Water and Green Growth Case Study Report 7

India

Water Management in Gujarat State: Mix of Policy and Infrastructure Initiatives Result in Green Growth

About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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The findings, interpretations, arguments, and conclusions expressed in this report areresponsibility of the authors and do not necessarily reflect the views of K-water and World Water Council.

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Abbreviations and Acronyms

AMC Ahmedabad Municipal Corporation

BJP Bharatiya Janata Party

CEO Chief Executive Officer

CETP Common effluent treatment plants

CHETNA Center for Health Education, Training and Nutrition Awareness

CMWS Community Managed Water Supply Project

CSO Central Statistical Organization

CSR Corporate social responsibility

DMIC Delhi Mumbai Industrial Corridor

DSC Development Support Center

EVs Extension Volunteers

GDP Gross Domestic Product

GERI Gujarat Engineering Research Institute

GGRC Gujarat Green Revolution Company Limited

GIDC Gujarat Industrial Development Corporation

GP Gram Panchayat

GPCB Gujarat Pollution Control Board

GR Government Resolution

GSDWICL Gujarat State Drinking Water Infrastructure Company Limited

GWRDC Gujarat Water Resources Development Corporation Limited

GWSSB Gujarat Water Supply and Sewerage Board

IMT Irrigation Management Transfer

INC Indian National Congress

IRAP Institute for Resource Analysis and Policy

ISP Indira Sagar Project

IWRM Integrated Water Resources Management

KL Kilolitres

MAF Million Acre Feet

MCM Million Cubic Metre

MDGs Millennium Development Goals

MI Micro Irrigation

MINARS Monitoring of Indian National Aquatic Resources System

MT Million Tons

NGO Non-governmental Organization

O&M Operation and Maintenance

PIM Participatory Irrigation Management

PS Pani Samiti

RO Reverse Osmosis

SDTT Sir Dhorabji Tata Trust Mumbai

SEWA Self-Employed Women's Association

SPPWCP Sardar Patel Participatory Water Conservation Project

SPVs Special Purpose Vehicles

SRTT Sir Ratan Tata Trust

SRFDCL Sabarmati River Front Development Corporation Limited

SRFDP Sabarmati River Front Development Project

SSNNL Sardar Sarovar Narmada Nigam Limited

SSP Sardar Sarovar Project

TERI The Energy and Resources Institute

VIKSAT Vikram Sarabhai Center for Development Interaction

WALMI Water and Land Management Institute

WASMO Water and Sanitation Management Organization

WGG Water and Green Growth

WUAs Water Users Associations

WWC World Water Council

Executive Summary

In November 2010, the World Water Council (WWC) signed a memorandum of understanding with the Government of the Republic of Korea to initiate a joint project on Water and Green Growth (WGG). The first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille in March 2012. A case study on water management in the State of Gujarat was included in the first edition; the expanded case study included here is an input into Phase II of the project, leading up to the Seventh World Water Forum in Daegu.

The Gujarat water management case study explores the rapid growth of the State's economy, based on an analysis of exogenous factors and water institutions at the State and local levels that have had a major impact on that growth. The present research explores how the exogenous economic, social, political, environmental and technical factors drive water resources planning and management processes. It examines how the institutional framework in the water and related sectors contributed to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in *The Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions. The questionnaires presented to representatives of the main water-related institutions in Gujarat State were developed to reflect that framework.

Gujarat is one of the most water scarce regions in India, with nearly 80% of its geographical area having a renewable water resource endowment of less than 1,000 m^3 per capita per annum, with north Gujarat being absolutely water-scarce (less than 500 m^3 per capita per annum). More importantly, the regions with a poor water endowment have excessively high water demands. Most of this demand comes from agriculture, due to aridity, high per capita arable land availability and high dependence of the rural population on water for their livelihoods. Water use in three out of the four regions, namely north Gujarat, Saurashtra, and Kachchh, is currently unsustainable. The State has been known for problems of groundwater mining in north Gujarat, and seawater intrusion in coastal areas of Saurashtra and Kachchh. Nearly two thirds of the state's geographical area is drought prone.

Yet, the State has made major economic progress during the past 10-15 years through rapid growth in the manufacturing sector and impressive growth in agriculture through technology, skill development and infrastructure development. In this drought-prone State, water security to drive this growth was achieved through water imports for rural and urban drinking supply, industrial use, and irrigation. For this, large water infrastructure projects were implemented, including the Sardar Sarovar Project (SSP); the transfer of water for recharge of depleted alluvial aquifers in north Gujarat; large scale promotion of drip and sprinkler irrigation systems; the Sabarmati Riverfront Development Project; and large-scale decentralized water harvesting. The conditions that enabled these developments were: a stable government; the determination to find permanent solutions to droughts and scarcity of water for drinking and irrigation; consistently high growth in GDP and better economic conditions; and improvements in human development; and a good pool of technical manpower.

While there are indications that the large inter-basin transfer projects have had a positive impact on the environment

and social well-being apart from improvements in economic conditions, it is crucial to monitor these impacts over time to make sure that they do not cause environmental problems in the water surplus areas over time. Intensive commercial farming, rapid urbanization, and industrial growth continue to pose challenges for water and environmental management, with depletion of groundwater, over-appropriation of surface water and threats to ecosystem health in rivers.

On the social development front, there are indications that rural women, as well as other demographic segments of the population, have not fared well. Trends show a shift in cropping patterns to high value cash crops, which can threaten domestic food security in the long run, if farming systems are not made resilient. Malnutrition among women and children in rural and urban areas still remains a concern for the state.

Water administration in Gujarat is organized around three State departments: Department of Water Resources (also includes minor and medium irrigation systems), Department of Narmada and Major Irrigation, and Department of Water Supply. Other ministries such as industry, environment, and local self-governments are also associated with the administration of water. The Gujarat Water Resource Development Corporation is an autonomous body whose primary responsibilities are survey, monitoring, and development of groundwater. The Sardar Sarovar Narmada Nigam Ltd. (SSNNL)is an autonomous body that is responsible for the implementation of the Sardar Sarovar project, one of the most ambitious multi-purpose projects of modern India.

The institutional structure of the water supply sector in Gujarat is complex. The administration and regulation of water supply, covering domestic and industrial sectors, is provided by a number of different government departments, municipalities, local governments, and public-private enterprises. The Water and Sanitation Management Organization (WASMO) was created to empower village-level institutions to manage their own rural water supply facilities. It has brought about effective citizen engagement through its innovative governance model for community-led water supply program throughout the State of Gujarat.

Overall, the state water administration is geared up to develop water resources and distribution and deliver for various competitive uses. However, the major reforms on the legal and policy front have not effectively addressed the concerns of equity, efficiency and sustainability in water use. The problems in the water sector, such as groundwater mining, environmental water scarcity in rivers and inefficient use of water in agriculture, are being tackled through technological interventions and large-scale infrastructure projects. Organizational changes to implement the large projects are often in the form of Special Purpose Vehicles. Changes in norms are brought about for speedy acquisition of land for building of the canal network of SSP. New regulations for issuing new power connections can be inequitable, as they entail metering of agricultural connections, while many of the old agricultural connections remain unmetered.

The major initiatives in Gujarat over the past decade, which had a significant impact on the development and management of water resources in Gujarat State are outlined in the case study. Amongst them, the SSP produced the most remarkable impact, by raising agricultural productivity in the command area; improving the groundwater regime not only in the command area, but also in alluvial areas of central and north Gujarat; reducing energy use for pumping groundwater for both irrigation and domestic water supply; improving sustainability of well irrigation; and producing clean energy.

To ensure that water resources became an engine of sustainable growth, the Government of Gujarat implemented

exactly the same types of policies which are recommended in the Water and Green Growth policy framework under "water as an engine of growth": promote technology transfer and invest in innovative tools to improve water and energy efficiency; revitalize and better use urban waterways and waterfront areas; adopt a package of economic instruments, including demand management and incentives for recycling and reuse of water; and balance green and grey infrastructure among the competing uses.

On the economic front, the case study demonstrates a good example of growth based on water. However, the other two dimensions of green growth have not been as strong: protection and conservation of water resources; and water for an improved quality of life.Some of the lessons learned and challenges still facing the State in the water sector are summarized below and are discussed in more detail in the case study.

1. Better coordination is needed among various line agencies of the government responsible for water resources development and management. A number of different departments and agencies are responsible for large, medium and small irrigation, and these overlap with those that implement watershed development, minor irrigation schemes and groundwater irrigation. There needs to be a coordination mechanism so that these do not work at cross-purposes.

2. The ecosystem needs are not sufficiently addressed in watershed development programs. In treated watersheds, there has been a shift in cropping and land-use patterns to more water-intensive crops, using more water, and causing water quality problems from agricultural runoff. A regulatory framework for development and management of water resources and water allocation is needed, with appropriate institutional mechanism to enforce it at the level of hydrological units, i.e., basins.

3. There is a need for empowering the local communities to derive maximum benefits from the water management initiatives. The village water committees require capacity building in operation and maintenance, and they need to understand their rights and responsibilities, so as to function as effective local institutions for overall governance of water resources.

4. Groundwater conservation initiatives, such as Micro Irrigation promotion, have focused on technical solutions, and have not sufficiently considered the needs of poor farmers. Such schemes need to consider not only economic aspects, but social aspects as well. Thus, the community institutions need to have the capabilities and powers to play an effective role in water governance at the local level.

5. Though the government of Gujarat has adopted a participatory irrigation management policy to promote farmers involvement in irrigation management at the tertiary level of canal systems, there has not been an effort to introduce volumetric pricing of water. Hence, the farmers have no incentive to use water efficiently in both physical and economic sense.

6. There are no well-defined rights or entitlements for groundwater or water allocated from surface water systems. In the absence of this, the opportunity cost of using water is very small in most situations. Water is inefficiently used in agriculture for growing water-inefficient crops, or appropriated by those who pay more rather who need it more. Water rights need to be established in the case of groundwater resources, which are still linked to land ownership, if equity and sustainability are to be addressed.

I. Introduction

1. Purpose of the Case Study

Since the Brundtland Commission defined the concept of sustainable development in 1987, it has been accepted that development must include not only economic growth, but also environmental and social dimensions.[1)]

Throughout the period since the UN Water Conference was held at Mar del Plata, Argentina in 1977, water resources have been at the center of international discussions on economic and social development. Water was a key chapter in Agenda 21, the outcome of Conference on Environment and Development (UNCED, Rio de Janeiro, June 1992). Since then the United Nations and the international community have considered water as essential to the attainment of sustainable development. Water resources and sanitation were at the top of the agenda for negotiations leading to the Johannesburg Plan of Implementation (World Summit on Sustainable Development, Johannesburg, August-September 2002) and the World Conference on Sustainable Development in Rio in June 2012. Since 1977 there have been two International Decades for water (International Water Supply and Sanitation Decade, 1981-1990 and the International 'Water for Life' Decade, 2005-2015), the International Year of Freshwater (2003), the International Year of Sanitation (2008) and the International Year for Water Cooperation (2013). Water and sanitation were an important part of the Millennium Development Goals and water resources are at the center of negotiations for the post-2015 Sustainable Development Goals. The General Assembly declared the right to water and sanitation as a basic human right in July 2010.

In addition, innumerable international conferences outside of the United Nations system on different aspects of water resources management have been held to build a consensus and cooperation over the years. Among the most prominent are the annual World Water Weeks convened in Stockholm since 1991 and the triennial World Water Forums, convened by the World Water Council every three years since 1997. The Seventh World Water Forum will be held in Daegu, Republic of Korea in 2015.

In November 2010, the World Water Council signed a memorandum of understanding with the Government of the Republic of Korea to initiate a joint project on Water and Green Growth (WGG).[2)] Following considerable background research and the collection of case studies, a policy framework was developed and the first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille in March 2012. A case study on water management in the State of Gujarat was included in the first edition; the expanded case study included here is an input into phase II of the project, leading up to the Seventh World Water Forum in Daegu. It has been supported by the World Water Council and the Government of the Republic of Korea, the organizers of the Forum.

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1) The World Commission for Environment and Development, led by Norwegian Prime Minister Gro Harlem Brundtland, produced *Our Common Future* (1987, Oxford University Press), also known as the Brundtland Report, as an input to the United Nations Conference on Environment and Development held in Rio de Janeiro Brazil in June 1992.

2) WGG is defined as the (growth) concept that emphasizes the role of water in terms of achieving economic well-being and social equity coupled with protection and revitalization of ecosystems.

2. Case Study Context

Gujarat State, located on the west coast of India, has a total geographical area of 196,000 km^2 with a coastline of 1600 km, one-third of India's total (see Figure 1). The state has experienced very rapid economic growth over the past 20 years.

Gujarat is one of India's most prosperous states, having a per-capita GDP that rose from well below India's average in 2000 to above the average in 2012 (US $1,142 compared to US $1,107 for India as a whole). The State's economy grew at an average rate of over 12.3% per year from 2000 to 2011 at constant prices, reaching US $70.27 billion in 2011.[3] Gujarat ranked third in India in terms of GDP per capita growth.[4] The state is considered the growth engine of India; while Gujarat contributes around 7% to the country's overall GDP, it has just 5% of the nation's population (just over 60 million).

The state experienced balanced growth in its economy, with robust growth in the agriculture, industry, and service sectors in the past decade. There are many reasons for the rapid growth of these sectors, but one main factor has been water security, with major improvements in the availability of dependable and reliable water supplies to meet the competing demands from all sectors. Analysis of global data sets shows how improved water security of countries drives economic growth and human development at the national level.

Source: Wikimapia: http://wikimapia.org/country/India/Gujarat/

<Figure 1> Map of Gujarat and Location in India

3) World Bank Country Dataset http://databank.worldbank.org/data/views/reports/tableview.aspx and Central Statistical Organization of India

4) http://states-of-india.findthedata.org/q/7/4242/What-is-the-Gross-Domestic-Product-of-Gujarat

The countries which had high levels of water security had high human development indices, which in turn drive economic growth, resulting in high per capita GDP.[5] This case study will examine a number of the initiatives taken in the water and energy sectors by the government, the private sector, and the communities, which have direct bearing on water security in different sectors, to realize economic well-being and social advancement.

3. Case Study Methodology

The Gujarat water management case study explores the rapid growth of the State's economy, based on an analysis of exogenous factors and water institutions at the State and local levels that have had a major impact on that growth. The work was undertaken based on an institutional approach developed under the Water and Green Growth project supported by the World Water Council and the Government of the Republic of Korea. Details on the institutional approach and methodology can be found in the Lake Sihwa Water Quality Improvement project case study.[6] The present research will explore how the exogenous economic, social, political, environmental, and technical factors drive water resources planning and management processes. It will examine how the institutional framework in the water and related sectors contributed to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in T*he Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions.[7]

The questionnaires presented to representatives of the main water-related institutions in Gujarat State were developed to reflect that framework. Saleth and Dinar define a water institution to be an entity defined interactively by three main components: water law, water policy, and water administration. The analytical framework is presented in detail in the Lake Sihwa case study.

4. Organization of the Report

This case study investigates the economic, social, political, environmental, and technological context in which the State of Gujarat (India) undertook its water management reform. The policies and institutions that have been responsible for the improvements in water availability underlying the State's rapid economic growth have mainly been implemented since the year 2000. These policies and institutions are still evolving, changing, and adapting to cliverse circumstances and lessons learned. The stability in government over that time period has made it possible to adapt those policies and institutions. From this investigation, the different water management institutions and policies are described, and their performance is analyzed and lessons drawn. First exogenous factors are examined, then institutional factors and the policy mix considered together, and performance analyzed last.

This report is organized as follows. First, the Gujarat Water Management case study is summarized, indicating the main reforms and the main economic and social impacts. Second, the external environment during

5) *Kumar, M.D. 2010. Managing Water in River Basins: Hydrology, Economics, and Institutions*. New Delhi: Oxford University Press.

6) Research Center for Water Policy and Economy at K-water Institute. 2013, Sept. Lake Sihwa Water Quality Improvement Project: A Water and Green Growth Case Study Report. Daejeon, Republic of Korea.

7) Saleth, R. and Dinar, A. 2004. The Institutional Economics of Water: A Cross Country Analysis of Institutions and Performance. Washington D.C.: The World Bank.

the evolution of the water management reforms is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Statistics from international, national, and State sources, and from independent academic studies, to provide an overview of the situation in the State.

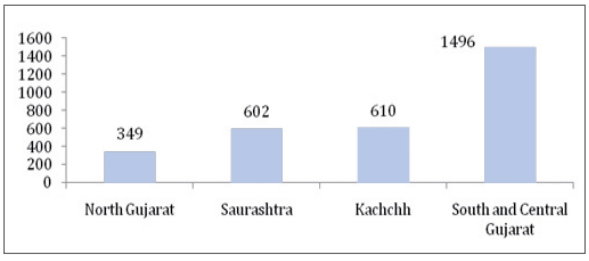
Next, the water resources developments, institutions and policies are summarized and analyzed, showing the changes over time. Finally, the impact and performance of the water management projects, survey results and expert interviews are used to analyze the current situation and performance of the water management reforms in Gujarat State.

II. An Overview: Water Management in Gujarat

1. About Gujarat

Gujarat is one of the most water scarce regions in India, with nearly 80% of its geographical area having a renewable water resource endowment of less than 1,000 m^3 per capita per annum, with north Gujarat being absolutely water-scarce (less than 500 m^3 per capita per annum). More importantly, the regions with a poor water endowment have excessively high water demands. Most of this demand comes from agriculture, due to aridity, high per capita arable land availability, and high dependence of the rural population on water for their livelihoods. Water use in three out of the four regions, namely north Gujarat, Saurashtra and Kachchh, is currently unsustainable. The State has been known for problems of groundwater mining in north Gujarat, and seawater intrusion in coastal areas of Saurashtra and Kachchh. The per capita renewable water resources of the four distinct regions of Gujarat are given in Figure 2.

The mean rainfall in Gujarat varies from from 350mm/year in Kachchh to 2000 mm/year in the Southern part.[8] The land is mostly fertile. There are 17 river basins in North Gujarat, with 71 river basins in the Saurashtra region and 97 river basins in Kachchh region. Although the state has more than 184 major and medium irrigation schemes, several parts of North Gujarat, Saurashtra, and Kachchh regions frequently suffer from severe water scarcity due to poor dependability of rainfall. Nearly 70% of the surface water resources of the state are concentrated in South Gujarat, which has perennial rivers[9] such as Mahi, Tapi, Narmada, Damanganga and Karjan. The rivers of north Gujarat, Saurashtra, and Kachchh are ephemeral, and the surface water resource potential is very low. When surface water is insufficient, groundwater has been overexploited to sustain intensive crop production in these regions. In many areas, people suffered from lack of adequate drinking water. Water levels in tube wells in certain areas of North Gujarat have fallen to 300 metres below ground level.



Source:Kumar, Sivamohan and Bassi, 2012 [10]

<Figure 2> Renewable Water Availability in Gujarat (m^3/capita/annum)

8) Institute of Rural Management Anand (IRMA)/UNICEF. 2001. White Paper on Water in Gujarat. Government of Gujarat, Gandhinagar.

9) Ibid.

10) Dinesh, K.M., Sivamohan, M.V.K., and Nitin B. 2012. Water Management, Food Security and Sustainable Agriculture in Developing Economies. London: Earthscan from Routledge.

Nearly two-thirds of the state's geographical area is drought prone, with half of it severely drought prone. The total geographical area of the state affected by droughts during the past three decades ranged from a low of 23% during 1973/74 to 87% during 1987/88, whereas the population affected by droughts ranged from a lowest level of 18% during 1973/74 to 67% during 1987/88.[11] Therefore, the state's experience in mitigating the impacts of climate variability and reducing carbon emissions would be valuable for many other developing and emerging countries. Water scarcity not only puts severe constraints on economic growth, but also threatens the very survival of the human population in certain parts of this large State, with people lacking access to water for basic needs locally. The unique agro eco-systems, the long coastline, and a large tribal population pose additional challenges.

2. Timeline for Water Management Advances

Over the last 30 years, Gujarat has tried both the dominant international model, and the decentralized participative model in the water sector. While construction of large multi-purpose reservoirs like the Sardar Sarovar Project and large regional water supply pipelines involving bulk water transfer are examples of the former, community-centered infrastructure for water harvesting is an example of the latter. Since 1997, the State introduced a large water conservation program in the Saurashtra peninsula, involving nearly 100 ephemeral rivers draining into the ocean, with nearly 100,000 small water harvesting structures built in the rural areas for capturing runoff.

On the drinking water front, Gujarat has experienced water riots; migration took place in search of water and to reduce the drudgery of women and the plight of villagers. Excessive withdrawals of groundwater posed serious quality problems affecting the health of millions of people in the coastal areas. The government realized that over-dependence on local groundwater for water supplies, whose availability is affected by excessive withdrawal for irrigation and consequent seasonal depletion, could threaten the sustainability of drinking water supplies in rural and urban areas. To ensure water supply dependability, the State, through the Gujarat Water Supply and Sanitation Board (GWSSB), created a "state-wide drinking water grid" for the transmission of surface water with the help of large-scale infrastructure installations. Box 1 presents water management milestones in Gujarat.

<Box 1> Significant Milestones in Water Laws, Policies, and Administrationin Gujarat

1974: The Gujarat Pollution Control Board (GPCB) was established; it is responsible for monitoring the quality of rivers, lakes, reservoirs, and other surface waters, bore wells and groundwater, as well as coastal waters.

1975: The Gujarat Water Resources Development Corporation Ltd. (GWRDC) was established to concentrate on groundwater investigation, exploration, management and recharge works. Presently, GWRDC is functioning under the Narmada Water Supply and Water Resources Department with a separate Board of Directors headed by a Chairman and Managing Director, who is also the Chief Engineer of the Government of Gujarat.

1978: The Government of Gujarat established the Gujarat Water Supply and Sewerage Board (GWSSB), a statutory body overseeing development, regulation, and control of drinking water in the State. The Board is mainly responsible for rural water supply systems and for operational management of rural regional water supply schemes.

1979: The Sardar Sarovar Dam project took form as part of the Narmada Valley Project, a development scheme to increase irrigation and produce hydroelectricity. It is a gravity dam on the Narmada River near Navagam, Gujarat and is the largest of 30 large dams planned on the Narmada River. The Narmada Valley Development Authority is an organization of the government of Madhya Pradesh. The Narmada Valley Project has been one of the most widely criticized water development projects around the world in recent years, because of its potential social and environmental impacts. At the same time, it is an ambitious project to provide water and energy security for the states of Madhya Pradesh and Gujarat.

11) Roy, A.K. and Hirway, I. 2007. Multiple Impacts of Droughts and Assessment of Drought Policy in Major Drought Prone States in India, Project Report Submitted to the Planning Commission, Government of India, New Delhi.

1988: Establishment of Sardar Sarovar Narmada Nigam Ltd (SSNN) as a Special Purpose Vehicle of the Government of Gujarat; the Nigam was registered under Companies Act. 1997: The Ahmedabad Municipal Corporation (AMC) set up the Sabarmati Riverfront Development Corporation (SRFCDL) as a Special Purpose Vehicle to oversee the massive task of cleaning up the Sabarmati River by flushing out the effluent and sludge in the riverbed using excess flows of Narmada from the main canal.

1999: The Government of Gujarat set up the Gujarat Water Infrastructure Co. Ltd. to implement, operate and maintain the Sardar Sarovar Drinking Water Supply program.

2000: The Gujarat Infrastructure Company, Ltd. was formed to build the water distribution infrastructure under the Narmada and Mahi Canal based regional water supply scheme.

2000 Onward: Construction of Sardar Sarovar Dam (Ongoing)

2000-01: Plan for the state-wide water grid completed.

2002: The Government of Gujarat set up the Water and Sanitation Management Organization (WASMO) as a Special Purpose Vehicle – an autonomous society – to implement decentralized rural water supply management

2000-01: Phase I of the Sardar Patel Participatory Conservation Project (SPPWCP). The project involved construction of check dams and village tanks or ponds by a designated beneficiary group, with technical and financial assistance from the district office. Over 10,000 works were completed in phase I.

2001-13: Phase II, III and IV of SPPWCP. By March 2013, over 88,000 check dams had been built with people's participation by Narmada Water Resources, Water Supply and Kalpasar Department and over 162,000 by other Departments in Gujarat State.

2005: Establishment of Gujarat Green Revolution Company Ltd. (GGRC) to popularize the adoption of drip irrigation and implement micro irrigation schemes among farmers on behalf of the government of India and Gujarat State. GGRC offers highly subsidized loans to farmers and has simplified the administrative procedures.

2006: The Jyotigram Scheme was initiated by the President of India. It is an initiative that uses a rationing system for farm power supply to limit the competitive pumping of water. The Scheme improved reliability and reduced low voltage fluctuations for agricultural power supply and also assured 24 hour, three phase power supply for the domestic sector.

2013: A new Irrigation and Drainage Act was adopted. The earlier Irrigation and Drainage Act (when Gujarat was part of Bombay State) was created in the colonial framework. The new Bill dropped irrelevant provisions and gave more legal authority to the irrigation departments (mainly to enforce penalties against those tapping illegal water). [12]

III. The Case Study

The case study on water management in Gujarat State chronicles a combination of huge investments in water infrastructure, modifications in water and energy policies, and changes in water administration. One of the important lessons learned from the case study is that technological initiatives to improve water supply for domestic consumption and irrigation have to be complemented by grassroots people's participation in management and distribution of water. The community-managed water supply program in Gujarat has been a model for the entire country. Small innovations, such as micro-water harvesting, have made a large impact on agricultural production.

Key factors for success of the water initiatives are:

- Support for large-scale infrastructure for transfer of water from relatively water rich regions to water-scarce regions that are affected by droughts, balanced with small-scale community-led innovations for local water harvesting and water management; and
- Proactive policies, institutional reforms and organizational development that led to rapid development of water and energy infrastructure for optimal use of water and adoption of efficient water use technologies in the major water consuming sectors.

The biggest investment in water infrastructure is the Sardar Sarovar Project on the Narmada River, part of a multi-State, multi-purpose river valley project, that resulted from a long period of deliberations of a constitutional body. The agreement was based on the principles of 'Equality of Right' and 'Equitable Utilization' along the entire course of the interstate

12) Gujarat Irrigation and Drainage Bill to replace Gujarat Irrigation Act of 1879. Full text at http://guj-nwrws.gujarat.gov.in/downloads/drainage_bill_2013_eng.pdf

river. The project is projected to irrigate 1.90 million ha of land, increase agricultural production by 8.7 million tons per annum (worth US $430 million) and generate hydropower with installed capacity of 1,450 MW. The project is also expected to supply drinking water to over 8,200 villages and 135 urban centers of Gujarat (around 20 million people) generate jobs in rural areas, and reduce the rate of desertification, saline intrusion and rural to urban migration in Gujarat. The command area and drinking water supply areas of the project represent the worst water scarcity-hit areas of the State.[13)]

Along with this huge infrastructure project is the Sardar Patel Participatory Conservation Project (SPPWCP), which involves construction of check dams and village tanks or ponds by a designated beneficiary group, with technical and financial assistance from the district offices of the water resources department of the government of Gujarat. More than 350,000 check dams and village tanks or ponds were created in the last 10 years, providing direct benefit to over 13 million people in rural Gujarat. Gujarat has also created the Gujarat Green Revolution Company Ltd. to popularize the adoption of drip irrigation technologies among farmers. GGRC offers highly subsidized loans to farmers and has simplified the administrative procedures for obtaining loans and government subsidy.

As described below, the State of Gujarat has taken a multi-pronged approach to tackling its water management challenges. This was necessary in an economically-vibrant but drought-prone and semi-arid region of the world.

1. Exogenous factors

This section presents the exogenous factors that helped shape the context in which Gujarat State implemented key water resources management decisions. It describes some of the economic, social, political, environmental, and technological elements that influenced the decisions that were made and contributed to the achievement of green growth.

1-1. Economic Factors

Gujarat's rapid economic growth is reflected in a balanced economy, with agriculture and food output averaging growth of 11% annually from 2001 to 2011, while industry and services attained over 10% per year growth.[14)] It should be pointed out here, however, that Gujarat was hit by a devastating earthquake in January 2001 and experienced a large rainfall deficit from 2000 to 2002, which would indicate that the base from which the growth rate figures were taken was relatively low. Nonetheless, Gujarat has recorded steady economic growth over the last decade.

Gujarat is one of India's most prosperous states, having a per-capita GDP (in constant prices) that rose from well below India's average in 2000 (US $352 to India's $ 578) to above the average in 2012 ($1,142 compared to US $1,107 for India as a whole).[15)] The State's economy grew at an average rate of over 12.3% per year from 2000 to 2011at constant prices. The per capita net state domestic product (per capita income) at constant prices grew at an annual compounded growth rate of 10.3% over the period 2000 to 2012.[16)] Economic growth for the period

13) *Gupta, R.K. 2003. Dams and Water Development for Poverty Reduction. Water and Development and Poverty Reduction.* Kluwer Academic Publishers. Part 4(Ch. 10): 199-226.

14) World Bank Country Dataset http://databank.worldbank.org/data/views/reports/tableview.aspx and Central Statistical Organization of India

15) Ibid.

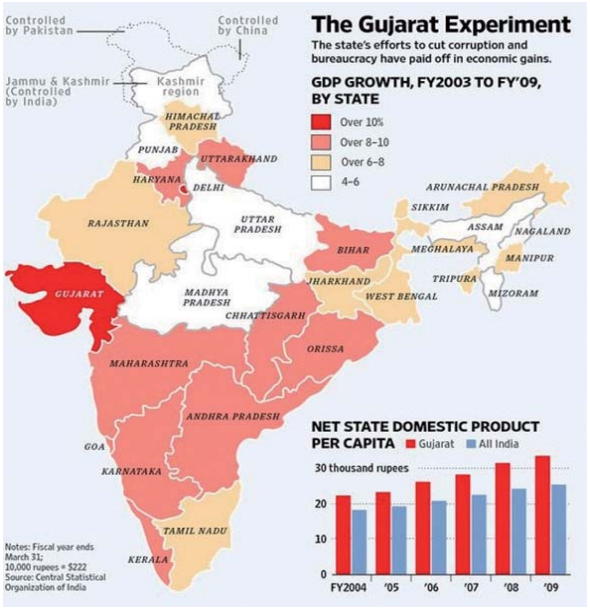
16) Author's calculations from Table 1 data.

2000 to 2012 in the State as compared to India as a whole is shown in Table 1. Figure 3 shows the comparison graphically, but in current rupees from FY 2004 to 2009.

<Table 1> Gross Domestic Product and its Growth in India and Gujarat, 2000-2012

Year	GDP at constant prices (in billion US $)		GDP growth (annual %)		GDP per capita at constant prices (in US $)	
	India	Gujarat State	India	Gujarat State	India	Gujarat State
2000	602.65	17.42	3.8	-4.9	578	352
2001	631.72	18.88	4.8	8.4	596	373
2002	655.76	20.42	3.8	8.1	609	395
2003	707.30	23.43	7.9	14.8	647	445
2004	763.34	33.90	7.9	8.9	687	630
2005	834.22	38.96	9.3	14.9	740	713
2006	911.50	42.23	9.3	8.4	797	761
2007	1,000.84	46.88	9.8	11.0	863	833
2008	1039778	50.06	3.9	6.8	885	877
2009	1127948	55.69	8.5	11.3	948	962
2010	1246906	61.26	10.5	10.0	1034	1052
2011	1325842	66.48	6.3	8.5	1086	1100
2012	1368759	70.27	3.2	5.7	1107	1142

Source: World Bank Country Dataset: http://databank.worldbank.org/data/views/reports/tableview.aspx and Central Statistical Organization of India



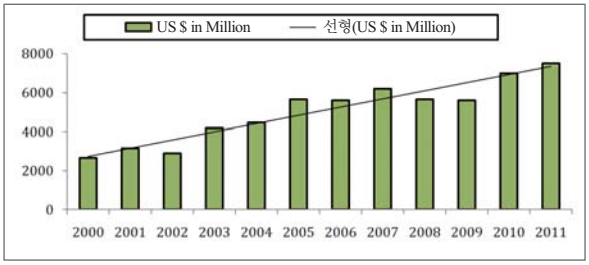
Source: Central Statistical Organization of India

<Figure 3> GDP Growth in Gujarat, 2003-2009.

1-1-1. Agriculture

According to the Directorate of Economics and Statistics, the agriculture sector in Gujarat has experienced an annual compound growth rate of 9.9 % over the decade 2000/01 to 2011/12. The State is a major producer of cotton, groundnuts, bananas, dates, sugar cane, oil seeds such as castor and mustard, milk and milk products, and tobacco.[17)]

The agriculture sector is still a critical factor in the overall performance of the state economy. During the period 2000 to 2011, the contribution of agriculture including animal husbandry to Gross State Domestic Product rose from US $ 2.66 billion to US $ 7.51 billion at 2004-05 prices (see Figure 4).



Source: Gujarat socio-economic reviews, 2012-13 [18)]

<Figure 4> Performance of the Agricultural Sector (at Constant 2005 Prices) in Gujarat, 2000-2011

Agricultural growth has been shown to have the greatest impact on poverty reduction and rural development. In recent years, a major expansion in irrigation has been achieved through the execution of the Sardar Sarovar Project, improvements in water management and use of water efficient irrigation technologies such as drips and sprinklers.

These and other innovations in the agriculture sector have led the rural economy towards more inclusive

17) Directorate of Economics and Statistics, Government of Gujarat. 2013. Socio-Economic Review, 2012-13, Budget Publication No. 34, Gandhinagar: http://financedepartment.gujarat.gov.in/budget13_14_pdf/34_Socio_Economic_Review_English.pdf.

18) Ibid.

growth. The role of the agriculture sector remains very critical, as it accounts for about 52% of employment in the State. Hence, the growth of agriculture can be considered a necessary condition for 'inclusive growth'. More recently, the rural sector (including agriculture), in addition to being a supplier of food, fodder, and raw materials for a vast segment of industry, is being seen as a potential source of domestic demand, a recognition that is shaping the marketing strategies of entrepreneurs wishing to widen the demand for goods and services.[19] Hence, agricultural growth is a precondition for balanced growth in the economy. During FY 2010 to 2011, production of food grains, which are generally low valued, dropped by around 8% over the year. The production of cotton rose by 5.5% and the production of oil seeds showed a slight decline over the year. Agricultural growth in the State in recent years has been driven more by crop diversification and expansion in the area under fruits, vegetables, oil seeds, and other cash crops.

Given the fact that the net sown area has not been changing significantly over the past few decades, the only way to achieve agricultural growth is through crop intensification and crop diversification. The former would be possible through the irrigation expansion, while the latter could be achieved through the production of lower water-using crops. The shift towards high value fruits and vegetables, oil seeds, and other cash crops such as cotton and castor has been water-intensive, and was accompanied by the adoption of micro irrigation systems, such as drips and sprinklers. The use of MI systems, especially drips, enhanced water use efficiency in irrigation. However, to promote green growth and water conservation in the long run, it would be appropriate to revert to the production of crops that use less water.

In Gujarat, it has been shown that there is a strong correlation between rainfall and the production of food grains. Both the area and production of food grains have been largely influenced by the rainfall fluctuations over the years. Over the decade FY2000 to 2010, six years registered declines in rainfall over the previous year. The largest decline was in 2000, followed by another deficit year, which caused food grain production to decline over 25% in each of those years. As FY 2000 was the baseline for growth rates over the 10-year period, the agricultural growth rates should be treated with caution. Nevertheless, it is indisputable that there has been a major recovery of the agriculture sector after the two consecutive years of drought, i.e., in 1999 and 2000. The SSP has played a crucial role in the recovery, by starting the delivery of large volumes of water for irrigation.[20]

1-1-2. Industry

One of India's most industrialized states, Gujarat established itself as a leader in various industrial sectors from the 1960s to the 1990s – textiles, engineering, chemicals, petrochemicals, drugs and pharmaceuticals, dairy, cement and ceramics, and gems and jewelry. Gujarat accounts for more than 35% of Indian chemical production. Newer industries include the production of fertilizers and petrochemicals. With 6% of India’s geographical area, the State has a coastline of 1600 km and is home to 41 ports and handles around 25% of the country’s sea-cargo. Growth of state GDP in the industrial sector for Gujarat as compared to GDP in industry for India as a whole is shown in Table 2.

19) Directorate of Economics and Statistics, Government of Gujarat. 2013. Socio-Economic Review, 2012-13, Budget Publication No. 34, Gandhinagar: http://financedepartment.gujarat.gov.in/budget13_14_pdf/34_Socio_Economic_Review_English.pdf.

20) Kumar, M., Dinesh, A., Narayan, A., Singh, O.P., Sivamohan, M.V.K., Sharma, M.K., and Bassi, N. 2010. Gujarat's Agricultural Growth Story: Exploding Some Myths. Occasional Paper #2. Hyderabad: Institute for Resource Analysis and Policy

<Table 2> Growth rate of Gross Domestic Product in the Industry Sector, India and Gujarat, 2000 to 2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gujarat	-12.3	-2.0	17.7	12.5	15.1	14.6	9.4	10.8	6.5	21.2	6.6	5.2
India	6.0	2.6	7.2	7.3	9.8	9.7	12.2	9.7	4.4	9.2	9.2	3.5

Source: World Bank Country Dataset and Central Statistical Organization of India

The State is rich in mineral resources such as calcite, gypsum, manganese, lignite, bauxite, limestone, agate, feldspar, and quartz.

Gujarat ranks first among India's states in gas-based thermal power generation, with a national market share of over 8%. The State increased its power generation capacity by over 35% during the period 1995/96 to 2000/01. It was one of the first states in India to have encouraged private sector investments, which has had a big impact on the energy sector.

India's total petroleum refining capacity in 2012 was 213 million tons (MT) per annum, of which around 120 MT was produced by the public sector, 15 MT by joint ventures and 78 MT by the private sector. The largest private producer is Gujarat's Jamnagar Refinery, a crude oil refinery owned by Reliance Industries Limited in Jamnagar.[21] The refinery was commissioned in 1999 and is the largest refinery complex in the world.[22] In 2012, the refinery had a capacity of 33 MT in its domestic tariff area and 29 MT in the Special Economic Zone (strictly for export).[23]

The State's industrial policy (2009) aims to catalyze robust, sustainable, and inclusive growth.[24] Since 2007 the State has held six investors' summits entitled Vibrant Gujarat (www.vibrantgujarat.com), and the seventh is planned for January 2015. Gujarat currently accounts for 15% of total investments in India (US $114 billion), the highest among the Indian states. It offers numerous investment opportunities, particularly through its Special Economic Zones and Special Investment Regions, which include industrial areas and industrial parks. Gujarat is in the middle of the Delhi Mumbai Industrial Corridor (DMIC), 38% of which passes through the State. Other industrial policy initiatives include port-led development, promotion of environmental protection, and green business.[25]

Gujarat is India's industrial powerhouse, but water is a key input for energy that fuels industrial growth. Water is a critical input for process and cooling requirements in a number of major industries. Unreliable supplies and water shortages can have an adverse effect on the expansion of small and medium sized enterprises, resulting in a loss of economic opportunities. Securing water and energy supplies of high reliability was the first step in positioning Gujarat to support rapid industrial growth. In many of the industrial areas of the State (including the manufacturing hub of Ahmedabad) and the inland and coastal areas of Kachchh and Saurashtra, obtaining freshwater for manufacturing has been a major challenge, due to high levels of salinity in groundwater or limited groundwater or surface water potential. Some of the large industrial groups such as Tata Chemicals and Reliance Petroleum had set up their own desalination systems in the coastal

21) http://data.gov.in/dataset/petroleum-refining-capacity-india-april-2012

22) http://en.wikipedia.org/wiki/Jamnagar.

23) *Economic survey 2011-12: India's oil refining capacity likely to rise 15% to 214 MT. 2012, 15 March. The Economic Times*. http://articles.economictimes.indiatimes.com/2012-03-15/news/31197265_1_refinery-production-refining-capacity-refinery-capacity (Accessed 1 Feb 2014)

24) Official State Portal http://gujaratindia.com/business/investment-oppurtunities.htm

25) http://www.vibrantgujarat.com/investment-opportunities.htm

areas of Saurashtra. While supplies from groundwater resources have become highly unreliable in most parts of the State, there has been enormous pressure on the government from industrial groups to invest in infrastructure that would help them secure freshwater supplies on a long-term basis. The State government also realized that this would be one major way to attract investors in the State.

1-1-3. Demographic Trends

The population of Gujarat State was 60.4 million according to the 2011 census data. The population density is 308/km^2, lower than most other Indian states. The latest census also reveals that the State has a sex ratio of 918 girls for every 1000 boys, one of the lowest (ranked 24) among the 29 states in India. The state has made impressive progress in reducing the population growth rate since the early 1970s, as can be seen in Table 3.

Many large cities have recorded exponential growth. As can be seen in Table 2, urbanization trends have shown faster growth than population increases. While the population of Gujarat rose by almost three times over the 50-year period, the people living in urban areas increased by almost five times (from 5.31 million in 1961 to 25.72 million in 2011). The state has witnessed the fastest urbanization in India. A little more than 43% of the people of Gujarat now live in urban areas, according to the 2011 census. Over the decade 2001-2011, the rural population decreased by 5.2 percentage points, while the urban population rose from 37% to 43% of the population over the 10-year period.[26] Ahmedabad is one of the fastest-growing cities in the world.

Cities being points of concentrated demands for high quality water, the government had to look for alternative sources of dependable water supplies to feed the growing urban population in the wake of drying up groundwater-based sources.

1-1-4. Effects of Economic Factors

Regarding agriculture, major strides were made in expanding the irrigated area through the completion of new gravity-based surface water transfer systems (mainly SSP) and use of water-efficient irrigation technologies, such as drips and sprinklers, especially in water scarce regions of the State. While availability of surface water for irrigation has reduced demand on energy-intensive groundwater irrigation. The adoption of micro-irrigation technologies has resulted in both groundwater and energy savings at the farm level. Thus, the growth in agricultural GDP in the State has been characterized by a "green pathway" as it resulted in water savings and more importantly reduction in carbon emissions due to lower energy use for groundwater abstraction.

<Table 3> Growth of Population and Trends in Urbanization, Gujarat State, 1961 to 2011

Sr. No	Year	Total Population (million)	Decadal Growth Rate	Density (Persons per km^2)	Sex Ratio (F/M per 1000)	Literacy Rate	Percentage of Urban Population
1	1961	20.6	+26.88	105	940	31.47	25.77
2	1971	26.7	+29.39	136	934	36.95	28.08
3	1981	34.1	+27.67	174	942	44.92	31.10
4	1991	41.3	+21.19	211	934	61.29	34.49
5	2001	50.7	+22.66	258	920	69.14	37.36
6	2011	60.4	+19.17	308	918	79.31	42.58

Source: Socio-Economic Review, Gujarat State, 2012 –13.

26) http://www.vibrantgujarat.com/investment-opportunities.htm

In the industrial sector, some of the large industrial groups had set up their own desalination systems in the coastal areas of Gujarat, and others have installed reverse osmosis plants to purify and reuse wastewater. These actions have reduced demand for freshwater sources and reduced the costs of energy for treatment of polluted freshwater sources. Setting up of common effluent treatment plants (CETPs) for industrial clusters is another important initiative from the manufacturing sector to promote sustainable growth, as seen in Ahmedabad, Vadodara, and Vapi. This again reflects the sustainable use of water resources for industrial production.

1-2. Social Factors

There has been a significant reduction in the proportion of people living in poverty in Gujarat since the 1970s. According to the Planning Commission of India, the percentage of people falling below the poverty line was 48% in 1973/74.[27] This fell to 31.6% in 2004/05 and further to 16.6% in 2011/12, according to the National Sample Survey Office.[28]

Methods of calculating poverty in India were revised in the last decade, showing a larger proportion of people considered poor under the new methodology. In 1993, the Government of India convened an expert group to review methodology for poverty estimation, chaired by DT Lakdawala, based mainly on calorie consumption and consumer prices (Lakdawala method). In 2005, another expert group was formed to review the methodology, chaired by Suresh Tendulkar, to address shortcomings of the previous methods. The committee formed in 2009, with Tendulkar as Chairman, came out with a new method to calculate poverty (Tendulkar methodology). According to this method, the number of the poor in India in 2004–05 rose from 27.5% to 37.2% of the total population. In the past, poverty had been estimated by looking at a limited view of money required for a stipulated minimum calorie intake by individuals. But the Tendulkar committee moved to a wider definition, including spending on food as well as education, health, light (electricity), clothing, and footwear.[29] The differences in estimates are shown in Table 4.

<Table 4> Percentage of Population below the Poverty Line, 1994 to 2010

	Lakdawala Methodology		Tendulkar Methodology		
	1994	2005	1994	2005	2010
Gujarat	24.2	16.8	37.8	31.6	23.0
India	36.0	27.5	45.3	37.2	29.8

Source: World Bank Country Dataset and Data Book DCH, 2013[30]

In both methodologies the percentage of people below the poverty line in Gujarat is considerably less than in India as a whole. Table 5 shows the comparison between Gujarat and India in 2012, using the Tendulkar Method. While the general indicators of social development in Gujarat are better than the national average, given its rapid economic progress, the State has the potential to perform much better on the social and human development front. According to the "India Human Development Report 2011" the human development index of Gujarat was 0.527 in 2007/08, ranking 11th among the Indian states. Between 1999/2000 and 2007/08, the human development index for the State increased by only 0.06 points. This marginal improvement is not commensurate with the economic progress that the State has witnessed since 2000/01. The dividends of the rapid economic progress are yet to be translated into improvement in the quality of life of the people of the State.[31]

27) http://planningcommission.nic.in/plans/planrel/fiveyr/10th/volume3/v3_ch3.pdf

28) http://www.business-standard.com/article/economy-policy/planning-commission-estimates-show-sharp-fall-in-poverty-rate-113071701028_1.html

29) http://en.wikipedia.org/wiki/Suresh_Tendulkar

30) Data Book for Deputy Chairman, Planning Commission, Government of India.

31) Directorate of Economics and Statistics, Socio-Economic Review, Gujarat State, 2012-13, Gandhinagar, p.x.

<Table 5> Number and Percentage of Population below the Poverty line in Gujarat and in India, 2012 (Tendulkar Method)

	Rural		Urban		Total	
	% of persons	No of persons (million)	% of persons	No of persons (million)	% of persons	No of persons (million)
Gujarat	21.54	7.53	10.14	2.69	16.63	10.23
India	25.70	216.66	13.70	53.13	21.92	269.78

Source: Press Note on Poverty Estimates, 2011-12, Government of India

1-2-1. Health and Education

The health status of the people in the State is better than the national average. Death rates and infant mortality rates in Gujarat are slightly lower than the national average. Life expectancy at birth is 66.8 years in Gujarat, compared to 66.1 in India as a whole. These comparisons are shown in Table 6.

During India's 11th five-year plan period (2007 to 2012), Gujarat increased its allocations for social services in terms of the proportion of the overall state budget. The allocation in 2011/12 was 42% of total state expenditure. This compares to 35% for social services in 2007/08. The largest proportion of social spending was for education, culture and sports, followed by water supply, sanitation, and housing.[32)]

According to the 2011 population census, more than 79% of the people over the age of 7 in the State were able to read and write with understanding. The proportion was 87% for males, 71% for females, 73% of people in rural areas, and 88% in urban areas. The provisional results of the 2011 population census suggest that the gap in literacy between men and women has been substantially reduced. The State aims to achieve universal literacy.

The total number of primary schools in the state increased by 220 from 2010/11 to 2011/12, accompanied by an increase in enrollment and a reduction in the dropout rate (from over 22% in 1999/00 to only about 2% in 2011/12). The literacy rate increased from 69.1% to 79.3% during the decade from 2001 to 2011. What is more remarkable is the fact that the enrollment in higher education increased by 15% from 2010/11 to 2011/12. The intake capacity of technical institutions for degree

<Table 6> Selected Indicators of Human Development in Gujarat State and India, 2000 to 2011

Year	Life Expectancy at birth		Infant Mortality Rate (total per 1000 live births)		Birth Rate per 1000		Death Rate per 1000	
	Gujarat	India	Gujarat	India	Gujarat	India	Gujarat	India
2000	65.6	62.2	62	68	25.2	25.8	7.5	8.5
2001	65.6	62.6	60	66	25.0	25.4	7.8	8.4
2002	65.6	62.9	60	63	24.7	25.0	7.7	8.1
2003	65.6	63.3	57	60	24.6	24.8	7.6	8.0
2004	65.6	63.7	53	58	24.3	24.1	6.9	7.5
2005	66.4	64.1	54	58	23.7	23.8	7.1	7.6
2006	66.8	64.5	53	57	23.5	23.5	7.3	7.5
2007	66.8	64.8	52	55	23.0	23.1	7.2	7.4
2008	66.8	65.1	50	53	22.6	22.8	6.9	7.4
2009	66.8	65.4	48	50	22.3	22.5	6.9	7.3
2010	66.8	65.7	44	47	21.8	22.1	6.7	7.2
2011	-	66.0	41	44	21.3	21.8	6.7	7.1

Source: World Bank Country Dataset; Databook for DCH, 18 December 2013 and SRS Based Abridged Life Tables

32) Directorate of Economics and Statistics, Socio-Economic Review, Gujarat State, 2012-13, Gandhinagar, p. S-105.

and diploma courses and for MBA and MCA courses also increased significantly during 2011/12.

The fertility rate in the state was 2.5 in the year 2010 according to the sample registration system, compared to replacement level fertility of 2.1 live births per woman of reproductive age. While the fertility rate had been reduced to the replacement level in urban areas by 2010, fertility rates in rural areas were over 2.7 live births per woman of reproductive age.

Because of the focus on engineering and science in the State, Gujarat has a highly-skilled work force prepared to support high tech industries. The situation of women in rural areas still lags behind other demographic segments, as illustrated by the case described in Box 2.

1-2-2. Effects of Social Factors

Enhancement in social indicators, such as the decline in the proportion of people falling below the poverty line, improvement in health status and literacy rate, has empowered people and improved their capacity to manage and use resource more efficiently. With better education and awareness, people have begun to recognize the value of obtaining better quality water and power supply, and keeping the environment clean. While many of these outcomes have resulted from investments in social welfare and in large-scale water projects, various local level institutions such as Water User Associations and Pani Samitis, have also played an important role in improving water security for both domestic and agricultural purposes.

Numerous NGOs, social activists, environmental groups, the international donor community, and many scientific and academic institutions that are active in the State have played a crucial role in highlighting the issues of water security, environmental protection, water management options, and their linkages with human development. Advancements in social indicators and human development indices contributed to economic growth, resulting in increased willingness of the government and the people to invest in sustainable development technologies, leading to 'green growth'. The investment in riverfront development projects, the CETPs, and the solar power project are a few examples of this process.

<Box 2> Case study of Women, Water, and Empowerment

A recent case study on the situation of women and water management [the "Drudgery Report" (2013)] was conducted in villages of Gujarat, Andhra Pradesh and Karnataka. The portion of the study in Gujarat showed that the situation for women in relation to their access to drinking water in the three villages studied was not satisfactory, although it is improving. The villages selected were Tarakwadia, Dhundhera, and Zarda in the Meghraj block of Sabarkantha District, where the Sujal project is located. The drudgery for the women includes fetching water, fetching fuel-wood and working in the fields, especially seed sowing, weeding, harvesting and other tasks. It was found that the main sources of water supply, mainly hand pumps and overhead tanks, generally did not function, and the villagers had not been trained in repair and maintenance. When the overhead tanks were working, the women appreciated improved access to water and reduction in time spent fetching water, but the motorized pump burned out and it was not repaired.

The water supply and sanitation in schools in the villages is inadequate. With poor quality water, insufficient water supplies and poor sanitation infrastructure in the villages, water-borne diseases are widespread, and most villagers do understand the relationship between disease and poor water and sanitation. Most of the people in the villages still practice open defecation in the fields. The three villages in Gujarat had a few toilets and pit latrines with open drainage systems. In one village the government dug 15 pits, but toilets were never installed.

In 2011 the Development Support Center (DSC), an EU-IWRM implementing partner in Gujarat, introduced the "People and Panchayat-led equitable water governance" project in 18 villages of Meghraj Block (three of which were from the case study above). The DSC has been working in Meghraj since 1996 undertaking projects on watershed development, agriculture enhancement and micro-finance. The DSC project focuses on three critical areas: improving access to water supply; improving water demand management through more efficient use of water; and better water governance through a people-led process that builds capacities to manage water resources, addressing the water needs of everyone including the poor, marginalized and the women.

In the three villages covered by the case study, the communities are mobilized into 'Sujal Committees' with the help of locally-selected women as extension volunteers (EVs). The three EVs are young, dynamic, reasonably educated, and with supportive families to enable them to do the extension work. The Sujal Committees include members of already existing self-help groups, farmers' clubs, Panchayats or other groups and have relatively equal numbers of men and women.

The main sources of drinking water in the villages are hand pumps and open wells. Through the project, the hand pumps were repaired, and a new hand pump was installed in Tarakwadia. People contributed about 10-20 % of the total cost for the pump. Now the villagers are getting a regular supply of water. The men and boys have started fetching water from the nearby hand pumps, and the women/girls have reported that hand pumps are especially useful when the power supply fails. They are learning about rainwater harvesting and the overhead water tank in Zarda is being repaired for use. Moreover, a number of simple labor-saving technologies have been introduced to reduce the drudgery in agricultural operations. Women mentioned that the reduction in drudgery enables them to expand agriculture and rest. Importantly, it enables girls to attend school.

Gujarat is home to thousands of NGOs. The type of project outlined above can improve water management and empower women at the same time.

Source:Access to Water and Empowerment of Women: Study of Drudgery Work and Relief by SUJAL (March 2013). IWRM: a pilot initiative in Gujarat, Andhra Pradesh and Karnataka [study of villages in Gujarat by Meena Bilgi]. Gender and Water Alliance and SUJAL.

1-3. Political Factors

From 1818 to 1947, most of present-day Gujarat was in the form of hundreds of princely states, but several districts in central and southern Gujarat were ruled directly by British officials. India's "Father of the Nation", Mohandas Karamchand (Mahatma) Gandhi, was a Gujarati who led the India's independence movement against British colonial rule.

The people of Gujarat were among the most enthusiastic participants in India's struggle for freedom, and many leaders of the independence movement, including Sardar Vallabhbhai Patel, hailed from Gujarat. It witnessed some of the most popular revolts and non-violent demonstrations. After independence and the partition of India in 1947, the new Indian government grouped the former princely states of Gujarat into three larger units: Saurashtra, which included the princely states on the Kathiawar peninsula; Kutch (Kachchh); and Bombay state, which included most of the former princely states of eastern Gujarat. In 1956, Bombay State was enlarged to include Kutch, Saurashtra and parts of Hyderabad and Madhya Pradesh States in central India. The new State had a mostly Gujarati-speaking north and a Marathi-speaking south. Agitation by Marathi nationalists for their own State led to the split of Bombay State into the two new States of Gujarat and Maharashtra along linguistic lines on 1 May 1960.[33)]

Gandhinagar, the capital of Gujarat, is one of the three planned cities in India and is considered to have excellent infrastructure, and the densest urban forest. There are 25 administrative districts in the State, and Gandhinagar is its political hub. Ahmedabad is the largest city in the State and is one of the fastest growing cities in the world.

The State is governed by a legislative assembly of 182 members, of which 13 constituencies are reserved for scheduled castes and 26 for scheduled tribes. The term of office for a member of the Legislative Assembly is five years. The leader of the majority party or coalition in the legislature acts as Chief Minister and Leader of the Legislative Assembly. The Chief Minister is responsible for the administration of the State. The governor of the State, currently Hon. Kamla Beniwal, is appointed by the President of India.

From 1947 until 1960, the Indian National Congress (INC) ruled the Bombay State, which included present-day Gujarat. The INC continued to govern Gujarat after the State's creation in 1960 and thereafter until 1995. In the 1995 Assembly Polls, the Congress lost to the Bharatiya Janata Party (BJP), and since that time the BJP has been the dominant party in the State. In 2002, the BJP retained a majority in the election and Narendra Modi became Chief Minister. Since 2002 Mr. Narendra Modi has served as Chief Minister of the State, and he is the longest serving Chief Minister of Gujarat. The BJP retained a majority in the most recent election in December 2012.

33) Directorate of Economics and Statistics, Socio-Economic Review, Gujarat State, 2012-13, Gandhinagar, p. S-105.

The government of Gujarat has shown remarkable stability over the past decade and has encouraged large-scale private and public investments in infrastructure and manufacturing throughout the period. The State government has promotional policies and incentives for investment in infrastructure, in particular energy, water and transportation. Water being an important subject for the people of Gujarat, the continuance of a single political party in power has also helped maintain consistency in policy measures with regard to water.

1-3-1. Effects of Political Factors

Since 1998, a single party has been in power in Gujarat, and since 2001 the Chief Minister in the State has not changed. As a result, decisions on important policy matters which have major implications for human development and economic growth have been consistent and the process of decision making has been smooth. Since water is a State subject in India, continuation of a stable government in Gujarat has led to major water resource development projects (small and large) being executed without major opposition and delays. The SSP, Sujalam Sufalam and Sardar Patel Participatory Water Conservation Program are a few examples. Reforms in the power sector were also pursued rigorously-with metering of agricultural connections, 24 hour power supply to households in rural areas and reduction in transmission and distribution losses. The result of such efforts can be seen in terms of expansion in irrigated area, adoption of MI technology and improved access to water supply and sanitation by the community, all contributing to green growth.

1-4. Environmental Factors

The State of Gujarat has an enormous variety of ecological systems. It has mountain ecosystems, vast arid and semi-arid plains, desert ecosystems and coastal ecosystems. The large mountains, coupled with a very long coastline, deserts, many agro-ecologies, important wildlife, complex geological formations and geographical features, as well as socio-economic and ethnic diversity, pose major challenges.

1-4-1. Environmental Degradation

The state is rich in biodiversity. The data on the total number of recorded species of flora and fauna in the state, against those at the national level, according to the Gujarat Biodiversity Board, is given in table 7. In spite of having nearly one fourth of the geographical area under a desert ecology, the state has nearly 9% of the plant species and 6% of the animal species. In the recent past, Gujarat's record in protection of flora and fauna has been good. Gujarat has many wildlife sanctuaries and national parks, including one marine national park in Jamnagarin the Gulf of Kachchh and a wild donkey sanctuary in Little Rann of Kachchh. The state is world renowned for the Gir sanctuary, which is the only home for Asiatic lions.

In its race to achieve rapid economic growth, Gujarat has introduced some policies and safeguards to protect the environment, but at the same time has not been very successful in tackling the vexing problems of environmental degradation in the state.

The following issues require long-term solutions:

- Saline intrusion in the coastal areas of Saurashtra, which has affected coastal aquifers and agricultural land, with the increase in salinity affecting water supplies for human and animal drinking and irrigated crop production;
- Rapid urbanization causing degradation of wetlands, with indiscriminate disposal of solid waste and construction debris in the reservoir area, and encroachment on their catchment area;
- Use of mineralized groundwater from deep aquifers in alluvial areas of north and central Gujarat, causing long-term changes in soil salinity levels; and

• Indiscriminate building of large and small dams in the rivers of Saurashtra, Kachchh and north, and central Gujarat have caused over-appropriation of stream-flows, environmental water stress, and destruction of riverine ecology.

The State of Gujarat will need a strong political will, as well as resources to address the environmental concerns outlined above. As seen in certain cases, engineering solutions are resorted to for solving the environmental problems, in particular setting up of common effluent treatment plants (CETPs). In Vapi, one of the oldest industrial estates in Gujarat, the Vapi Waste and Effluent Management Company Ltd. treats effluents from industries, using a very advanced treatment process. In addition to primary treatment and aeration tanks, the treatment system includes secondary clarifiers, sludge thickener, sludge drying beds, up-flow anaerobic sludge blanket, reactivated clarifier, and other highly advanced oxidation systems.[34] In general, however, institutional interventions would be required to deal with many of the pollution and environmental problems on a long-term basis.

<Table 7> Biological Diversity in Gujarat and India

Flora/Fauna	Total number of recorded species	
	Gujarat	India
Flora		
Algae	1,933	6,500
Fungi	164	16,500
Bryophyta	8	2,850
Pteridophyta	16	1,100
Gymnosperms	1	64
Angiosperms	2,198	17,500
Total Flora	4,320	46,286
Fauna		
Lower animals	1,736	76,455
Fish	606	2,546
Amphibians	19	206
Reptiles	107	485
Birds	479	1,228
Mammals	107	372
Total Fauna	3,054	81,292
Overall (Flora + Fauna)	7,374	127,578

Source: Gujarat Biodiversity Board

1-4-2. Department of Forests and the Environment

The Department is divided into an environment wing and a forest wing. The Forest Wing covers forestry, wildlife (fauna and flora) and the social forestry program. The environment wing is the primary body for dealing with all the environment-related matters including enforcement of the Environment (Protection) Act of 1986, which is the umbrella act to oversee environmental matters in the country.

The mandate of the Department is to achieve sustainable development in the State and to introduce sound environmental management practices. The Department has four executing agencies for discharging its functions: Gujarat Pollution Control Board, Gujarat Ecology Commission, Gujarat Institute of Desert Ecology, and Gujarat Environmental Management Institute.[35]

The Department's Social Forestry Program for planting trees on non-forest lands has improved the green cover of the State. The objectives were to increase the number of trees in the State, promoting the participation of people and institutions to grow trees, and to make use of unproductive land for productive use. As 57% of the people still live in rural areas, the regeneration of forests and maintenance of non-forest lands, particularly the common lands, have become imperative for the State to meet the needs of rural people.

34) *Doshi, R. 2014. Experience of Wastewater Treatment Technologies: A Case Study of Vapi Waste and Effluent Management Co. Ltd. The Asian Journal*, 1(1).

35) Forests and Environment Department http://www.envforguj.in/department/

1-4-3. Impacts of Large-Scale Infrastructure Works

At the national level, the Ministry of Environment and Forests of India conducted an assessment of planning and implementation of environmental safeguards related to the Sardar Sarovar (SSP) and Indira Sagar projects (ISP) on the Narmada River.[36] The report covered the status of compliances on catchment area treatment, flora and fauna and carrying capacity upstream, command area development, compensatory afforestation, and human health aspects in project impact areas. The report recommended that no further raising of dam height be done at either SSP or ISP, until compliance on the various environmental parameters has been fully met. The government of Gujarat, particularly the Sardar Sarovar Narmada Nigam, is working towards compliance of the norms set for environmental clearance by the Ministry of Environment and Forests, to get permission for raising the dam height to realize the full benefits from the project.

In its efforts to minimize the negative environmental impacts of the SSP, a massive program of afforestation and catchment area treatment works have been carried out. Catchment area treatment, which includes planting new trees and carrying out soil conservation measures, had been completed in the entire catchment area (almost 30,000 ha) of the Sardar Sarovar reservoir within Gujarat. Compensatory afforestation has been carried out in over 4,500 ha of non-forest area and over 9,000 ha of degraded forest area in Kachchh district. A plantation of 4,600 ha has been established in the vicinity of the dam and along canal banks. The temples of Hamfeshwar and Shoolpaneshwer were relocated to higher elevations. Appropriate measures are also being undertaken for fisheries development, control of malaria, and other water-borne diseases in the command area sites.[37]

A number of impact studies have been undertaken on the environmental, agricultural, flora and fauna, wildlife sanctuaries, health, and socio-economic aspects that have been affected by the project. Work plans have also been prepared for forests, health, and fisheries and they are being implemented through the concerned State Government Departments.

1-4-4. Water Pollution Control

With high growth in urban population and rapid industrialization happening around cities and towns in Gujarat, safe disposal of effluents and control of pollution of water bodies such as rivers, lakes and naturally drained groundwater are posing major challenges. The volume of sewage generated in cities and towns of Gujarat (from metro areas, Class I and Class II towns) and the sewage treatment capacity available in the state as of 2009 are provided in Table 8. While the capacity of wastewater treatment systems available in Gujarat is sufficient to treat only 40% of the sewage generated, the capacity is only 30 per cent at the national level.

<Table 8> Wastewater Generation and Treatment in Gujarat

Sr. No.	Urban Center	Total No. of Cities/ Towns		Sewage Generation (MLD)		Sewage Treatment Capacity (MLD)	
		Gujarat	India	Gujarat	India	Gujarat	India
1	Metropolitan cities	4	35	1,045	15,644	728	8,040
2	Class I cities (other than metropolitan cities)	24	463	636	19,914	55	3,514
3	Class II towns	31	410	228	2,697	-	234
	Total	59	908	1,909	38,255	783	11,788

Source: Adapted from Central Pollution Control Board, 2009

36) Committee for Assessment of Surveys/Studies/Planning and Implementation, 2010, February. Second Interim Report of the Plans on Environmental Safeguard Measures for Sardar Sarovar & Indira Sagar Projects. Final Report submitted to the Ministry of Environment and Forests, Government of India.

37) Directorate of Economics and Statistics, Government of Gujarat. 2013, February. Gujarat State Profile Socio Economic Review 2012-13. Budget Publication no. 34, 15.

<Table 9> Status of Water Quality in Gujarat, 2011

River basin/type of water body	No. of observation stations	Water quality parameters					
		pH	Conductivity (μmhos/cm)	DO	BOD	Faecal Coliform	Total coliform
		Water quality criteria					
		6.5-8.5	-	→4 mg/l	←3 mg/l	←2500 MPN/100ml	←5000 MPN/100ml
		Observed range					
Mahi basin	9	7.1-8.7	256-903	3.0-8.9	0.9-8.0	2-9	7-26
Sabarmati basin	2	8.1-8.5	506-3830	7.1-7.9	2.9-32.0	6-90	20-430
Narmada basin	1	7.1-8.4	222-404	6.9-8.2	1.1-5.0	0.6-14	4-34
Tapi basin	8	7.1-7.8	318-41836	3.2-7.6	1.2-9.0	33-9000	430-24000
Medium & Minor reservoirs	11	7.0-8.5	4-38593	1.1-7.9	0.7-19.0	3-2300	3-9300
Canal	1	7.3-8.4	207-628	6.1-7.5	1.0-3.0	9-43	23-150
Lake/Pond	7	7.5-8.8	230-3610	3.2-9.0	1.4-12.0	2-4300	4-24000
Groundwater	19	7.5-8.5	381-12018	-	0.8-3.1	2-400	2-900

Source: Compiled using data tables from Central Pollution Control Board, 2010

The Gujarat Pollution Control Board (GPCB), established in 1974, is responsible for the Monitoring of the Indian National Aquatic Resources System (MINARS) Project. The program monitors the quality of rivers, lakes, reservoirs and other surface waters, bore wells and groundwater, as well as coastal waters. It provides information on the status of water quality and the status of rivers under water quality stress. Under MINARS, the Board has 70 monitoring stations on rivers, 10 on lakes and groundwater monitoring in 20 districts.[38] Table 9 summarizes the results of water quality monitoring done by GPCB.

A quick review of the data in Table 9 shows that there is a wide variation in the values of chemical and biological quality of water even within the same river basin, with the maximum values exceeding the permissible levels or minimum values falling below the threshold levels in many cases. Overall, Tapi river basin in South Gujarat and the medium and minor reservoirs have high levels of biological contamination and salinity levels. Comparing groundwater and canal water, canal water has very low levels of salinity and is within the permissible levels, as indicated by low values of conductivity. Groundwater sources appear to be low in biological contamination, with faecal coliform and total coliform count much below the permissible levels.

1-4-5. Climate Change

In order to address the challenges of climate change, Gujarat established a separate Department for Climate Change in February 2009 to be headed by Chief Minister Narendra Modi.[39] The Department was supposed to empower people to become active agents of sustainable development and to promote an understanding that communities are pivotal to changing attitude towards environmental issues. By late 2013, however, it appeared that the State government did not accept the draft report of the State's Climate Change Action Plan 2012-17

38) Gujarat Pollution Control Board http://www.gpcb.gov.in/projects-water-quality-monitoring-programmes.htm

39) Climate Change from Official Gujarat State Portal http://www.gujaratindia.com/initiatives/initiatives.htm?enc=TEnmkal8rLd9cWRBUEX85lswwfZZ+o8b+w+YfQPy7dU93tk/rntr0H+OnwOK0bubl3+goYyJYykc1/dBRv+06CbmqSVNPGxGVsKl4u4sIibrqAnIU6NnDw0tj6RQxr6Wy2kLs1KAPRYw6nzEy3BJww==

prepared by The Energy and Resources Institute (TERI).[40] Thus, Gujarat failed to submit its action plan for inclusion in the Prime Minister's National Climate Change Action Plan, and the department was not functioning at the end of the year.

According to the Times of India, the draft action plan raised serious concerns about the likely socio-economic and environmental impact of climate change on Gujarat, while predicting an adverse impact on agriculture, health and environment. It recommended huge investments in new infrastructure to mitigate the impact of climate change and also stressed radical policy changes in the functioning of the government departments and overall policy changes for industries and other sectors. The draft proposed that the government create environment-friendly water resource management, public health projects, forest and environment improvement projects, agriculture improvement projects, and a number of studies.[41]

1-4-6. Effects of Environmental Factors

Most parts of Gujarat are located in fragile ecosystems, and around two thirds of State territory has an extremely limited water resource endowment and is drought prone. This situation had attracted attention from the national government and international community to improve its natural resources management, particularly for water and forests, ecosystems, biological diversity, and environment in the State. For instance, the problems of groundwater depletion in Gujarat had attracted the attention of UNDP in 1976; the agency implemented a pilot project on artificial recharge in Mehsana. Gujarat issued a White Paper on Water in Gujarat, which was the result of the attention it received from the international development community (particularly from the UNICEF), after the consecutive droughts of 1999 and 2000.

The poor water resources endowment, groundwater depletion, and the consequent environmental degradation helped the state to mobilize international development assistance for many of its major projects, including the Narmada Canal based Drinking Water Supply project for Saurashtra and Kachchh. The ability of the State to bring water resources to the development discourse of the international community by linking it to issues of rural livelihoods and human security was crucial to this effort.

The efforts to conserve the natural environment through the establishment of common water effluent treatment plants, forest regeneration, sewage treatment, catchment area treatment, and building institutions to deal with the projected impacts of climate change, hint at the 'green path' which the State has pursued for protecting its natural resource and thereby achieving the well-being of the people who depend on these resources. The State's inability to pass a climate change plan has delayed efforts to prepare for and adapt to climate change and thus undermines its commitment to promote green growth.

1-5. Technical Factors

Gujarat has been a leader in engineering, science and technology, and information technologies in India. It has a relatively high Internet density, and is home to some world-renowned institutes of management, engineering and design. The government through the Gujarat Council on Science and Technology has provided support to Centers of Excellence in such fields as nanoscience, nanomaterials, nanotechnology, nano polymeric materials and nanocatalysts. Out of six sponsored COE projects, five have been completed with their targeted

40) 2013, 14 Nov. Times of India. http://articles.timesofindia.indiatimes.com/2013-11-14/ahmedabad/44072702_1_climate-change-action-plan-draft-report

41) Ibid.

research outcomes at Bhavnagar University, Saurashtra University, Gujarat University, M.S.University of Baroda, and Sardar Patel University.[42)]

The Gujarat Technological University Ahmedabad, and its affiliates the Gujarat Institute of Technical Studies and Gandhinagar Institute of Technology, are considered as international innovative institutions. Masters and Bachelor degrees and diplomas are available to national and international students in Engineering, Computer Science, Pharmacy and Business Administration, among others. The University includes an Indo-Canadian and an Indo-German Study Center and has a number of international professors.[43)] The Indian Institute of Technology Gandhinagar and other technical institutes also provide engineering degrees, research and development opportunities, and technical education to the rising numbers of educated youth. Many of the courses are also available to international students.

While these universities and institutes provide high quality education, the Gujarat Matikam Kalakari and Rural Technology Institute also provides skills training and extension services to both women and men in rural areas.[44)]

Gujarat is the hub of the chemical industry in India, contributing 51% of chemicals and over 60% of the petrochemicals.

1-5-1. Effects of Technical Factors

Gujarat has the intellectual capital for technical and engineering manpower, and this has been an important factor in improving water management and building water infrastructure. The State has been able to move forward with projects such as the water grid, the Sardar Sarovar project and other important large-scale engineering infrastructure for water resources development and management. It is important to ensure that these works also provide equitable access to water for poor people in urban and rural areas. In order to make green growth a reality, rural people who are stewards of the watershed areas must be involved in making the system sustainable.

1-6. Concluding Remarks

Gujarat has made major economic progress during the past 10-15 years through rapid growth in the manufacturing sector and impressive growth in agriculture through technology, skill development through investment in human capital and infrastructure development, particularly the development of large water infrastructure. In this drought prone state, improved water security achieved in the regions facing desiccation, through water imports for rural and urban drinking supply, industrial use and irrigation have been crucial in achieving this. As a matter of fact, Gujarat has become an illustrative example of how water development can drive economic growth, with progress in human development indices. While there are indications that the large inter-basin transfer projects have had a positive impact on the environment and social well-being apart from improvements in economic conditions, it is crucial to monitor these impacts over time to make sure that they do not cause environmental problems in the water surplus areas as time goes by.

As for social well-being, there are indications that rural women, as well as other demographic segments of the population, have not fared well. It may be the case that, when new irrigation projects are introduced,

42) Gujarat State Portal http://www.gujcost.gujarat.gov.in/centre-excellence.htm
43) Gujarat Technological University Website http://www.gtu.ac.in
44) Gujarat Rural Technology Institute Website http://www.rtigujarat.org/extension-work.html

the land which is used for growing cereals, which takes care of the domestic food security needs, has been reallocated for growing cash crops. Trends show a shift in cropping patterns to higher value cash crops. Malnutrition among women and children in rural and urban areas still remains a concern for the state.

The State of Gujarat should thus make sure that the marginalized and poor people in rural areas are not left behind by rapid economic growth, and that the growth is inclusive. The state should lay equal emphasis on reducing income disparities between the rich and the poor through special policy measures. While water security drives growth in the state, the emphasis should be on improving the water security of the poor and the marginalized. People in rural areas. Women in particular can be engaged in water resource protection, watershed management, operation and maintenance of drinking water supply systems, while the access of poor families to improved water supply and sanitation systems should be improved. Skills development and engagement of rural women in protecting the environment are essential ingredients of green growth.

2. Water Resources Governance and Institutions

2-1. National/Union Water Policy, Law, and Administration

2-1-1. National Water Policy

India does have a National Water Policy that was first enacted in 1987 and then updated in 2002 and 2012.[45] One problem is that the national water policy falls under the Ministry of Water Resources, which despite its name is not a real umbrella water ministry; but only one of the several ministries having key responsibilities in the water sector, some of the others being, for instance, the Ministry of Drinking Water & Sanitation. One of the results has been that the national water policy does not constitute a comprehensive policy statement taking into account the needs and specificities of all water uses to the same extent. The Planning Commission recognizes this and has initiated an attempt to draft framework water legislation in the context of the preparation of India's 12th five-year plan (2012-17).

Although the legal and policy framework for water in India has evolved dramatically over the past two decades, India lacks an umbrella framework to regulate freshwater in all its uses. The existing water law framework in India is characterized by the co-existence of a number of different principles, rules and acts adopted over many decades. These include the common law principles and irrigation acts from the colonial period as well as more recent regulation of water quality and the judicial recognition of a human right to water.

2-1-2. National Water Law and Administration

The lack of umbrella legislation at the national level has ensured that the different state and central legal interventions and other principles do not necessarily coincide and may in fact be in conflict in certain cases. Thus, the claims that landowners have over groundwater under common law principles may not be compatible with a legal framework based on the human right to water and the need to allocate water preferentially to domestic use and to provide water to all, whether landowners or not on a equal basis.[46]

Historically, irrigation laws constitute the most

45) Full texts available at International Environmental Law Research Center http://www.ielrc.org/water/docs.htm.

46) Cullet, P. 2007. Water Law in India: Overview of Existing Framework and Proposed Reforms. IELRC Working Paper 2007-01. International Environmental Law Research Center. http://www.ielrc.org/content/w0701.pdf

developed part of the water law, because of the colonial government's promotion of large irrigation works and the need to introduce a regulatory framework in this area. As a result, some of the basic principles of water law applicable today in India derive from irrigation acts. For example, the early Northern India Canal and Drainage Act 1873 sought to regulate irrigation, navigation and drainage in Northern India. One of the long-term implications of this act was the introduction of the right of the Government to 'use and control for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes.'[47] The 1873 act refrained from asserting state ownership over surface waters, although surface waters are considered in the public domain.

Nonetheless, a number of new water laws have been adopted that relate to the national water policy since the second half of the 1990s. The general characteristic of these new acts is that they are all sectoral (i.e., irrigation, drinking water supply, and industrial water supply,). For groundwater, new legislation filled a gap where there was no statutory framework, while legislation related to water user associations is in need of an updated legal framework. National (or Union) water law has thus evolved rapidly but in a sporadic manner that does not strengthen water law as a whole.[48]

The union government frequently has used administrative directions as a mode of intervention in the water sector. In certain cases, as for rural drinking water supply, the national-level intervention has been extremely influential, even though it has never taken the form of a legislative instrument.[49] Even though the union has no specific mandate to get involved in rural drinking water in individual states, its policy framework has been widely adopted across the country. This also means that when the policy framework changes at the center, states are relatively quick to adopt the same, as happened with the adoption of a new policy framework for the 11th plan (2007-12).[50]

Similarly, the union government has used its authority to adopt programs such as for drinking water supply in rural areas without accompanying legislation. These have in practice been followed by states throughout the country, in part because of the related financial incentives. The use of such administrative directions (policy) that are not backed by a legal framework may have drawbacks. Thus, even though the human right to water is now clearly established in India, the administrative instruction may not include human rights language in its scope.[51]

2-2. State Water Policy, Law, and Institutions

Water resources—precipitation and surface water resources—are inadequate in three out of the four regions: Saurashtra, Kachchh, and north Gujarat. Groundwater has been seriously over-exploited, and the State suffers frequent droughts. The depletion of groundwater resources in regions like north and central Gujarat had affected the drought proofing ability of the State. Prior to 2001, drinking water scarcity posed a serious threat

47) Cullet, P. 2007. Water Law in India: Overview of Existing Framework and Proposed Reforms. IELRC Working Paper 2007-01. International Environmental Law Research Center. http://www.ielrc.org/content/w0701.pdf

48) *Cullet, P. 2012. Is Water Policy the New Water Law? Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin*, 43(1).

49) Government of India, 2010. National Rural Drinking Water Program – Movement Towards Ensuring People's Drinking Water Security in Rural India: Framework for Implementation. Dept. of Drinking Water Supply, Ministry of Rural Development, www.ielrc.org/content/e1002.pdf. Accessed 06 March 2014.

50) *Cullet, P. 2012. Is Water Policy the New WatCullet, P. 2012. Is Water Policy the New Water Law? Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin*, 43(1).er Law? *Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin*, 43(1)..

51) Ibid.

to human and cattle populations. The State government addressed these problems by spending billions of rupees on temporary measures to supply drinking water by road tankers and special water trains. Water shortages in the past had affected access to drinking water and irrigation, constraining economic and social development in the State. The response of the State over the last 15 years has been to introduce a number of programs, institutional, and technological solutions that have included: creation of a state-wide water grid; small water harvesting for irrigation; inter-basin transfers of water from the Narmada River Basin; and power sector reforms. Community-based institutions and private sector participation have been incorporated into these initiatives.

Providing access to good quality drinking water and improved irrigation were among the top priorities in water policy. Many areas suffered from serious water quality problems due to excessive fluoride, nitrate and salinity. Fluoride has been the cause of extensive health problems in many parts of Gujarat. As most of the drinking water supply had earlier consisted of groundwater from deep tube wells with high-capacity pumping machinery, water supply was also a very high consumer of electricity.

The water problem also led to intra-state migration from drought prone-regions in the west and southwest of the State to the central and southern regions. The migration of people and livestock resulted in the economic, social, and cultural dislocation of hundreds of thousands of people. Therefore, the regional imbalances in Gujarat were accentuated because of increasing water scarcity.[52] Growth in the proportion of people with access to safe drinking water over time is shown in Table 10.

2-2-1. Policy Instruments

Gujarat drafted a state water policy in 2012 that provides general guidelines on water resource development, use, and water management that are meant to affect the water sector as a whole, but it still hasn't finalized the water policy. Outside of such a policy, however, most of the water sector reforms in Gujarat have been implemented under strategies, programs or legislation relating to a specific sub-sector.

For example, the state in 2001 drew up an ambitious strategy for extending the water grid through bulk water transmission from sustainable surface water resources to areas with shortages. This was a part of the State water policy, but was not based on legislation. The strategy involved a huge investment in large-scale infrastructure, including bulk pipelines, distribution pipelines and water filtration, and treatment plants. This initiative, carried out by the GWSSB, largely solved the problems of drinking water distribution and poor water quality associated with excessive fluoride contamination.

Other policy instruments have been issued for the irrigation, water supply, and sanitation sub-sectors. One state-level policy covers the construction of "sub-minors" (tertiary canals) involving the Public-Private Partnership model. This policy sets out how the construction will be

<Table 10> Percentage of Households With Access To Safe Drinking Water (Tap Water, Hand Pumps, Tube Wells)

Gujarat/ India	1981			1991			2001			2011		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Gujarat	52.4	36.2	86.8	69.8	60.0	87.2	84.1	76.9	95.4	90.3	84.9	97.0
India	38.2	26.5	75.1	62.3	55.5	81.4	77.9	73.2	90.0	85.5	82.7	91.4

Source:Data book for DCH, Planning Commission, Government of India 18 December 2013.

52) Gupta, R.K. 2003. Dams and Water Development for Poverty Reduction. Water Development and Poverty Reduction. Kluwer Academic Publishers. Part 4(Ch. 10): 199-226.

paid for (between SSNNL and farmers); it also provides incentives to Water User Associations to adopt micro irrigation systems. The State of Gujarat has also adopted a "Total Sanitation Policy" under the Rural Sanitation Program, under which it is providing assistance to construct low-cost latrines in all districts.[53)]

2-2-2. Legal Instruments

According to the existing legal framework in the State, surface and groundwater are treated differently. Further, the water law does not recognize private property rights in water. Currently, surface water is managed as State property, whereas, De Jure rights to groundwater are not clearly defined. De facto, the rights to groundwater are linked to land ownership rights. Those who own land have rights to the groundwater underlying their land, though these rights are not defined in volumetric terms.

The State of Gujarat has enacted a number of sector-specific legislation relating to water. For example, the State enacted the Gujarat Irrigation and Drainage Act in 2013, to replace the Gujarat Irrigation Act of 1879. The Act covers: irrigation from rivers, canals, tanks and groundwater; construction and maintenance; compensation; conflict resolution; adjudication; supply rates (set by State government); and offences and penalties. Another example of a specific water law is the Gujarat Water Users Participatory Irrigation Management Act of 2007 that provides a framework to encourage participatory irrigation management by water users.

According to the respondents to the questionnaires, the overall water laws in the state are perceived as effective in terms of promoting green growth and implementing various reforms in the water sector. However, respondents felt that water laws were not very effective in: addressing conflict resolution among stakeholders; ensuring accountability of various stakeholders (officials, water suppliers, users); promoting integrated water resources management; and encouraging private sector participation in the water sector.

There are no laws or state wide regulations pertaining to inter-sectoral water allocation in the state, except that drinking water gets the highest priority in water allocation from public water sources such as reservoirs, as per the National Water Policy (2012). In the case of SSP, a norm for inter-sectoral water allocation was laid out by the Narmada Water Disputes Tribunal in 1979. This norm is being adhered to.

2-2-3. Water Administration in Gujarat

The case study in Gujarat shows an enormous state-wide effort with many components working together to improve the water situation. The multi-faceted effort was made almost entirely by the public sector, with enormous public investments. While the case study shows savings in some areas such as provision of drinking water and electricity costs, a huge public sector investment was needed for such a wide range of initiatives.

The governance and management of water resources and services include management of water-related organizations, water bodies, and water supply systems. Their domain comprises: storage and control of water sources; delivery of water to different use sectors; actual use and management of water; and disposal of used/waste water. Each of these functions involves a number of distinct activities such as construction, operation and maintenance of facilities, allocation of water, conservation and management of water bodies, and resolution of conflicts among users and service providers. Table 11 shows the institutional structure of the water sector in Gujarat.

53) Socio-Economic Review, 2013. http://www.gujaratindia.com/state-profile/socio-eco-review.htm

<Table 11> Institutional Structure of Water Sector in Gujarat

Administration and regulation		
Agency	Jurisdiction	Role
Department of Narmada, Water Resources, & Water Supplies	State level	Regulatory oversight of the water sector in the State Oversight of State government owned corporations involved in the implementation and operation of water schemes.
Department of Urban Development	State level	Oversight of urban local bodies, excluding corporations, in matters of financial, planning and management issues. Regulation of political and administrative appointments in the local authorities.
Municipal Corporations	Major cities	Provision of retail water supply services for domestic and industrial purposes in the area of their jurisdiction
Municipalities & Nagarpalikas	Smaller Cities	Provision of water supply services for domestic and industrial purposes in the area of their jurisdiction.
Gram Panchayats	Villages	Provision of water supply services for domestic and industrial purposes in the area of their jurisdiction
Gujarat Industrial Development Corporation	State level	Provision of retail water supply services in industrial estates owned by GIDC.
Gujarat Water Resources Development Corporation	State level	Survey, assessment and planning of groundwater resources in Gujarat Planning and design of artificial recharge schemes
Implementation and Operation		
Agency	Jurisdiction	Role
Gujarat Water Supply and Sewerage Board (GWSSB)	State level	Mainly Implementing water supply and sewerage schemes for urban local bodies Operation of some schemes Inspection of schemes where State government fund is provided.
Gujarat State Drinking Water Company Limited	State level	Bulk transmission and bulk supply of drinking water to local bodies, GWSSB, and Industrial estates.
Water and Sanitation Management Organization	State level	Responsible for ensuring decentralized management of water supply at the village level, through promotion of village level pani samitis, with the involvement of NGOs
Sardar Sarovar Narmada Nigam Ltd.	State level	Implementation of Sardar Sarovar Narmada project; Operation and maintenance of the multi-purpose project Operation and maintenance of the irrigation infrastructure under the project Bulk supply of water for industrial water supply, domestic water supply (rural and urban)
Narmada and Major Irrigation Department	State level	Operation and maintenance of large irrigation projects, excluding SSP
Department of Water Resources	State level	Operation and maintenance of medium and minor surface Irrigation Schemes in the state

Source: Gujarat Infrastructure Development Board: http://www.gidb.org/cms.aspx?content_id=358; and IRMA/UNIEF (2001)

Water administration in Gujarat State is the responsibility of three State departments: Department of Water Resources (also includes minor and medium irrigation systems); Department of Narmada and Major Irrigation; and Department of Water Supply. Other ministries, such as industry, environment, and local self-governments are also associated with the administration of water. The Department of Water Resources is responsible for the management of water bodies, which includes conservation and protection of water resources, as well as designing, construction and operation and maintenance of small and medium size surface and groundwater irrigation systems. To assist the Department in promoting groundwater development, the Gujarat Water Resource Development Corporation (GWRDC) was established in 1975. The Corporation is an autonomous body, and its primary responsibilities are survey, monitoring, and development of groundwater.

The Corporation had established over 3000 public tube wells all over the State to promote the groundwater utilization. In addition, the department is responsible for

management of drainage and drainage-based irrigation within the command areas of major canal systems. Two state-level institutes under the department, the Gujarat Engineering Research Institute (GERI) and the Water and Land Management Institute (WALMI) were established to support design, construction and management of water resources and services.

The selection of any new water project in the State is guided by multiple criteria that include financial, equity and ecological considerations. In most of the projects, water is priced below the production and supply cost, leading to only partial cost recovery. However, rates for industry and the commercial sectors are substantially higher than the irrigation and domestic sectors.

Irrigation Administration

The Narmada and Major Irrigation Department is responsible for designing, construction, operations, and maintenance of major irrigation systems. The Sardar Sarovar Narmada Nigam Ltd. (SSNNL), a Special Purpose Vehicle, is responsible for the implementation of the Sardar Sarovar project. The SSNNL is an autonomous body that has linkages with the department for the purposes of resource generation. The department is also responsible for negotiation and settlement of disputes related to the Sardar Sarovar Dam in the other States.

There are twelve major irrigation systems (excluding Narmada) in the State. The maintenance and operation of these major irrigation systems is the responsibility of this Department. The performance of major irrigation systems varies widely. In order to improve its performance and increase water use efficiency, the department has launched several programs, including participatory irrigation management, which actively seek farmers' involvement in the management and control of water resources.

One could infer from the above description that there are overlaps of authority and control exercised by various water related line agencies of the State government. For example, the Chief Engineer, Command Area Development, who works as part of the Department of Narmada and Major Irrigation, is also accountable to the Department of Water Resources for activities related to water conservation and minor irrigation networks within the canal command areas as well as groundwater.

Similarly, the Gujarat Water Resources Development Corporation Ltd. (GWRDC) has a role within the command areas of canals for groundwater development and utilization. This overlap of authority and jurisdiction creates confusion among water resources and services managers, which leads to inefficiency and delay in the implementation of the projects. While it is possible that top officials within the water departments may coordinate their activities, the same cannot be said about the lower-level functionaries within each ministry. As a result, it creates frustrations among the personnel of each ministry.

In general, any proposal for a new scheme goes through a very long and tedious process. It begins with an application made by the beneficiary to the district council. The application is routed through a number of local government intermediaries, and is processed by the Executive Engineer, Superintendent Engineer, Minor Irrigation Department, Tribal Development Department, and the Executive Committee of the district council. If everything is found in order, the State government invites tenders for implementation of the irrigation works. Execution and completion of a scheme is a long drawn out process, with delays at every level. Although the local community institutions are expected to contribute a part of the project costs from their own resources, common experience has been that the entire expenditure was borne by the State government.

Administration of Water Supply Services

The Water Supply Department, under a Minister, is responsible for providing water supply services that include domestic water supply and water supply for industries. Thus, it is responsible for the identification of sources of water and design, construction, and operation of water supply systems for domestic and industrial purposes. Depending upon the source of water, the Department has to constantly coordinate its activities with the Department of Water Resources (Minor and Medium Irrigation) or the Department of Narmada and Major Irrigation. For water supply to rural areas, it has to build strong linkages with village authorities, the Gujarat Industrial Development Corporation (GIDC) and municipalities for the operation and management of water supply systems.

The design, construction, and implementation of water supply schemes is done through the Gujarat Water Supply and Sewerage Board (GWSSB), which is an autonomous board, headed by a Chairman appointed by the State government. The relationship between the Department of Water Supply and GWSSB is similar to that between the Department of Narmada and Major Irrigation and the Sardar Sarovar Narmada Nigam.

The institutional structure of the water supply sector in Gujarat is complex. The administration and regulation of water supply, covering domestic and industrial sectors, is provided by: the Department of Narmada, Water Resources and Water Supplies; Department of Urban Development; Municipal Corporations; Municipalities; local governments; and the Gujarat Industrial Development Corporation. At the same time, the implementation and operation of water supply projects are handled by: the Gujarat Water Supply and Sewerage Board; Gujarat State Drinking Water Infrastructure Company; Sardar Sarovar Narmada Nigam Ltd. (SSNNL); and Department of Narmada, Water Resources and Water Supplies.[54)]

The Department of Narmada, Water Resources and Water Supply (now Narmada, Water Resources, Water Supply and Kalpasar Department) under the Minister for Water Supply is responsible for domestic water supply, both rural and urban, and is administered by the Secretary-Water Supply.

Gujarat Water Supply and Sewerage Board(GWSSB)

The establishment of the state-wide water grid that would eventually provide safe drinking water throughout the State was the responsibility of the GWSSB, the largest player in the water supply sector (see Figure 5). Its jurisdiction extends to the entire State with the exception of the large cities headed by Municipal Corporations and the cantonments. This is an autonomous body headed by a Chairman and administered by a full-time Member-Secretary who is appointed by the State Government. It has three zones, each headed by a Chief Engineer. Each zone is further divided into circles of Project, Mechanical

Source: GWSSB, Gandhinagar

<Figure 5> Proposed Water Grid for Supply of Drinking Water in Gujarat Towns and Villages

54) Socio-Economic Review, 2013. http://www.gujaratindia.com/state-profile/socio-eco-review.htm

and Works, each headed by a Superintending Engineer. Each circle is further sub-divided into divisions, each headed by an Executive Engineer. The smallest unit is the sub-division headed by a Deputy Executive Engineer. In the line function, the GWSSB has five zonal offices, 15 circle offices, 41 divisional offices and around 200 sub-divisional offices.

The objectives of the Board are: to provide safe and adequate drinking water on a sustainable basis to all; and to maintain sanitary conditions so as to promote public health by preventing water-borne diseases. The main functions are:

1) to identify "no-source" villages and develop water resources for them;
2) to undertake rural sanitation works and regenerate/ augment rural water supply schemes;
3) to combat drought-related water problems in the rural area;
4) to undertake research and development; and
5) to conduct training.

The villages of Gujarat State were broadly classified for purposes of planning the drinking water supply schemes as: 1) difficult and scarcity villages; 2) villages in specially deprived areas; 3) villages having unsafe water; 4) villages having inadequate water sources to be stepped up in per capita water supply; and 5) deserted villages.

The design considerations adopted by the agency for planning rural water supply schemes take into account several physical and socio-economic parameters such as water availability, quality and distance to the sources of water, and minimum water required for human and cattle populations. A study of water-borne diseases was made for each district for providing suitable precautionary measures in selecting sources of water, location of stand posts, cisterns etc., and chlorination was done in all the schemes. The approach for solving the drinking water supply was to bring water sources very close to the village or bring water through pipelines in unavoidable circumstances.

In early years, when GWSSB started its operations, water levels in the wells and tube wells were at reasonable depths all over Gujarat. There was no fear of water level receding as irrigation water withdrawal was at moderate levels. But, as groundwater irrigation grew at a rapid rate with energized wells and deep tube well pumping, the depth increased and wells started drying up. Drinking water supply sources faced the greatest threat from irrigators and industries. In years of low rainfall, thousands of villages lack surface and groundwater sources. Hence, drinking water problems become acute in drought years.

Photo by Nitin Bassi

<Picture 1> Community Stand Post in a village near Bhavnagar, Gujarat

With over 4000 people on its staff, GWSSB is a massive bureaucracy. Among its human resources, it has a large number of engineers, who are its strength when it comes to implementing large engineering projects. But most of the engineers are not competent in managerial functions, due to inadequate managerial training. Further the lack of real autonomy for the GWSSB hinders efficient planning and operations.

A detailed analysis of GWSSB's strengths and weaknesses was done twice, in 1994 and in 1999, as a part of the Netherlands mission.[55] It was found that the strengths of GWSSB derive from its infrastructure,

professional human resources and access to State funds. It is the nodal agency for all water supply and sewerage projects in the State. It also has a significant planning and regulatory role envisaged in the GWSSB Act that has been largely unfulfilled. The Board also can tap any natural source for water, and can set tariffs, but the government endorses the upper limit. The Board is even allowed to "enter into contract or agreement with any person… for performing its duties and discharging its functions" (Section 15[2] [f]). Despite the impressive room for maneuver, the Board has been unable to derive any effective autonomy because it has no powers of enforcement or policing, and is too closely linked with the Government.

Its weaknesses derive from its structure, its procedures, its systems, and the fact that, in many ways, it functions no differently from a government department. Its human resources management policies are not strategic in nature and generate apathy, inefficiency, and even incompetence in otherwise qualified people. It is not financially self-sufficient because of poor cost recovery and limited sources of independent resource generation. Operations and maintenance have been a major failing of the Board, particularly for hand pumps, which are supposed to be maintained by the Panchayats. The O&M of the regional piped water supply schemes fares slightly better, but is still beset with the problems of a slow moving bureaucracy, inappropriate procedures and vandalism by citizens. The dug wells and individual water supply schemes are handed over to the local governments.

2-3. Market-oriented Institutions

Although most of the reforms in water management have been undertaken by the public sector, the government of Gujarat is promoting wide participation of the private sector in infrastructure development, including in the water supply sector. One of the approaches the State has taken to involve the private sector is to create Special Purpose Vehicles (SPVs) to handle aspects of water resources management. An SPV is a legal entity (usually a limited company or partnership) that is created to fulfill narrow, specific or temporary objectives. Such SPVs are typically used by a government agency or water management entity to limit its financial risk. A government agency can transfer assets to the SPV for management or use it to finance a large project, thereby achieving a narrow set of goals without putting the entire agency or department at risk. They are an integral part of public-private partnerships that rely on a project finance type structure. It thus involves the private sector, but in partnership with a government agency.

2-3-1. The Gujarat Green Revolution Company

The Gujarat Green Revolution Company (GGRC) is an agency set up by the government of Gujarat as a SPV to promote efficient irrigation technologies in Gujarat on a large scale. The state government's initiative to bundle all the state assistance and central scheme for promotion of micro irrigation under one agency with a large endowment, had led to setting up of the GGRC in 2005. It had an operating capital of 1500 crore rupees (nearly US $250 million) to start with.

The GGRC had made it easy for the farmers to purchase a micro irrigation (MI) system, mainly using drip or sprinkler irrigation, with state subsidy. Under the MI scheme, a farmer who wants to install an MI system in his or her farm and also wants to avail of the government subsidy will have to first have his farm surveyed and have the surveyors prepare the estimates. Along with the survey record and cost estimates for MI system, the farmer makes an application to the GGRC, along with payment of 50% of the total cost. On receiving the

55) The Netherlands Government, which had assisted four drinking water supply projects in Gujarat, initiated studies on institutional reform, one of the objectives of the Dutch assistance.

necessary documents from the farmer, the agency places a work order to the Company identified by the farmer. A tripartite agreement is signed between the farmer, the MI Company, and the GGRC.

In Gujarat, more than 20 MI Companies are partners of GGRC in the micro irrigation enterprise. They include some well-known firms such as Netafim, Plastro, Nan Dan, and Jain Irrigation. Some of these companies have their manufacturing plants in Gujarat, while others have suppliers and dealers.

Once the company installs the system in the farmer's field, the concerned officials of GGRC visit the farmer's field and make sure that the installation is done as per the specifications made in the work order, and upon certification by the agency official a payment equal to 90% of the cost of the system is released to the company. An amount equal to 10% of the system cost is retained with GGRC, and would be released only after five years. This is to make sure that the farmer uses the system properly and the company provides the necessary 'after sales' service for smooth working of the system. Though GGRC offers up to 60% subsidy on the capital cost of the MI system, the maximum subsidy available for the farmers is only Rs. 60,000 per ha (US $ 1000 per ha).

Photo by Nitin Bassi

<Picture 2> Cotton Crop Using Drip Irrigation, North Gujarat

The entire process, starting from the day farmer makes the application to the day the company receives the payment, takes around three months. If the farmer also applies for a bank loan for purchase of an MI system, then the total time required, which includes the time required for sanctioning the agricultural loan, would be nearly six months.

Overall, though water scarcity is driving MI adoption in the country, not all water-scarce areas are experiencing the same level of MI adoption in spite of the high potential. This means that water scarcity at the societal level alone is not a motivating factor for the farmers to adopt MI.

To the farmer, what matters is how the adoption improves the economics of crop cultivation. Water scarcity provides the required economic incentive to adopt MI systems only in certain situations. Factors in the consideration include access to an individually owned well and presence of favourable power supply. The economic incentive comes from the ability to expand the area under irrigated production with MI adoption, as only a small percentage of the area is currently irrigated in Gujarat due to severe groundwater scarcity. Other factors taken into consideration are affordability, which is improved by the subsidy, and the presence of crops that are amenable to MI systems.

2-3-2. Other Special Purpose Vehicles

The Sardar Sarovar Narmada Nigam Ltd. (SSNNL) is a Special Purpose Vehicle set up for transferring water from surplus areas to scarcity areas, and implements the Sardar Sarovar Project of the Narmada Canal. It is responsible for bulk supply of the water from Narmada through its canal network.

The State Government set up the Gujarat Water Infrastructure Co. Ltd. in 1999 for the implementation, operation and maintenance of the Sardar Sarovar Drinking Water Supply program. This is still a growing organization and therefore has been entrusted with limited responsibilities, The major responsibility of regulation and development of drinking water sector is shouldered by the GWSSB.

The Gujarat State Drinking Water Infrastructure Company Limited (GSDWICL) is another Special Purpose Vehicle, a bulk carrier, set up to purchase Narmada waters from the SSNNL in bulk and sell in bulk to other users such as GWSSB, Municipal Corporations, municipalities, and industrial estates.[56)]

2-3-3. Sabarmati Riverfront Development Project

In Gujarat's largest city Ahmedabad, the Sabarmati Riverfront Development project aims to protect the deteriorated river banks of Sabarmati, which was once was the lifeline of Ahmedabad city. As the city grew, the river became increasingly polluted from the disposal of untreated and partially treated urban domestic and industrial effluents, and remained one of the most polluted rivers in India. The Sabarmati River became essentially a trunk sewer carrying the effluent from Ahmedabad city and the neighbouring industrial areas, compounded by lack of inflows from the upper catchment.

To improve the urban environmental conditions, the Ahmedabad Municipal Corporation (AMC) set up the Sabarmati Riverfront Development Corporation (SRFCDL) in 1997 as an SPV to oversee the project. It has begun the massive task of cleaning up the river by flushing out the effluent and sludge in the riverbed using excess flows of Narmada from the main canal. Plans include: the construction of artificial water channels; diversion of clean water from the main canal into the river; and storage in a 16-km long stretch, with approach roads, gardens and other recreational facilities. Simultaneously, water treatment systems were installed for treating the polluted water from industrial and other sources, and the entry of wastewater into the river was completely stopped. This was a very important step to begin urban renewal and restore the waterway for environmental, social, and economic benefits.

2-3-4. Power Sector Reforms

The power sector reforms in Gujarat mainly involved unbundling the State Electricity Board into a power generation company and regional power distribution companies. Four power distribution companies were subsequently created in Gujarat. The power distribution companies purchase electricity from the state electricity utility and supply to various consumers. Metering of power distribution is done up to the level of the transformer. The privatization led to major reduction in transmission and distribution losses, which were mainly occurring due to power theft from the feeders, particularly in the rural areas by farmers.

Another important step was metering of electricity in the farm sector. Earlier the State Electricity Board used to charge for electricity from farmers on the basis of connected load or pump horse power. This created a situation where farmers had no incentive to use either groundwater or electricity efficiently for irrigation. But since 2003, there has been a gradual shift towards metered tariff regime, as the State was under enormous pressure to reduce the revenue losses through power subsidies. This is achieved by adopting a norm that new power connections would be offered only to those farmers who are willing to agree to a pro rata tariff. This appears to have been a very pragmatic approach, and currently nearly 50% of the agricultural connections in Gujarat are metered. Empirical studies carried out in north Gujarat show the positive impact of pro rata pricing of electricity in the farm sector for groundwater pumping on efficiency and sustainability of groundwater use and socio-economic viability of raising power tariff in

56) GSDWICL will also be responsible for laying down and managing 2500 km of drinking water trunk transmission mains from the Narmada canal network. In order to avoid the same problems faced by GWSSB, it needs to retain autonomy and run on professional lines.

agriculture. Not only was the water use efficiency higher in physical and economic terms, but also the amount of groundwater pumped per unit irrigated area was lower for farmers who paid for electricity on a pro rata basis. The net return per unit area of land was equal to or higher for the farmers paying on a pro rata basis compared to their counterparts who paid for electricity on the basis of connected load[57]. The introduction of electricity metering in the agriculture sector is emerging as a major policy initiative for water demand management.

2-3-5. Role of Corporate Social Responsibility in the Water Management Sector

The role of private sector in water resources development and water management cannot be overstated. Several of the industrial groups which operate in Gujarat have set up their own philanthropic organizations which are active in economic and social development. Water management is one of the key activities of these organizations. The interventions of these organizations revolve around the broader theme of natural resources and rural livelihoods, and they follow community-centered approaches for addressing water problems.

Some of the most well established institutions are:

1) Sir Ratan Tata Trust (SRTT) and Sir Dhorabji Tata Trust (SDTT) Mumbai, which are the philanthropic arms of the largest industrial conglomerate in India, i.e., the Tata Group of Companies;
2) Ambuja Cement Foundation, a corporate social responsibility (CSR) wing of the Ambuja Cements Ltd;
3) NM Sadguru Water and Development Foundation, initially set up as a CSR wing of Mafatlal Industries;
4) the Aga Khan Foundation, which works through Aga Khan Rural Support Program (India); and
5) the Nehru Foundation for Development, which works through VIKSAT (Vikram Sarabhai Center for Development Interaction).

The NM Sadguru water and development foundation works in the tribal area of eastern Gujarat, whereas Ambuja Cement Foundation works in the coastal area of Saurashtra. The SRTT and SDTT have national presence, and are actively supporting a wide range of projects related to water and livelihoods, including several field projects on coastal salinity ingress in Saurashtra and Kachchh, a project on groundwater depletion in north Gujarat, and grassroots interventions on improving access to water for agriculture in the tribal area of eastern Gujarat. The Aga Khan Rural Support Program works in three regions in Gujarat: coastal Saurashtra (Junagadh); Bharuch district of South Gujarat; and Surendranagar district. VIKSAT works in north Gujarat addressing water management issues.

Some of these philanthropic institutions have been active in the water management sector of Gujarat over the past three decades. They support NGOs, both large and small, using financial and other resources. These NGOs work in the villages to mobilize community action to address the specific problems, which translate into technical and institutional interventions. The positive outcomes of many of the small-scale water management projects supported by private foundations in different parts of Gujarat in many cases influenced the launching of large schemes on water conservation and management by the state government.

In addition to supporting grassroots level action on local water management, the private companies have also started water stewardship programs to reduce 'water footprint' of their manufacturing activities. The most illustrative example is the Ambuja Cements, which while implementing water harvesting and water

57) *Kumar, M.D., Scott, A.S., and Singh, O.P. 2001. Inducing the Shift from Flat Rate or Free Agricultural Power to Metered Supply: Implications for Groundwater Depletion and Power Sector Viability in India. Journal of Hydrology*, 409(1-2): 382-394.

use efficiency improvement programs in the villages surrounding their plant through their CSR wing, had initiated many steps to reduce wastage of water in their manufacturing plants. The company aims to make their plants in Gujarat water neutral. The Tata Chemicals runs mobile RO plants to supply fresh water to many villages in the coastal areas of Saurashtra that do not have access to freshwater from public systems.

2-4. Community-centered Institutions

The importance of decentralization in India also has an impact on water law. At the local level democratically-elected Gram Panchayats have control over most water-related issues at the local level in rural areas.However, numerous laws related to water user associations adopted in the past decade may bypass the GPs in favour of an alternative institutional structure. Water user associations tend to be less inclusive in terms of participation, as they are generally based on land ownership, and some of the more progressive aspects of the Panchayat system such as reservation for women and scheduled castes and scheduled tribes are often dispensed with.[58)]

2-4-1. Pani Samitis (Village Water Committees)

A proposed solution to make a bridge between the various bodies that are responsible for water management at the community level was to establish Pani Samitis (elected water committees with at least one third women). Pani Samitis were first tried out during the Santalpur project with both the Self-Employed Women's Association (SEWA) and the Center for Health Education, Training and Nutrition Awareness (CHETNA) trying different approaches. The pani samitis were expected to assist with local operation and maintenance, since there was no user organization that deals exclusively with O&M.

The Panchayat and Rural Housing Development Department of the Government of Gujarat introduced a resolution in 1995 that requires that a Pani Samiti be formed in every village panchayat, especially where a drinking water scheme was being implemented. The purpose was to facilitate local participation. The order stipulates the structure, the duties and functions in a typically top-down manner. The resolution and a subsequent one passed later in the year only increase the responsibilities of the villagers without giving them any corresponding authority. Having been charged with the bulk of the responsibility for O&M, the committees have been given less than 50% share in the taxes collected. The responsibilities assigned require considerable managerial skills as well as power to enforce rules, regulations, and impose penalties. The resolution does not take into account the existence of any other grassroots institutions, such as Water Users Associations (WUAs) or other social or cultural institutions that could support more effective discharge of the functions. However in 2002, the Water and Sanitation Management Organization (WASMO) was set up, which is supposed to deal with community-based management committees, including the pani samitis and the WUAs.

Despite the lack of capacity among the pani samitis, there are many examples of self-help initiatives where villagers have managed the problems by themselves. For a pani samiti to function well, it should be formed at the initiative of the people, be able to generate resources, have the skills required, function democratically, be accountable to the people, and enjoy a reasonable degree of freedom from government control. Skills required for hand pump repair, for example, can be taught to relatively uneducated people. Training can be done at the village level so as to reduce dependency on the GWSSB. Besides managing the infrastructure installed by the government, the pani samiti should also protect other

58) Cullet, P. 2012. Is Water Policy the New Water Law? Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin, 43(1).

sources of water that the village relies on, such as ponds, lakes, and wells. The committee should ensure that sufficient water is set aside for drinking purposes, and thereafter allocate water judiciously for agriculture and other uses.

photo by Nitin Bassi

<Picture 3> Elevated Service Reservoir with Pump House in a Village, Saurashtra, Gujarat

Avoiding nepotism and discrimination in the committees requires strong institution building processes that can be catalyzed by NGOs such as SEWA having the requisite trust and competence. Sometimes, minor innovations such as "parceling" of the stand post by having more posts with fewer taps each and spread around the village rather than having one with several taps, reduces conflicts and promotes equity. With the tradition of sharing that is common in Gujarat, there could also be experiments with quasi-private ownership, where an accepted individual could be given the connection or hand pump on a small group ownership basis.

There are many cases where water meant for drinking is utilized for irrigation by a few. Until such practices are curbed with gradual democratization of village society and increased accountability, the GWSSB can play a policing role by identifying such inequities and helping to resolve them. They should have the power to impose penalties on offenders.

Alternatively, strong NGO involvement should be facilitated wherever there are respected and reliable NGOs. In those cases the role of the Board would be that of a partner or a facilitator. Experiments with micro water resources management at the village level, and conducting water audits would indicate if comprehensive water resources management is possible in the individual village. Finally, the restructuring of roles and responsibilities should be based on who can manage the system most effectively. In many cases, it is village women who can perform these tasks effectively, as they have high stakes in keeping the system running and they are more likely to remain in the village during the day. Training of women in pump maintenance and other tasks has proved valuable in a number of pilot projects, as demonstrated by the work of SEWA (Self Employed Women's Association). It should not become an exercise in abdication of its duties by the State and handing over duties without any compensation of power or authority.

In some instances, tankers were also provided mainly to meet the water demand for livestock. Rainwater harvesting has also been promoted, and more than 14,000 roof top rainwater harvesting tanks have been constructed. The establishment of the water grid has improved the domestic water security in the villages. It has especially helped to increase in dairy production in North Gujarat and Kachchh.[59)]

59) Interview with Mr. Mahesh Singh, Member Secretary GWSSB 30-01-14

Photo by Nitin Bassi

<Picture 4> Check Dam, Saurashtra

2-4-2. Participatory Water Conservation Project

One technique used to improve water supply to small and marginal farmers was the introduction of rainwater harvesting for micro-irrigation. The Sardar Patel Participatory Conservation Project (SPPCP) involves construction of check dams and village tanks/ponds by a designated beneficiary group or an NGO, with technical and financial assistance from the district office. Six prototype designs were circulated with a maximum cost of 1 million rupees. More than 350,000 check dams and village ponds/tanks have been created in the last 10 years, providing direct benefit to over 13 million people in rural Gujarat.

Gujarat State had been implementing the construction of check dams in the 1990s, but the progress was slow under the government-sponsored system. In 2000, the government of Gujarat decided to launch the Participatory Water Conservation Program to promote water conservation programs all over the State. This was an institutional innovation for implementing small water harvesting schemes, as it promoted decentralization in water development and management by giving powers to the local village Panchayat to identify sites, prepare estimates and secure funds directly from the water resources department for execution of schemes.

Check dams have been identified as viable water conservation structures particularly for Saurashtra, given its drainage pattern and terrain conditions. They collect and conserve surface water, while at the same time replenish and recharge groundwater in the adjacent areas depending on the presence of geological conditions such as weathering and presence of fractures and fissures.

Check dams are constructed across rivers and streams at a height of 1.5 to 2.0 m. They are low weirs which divert some water, but without canals. They generally require less operation and maintenance compared to surface irrigation projects, but do get silted up in 3-5 years depending on the nature of catchment. They are effective in conserving water at low maintenance and low operational cost. Check dams do not require land acquisition and thus legal complications are avoided. Moreover the benefits are made available to the farmers quickly, and poor farmers can participate. The check dams do not require expensive technology and they provide employment opportunities to local residents. The widespread and equitable distribution of water resources through this project has had a positive impact on social and economic development.[60)]

However, the implementation of the SPPCPscheme lacked serious hydrological and technical (engineering feasibility) considerations of the total amount of utilizable/'uncommitted' flows in the river basins in which it was carried out. As a result, in most instances, the total capacity of the structures built was much higher than the total utilizable flows in normal years, leading to over-appropriation of water in normal and drought years. Large-scale construction of water harvesting structures led

60) Narmada, Water Resources, Water Supply and Kalpasar Department http://guj-nwrws.gujarat.gov.in/showpage.aspx?contentid=1538&lang=English

to negative impacts on the existing downstream (minor, medium and major) reservoirs and local tanks and ponds in many basins of Saurashtra and Kachchh regions where maximum structures were built. The planning also did not consider the storage capacity of the aquifers for receiving the impounded 'water' that is recharged artificially. In wet years, the wells in Saurashtra, which is underlain by hard rock formations, over-flowed, and as a result the water remains in the impounding structures. Some scholars have argued that the economic viability of such structures in terms of cost per cubic metre of water captured would also be very low for the high degree of water development at the basin scale, given the high inter-annual variability in rainfall experienced in the naturally water-scarce regions[61].

2-4-3. Community-managed Water Governance Model

The creation of the Water and Sanitation Management Organization (WASMO) was a significant shift in the role of Government from provider to facilitator by empowering village-level institutions (such as the pani samiti) through extensive capacity-building and facilitation. It has brought about effective citizen engagement through its innovative governance model for community-led water supply program throughout the State of Gujarat. More than 16,700 village water and sanitation committees have been formed in the State and are ready to take responsibility for managing of service delivery and water resources at the decentralized level. More than 6,500 villages have already commissioned infrastructure and water conservation projects in a demand driven mode, with another 4,550 villages currently implementing community-managed rural water supply programs.

The government of Gujarat set up WASMO as an autonomous society to carry forward the concept of decentralized rural water supply management. WASMO acts as a catalyst to promote, develop and strengthen community participation from the stage of planning to operation and maintenance of village water supply schemes. It was conceived to bridge the gap between GWSSB and the community in managing and supplying drinking water to the rural villages and towns of Gujarat. WASMO is a body with representations from almost all stakeholders concerned with rural water supply.

WASMO is different from other water supply organizations that are, by and large, "delivery oriented". This organization demands community, civil society and government participation; it combines software and hardware components of water supply by linking communities and their social concerns with engineering and structural solutions. WASMO uses local as well as bulk water transfer sources, and integrates water conservation into the water supply schemes, since water conserved is water supplied. Finally, it mixes the traditional approach with the modern one by reviving and promoting traditional rainwater conservation systems. In this, WASMO's role is that of a facilitator and an enabler.

These principles have been applied in 82 villages covered under the community-managed Ghogha regional water supply and sanitation project in three blocks of Bhavnagar district and in 1,260 villages in the earthquake-affected districts of Kachchh, Patan, Surendranagar and Jamnagar.

The organization has staff strength of 151 people, of which 42 are based in the head office, and the rest 112 are based in field units. There are four field units: the Ghogha project unit; and three earthquake rehabilitation and reconstruction units, located in Bhuj, Surendranagar and Jamnagar. The staff is dominated by technical personnel (38%), administrative staff (40%) and community

61) *Kumar, M., Patel, A.R., Ravindranath, R., and Singh, O.P. 2008, 30 Aug. Chasing a Mirage: Water Harvesting and Artificial Recharge in Naturally Water Scarce Regions. Economic and Political Weekly*. Aug

mobilisers (12%). The inclusion of community mobilizers in the organization is a major departure from the existing practice in most water supply agencies.

Attempts are being made to ensure genuine participation of the communities through implementing support agencies. WASMO is also working towards total village development by integrating the provision of sanitation facilities, promoting health and hygiene in the community and improving the local ecology. Already, the efforts to raise awareness on hygiene and sanitation issues are bearing fruit as communities slowly adopt cleaner practices.

IV. Performance of Water Management Reforms in Gujarat

The following sections provide empirical and observational evidence of the impacts of the large infrastructure projects and the water management reforms. The first section has results from a study of the Sardar Sarovar Narmada project. It also includes observations from top experts with extensive knowledge of the sector and of Gujarat State. The results of interviews with these experts are included in Annex A. The second section summarizes the performance results from the questionnaires completed by managers and practitioners in the water resources sector.

A few observations on the overall impact of the reforms were made by some of the experts. Mr Sachin Oza, Executive Director of the Development Support Center, Ahmedabad,[62] identified the most important reforms in the Gujarat water sector as: irrigation management transfer (IMT); awareness regarding water recharge (harvesting and pond deepening); formation of the Gujarat Green Revolution Company for the promotion of micro irrigation; electric supply feeder separation; and domestic water supply security. He noted that, while all of the schemes are good, they are not integrated. Different departments are running different programs, but without any coordination among them.

Professor Rohit Desai is of the opinion that in the past few years, the water scenario in Gujarat has improved as a result of good rainfall and water management efforts by the Government of Gujarat through both decentralized water harvesting and large-scale water transfer to poorly endowed regions by SSP. The per capita income in rural areas of water-scarce north Gujarat has improved, owing to additional water for irrigation from Narmada. South Gujarat is getting more prosperous due to soil fertility and ample reliable water supplies from Narmada. He notes that agricultural growth in Gujarat is primarily due to linking of rivers (through SSP) and growth in the area under irrigated cotton and improved yields. The adoption of high yielding hybrid cotton in Gujarat has been very high in the recent past.

The problems of drinking water in the water scarce regions especially in North Gujarat and Kachchh have largely been resolved. Further, because of the awareness created by WASMO, community-centered reverse osmosis (RO) plants have been adopted by many villages in remote coastal areas, and the problem of water scarcity is no longer acute.

1. Economic Performance

1-1. Sardar Sarovar Project and Inter-basin Water Transfer

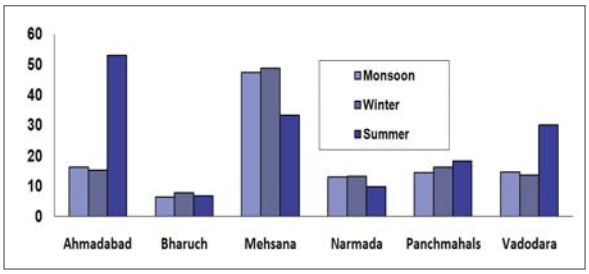
The Sardar Sarovar project is a large modern, multi-purpose water resource project. While complying with the project obligations for the rehabilitation of project-

62) Interview with Mr. Sachin Oza, 30 Jan 2014.

affected people, the dam height was raised incrementally and the storage capacity enlarged. The long delayed 250 MW head power house has been operationalized, and from 2004 to 2010 SSP generated 15,070 million KWh of eco-friendly energy.

A recent study of the impacts of SSP has been undertaken by the Institute for Resource Analysis and Policy (IRAP)[63] for Sardar Sarovar Narmada Nigam Ltd. It shows that an important indirect benefit from canal irrigation is the reduced economic cost of energy used for pumping groundwater for irrigation, estimated to be huge. This was the result of a rise in groundwater levels across the areas benefited by canal water supply (see Figure 6), which occurred due to two major factors: (i) reduction in groundwater pumping owing to availability of surface water for irrigation; and (ii) the increased groundwater recharge in the areas receiving canal water through irrigation return flows. For every hectare that had been irrigated by groundwater in the SSP command area, the economic benefit through energy saving in groundwater pumping ranges from a low of Rs. 768 (US $12.80) in Bharuch to Rs. 9170 (US $152.80) in Mehsana per annum. In addition, the incremental income of well irrigators due to improved sustainability of wells resulting from recharge from canals and gravity irrigation return flows ranged from a low of Rs. 24,000/ha (US $400 per ha) to a high of Rs. 113,000/ha (US $1,884 per ha) of gross cropped area per year.

The introduction of gravity irrigation also benefitted drinking water supply in the command areas, by recharging the shallow aquifers which are tapped for rural water supply. The indirect economic impact of canal irrigation in the form of improved sustainability of groundwater-based drinking water supply schemes in south and east Gujarat parts of Narmada command for a population of five million was estimated to be Rs. 1032.5 million (US $18 million) per annum.



Source: IRAP,2012. Realistic vs Mechanistic: Analyzing the Real Economic and Social Benefits of Sardar Sarovar Narmada Project, Submitted to Sardar Sarovar Narmada Nigam Ltd., Gandhinagar, Gujarat. IRAP.

<Figure 6> Average Rise in Groundwater Levels (Feet) following Narmada Water Release in Six Districts (Measurements Taken in 2010)

As a result of the distribution of Narmada water for domestic supply, the expenditure on tanker supply in the State came down from Rs. 2,168 million (US $36.1 million) in 2002-03 to Rs. 262 million (US $4.4 million) in 2008-09. In addition, a large amount of electricity is being saved every year because of surface water supply, which replaced groundwater pumping in the rural and urban areas of Saurashtra and Kachchh. Moreover, reductions in groundwater pumping for drinking water supply resulted in lower CO_2 emission (16,076.14 ton of equivalent CO_2). The energy savings reached 72 million kWh per annum. With the supply of water free from salts from Sardar Sarovar reservoir to the villages and towns and the consequent reduction in dependence on well water for drinking purpose, the number of villages affected by high levels of fluoride in drinking water decreased from 4187 in 2003 to 987 villages at present.

The indirect economic impact of Narmada canal-based piped water supply to over 24 million people in Saurashtra, Kachchh, and north and central Gujarat was estimated at Rs. 857.7 million (US $14.3 million) per year, owing to the saving in energy used for

63) Realistic vs Mechanistic: Analyzing the Real Economic and Social Benefits of Sardar Sarovar Narmada Project, Submitted to Sardar Sarovar Narmada Nigam Ltd., Gandhinagar, Gujarat. IRAP, 2012, July.

pumping groundwater. The indirect economic impact of clean energy production for an energy-scarce State through hydropower from SSP is estimated to be Rs. 161.1 million (US $2.7 million) per annum (for a total estimated average energy production of 3436 million kWh per annum).

While the State of Gujarat has sharp differences in water endowment among its regions, the SSP has provided a better balance between water availability and demand. The main canal of SSP takes water from relatively water rich south Gujarat to the water-stressed regions of central and north Gujarat and farther up to south-eastern Rajasthan. An inter-basin water transfer project, called the 'Sujalam Sufalam' scheme, was launched in 2004 by the government to use the main canal of SSP to bring excess flows from the Narmada River to the water-stressed regions, which are also facing problems of groundwater mining. The project takes advantage of the fact that the main canal traverses the alluvial aquifers of north and central Gujarat that have storage potential and intersects many rivers of the region that are not perennial. These ephemeral streams can be used to receive water from the canal and spread it over large geographical areas for replenishment of aquifers. A project of this magnitude is almost unheard of in the water management history of the developing world. It was an effort of the government of Gujarat to make judicious use of the waters from Sardar Sarovar reservoir, which is still waiting to be fully utilized for irrigation.

Photo by Nitin Bassi

<Picture 5> Sardar Sarovar Project Branch Canal, Surendranagar, Gujarat

1-2. Performance of Sardar Sarovar Narmada Nigam Ltd. (SSNNL)

According to Dr. M.B. Joshi,[64] the SSNNL is unique in many ways. It is a SPV registered as a company that can generate its own resources through public deposits (deep discount schemes were introduced). Thus, since World Bank support was withdrawn from the project[65], the Government of Gujarat has been able to continue SSP projects by mobilizing its own resources. Further, SSNNL is the only irrigation agency in the country having people in the senior management from multiple disciplines, such as environment, forests, and agricultural economics.

SSNNL's performance has improved because of the reforms related to land acquisition and compensation. In most of the SSP projects (especially related to irrigation), there have been delays in project completion due to problems in acquisition of land. Up until 2010, only 17,000 ha of land (42.5% of the required) were acquired for SSP over a period of 30 years. With the introduction of the new policy in 2010, compensation for land acquisition is being paid as per the market rate. Over and above the existing land prices, 30% extra is paid to

64) Interview with M.B. Joshi, General Manager-Coordination of SSNNL on 30 Jan 2014.

65) The support to the project was withdrawn by the World Bank in the wake of the report submitted by Bradford Morse in 1992 after an independent review of the project. The report criticized the government of Gujarat for the 'not so satisfactory' implementation of the Rehabilitation & Resettlement of the dam oustees. However, this report was heavily criticized by many including NGOs to be highly biased.

the evictee. As a result, in the last 3 years, an additional 17,000 ha of land had been acquired. Now, only 6,000 ha of land remain to be acquired. Before the 2010 policy initiative, there were about 60,000 cases related to land acquisition pending in the courts. After the adoption of the new land acquisition policy, there are no court cases as the farmers and other landowners are satisfied with the compensation being paid.

In Dr Joshi's view, the major reason for non-completion of the tertiary system (sub-minors) is that farmers do not want to give up their land for sub-minors (water courses), as no compensation is paid for it. As a result, farmers are directly lifting water from minor canals.

In order to encourage completion of the tertiary supply system, a new policy approach has been adopted by SSNNL. This gives farmers the option of having either an open channel or an underground pipeline in place of the sub-minor and field channels. In cases where farmers prefer an underground pipeline, they do not have to give up land. Negotiations for laying underground pipeline are done with Water User Associations (WUAs), not with individual farmers. Presently, it is being tested at some locations in the command area.

However, as pointed out by Dr Joshi, in many regions underground pipelines do not work under gravity systems. It is estimated that about 60% of the area is suitable to be irrigated through gravity-flow-based underground pipeline. In the remaining areas, installation of pressurized pipes (underground) is proposed. However, in such areas adoption of micro-irrigations systems has been made mandatory to stop the wastage of water, as pressuring the flow would be expensive. Also, O&M of the underground pipeline is the responsibility of farmers. As a result, there is not much demand by farmers for a pressurized underground pipeline system.

1-3. Impacts of Power Sector Reforms

Mr Sachin Oza notes that in Gujarat, power sector reforms are positive for domestic users. As the quantity and timeliness of electricity supply improve, there is a better management of water and power. While water wastage has gone down as a result of the Jyotigram scheme, groundwater abstraction for irrigation has remained the same.

Mr Divyang Waghela agrees that there is an overall positive feedback from domestic users about getting 24-hour power supply, as they are able to set up small-scale household enterprises that require 3-phase electricity. The farming community still has issues with quality and reliability of supplied power, as 8-hour power supply is not guaranteed.

While the scheme has no impact on groundwater abstraction, metering of farm power supply is there only for 50% of the agricultural consumers. This negates the effectiveness of rational power supply for such consumers, who continue to pay on the basis of connected load.

Prof. PK Viswanathan observes that Jyotigram technical transmission losses have declined, but administrative losses (power theft) have increased. Even after the power sector reforms, the Government has not been able to meter all the well connections. Almost 50% of connections have been metered, but it varies from region to region. In water-scarce regions of the State, farmers are not able to appreciate the positive side of metering. Farmers believe that under the metered regime they have to pay more for the electricity.

Prior to 2003, the farmers in Gujarat were supplied 8-hour, three phase power supply for agricultural uses and 24-hour single phase supply for domestic purposes from the same feeder. This meant that the farmers could tap single phase electricity from the feeder for

running low capacity pumps. Jyotigram Yojna involved separating the feeder line for agriculture from that for domestic consumers. Under the scheme, the government wanted to ensure 24 hour, three phase power supply to the domestic sector, in order to encourage rural small industries. But, fearing that a common feeder line for both agriculture and domestic sectors would enable farmers to take advantage of three phase supply to run agricultural pumps, a separate feeder line was established for agriculture.

The JyotigramYojna, which is now being adopted by a few other States with modifications, is being praised for controlling groundwater overdraft. However, the available evidence suggests that such approaches may be counter-productive. It was widely argued that this rationing of power supply to agriculture would cut down groundwater overdraft. But, farmers in many situations were found to be circumventing the problem of restricted power supply, by shifting to higher capacity pumps and under-reporting their connected load to the power supply utility. The ultimate result is that they often use more electricity than in the earlier situation. In order to reduce power thefts, the power distribution companies are resorting to frequent raids in the rural areas by checking the connected load of the pumps used for energizing the wells.

Nevertheless, Jyotigram had a significant positive impact on the quality and reliability of power supply in agriculture, and the number of cases of burn out of motors has come down remarkably. Power supply schedule is maintained, and voltage fluctuations remain quite low. Good quality power supply means better quality irrigation to crops.

2. Environmental Performance

The inter-basin water transfers to the water-scarce regions of central and north Gujarat have had positive impacts in the form of enhanced groundwater recharge, reduced energy use for groundwater pumping, and dilution of minerals in groundwater (with positive health benefits). These results can provide good lessons for other arid and semi-arid regions of the world, particularly where farmers are using groundwater intensively for agriculture, and are struggling to reduce over-exploitation. The ecological and environmental benefits resulting from the perennial flow of water in the region's rivers would surprise many environmentalists. With the introduction of flows in the otherwise environmentally stressed rivers in north and central Gujarat, groundwater table in the surrounding areas have come up, and the TDS levels in the groundwater has reduced significantly.[66)]

Mr Divyang Waghela,[67)] the CEO of Coastal Salinity Cell, Ahmedabad observes that good rainfall recent years has led to good supply of water through canals. He cautions that groundwater quality in command areas for drinking water is questionable and that there is a huge electricity cost in supplying Narmada water to Kachchh and Saurashtra. Also, there is a concern about whether Narmada water supply will meet growing domestic (including livestock) water demand in the region. Therefore, multiple sources of water supply need to be explored in those areas.

Professor Rohit Desai notes that there are issues of sustainability in irrigation services delivered under SSP. The water charges are not in parity with inflation (last revised in 2005-06). These need to be increased or reviewed. Land prices are increasing in the command areas. Agricultural land is difficult to get and getting

66) Modi, N. 2011. Convenient Action: Gujarat's Response to the Challenges of Climate Change. New Delhi: McMillan Press.
67) Interview with Mr. Divyang Waghela, the CEO of Coastal Salinity Cell, Ahmedabad, 01 February 2013.

fragmented because of the growth in industry. There should be ceiling on conversion of agricultural land for non-agricultural purposes, especially for setting up of industries. Land fragmentation can become a major issue for irrigation management in the command area. He added that Narmada water has yet to reach Kachchh. The branch canal for Kachchh is under construction. Once it reaches there, it will improve the agricultural situation.

While there is criticism that the SSNNL is diverting more water to industrial uses in view of the greater willingness of industrial consumers to pay for water, Dr Joshi pointed out that Narmada Water Disputes Tribunal had awarded 9.0 million acre feet (MAF) of water to Gujarat (10,800 million m^3). Out of this 1.06 MAF can be for non-agricultural uses, and the remaining 7.94 MAF for irrigation in the command areas. Considering an irrigation system efficiency of 60%, 4.76 MAF is available at farm level. From 1.06 MAF, 0.86 MAF is given for domestic water supply and the rest for industries. Once demand from industries is greater than their allocation, no additional requests from industries are entertained.

It was further pointed out that, initially water rates from SSP were Rs 1 per 1,000 litre (KL) for domestic uses and Rs 6 per KL for industrial uses. Every year the rates are increased by 10%. Presently, water rates are around Rs 5-6 per KL for domestic uses and Rs 16 per KL for industrial uses. Rates for domestic uses are very low, considering that they are willing to pay more. Even upcoming residential townships are willing to pay for water at industrial rates.

2-1. Impacts of Check Dams for Water Harvesting

Mr Divyang Waghela observed that historically, Gujarat experienced high (spatial and temporal) variability in rainfall, with South Gujarat being the water surplus region. In the last 10 years, as a result of water sector initiatives such as the construction of large numbers of check dams in villages and adoption of MI systems, the water situation has improved, especially in Saurashtra. Many consecutive years of good monsoon helped in bringing sufficient rainfall. However, in 2012, rainfall was below average which led to reduction in cropped area especially in Saurashtra (by over 40%). This resulted in huge set back to agricultural growth especially in Saurashtra and Kachchh. Thus, a single bad rainfall year was able to undo the gains from the initiatives for improving water security in the state. Hence, there are concerns about long-term sustainability of irrigated production in these fragile environments.

Another important issue is the scale at which the water harvesting structures are built in different basins of Saurashtra and Kachchh. The structures are not planned as per the catchment hydrology and regular de-silting is not done. As a result, there are no major benefits from these interventions. In fact it has led to more conflicts between upstream and downstream communities.

Prof. Rohit Desaiis of the opinion that, while water harvesting has done a lot of good to the local farmers, there has to be some optimum level of water harvesting at the basin scale. Some regulation on building of water harvesting structures which capture the natural runoff has to be exercised at the basin level. While several NGOs have participated in the water conservation movement in Saurashtra, they need to be evaluated in terms of their experience and technical expertise for carrying out such works.

Prof. PK Viswanathan[68] says that check dams have been successful in water harvesting especially during wet years. He noted that tank rehabilitation has not worked. It has been promoted as a uniform approach without understanding the catchment hydrology.

68) Interview with Prof. PK Viswanathan, Gujarat Institute of Development Research, Ahmedabad, 31 Jan 2014.

Wherever rains are good and water is abundant, impacts of water harvesting on groundwater recharge is visible.

There are no scientific data available to show that the groundwater recharge scheme in Saurashtra had actually resulted in improved aquifer conditions in the region. The data on water levels for Saurashtra region (pre and post monsoon) available from Central Ground Water Board (CGWB), which monitors groundwater level trends across the state, shows rise in water levels pre monsoon, during 2008 as compared to the year 2000.[69] However, this analysis did not segregate the effect of good monsoon received in four consecutive years on the natural recharge. Hence, there is no conclusive evidence to the effect that the recharge scheme had actually helped address the region's groundwater depletion problems.

2-2. Performance of Micro Irrigation

Mr Divyang Waghela feels that setting up of GGRC was a major institutional innovation to address the issue of low adoption of MI in the state of Gujarat. GGRC is promoting MI in the State but whether it is used by farmers for the intended purpose of water saving remains questionable. The technology is there, but the demand for MI has not been properly diagnosed. For example, no attention has been paid to the cropping pattern in the target regions, water quality issues and irrigation scheduling. The biggest roadblock in MI adoption is that there are no post-installation services. Mr. Divyang feels that there is some water saving as a result of MI adoption at the field level, but the system is not used properly by about 90% of the farmers, who are not aware of the benefits and the way to go about doing MI.

Further, no major intervention is undertaken on Integrated Nutrient Management. For instance, farmers in Saurashtra spend almost Rs.16-17,000 per acre as input cost for cotton, mainly on fertilizers and pesticides. In Saurashtra, the area under sugarcane, which is a highly water intensive crop, has grown to around 10% of the total cropped area. This is a concern from a resource sustainability point of view. Farmers are not using drips for sugarcane. Crop diversification is also less with almost no area under horticulture crops. Thus there is little scope for further promotion of MI in the region.

Prof. PK Viswanathan notes that post technological adoption services are not provided. He notes that adoption of MI using public/community based tube wells has led to social exclusion.

2-3. Performance of Groundwater Management Initiatives

Prof. Rohit Desai says that to regulate groundwater over-abstraction, a proper institutional mechanism is required. As illegal water trading, though limited in terms of aggregate volume of water transferred, is rampant between rural areas and urban areas, water rights have to be established for different sectors and users within each sector.

Water cooperatives can be formed and some norms for volumetric water withdrawal and use can evolve in the years to come.

Prof. PK Viswanathan adds that groundwater management initiatives in Gujarat have focused only on technical solutions. Groundwater recharge does not mean that those who need water will get it. One's effort might benefit resource rich farmers as groundwater remains in the private domain, attached to land ownership rights.

An increase in surface water allocation through SSP may not lead to a reduction in groundwater usage in some of the over-exploited regions such as north Gujarat.

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69) *Shah, T., Gulati, A.K., Jain, P.R.C. 2009, 26 Dec. Secret of Gujarat's Agrarian Miracle after 2000. Economic and Political Weekly*.

When farmers get more water they tend to grow more water intensive high-value crops. Therefore, even adoption of MI may not lead to water saving at the farm level.

In the long run, water rights need to be established in the case of groundwater resources, if sustainability is to be achieved.

3. Social Performance

3-1. Performance of Pani Samiti (PS) and Water Users Associations (WUA)

Mr Divyang Waghela pointed out that in many regions the communities have abandoned traditional water sources because they expect that the Narmada water will meet their requirements. However, the Narmada water is supplied once in every 3-4 days, and the villages have to depend on poor water quality water sources, such as tankers, if they do not take care of their local water sources. The Pani Samiti were formed and given legislative power to manage village water supply. The Committee is supposed to receive 30% of the total O&M cost from the Finance Commission.

He feels that, in order to address inter-village conflicts and to take care of the management of the main system (including prevention of thefts), federations of village water supply committees (PS) need to be formed to manage the regional water supply scheme.

The pani samitis need to be evolved, and they require capacity building on their rights. Presently, PS is like a political entity, as it is a sub-unit of the Gram Panchayat. The PS could be promoted as a local institution for overall water resource management in the village.

Water Tax collection has improved after formation of PS. This fund goes to GP. However, the money is not being used to cover the water supply system maintenance. Water demand management still needs priority in the command areas especially on promoting low water intensive crops.

Prof. PK Viswanathan agrees that policy reforms in surface irrigation are not effective in terms of water distribution and management. While WUAs may be managing the supply, the water pricing system is not proper. There are about 4,000 WUAs in Gujarat, out of which around 10-15% are working well. Each WUA takes care of one minor system serving around 300-400 ha of area. However, there are issues with the scaling up of PIM activities.

Government provides support for carrying out software activities mainly for organizing training program for WUAs. The SSNNL is paying Rs 880 per ha for WUA formation to the NGOs which participate in PIM initiatives. Money for canal rehabilitation comes separately. But, the State Water Resources department is paying less (Rs 400 per ha).

Federation can be involved for capacity building of new WUAs committee. DSC is putting its own resources for second generation capacity building.

The IMT [Irrigation Management Transfer] Act in Gujarat doesn't make it mandatory to have all the farmers served by a single minor to be part of a WUA for getting water. Even if 51% of the farmers are in WUAs, all farmers will get water. Further as the IMT Act, WUAs can charge 30% more than the rates kept by ID. WUAs also get 50% rebate from the irrigation department if they pay the entire irrigation charge on time. As per the Act, 60% of the money saved by WUAs is spent on O&M and the rest on administration.

3-2. Performance of Participatory Irrigation Management (PIM) and Watershed Management schemes

Mr Sachin Oza DSC tried integrated watershed management and PIM in canal command areas. As compared to other States, water sector reforms have led to better results in Gujarat. In watershed programs, there is always competition between livelihoods and natural resources management. For instance, there is a shift in cropping pattern from maize to cotton, using more water and compounding water quality problems (agricultural runoff) after obtaining good results from watersheds. In Sabarkantha, for instance, the number of bore/tube wells has increased with improved recharge in the watersheds. Also, land use changes (especially conversion of agricultural land for non-agricultural uses) are having an impact on resource conservation. Thus, the policy needs to better addresses resource sustainability concerns.

There is no clear water allocation from groundwater and surface water irrigation schemes. In the absence of clear water entitlements and water rights, water is inefficiently used or used by those who pay more rather than by who need it more. DSC started a dual accountability system where the Irrigation Department and the WUA give clear information to each other.

While there has not been any initiative from the government to introduce volumetric pricing of water in the command areas, DSC is promoting volumetric pricing of water in its projects. Now farmers pay on the basis of each watering they receive. Fifty-six NGOs are promoting participatory irrigation management in Narmada canal command areas.

However, IMT Act is silent on formation of higher-level institutions, such as at the distributary level and project level committees for irrigation management. These institutions are important for managing irrigation water at system level.

4. Overall Performance

To assess the role of water in green growth in Gujarat, 20 professionals having profound knowledge on the various reforms in the water and energy sectors and projects in Gujarat were selected as respondents to the questionnaire. They were asked detailed questions about their particular water project; state-driven institutions; market-oriented institutions; community-centered institutions; and project performance.

As per the expertise of the respondents, inputs were obtained on the following projects:

1) Sardar Sarovar Project (SSP);
2) Sardar Patel Participatory Water Conservation Project (SPPWCP);
3) Community Managed Water Supply Project (CMWS);
4) Groundwater (GW) Recharge efforts;
5) promotion of Micro-Irrigation (MI);
6) Participatory Irrigation Management (PIM); and
7) Use of wastewater for irrigation (WW-Irri).

Performance results from the analysis of questionnaires are presented below.

As per the existing legal framework in the State, surface and groundwater are treated differently. Further, the water law does not allow private rights over water, and currently water is managed as State or common property.

The respondents felt that water laws in the state were effective in promoting green growth, and the State government got a high rating for implementation of various reforms in the water sector. However, the respondents indicated that water laws were less effective in addressing: conflict resolution among stakeholders; ensuring accountability of various stakeholders (officials, water suppliers, users); promoting integrated water

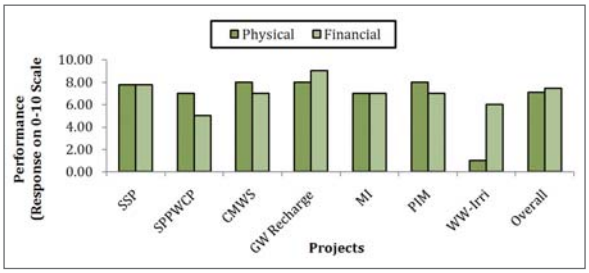
resources management; and encouraging private sector participation in the water sector.

The selection of any new water project in the State is guided by multiple criteria that include financial, equity and ecological considerations. In most of the projects, however, water is priced below the production and supply cost, leading to only partial cost recovery. However, water tariffs for industry and the commercial sectors are substantially higher than the irrigation and domestic sectors.

Overall, the respondents indicated that policy initiatives for water resources development and management in the State were effective, as were the water regulation and directives. The respondents also gave a high rating to the State encouragement of inter-basin and inter-sectoral water transfers, as it has really promoted agricultural growth in the state. Policies related to public participation were considered less effective.

Water administration in the State is mainly organized on the basis of administrative divisions (geographical divisions). Though there are several departments in charge of water supply in the State, the overall operational ability of water administration in the State was considered good. The policies and water administration in the state were rated as reasonably good in the following areas: making adequate and reliable data available on projects for water-related decision making; and promoting green or innovative technologies. However, their effectiveness in accountability arrangements both within formal and outside formal water administration was rated less than satisfactory.

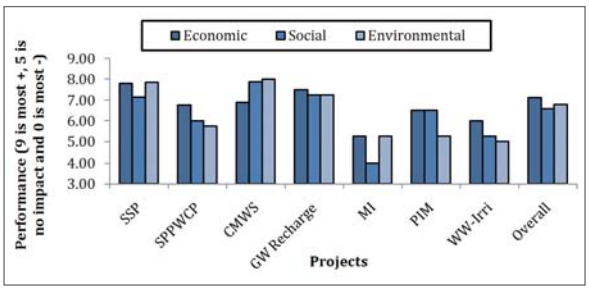
With regard to water projects overall, both physical and financial performances received satisfactory ratings (Figure 7). On these two attributes, projects such as SSP, groundwater recharge intervention, CMWS, MI and PIM were found to be quite effective.



Source: Authors' analysis based on respondents' inputs

<Figure 7> Physical and Financial Performance of Various Water Projects

Overall, all the projects have positive economic, social and environmental outcomes (Figure 8). However, project interventions related to use of MI and use of wastewater for irrigation have not made as significant an impact as compared to other projects. In fact, MI was found to have a negative social impact. Contrary to this, in view of the respondents, SSP and CMWS have had the highest positive impact on economic, social, and environmental outcomes.



Source: Authors' analysis based on respondents' inputs

<Figure 8> Economic, Social and Environmental Performance of Water Projects

V. Lessons Learned and Conclusion

There is no question that access to reliable water supplies for domestic, industrial, and agricultural purposes has fueled a robust economic growth in Gujarat State, India since 2000. To ensure that water has been an engine of growth, the Government of Gujarat implemented exactly the types of policies recommended in the Water and Green Growth policy framework under "water as an engine of growth":

- Promote technology transfer and invest in innovative tools to improve water and energy efficiency
- Revitalize and better use urban waterways and waterfront areas
- Adopt a package of economic instruments, including demand management and incentives for recycling and reuse of water
- Balance green and grey infrastructure among the competing uses – e.g., energy, industry, municipal, domestic, agriculture

In the economic sphere, the case study demonstrates a good example of green growth. However, the other two dimensions of green growth, while present in the policy mix, have not been as strong: protection and conservation of water resources; and water for an improved quality of life.

Some of the lessons learned and challenges still facing the State of Gujarat as it moves forward with its water reforms are described below.

Better coordination is needed among government departments responsible for water management.

The State's multi-pronged approach has been successful in providing domestic water supply security, decentralizing irrigation management and promoting micro-irrigation (MI), raising awareness regarding water recharge, and separating electric supply between domestic and agricultural feeders. However, while all of the schemes are good, and have made a difference where they are working well, they are not integrated. Different departments are running different programs, but without any coordination among them.

There are overlaps of authority and control exercised by various water related line agencies of the State government. For example, the Department of Narmada and Major Irrigation and the Department of Water Resources are responsible for activities related to water conservation and minor irrigation schemes within the canal command areas, including groundwater based schemes. Similarly, the Gujarat Water Resources Development Corporation Ltd. (GWRDC) has a role within the command areas of canals for groundwater development and utilization. This overlap of authority and jurisdiction creates confusion among water resources and services managers, which leads to inefficiency and delay in implementation of the projects. Clear delineation of responsibilities and approaches to better coordination are needed. This could be done at the working level.

Similarly, there is no coordination between the wing of the Dept. of Water Resources, which implements reservoir projects (medium and minor) and the wing which implements the small water harvesting schemes, which leads to over-appropriation of water in the basin. The situation is worse when it comes to coordination between the rural development department, which implements watershed development program, and the Dept. of Water Resources. They work at cross purposes, with the actions of the former affecting the performance of the latter.

Ecosystem needs should be systematically addressed.

In watershed programs, there is always competition between livelihoods and natural resources management.

In treated watersheds, there has been a shift in cropping patterns to more water-intensive crops (from maize to cotton), using more water and causing water quality problems (from agricultural runoff) that impact watersheds. Also, land use changes (especially conversion of agricultural land for non-agricultural uses) are having a negative effect on resource conservation.

Moreover, while water harvesting has done a lot of good for the local farmers, there has to be some regulation at the basin level on the number of such structures, so as to obtain the optimum level of water use at the basin scale. The structures need to be planned according to catchment hydrology, and they require regular de-silting. Wherever rains are good and water is abundant, the impacts of water harvesting on groundwater recharge are visible. However, in drought periods adequate flows to meet ecosystem needs have to be maintained. Farmers who are using MI systems need to be trained to conserve water, because they are not aware of the benefits and the ways to go about saving water. Thus, Gujarat needs a policy that addresses resource sustainability concerns over time. This will require engagement of the communities and farmers who live in the watershed and along the rivers. A regulatory framework for development and management of water resources is needed at the state level, with appropriate institutional mechanisms to enforce it at the level of hydrological units.

Water demand management still needs priority in command areas, especially for promoting low water intensive and water efficient crops.

Communities have to be empowered to manage water systems.

The village water committees require capacity building in operation and maintenance, and they need to understand their rights and responsibilities. These committees could be promoted as a local institution for overall water resource management in the village. They need to work closely with WASMO and Water User Associations to get needed support. It is important that there is gender balance in the water committees, as it is the women who can take care of domestic water and sanitation facilities and who care about them most. Skills required for hand pump repair, for example, can be taught to relatively uneducated people.

For a pani samiti to function well it should be formed at the initiative of the people, be able to generate resources, have the skills required, function democratically, be accountable to the people and enjoy a reasonable degree of autonomy. Besides managing the infrastructure installed by the government, the pani samiti should also protect other sources of water that the village relies on, such as ponds, lakes, and wells. The committee should ensure that sufficient water is set aside for drinking purposes, and thereafter allocate water judiciously for agriculture and other uses.

As regards groundwater conservation measures, initiatives such as MI promotion, in Gujarat have generally focused on technical solutions, and have not sufficiently considered the needs of poor farmers. Whereas, groundwater recharge schemes do not necessarily help those who need water, and might end up benefiting resource rich farmers, as access to groundwater is attached to land ownership rights. In cases where MI is based on public/community tube wells, there has been social exclusion. Contrary to this, SSP and community-managed water supply have had a positive impact on economic, social and environmental outcomes. Promotion of MI through the GGRC needs to consider social aspects of micro irrigation schemes, not only economic aspects. Groundwater recharge schemes should also be concerned with equitable distribution of the newly available water amongst the communities. These would be possible only if local community institutions are capacitated and sufficiently empowered to play an effective role in the governance of water at the local level.

Water tariffs should be rationalized.

At the village level, water tariff collection has improved since the formation of the village water committees. However, the fund goes to the gram panchayat, and the money is not necessarily used to cover the water supply system maintenance. The pani samitis should be responsible for collecting the fees and using them for operation and maintenance requirements.

In agriculture, there has not been a government effort to introduce volumetric pricing of water in the command areas. Cost recovery would be greatly improved if farmers paid on the basis of each watering they receive. Moreover, the water charges under SSP are not in parity with inflation (last revised in 2005-06). These need to be increased or reviewed. Water cooperatives can be formed at various levels in the hydraulic system, and some norms for volumetric water withdrawal and use can evolve in the years to come.

Water rights need to be defined.

There are no clear rights or entitlementsfor groundwater or water allocated from surface irrigation schemes. In the absence of well-defined water entitlements and water rights, the opportunity cost of using water is very small in most situations. Water is inefficiently used in agriculture for growing water-inefficient crops, or appropriated by those who pay more rather who need it more. Over and above the issue of efficiency, there are greater concerns of growing inequity, particularly in the context of groundwater. With resource depletion and rising cost of drilling wells, groundwater is increasingly becoming inaccessible to the resource poor small and marginal farmers in arid and semi-arid areas of the state. Water rights need to be established in volumetric terms for groundwater resources, which are still in the open access regime and where the situation is more serious, if equity and sustainability have to be addressed.

Proper follow up is needed after services are provided.

In many cases, adoption of projects, such as MI or PIM, are not followed up by post technological adoption services.

There were many examples of facilities, such as overhead tanks and hand pumps, not functioning, and sanitation facilities not being used. Several respondents indicated that the villagers were not trained in operation, maintenance and repair and did not understand the connection between clean water, sanitation and disease. It is essential that proper follow up (similar to extension services) be provided to ensure that installed facilities are used and maintained. Similarly, farmers, who install drip and sprinkler irrigation systems in their farms, are trained in irrigation scheduling.

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Interview 1

Gandhinagar Domestic Water Supply

There is a three-tier structure for implementing domestic water supply projects in Gujarat. The Gujarat Water Supply and Sewerage Board is the parent body formed in 1978, Gujarat Infrastructure Company limited is its subsidiary formed in 2000 for building the water distribution infrastructure under the Narmada & Mahi Canal based regional water supply scheme, and WASMO is a social mobilizing wing formed in 2002. As per the State policy, surface water has to be supplied for drinking purpose in rural areas as it is far more dependable than local groundwater based sources. Under the state-wide water grid project, development of dual sources is promoted in target villages. They include mini and individual schemes based on groundwater and regional water supply scheme based on surface water. Fifty two reservoirs have been identified in Saurashtra and Kachchh to supply surface water for drinking purpose, which would augment the supplies from Narmada and Mahi. In some instances, tankers were also provided mainly to meet the water demand for livestock. Rainwater harvesting has also been promoted. More than 14,000 tankas (roof top rainwater harvesting tanks) have been constructed. Water harvesting for recharge of shallow aquifer has also been promoted by WASMO, which promotes the village water supply committees. Structures such as check dams and pond de-silting are being promoted to augment the local sources. SCADA (supervisory control and data acquisition) is being implemented for main system management in some parts of the regional water grid to control the pressure, detect leakages etc., but there are problems. Given the fact that there is widespread scarcity of water for agriculture and livestock, water theft from the air valves in the main system along its course has been noticed. This is mainly by the cattle rearing community in Saurashtra and Kachchh. PaniSamitis (PS) are able to manage water supply system within the village; but their involvement at system level (through formation of federation) is not possible as it may lead to conflicts between two different communities (Mainly maldharis who are mostly Hindus and cattle grazers who are Muslims). Further, there is concern that federation of PSs' may become a political entity. According to him, the establishment of water grid has improved the domestic water security in the villages. It has especially helped in increase in dairy production in North Gujarat and Kutch. The Tata Institute of Social Sciences has been given an assignment to study the impact of regional water supply.

Interview 2

Gandhinagar SardarSarovar Project (SSP)

The SSNNL, which is implementing the SSP, is unique in many ways. First: SardarSarovar Narmada Nigam Limited (SSNNL) is a special purpose vehicle registered as a company which can generate its own resources through public deposits (Deep discount scheme were introduced). After the World Bank withdrew its financial support to the project in the wake of the report of Morse Commission, the Government of Gujarat has been able to continue SSP projects by mobilizing its own resources. Further, SSNNL is the only irrigation agency in the country having people in the senior management from multiple disciplines--environment and forests, agricultural economics. Second, is the reforms related to land acquisition and compensation. In most of the projects (especially related to irrigation) there is delay in project completion due to

problems in acquisition of land. Till 2010, only 17,000 ha of land (42.5% of the required) were acquired for SSP over a period of 30 years. With the introduction of new policy in 2010, compensation for land acquisition is being paid as per the market rate. Over and above the existing land prices, 30% extra is paid to the evictee. As a result, in last 3 years, 17,000 ha of more land had been acquired. Now, only 6,000 ha land remains to be acquired. Before the 2010 policy initiative with regard to the land acquisition, there were about 60,000 cases related to land acquisition pending in the courts. After the adoption of the new land acquisition policy, there are no court cases as the farmers and other land owners are fully satisfied with the compensation being paid.

According to Dr Joshi, the main problem in land acquisition is that unless farmers see water in parent canal (either branch, distributary, minor or sub-minor) they do not give land. Therefore, once the construction of distributaries is completed, acquiring land for minors would not be a problem. Major reason for non-completion of tertiary system (sub-minors) is that farmers do not want to give up their land for sub-minors (water courses) as no compensation is paid for it. As a result farmers are directly lifting water from minors. In order to encourage completion of tertiary supply system, a new policy approach is adopted by SSNNL. This gives farmers the option of having either an open channel or an underground pipeline in the place of the sub-minor and field channels. In case farmers prefer underground pipeline, they do not have to give land. Negotiations for laying underground pipeline are done with WUAs not with individual farmers. Presently, it is under trial at some locations in the command. However, as pointed out by Dr Joshi, in many regions underground pipeline won't work under gravity. It is estimated that about 60% of the area is suitable to be irrigated through gravity flow based underground pipeline. In the remaining areas, installation of pressurized pipes (underground) is proposed. However, in such areas adoption of MI has been made mandatory to stop the wastage of water, as pressuring the flow would be expensive. Also, O&M of underground pipeline is to be done by farmers. As a result there is not much demand by farmers for a pressurized underground pipeline system.

While there is a criticism that the SSNNL is diverting more water to industrial uses in view of the greater willingness on their part to pay for water, Dr Joshi pointed out that Narmada Water Disputes Tribunal had awarded 9.0 million acre feet (MAF) of water to Gujarat (10,800 MCM). Out of this 1.06 MAF can be for non-agricultural uses, and remaining 7.94 MAF for irrigation in the command areas. Considering an irrigation system efficiency of 60%, MAF is available at farm level. An additional 3 MAF (2.7 MAF from groundwater and 0.3 from en-route rivers) is provided in the command areas. Water allocation and planning is done as per the 12 MAF of water availability. From 1.06 MAF, 0.86 MAF is given for domestic water supply and rest for industries. Once demand from industries become more than allocation, no additional requests for claiming water from industries is entertained. It was further pointed out that, initially water rates from SSP were Rs 1 per KL for domestic uses and Rs 6 per KL for industrial uses. Every year the rates are increased by 10%. Presently, water rates are around Rs 5-6 per KL for domestic uses and Rs 16 per KL for industrial uses. Rates for industries are very low considering they are willing to pay more. Even upcoming residential townships are willing to pay for water at industrial rates. On the issue of handling water theft (by farmers) along the canal alignment, Dr Joshi pointed out the new Irrigation and Drainage Act of 2013. The earlier Irrigation and Drainage Act (when Gujarat was part of Bombay State) was derived from colonial framework. Subsequently, improvements were made in the Bill. Irrelevant provisions were dropped and many more provision, particularly for giving more legal authority to the irrigation departments (mainly to punish those tapping illegal water) have been added. However, though the State Assembly has passed the bill, it has not been notified due to fear of losing votes in the rural areas.

Disclaimer: the views expressed in this interview are the personal opinion of Dr MB Joshi, and do not necessarily represent the views of the SSNNL, Gandhinagar.

Interview 3

Ahmedabad Decentralized Water Harvesting

Historically, Gujarat experienced high (spatial and temporal) variability in rainfall with South Gujarat being the water surplus region. In last 10 years, due to various water sector initiatives (like the construction of large number of check dams in villages and adoption of micro irrigation systems), water situation has improved especially in Saurashtra. Many consecutive years of good monsoon helped in this. The region recorded highest per acre cotton yield in the State. However, in 2012, rainfall was below average which led to reduction in cropped area especially in Saurashtra (by over 40%). This resulted in huge set back to agricultural growth especially in Saurashtra and Kachchh. Thus, a single bad rainfall year was able to undo the gains from the initiatives for improving water security in the state. Hence, there are concerns about long term sustainability of irrigated production in these fragile environments. Another important issue is the scale at which the water harvesting structures are built in different basins of Saurashtra and Kachchh. The structures are not planned as per the catchment hydrology and regular de-silting is not done. As a result, there are no major benefits from these interventions. In fact it has led to more conflicts between upstream and downstream communities.

Micro-Irrigation

MrDivyang feels that setting up of Gujarat Green Revolution Company (GGRC) was a major institutional innovation to address the issue of low adoption of MI in the state of Gujarat. GGRC is promoting MI in the State but how far it is being used by farmers for the intended purpose (water saving) remains questionable. Technology is there but demand for MI has not been properly diagnosed. Especially, no attention has been paid to the cropping pattern in the target regions, water quality issues and irrigation scheduling. The biggest roadblock in MI adoption is that there are no post-installation services. Divyang feels that there is some water saving happening through the use of MI (at the field level), but the system is not used properly by the adopter farmers. About 90% of the farmers are not using it to conserve water because they are not aware of the benefits and the ways to go about doing it. Further, no major intervention is undertaken on Integrated Nutrient Management. For instance, farmers in Saurashtra spend almost Rs.16-17,000 per acre for inputs to the cotton crop, mainly on fertilizers and pesticides. In Saurashtra, the area under sugarcane, which is a highly water intensive crop, has grown to around 10% of the total cropped area, which is a concern from resource sustainability point of view. Farmers are not using drips for sugarcane. Crop diversification is also less with almost no area under horticulture crops. Thus there is no further scope for promotion of MI in the region.

Sardar Sarovar Project

Good rainfall in recent years has led to good supply of water through canals. However groundwater quality in command areas, especially for the purpose of drinking water, is questionable. There is a huge electricity cost in supplying Narmada water to Kutch and Saurashtra. Also, there is a concern about whether Narmada water supply will meet growing domestic (including livestock) water demand in the region. Therefore, multiple sources of water supply need to be explored in Kutch and Saurashtra. WUAs are formed only in about 10% of the command areas. Further, there functional capabilities remain a big issue.

Pani Samiti (PS) and Water Users Associations (WUA)

In many regions, communities have abandoned their traditional local water sources due to the expectation that Narmada water will meet their requirements. But water from Narmada is supplied once in 3-4 days. As a result they have to depend on poor water quality source, such as tankers. Water demand management still needs priority in command areas especially on promoting low water intensive crops. As per the GR 2002, PaniSamiti were formed and given legislative power to manage village water supply. It receives 30% of total O&M cost from the 12th Finance Commission. He feels that in order to address the inter-village conflicts and to take care of the management of the main system (including prevention of thefts), federations of village water supply committees (PS) need to be formed for the regional water supply scheme. PS needs to be evolved and require capacity building on their rights. Presently, PS is more a political entity as it is a sub-unit of the Gram Panchayat (GP). He feels that they could be promoted as a local institution for overall water resource management in the village. Water Tax collection has improved after formation of PS. This fund goes to GP. However, the money is not being used to cover the water supply system maintenance.

Power Sector Reforms (Jyotigram)

Overall, there is a positive feedback from domestic users of getting 24-hour power supply, as they are able to set up small-scale household enterprises which require 3-phase electricity. Farming community still has issues with quality and reliability of supplied power as 8-hour power supply is not guaranteed. The scheme has no impact on ground water abstraction. But, metering of farm power supply is still not available for more than 50% of the agricultural consumers, which negates the whole idea of rationale power supply.

Interview 4

Ahmedabad Overall

The most important reforms in Gujarat water sector relates to: irrigation management transfer (IMT) to users; awareness regarding water recharge (harvesting and pond deepening); formation of the GGRC as a special purpose vehicle for promotion of micro irrigation (MI); electric supply feeder separation; and domestic water supply security. All the schemes are good, but they are not integrated. Things are moving in silos. Different departments running different programs but without any coordination among them.

Participatory Irrigation Management (PIM) and Watershed Management

DSC tried integrated water resources management (IWRM) in canal command areas, integrating watershed management program and PIM. As compared to other States, water sector reforms have led to better results in Gujarat. In watershed programs, there is always competition between livelihoods and natural resources management. For instance, there is a shift in cropping pattern from maize to cotton, using more water and causing water quality problems (agricultural runoff) after obtaining good results from watersheds. In Sabarkantha, for instance, number of bore/tube wells has increased with improved recharge in the watersheds. Thus, policy which addresses resource sustainability concerns is missing.Also, land use changes (especially conversion of agricultural land for non-agricultural uses) are having an resource conservation. No clear water allocation from groundwater and surface irrigation schemes. In absence of proper/clear water entitlements and water rights, water is inefficiently used or used by those who pay more rather who need it more. DSC started dual accountability system where Irrigation department and WUA give clear information

to each other. There hasn't been any initiative from the government to introduce volumetric pricing of water in the command areas. But, DSC is promoting volumetric pricing of water in its projects. Now farmers pay on the basis of each watering they receive. Fifty six NGOs are promoting PIM in Narmada canal command areas. There are about 4,000 WUAs in Gujarat out of which around 10-15% would be working well. Each WUA takes care of one minor canal serving around 300-400 ha of area. However, there are issues with the scaling up of PIM activities. Government provides support for carrying out software activities mainly for organizing training program for WUAs. The SSNNL is paying Rs 880 per ha for WUA formation to the NGOs which participate in PIM initiatives. Money for canal rehabilitation comes separately. But, the State Water Resources department is paying less (Rs 400 per ha). Federations can be involved for capacity building of new WUAs committee. DSC is providing its own resources for second generation capacity building. The Irrigation Management Transfer [IMT] Act in Gujarat doesn't make it mandatory to have all the farmers served by a single minor to be part of a WUA for getting water. Even if 51% of the farmers or area is there in WUAs farmers will get water. Further as the IMT Act, WUAs can charge 30% more than the rates kept by the Irrigation Department. WUAs also get a 50% rebate from the irrigation department if they pay the entire irrigation charge on time. As per the Act, 60% of the money saved by WUAs is spent on O&M and the rest on administration. However, the IMT Act is silent on formation of higher level institutions, such as at distributary level and project level committees for irrigation management. These institutions are important for managing irrigation water at system level.

Power Sector Reforms

In Gujarat, power sector reforms are good especially in context of domestic users. As the quantum and timeliness are taken care, there is a better management of water and power. Water wastage has gone down after Jyotigram. However, groundwater abstraction for irrigation has remained same.

Domestic Water Supply

Multi-village water supply schemes are not that successful unless you develop local sources. Water theft is rampant. Reliability of water supply is also a problem. There is a need for developing an institutional mechanism to make multi-village schemes functional.

Interview 5

Ahmedabad Overall

Prof Desai is of the opinion that in the past few years, the water scenario in Gujarat has improved due to good rainfall and water management efforts by Government of Gujarat through both decentralized water harvesting and large-scale water transfer to poorly-endowed regions by SSP. Per capita income in rural areas of water scarce north Gujarat is going up, owing to additional water for irrigation from Narmada. South Gujarat is getting prosperous due to soil fertility and ample reliable water supplies from Narmada. Additionally, Tata power is running a corporate social responsibility initiative, providing help to the rural poor, but their activities have not achieved desired outputs.

SSP and Inter-basin Water Transfer

Agricultural growth in Gujarat is primarily due to linking of rivers (through SSP) and growth in area under irrigated cotton and yield. The adoption of BT cotton and high yielding hybrid cotton in Gujarat has been very high in the recent past. SSP is yet to reach the desired level (water delivery system has not reached at the tertiary

level). The problems of drinking water in the water scarce regions especially in North Gujarat and Kutch have been largely resolved. Further, because of the awareness created by WASMO, community-based RO plants have been adopted by many villages in remote coastal areas, and the problem of water scarcity is now not acute. The Sabarmati riverfront development project has created a good urban environment and people are willing to pay for the environmental services. For instance, the people are paying Rs. 10 per person for using the garden which has come up on the bank of the river, as part of the SRFDP. There are issues of sustainability in irrigation services delivered under SSP. The water charges are not in parity with inflation (last revised in 2005-06). These need to be increased or reviewed. Land prices are growing up in the command areas. Agricultural land is difficult to get and getting fragmented because of growth in industry. There should be a ceiling on conversion of agricultural land for non-agricultural purposes, especially for setting up of industries. If it is then equal expanse of agricultural land should be created elsewhere. Land fragmentation can become a major issue for irrigation management in the command area. Narmada water has yet to reach Kachchh. The branch canal for Kachchh is under construction. Once it reaches there it will improve the agricultural situation. Groundwater still remains the main source of irrigation in north Gujarat, Kachchh and Saurashtra regions. The over-dependence on groundwater can be reduced if all the south Gujarat rivers are linked with water-scarce north Gujarat basins. Legal provision for preventing water theft from canal (water lifting) is there but institutional mechanism for monitoring and control of theft etc. is lacking.

Power Sector Reforms

In rural areas, electricity has reached and has helped promote rural entrepreneurship. As a result households have been able to generate more income. However, there is no major impact on the groundwater abstraction for agricultural use.

Water Harvesting

He is of the opinion that while water harvesting has done a lot of good to the local farmers, there has to be some optimum level of water harvesting at the basin scale. Some regulation on building of water harvesting structures which captures the natural runoff has to be exercised at the basin level. While several NGOs have participated in the water conservation movement in Saurashtra, they need to be evaluated in terms of their experience and technical expertise for carrying out such works.

Groundwater Regulations

To regulate groundwater over-abstraction, proper institutional mechanism is required. As illegal water trading is quite rampant between rural areas and urban areas, water right have to be established for different sectors and users within each sector. Water cooperatives can be formed and some norms for volumetric water withdrawal and use can be evolved in the years to come.

Interview 6

Ahmedabad Power Sector Reforms (Jyotigram)

As per the Gujarat Electricity Regulatory Commission (GERC) study, after Jyotigram technical transmission losses has reduced but administrative losses (power theft) have increased. Even after the reforms, Government is not been able to meter all the well connections. Almost 50% metering has been done but it varies from region to region. In water-scarce regions of the State, farmers are not able to appreciate the positive side of metering. Farmers believe that under the metered regime they have to pay more for the electricity.

SSP

It may take more time to complete the tertiary system. Urban water supply has improved especially supply of good quality water and reliability.

Water Harvesting

Check dams have been successful in water harvesting especially during wet years. However, water harvesting becomes effective depending upon the feasibility. Tank rehabilitation has not worked. It has been promoted as a uniform approach without understanding the catchment hydrology. Especially in dark zones nothing has been working. Wherever rains are good and water is abundant, impacts on water harvesting on groundwater recharge is visible.

PIM

Policy reforms in surface irrigation are not effective in terms of water distribution and management. WUAs may be managing the supply but water pricing is not proper. Gujarat doesn't have a proper water policy. Water allocation policy is non-existing.

Groundwater management and MI

Groundwater management initiatives in Gujarat have focused only on technical solutions. Groundwater recharge doesn't mean that those who need will get water. One's effort might benefit resource rich farmers as groundwater remains in private domain (attached to land ownership rights). Increase in surface water allocation through SSP may not lead to reduction in groundwater usage in some of the over-exploited regions such as north Gujarat. When farmers get more water they grow more water intensive crops. Therefore even adoption of MI may not lead to water saving at the farm level. In the long run, water rights need to be established in the case of groundwater resources, if sustainability has to be achieved.

Micro-irrigation and GGRC

Post technological adoption services are not attended to. In case of adoption of MI on public/community based tube wells, lot of social exclusion is happening.