters are a major discouraging factor for the wastewater reuse. Although ULB has adequate manpower for undertaking such projects into implementation the funds availability to finance such projects do not exist.

FACTORS INFLUENCING WW REUSE

From the Policy framework of India and the responses of various industries from Kalol and Ahmedabad it can be concluded that reuse of wastewater has not yet been accepted as a measure to decipher water crisis in India. While water scarcity has been a major driving factor for the initiatives of wastewater reuse in the water scarce countries, the developed countries have reused wastewater to control the environmental impacts of discharge into water bodies. Even the examples of wastewater reuse in India (Refer Chapter 3) like Chennai or Rajkot have been successful due to the intense water scarcity leading to high prices of freshwater. With water scarcity as a key push factor for wastewater reuse, the major factors discouraging the reuse can be summarized as higher cost of treated wastewater, unaccounted groundwater extraction and undefined institutional framework.

Apart from the above mentioned major factors, various other factors can be classified into external and internal factors. From the Indian provisions for wastewater reuse, review of case cities - Ahmedabad and Kalol and international examples of reuse applications, internal and external factors and measures can be derived.

External & Internal Factors Influencing Reuse and its Measures:



Internal factors influencing wastewater reuse:

Participation of ULB in Reuse process:

The case of Kalol Nagarpalika was an example where the ULB was unwilling to undertake reuse mechanism under the justification of lack of manpower and funds. Smaller ULB's most often do not have technical expertise and also the surplus funds available for treating wastewater to higher levels. In such cases, reuse of wastewater in irrigation is an appropriate option. The case of Ahmedabad Municipal Corporation was an example where the treatment levels are higher (though not tertiary) and various privates operators are interested in investing on reuse mechanisms through concession agreements.

However, this willingness of ULB's to undertake reuse mechanism to address environmental concerns cannot succeed unless there is a mandate to reuse.

Cost of treated wastewater:

It is essential to know the actual price of treated wastewater in order to sell and reuse it. For estimating the cost of treated wastewater we take an example of 70 MLD Vinzol STP of Ahmedabad. In order to add tertiary treatment at the existing Vinzol Plant located 5 kms from Vatwa GIDC Estate, a Capital expenditure of 54 crores has to be incurred. Assuming that the cost charged from the Industries would be Rs. 15/Kl and increased 5 per cent every year, the capital cost would be recovered only by the end of 8 years.

The revenue from wastewater does not keep pace with O & M expenses of the plant. Also, the past trend of O & M expenses of STP's show that the total expense after 3 STP's is on an average 7 crores/ year, while, the tertiary treatment plant of one STP of 70 MLD would require 8 crore/year. The high cost of tertiary treatment makes the reuse of wastewater an unviable option even for Municipal Corporations lie Ahmedabad. Such projects can be made feasible through private sector participation like proposed Rajkot Reclamation project, given there is demand of wastewater. It can be seen that even if the capital cost of treatment gets subsidized, the operating expenditure of the plant is high. Also, subsidizing wastewater does not ensure that the users will prefer wastewater over freshwater from bore wells which are available at almost free rates.

Since it is costly to build and maintain wastewater treatment plants, and install water distribution lines for reuse, expanding a range of financial services and opportunities is a key component for promoting water and wastewater recycling. Various bi- and multi-lateral cooperation agencies have increasingly provided financing opportunities for water and wastewater reclamation projects.

Public awareness:

Raising the awareness of the public about water shortages and encouraging their participation in remedial action is crucial in the implementation of wastewater reuse. The issue is of particular importance for water reuse for indirect and direct potable use, including groundwater recharge, as many initiatives have been delayed due to public resistance and legal action. Public participation can be aimed at different objectives including the payment of user charges, conservation, minimizing unaccounted for water rates and recycling and reuse of water.

Interplay of various organizations involved:

International experience from case study suggests that to reuse wastewater in a safe manner it is essential to have a formal reuse mechanism in place. Various countries have constituted dedicated organizations for distribution, regulation and monitoring of wastewater. Presently, in India, there does not exist any organization dedicated to wastewater treatment and reuse. The organizations involved in the reuse mechanism are classified as organizations which directly influence or are in charge of provision of the sanitation services, regulation of standards related to discharge, monitoring agency or funding sanitation and organizations indirectly influencing reuse of wastewater like those in charge of groundwater governance, supply for industries, bulk water supply, or for irrigation purposes.

External factors influencing wastewater reuse:

Wastewater Reuse Policy and defined reuse framework:

International experience shows that wastewater policy and defined reuse mechanism are inevitable for reusing wastewater due to the varied interests of the Urban Local Bodies and the users (particularly industries) of wastewater. Countries like Tunisia, Jordan etc have succeeded in reusing wastewater due to the clarity in framework starting from defining a Reuse program, defining standards and guidelines, institutions involved, legal provisions for reuse to providing subsidies to the users of wastewater. Water reuse projects must include regulatory development and implementation to ensure the protection of human health and the environment. Necessary regulations may include permit systems to authorize wastewater discharges, technical specifications on wastewater treatment, reclaimed water quality standards for various applications, and regulations on disposal of waste from treatment.

Surface water availability for industries:

In Gujarat, surface water is made available to some of the industries by the Sardar Sarovar Narmada Nigam ltd. (SSNNL) through Gujarat Water Infrastructure ltd. (GWIL). SSNNL was established for sustainable development of western India by providing water and energy through developing water supply policy for industries, domestic use and irrigation. The major focus of SSNNL is to provide water for domestic uses and irrigation. However, lately the Naramada water has been made available to industries as well on Rs.11/Kl

rates excluding the distribution network charges. Due to the fresh water availability, industries are unwilling to experiment with reuse of wastewater.

Groundwater Governance:

As per the ***National Water Policy 2002***, each State government was expected to adopt its own water policy and action plan by 2004. Till now Andhra Pradesh, Karnataka, Maharashtra, Rajasthan, Orissa and Uttar Pradesh have adopted their water policies while states like Andhra Pradesh and Tamil Nadu have their water vision, framework for action plan and operationally viable action plan. While these states are seriously trying to reform their water sector with the help of the support extended by the World Bank, the draft of Gujarat's Water Policy 2004 is still waiting for adoption.

Way Forward:

Wastewater has been an untapped resource in India till now and various external and internal factors play an essential role in influencing wastewater reuse mechanisms. Only internal factors like mitigating the higher costs of treated wastewater, or increasing public awareness to reuse, or educating the ULB's towards water conservation does not ensure wastewater reuse as the users (industries) will always try to maximize their profits through reducing their production costs in absence of mandates and penalties for utilizing ground and surface water. These users have to be pushed and mandated to use a minimum of percentage of treated wastewater to ensure environmental sustainability or the groundwater governance in Gujarat state should be improved. Overall, factors like building capacity and defining institutional framework, policy and legal framework, formulating standards and guidelines, increasing public awareness and appropriate pricing of fresh water are some of the measures whose combined results would be safe and successful reuse of wastewater.