

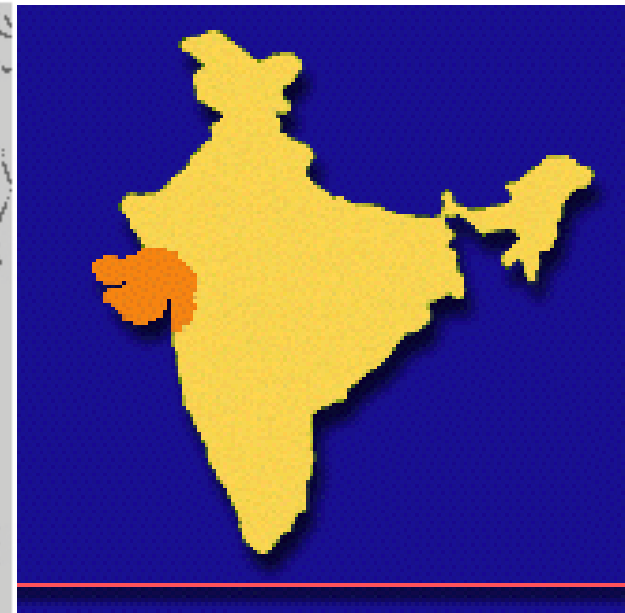
The Role of Water Technology in Development: A case study of Gujarat, India



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About Gujarat

Gujarat - located in western part of India having a population of 60 million with an area of 196024 sq.km.

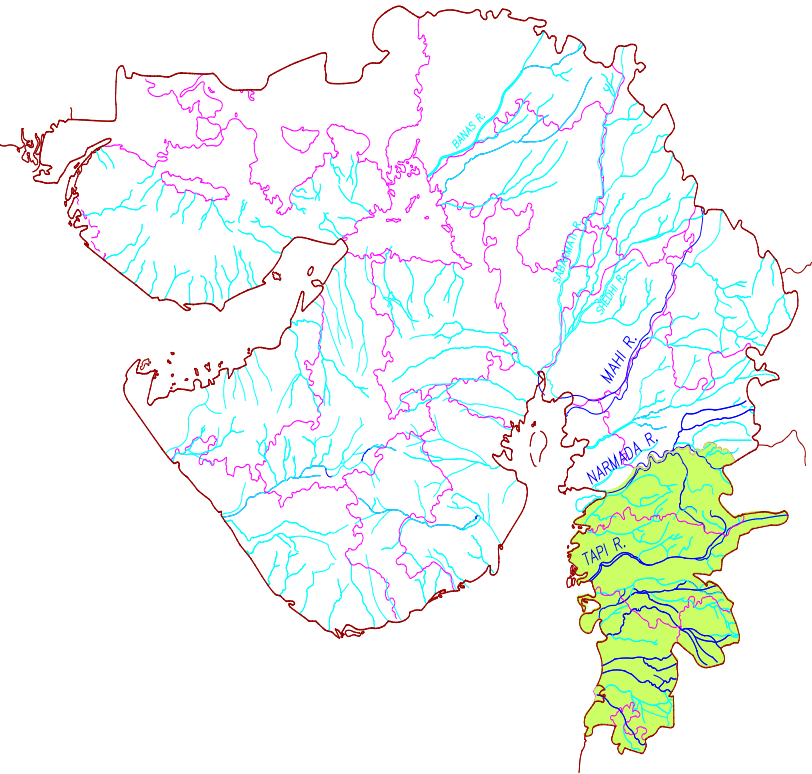


Location :
Latitude 20.60° to 24.42° North
Longitude 68.10° to 74.28° East

Gujarat State as compared to India

- Geographical Area 5.96%
- Population (Census 2011) 4.99%
- **Surface Water Resources 2.28%**
- Annual growth rate 1.9 %
(Country's average 1.77%)
- Per capita income ₹63961 (1300 US \$)
(Country's ₹ 46492 (around 937 US\$ per annum))
- Contribution to the Nation
 - 15% in industrial production, 22% in exports,
 - 30% in stock market capitalization

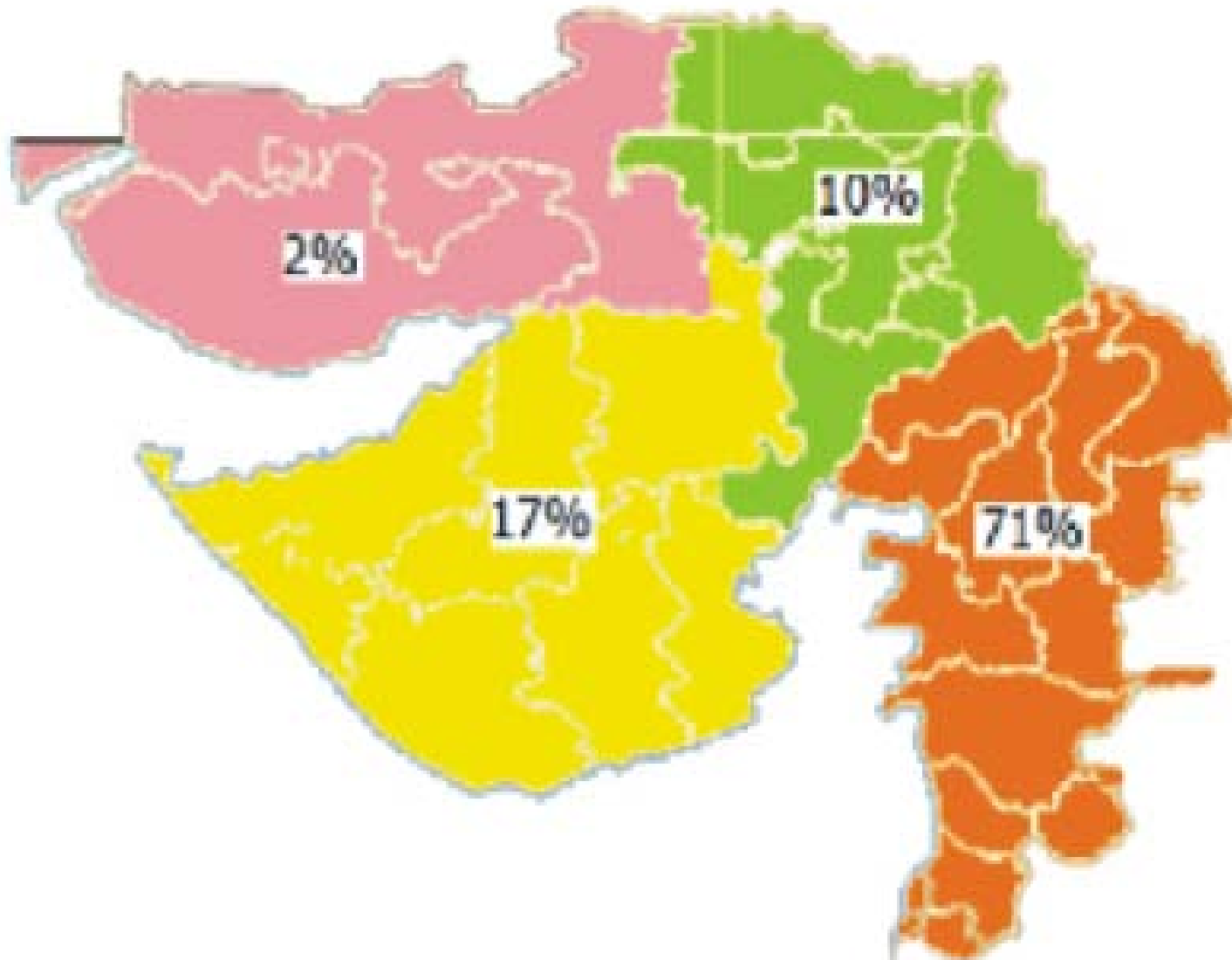
River Basins Of Gujarat



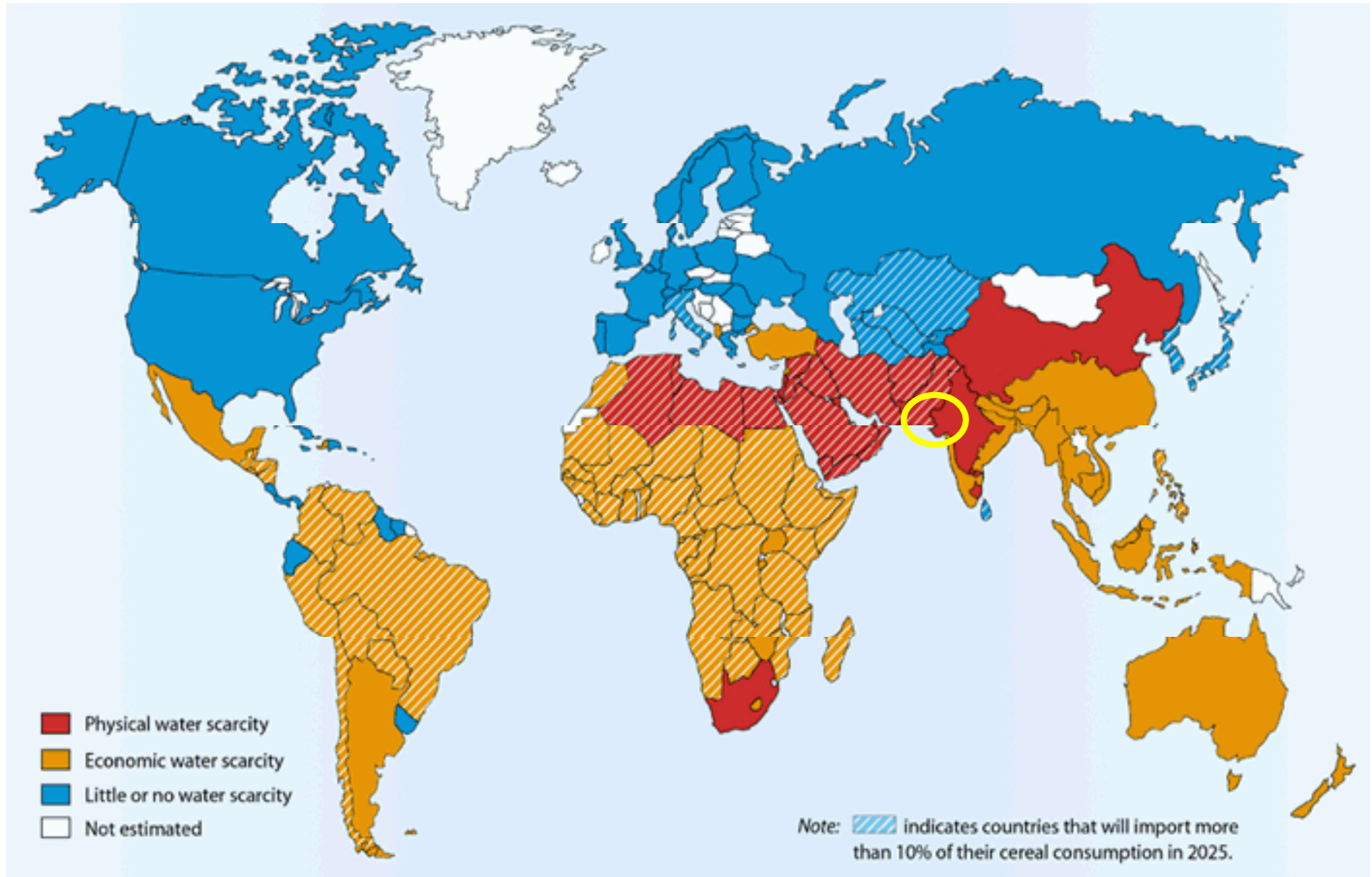
Total 185 Rivers, only 8 Perennial, All located in southern part

No.	Basin Name	Average Annual Rainfall (MCM)	Major Projects		
			Name	Gross Storage (MCM)	Live Storage (MCM)
1	Tapi (South Gujarat)	6,694	Ukai Dam	8,510	7,092
			Kare purna	98	86
2	Narmada (South Gujarat)	34,273	Karjan	630	-
			Tawa	2,310	2,050
			Bama	539	465
3	Mahi (North Gujarat)	4,359	Mahi Bajaj Sagar	2,180	1,712
			Kadana	1,542	1,203
4	Sabarmati (North Gujarat)	1,559	Dharoi	908	732
			Watrak	177	154
5	Banas (North Gujarat)	450	Sipu Dam	178	156
			Dantiwada Dam	464	444
6	Shetrunji (Saurashtra)	182	Shetrunji irrigation Scheme	350	309
7	Bhadar (Saurashtra)	474	Bhadar irrigation Scheme	238	221

Intra-State Distribution of Water



Projected Water Scarcity in 2025



Source: The Global Water Scarcity Study, IWMI, 1998

Background of Water Scarcity in Gujarat



ce firing
up was over sharing water with Jamnagar

Judicial probe into Gujarat 'water riots'
The Times of India News Service

Violent
Patel has announced Rs 2 lakh in compensation to the families of 3 killed in Jamnagar

Generator set ablaze; alert in Jamnagar district
ISRO survey may be ground water resor

Police preventing a self-immolation bid by two activists of Sankalp Seva Samiti at the east zone office compound of Ahmedabad Municipal Corporation in Rakhiyal area over water supply problem
Newsline Photo

Dam sites being guarded
The cont... demanded of the Home... invention. The... However, no untoward in... was reported from any pa... ing the bandh call... The Jamnagar distric... chayat President Manji Joshi has criticised the sta...

Villagers agitating against water proposal turn violent
EXPRESS NEWS SERVICE
RAKHIYAL, DEC 10

Farmers win water
Dams

Agitation tu

3 killed in Ja
Police opens fire as dispute o

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Police preventing a self-immolation bid by two activists of Sankalp Seva Samiti at the east zone office compound of Ahmedabad Municipal Corporation in Rakhiyal area over water supply problem
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Newsline Photo



Water Scarcity in Gujarat



Before the year 2001 drinking water scarcity posed serious threat to human and cattle lives in Gujarat State.

The State with track record of peace and cooperative social ethos, even witnessed '**water riots**' due to severe water scarcity .

Water Scarcity in Gujarat



Lack of access to safe drinking water, time loss in collecting available water, effects of head loading and burden of household responsibilities – all caused detrimental effects on the health of women and general family welfare including their income-earning abilities.



Water Scarcity in Gujarat



Permanent disability by skeletal fluorosis

Over drafting of ground water (as compared to annual recharge) caused serious water quality problems due to excessive **fluoride**, **nitrate** and **salinity**. Fluoride has been the cause of extensive health damages in many parts of Gujarat.

Dental fluorosis causes permanent pigmentation of teeth in children.



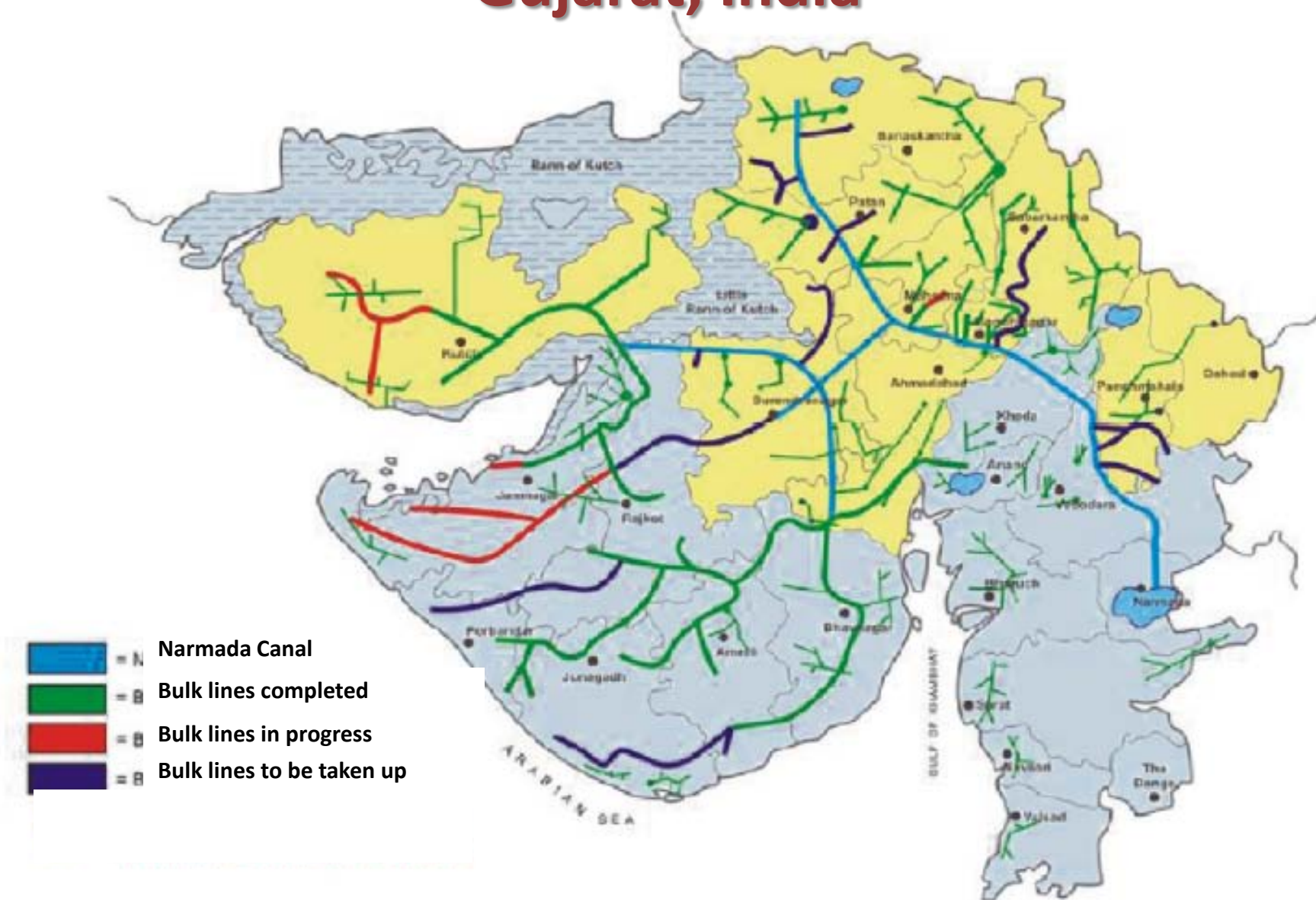
Water Scarcity in Gujarat

- Water problem induced intra-State migration.
- Migration used to be along with livestock population.
- Dislocation of prime workforce economically, socially and culturally.

Migration in search of water, in dry summer



2001- Creation of "State Wide Drinking Water Grid", Gujarat, India



Technology for drought proofing



Statewide Drinking Water Grid

- **1,987** km bulk pipelines
1,15,058 km distribution pipelines
10,781 hydraulic structures
10,683 storage sumps, **151** water filtration and treatment plants.
- **2,250** MLD of treated water delivered to 10,501 villages and 127 towns in drought prone areas.

Impacts

Fluoride affected habitations reduced from **4,187** in 2003 to just **987** now.

District	No. of Total Habitations	As per 2003 survey	As per recent survey	Maximum Fluoride level (PPM)
Ahmedabad	727	120	20	7.20
Gandhinagar	424	132	2	6.27
Patan	651	246	43	13.25
Mehsana	851	176	2	4.40
Sabarkantha	2438	531	9	6.93
Banaskantha	1736	521	20	5.75
Surendranagar	696	205	72	8.72
Rajkot	871	126	120	5.40
Jamnagar	756	52	5	2.00
Junagadh	925	76	48	2.80
Porbandar	184	46	0	3.70
Bhavnagar	804	108	66	6.40
Amreli	650	49	146	3.20
Kutch	1126	34	6	3.20
Vadodara	2187	438	189	5.81
Narmada	722	49	0	2.60
Kheda	2101	406	52	10.03
Anand	920	96	17	5.89
Panchmahals	2531	401	86	6.40
Dahod	3168	286	0	12.50
Surat	3258	44	29	2.20
Bharuch	790	21	30	4.00
Valsad	3923	2	25	1.79
Navsari	2080	22	0	--
Dangs	326	0	0	--
Total	34845	4187	987	

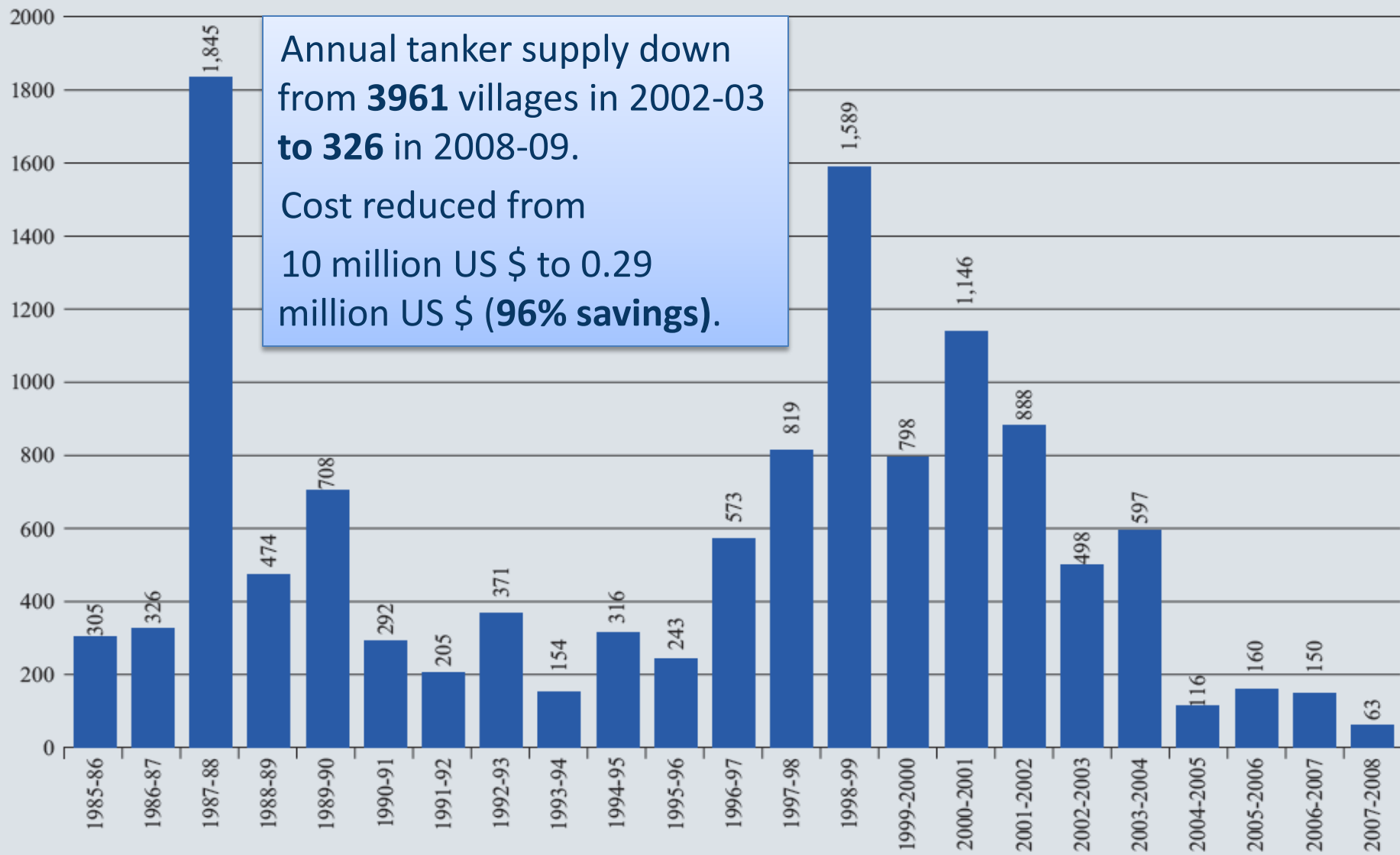
Source: Gujarat Water Supply and Sewerage Board, 2009

Impacts

- Reduction in tube well pumping:

No. of tube wells installed during the year

Annual tanker supply down from **3961** villages in 2002-03 to **326** in 2008-09.
Cost reduced from 10 million US \$ to 0.29 million US \$ (**96% savings**).



Reduction in Carbon Footprints in Water Supply

- Commission of Solar pumps in many villages in the State.
- Roof top rain water harvesting structures have also been taken up in public and private buildings leading to substantial electricity savings.
- Comprehensive energy audits for various group water supply schemes have also resulted in energy savings.

Sr. no.	Particulars	Energy Saving MWh annum	Equivalent Carbon Dioxide Emission per annum in tons
1.	Piped water supply to villages and towns	65,905.00	14,696.82
2.	Savings due to energy audit	5,184.78	1,156.21
3	Solar pumping systems	611.16	136.29
4	Rooftop rain water harvesting	386.74	86.24
	Total	72,087.68	16,076.14

Paradigm Shift

- Achievement of paradigm shift from dependence on drinking water supply by tankers, trains and deep bore wells to safe surface water.
- Fluoride affected habitation have been covered by piped water supply.
- Technological intervention like defluoridation through reverse osmosis have also been taken up in villages.
- **Thus, a 'vicious circle' has been transformed into a 'virtuous cycle' with a win-win situation for water, energy, environment and health sectors with considerable economic benefits.**

New Participative Water Governance Model Water and Sanitation Management Organization (WASMO)

- Significant shift in the role of government from provider to facilitator by empowering village level institutions through extensive capacity building and pro-active facilitation.
- More than 17,000 Village water and sanitation committees are undertaking responsibility of management of service delivery and water resources management at the decentralized level leading to water sustainability.
- Villages monitor their water quality through field test kits provided to 5-6 trained persons of village water quality team.



Water and Sanitation Management Organization (WASMO)

- Enabling environment by WASMO resulted in community being fully empowered to take ownership of their water service delivery while tariff mechanism devised by consensus in Village assembly.
- WASMO has emerged as model for learning and exchange, influencing policy in water sector at country level.
- WASMO was given **United Nations Public Service Award** in the category of fostering participation in policy-making decisions through innovative mechanisms.





Sardar Sarovar Project: Lifeline of Gujarat

Inter-basin water transfer through Sardar Sarovar Project

- A multi-State, multi-purpose river valley project following the principles of 'Equality of Right' and 'Equitable Utilization' of the whole course of an Inter-State River.
- The project is planned to:
 - Irrigate **1.905** M ha of land
 - Increased the agriculture production by **8.7** million tons per annum (worth US \$ 430 million)
 - Generate environment friendly hydropower with installed capacity of **1,450** MW
 - Supply drinking water to more than 8000 village and 135 urban centers of the State (around 20 million population)
 - Generate 1 million jobs
 - Prevent rapid process of desertification, salinity ingress and rural to urban migration

Inter-basin water transfer through Sardar Sarovar Project



- Water supply increased from **705 MCM** in 2001 to **4761 MCM** in **2010**.
- Irrigation security in a command area of around **5,30,000 ha**.

Sardar Sarovar Dam Height and Storage Increase in Sardar Sarovar Project

Stage	2003	2004	2006	Ultimate
Height	100 m	110.64 m	121.92 m	138.68 m
Gross storage	2,602.6 MCM (3.00MAF)	3,700 MCM (3.00 MAF)	5,265.8 MCM (4.27 MAF)	9,460 MCM (7.7 MAF)
Live (usable) Storage	—	—	1,565.8 MCM (1.27 MAF)	5,800 MCM (4.77 MAF)

Source: Sardar Sarovar Narmada Nigam Limited, 2009

Sardar Sarovar Project

Participatory Irrigation Management (PIM)

- Irrigation cooperatives formed in 200 ha. to 500 ha. area of each Village service area (VSA).
- Total 1595 village irrigation cooperatives formed.
- 304 cooperatives handed over the administration.
- 28 NGOs in first phase while 21 NGOs in second phase involved in capacity building of Water Use Association (WUA).
- PIM practised in more than **1,11,196** ha.

Micro Water Harvesting

Sardar Patel Participatory Water Conservation Project



Farm pond: Accessing water for agriculture

State government launched the Sardar Patel Participatory Water Conservation Project (SSPWCP) in the year 2000 for the construction of water harvesting and ground water recharge structures like check dams, Village and farm ponds under a 60:40 scheme

in which government contributed 60% of the cost while the farming communities contributed 40%.

Micro Water Harvesting

Sardar Patel Participatory Water Conservation Project

- Technical scrutiny and work supervision would be done by the engineers of local body.
- Entire responsibility of the quality of construction of work would rest with the beneficiary group/NGO under continuous guidance and technical inputs from the Government technical staff.
- Maintenance works for micro water harvesting structures would be carried out by the beneficiary group at their own expense.

Micro Water Harvesting

Sardar Patel Participatory Water Conservation Project

More than 3,50,000 check dams and village ponds / tanks have been created in last eight years providing direct benefits to over 13 million people in rural Gujarat.



Micro (Drip) Irrigation Systems

Gujarat Green Revolution Company Ltd.

- State has created Gujarat Green Revolution Company Ltd in 2005, a special purpose vehicle to expedite the promotion of drip irrigation among farmers.
- GGRC offer subsidy loan to adopters and has fast-tracked and simplified administrative procedure for accessing. 50% subsidy is being provided by GGRC and helps arrange a loan for the balance 45%



Micro (Drip) Irrigation System Gujarat Green Revolution Company Ltd.

Around 100,000 ha are covered by drip irrigation; and most of these have moved to high value crops.



Farmer loading bananas in Ahmedabad

Around **74 million kWh energy** has been saved in just one year due to adoption of drip irrigation.

Initiative to regulate electricity and groundwater use

Jyotigram Scheme

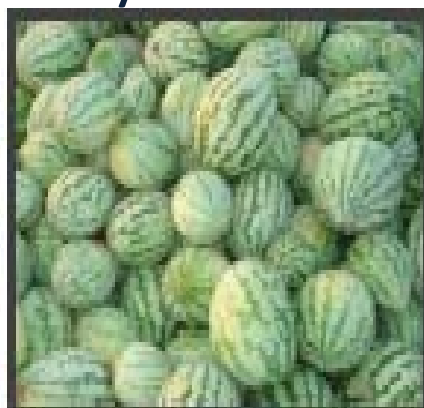
- In 2003 the Gujarat government implemented the Jyotigram Scheme (JGS- the '**lighted village**' scheme), which incorporated the core ideas of **intelligent rationing**.
- Jyotigram, pioneered a **real-time co-management of electricity and groundwater for agriculture**, in India.
- Jyotigram's aim was to provide 24x7 three phase power supply to Gujarat's 18000 odd villages.

Jyotigram Scheme

- During 2002-06 around US \$ 260 million was spent on the project, to ensure 24 hour, three-phase power supply for domestic and commercial uses in schools, hospitals etc. and 8 hours a day, three-phase full voltage power supply for agriculture i.e. continuous and full voltage power especially for agriculture at predictable timings for villages across Gujarat. By 2007/08, all the 18066 villages were covered under JGS.
- Gujarat has become the first state where villages get three phase power supply 24x7, and farmers get three phase, uninterrupted power supply at 430-440 voltage for 8 hours according to a strict, pre-announced schedule.

Jyotigram Scheme

- Ground water and power rationing through the Jyotigram scheme not only **increases efficiency of water and power utilization for agriculture**, but also frees up these resources for the rural nonfarm economy to grow.
- Higher access to water does not only has a **land augmenting** effect, but also allows for **multi cropping** and **growth of high value fruits and vegetables like mango and banana** (that require much water). More water is also available for **livestock, animal husbandry and fisheries**, which are significant sectors in Gujarat's economy.



Overall Impacts

Greening of other Rivers

- Narmada water has been released in the dry beds of **Heran, Orsang, Karad, Dhadhar, Mahi, Saidak, Mohar, Shedi, Watrak, Meshwo, Khari, Sabarmati** and **Saraswati** rivers, improving their ecology and water quality over the last couple of years.

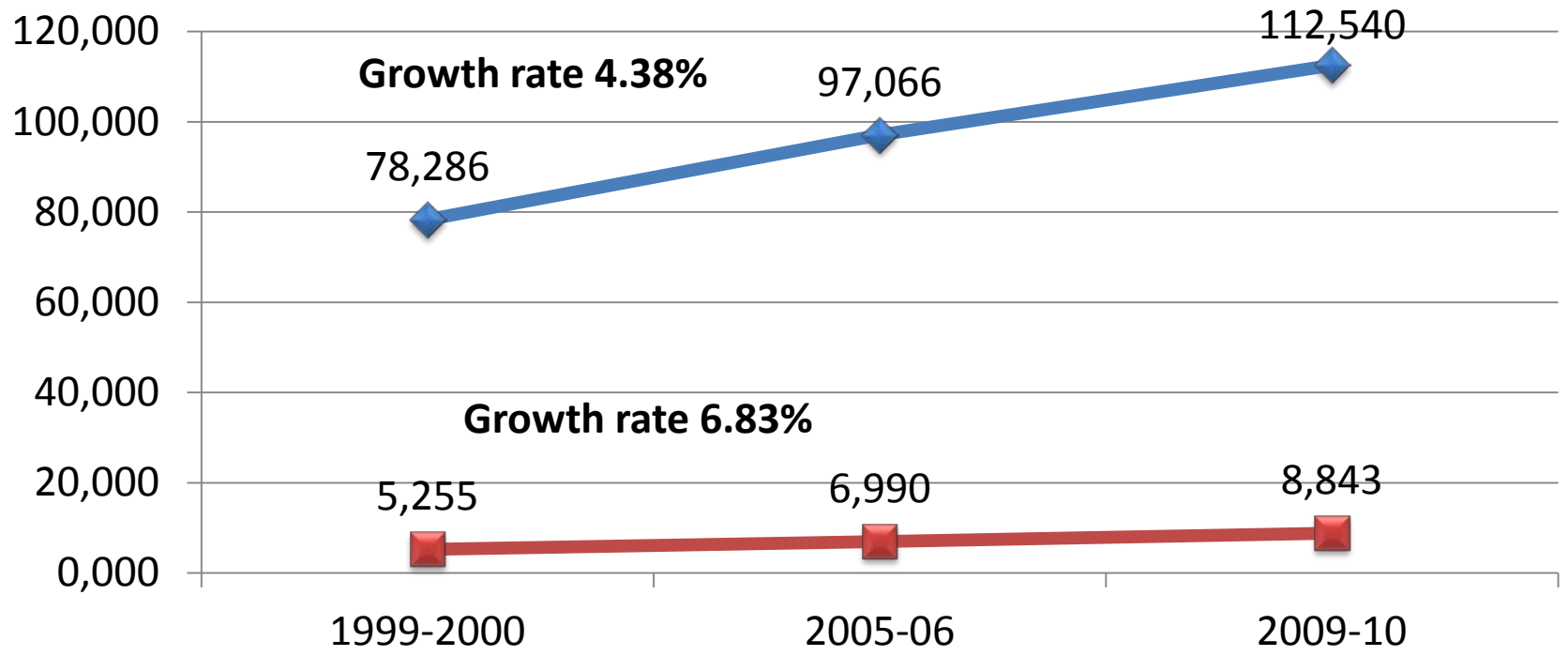
Boost to Rural Economy

- Micro Water Harvesting Structures have led to the **reduction in soil moisture evaporation** in agricultural fields and have facilitated **orchard creation** in places barely producing single rain fed crops.

Overall Impacts

- The average **productivity of milch animals has also gone up** due to year round availability of fodder.
- Average annual growth rate of milk production of State last decade has been **6.83%** while for entire country it was **4.38%**.

Comparative Growth of Milk Production in Last Ten Years



Source: Directorate of Animal Husbandry

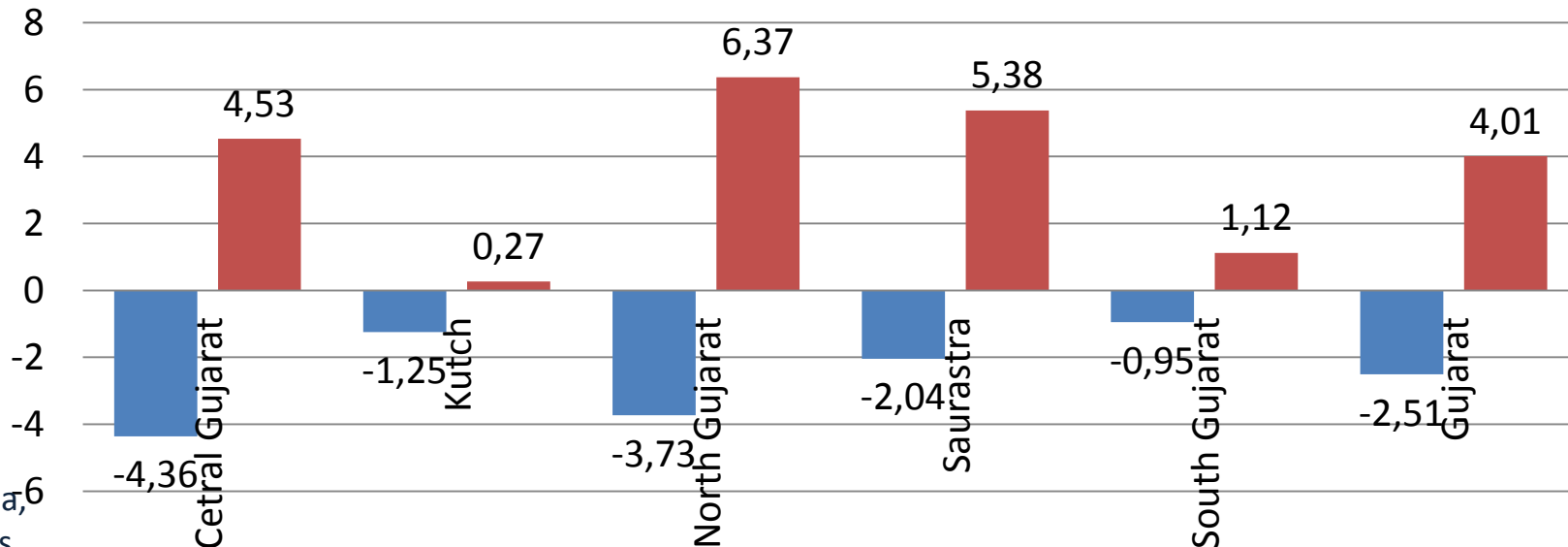
◆ India- in Million MT ■ Gujarat- in Million MT

Overall Impacts

Increasing Water Table

- The average depletion of water levels in north Gujarat was around 3 m per year, which by now would have cumulatively declined almost 20-26 m – leading to sharp rise in electric consumption for drawal of ground water. But there has been a **reported average water level rise of about 4 m during recent years.**

Ground water level fall/rise (in Meters)

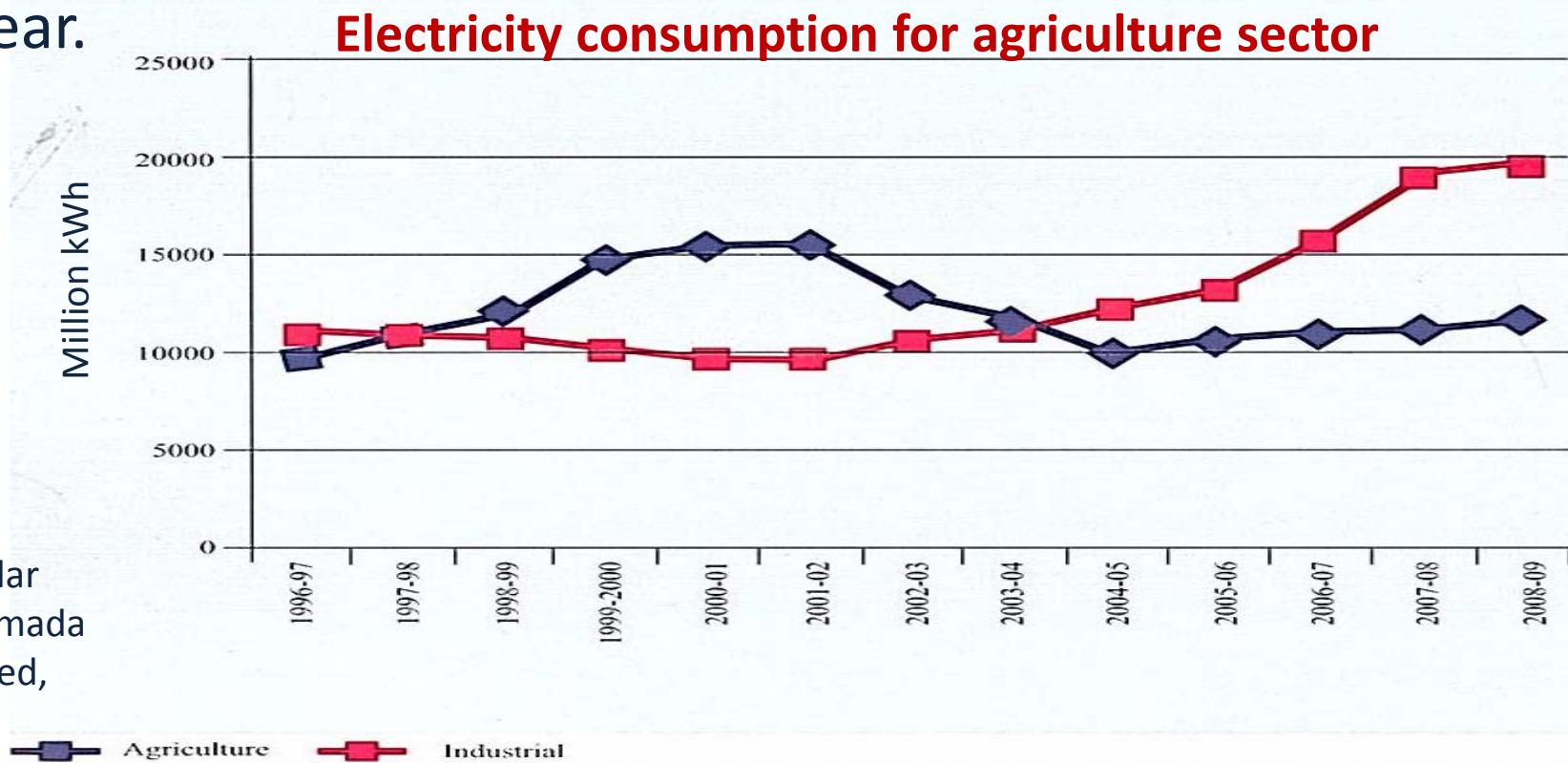


Source: Narmada, 6
Water Resources,
Water Supply and
Kalpsar Department,
2009

■ Yearly water level difference in metre (May 1998 to May 2002)
■ Yearly water level difference in metre (May 2003 to May 2007)

Overall Impacts

- Combined effects of (a) no more need to pump groundwater in many areas and (b) lower pumping requirements due to recharge of aquifers.
- Electricity consumption for agricultural sector drastically reduced from 45.12% to 21.1% - saving of **11,733 Million kWh** per year.



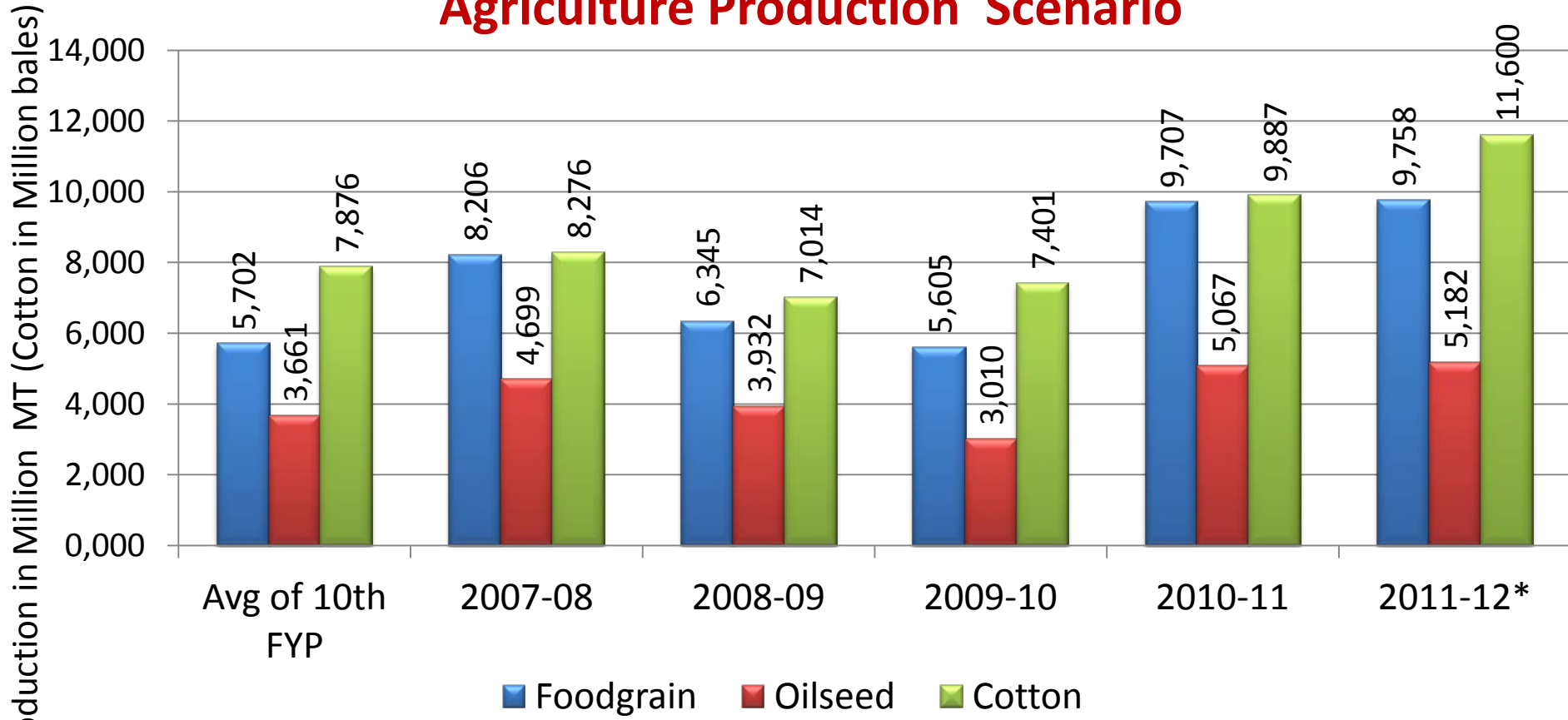
Source: Sardar Sarovar Narmada Nigam Limited, 2009

Overall Impacts

Outstanding Performance in Agriculture

- Gujarat an outstanding performer in agriculture – growth rate 9.6% per annum, coming in for special praise by IFPRI (International Food Policy Research Institute).

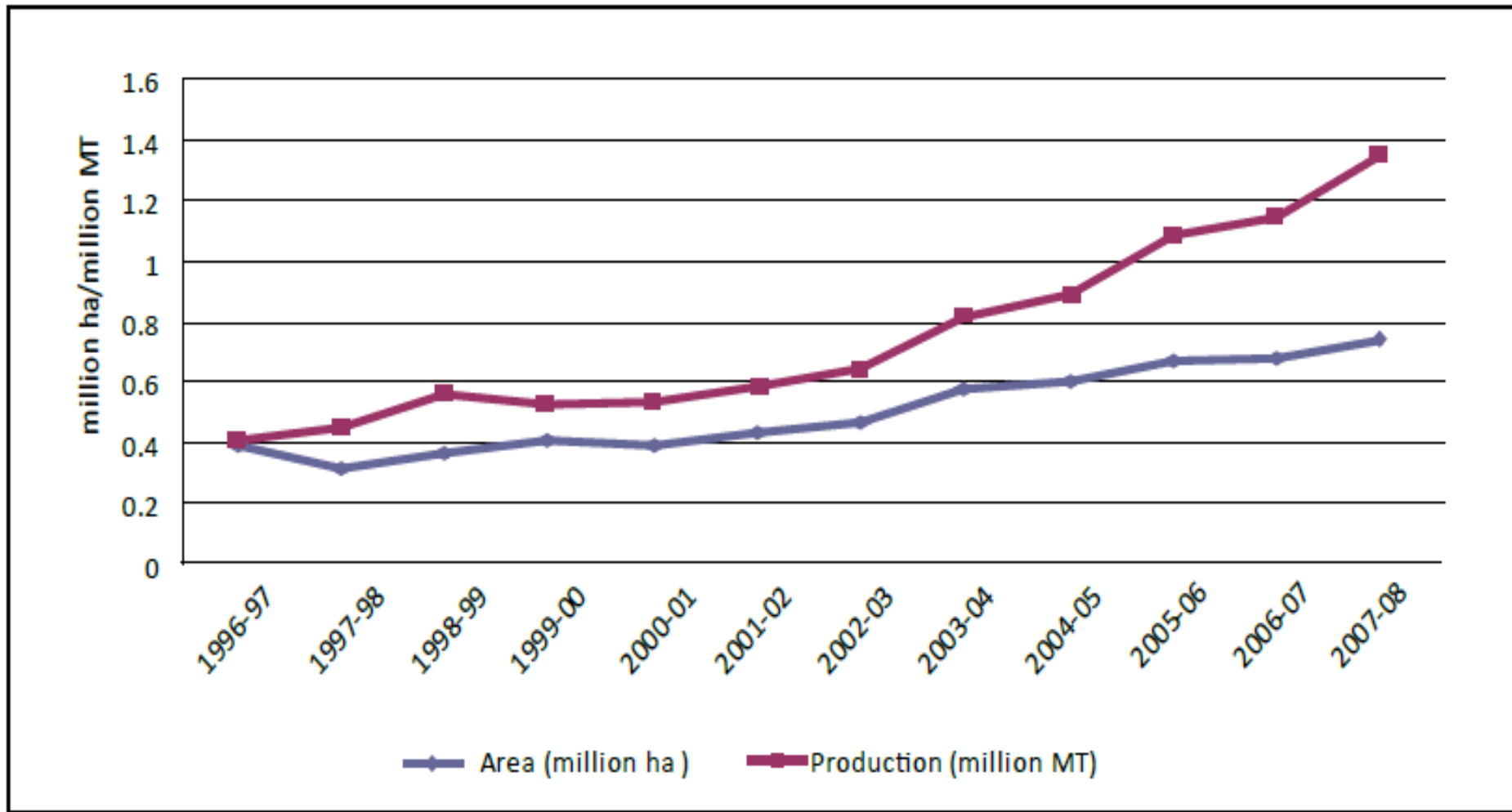
Agriculture Production Scenario



*Data of 2011-12 is provisional

Overall Impacts

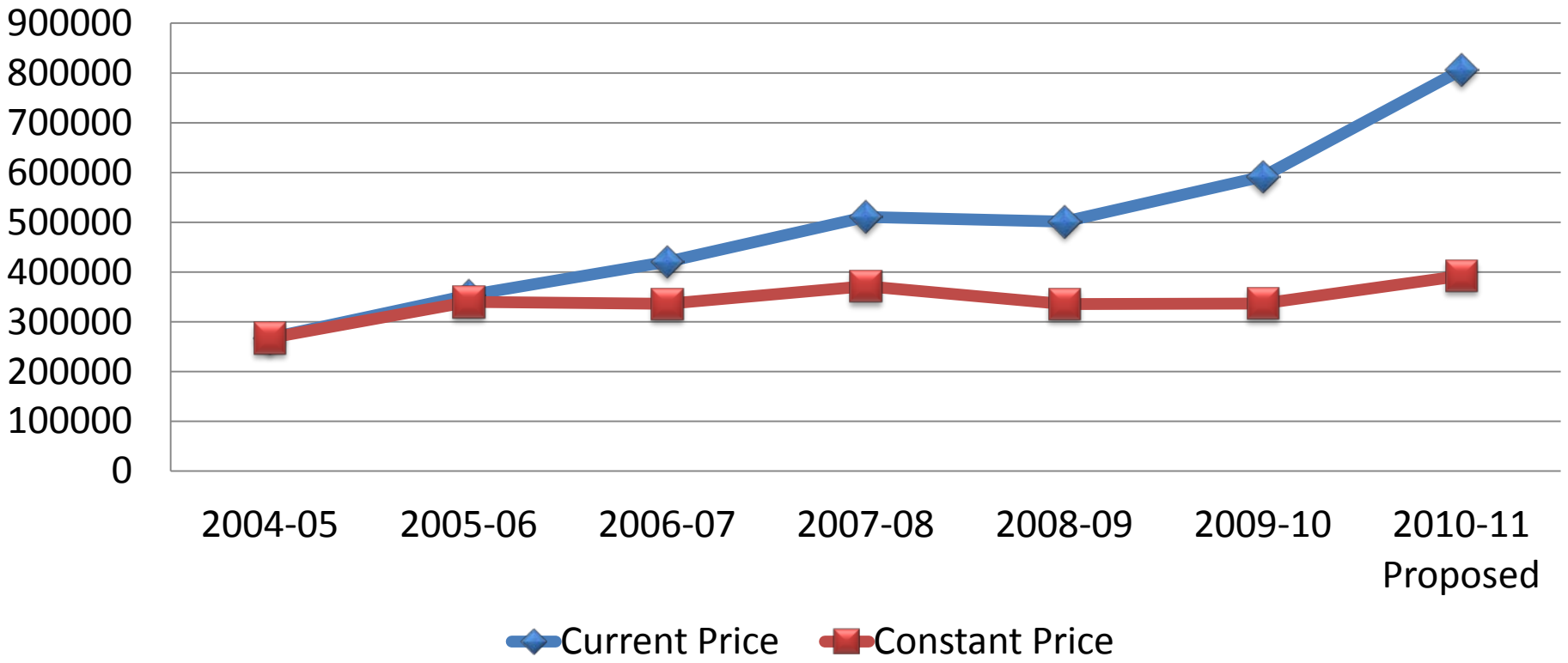
Area and Production under Total Fruits and Vegetables in Gujarat (Area in Million ha, Production in Million MT)



Overall Impacts

- The agriculture income between 2005-06 and 2010-11 has risen by 300%.

Growth in Agriculture income (Rs in Million)



Source: Agriculture and Cooperation Department, 2011

Conclusion

- Technical Initiatives to be complimented by **grassroot people's participation in management of water distribution.**
- Balanced importance given to **both micro-water harvesting and large water resources development projects** which has led to unprecedented agricultural growth in the State.
- Increased availability of water and reduction in consumption of conventional power has led to **reduction in carbon footprints in water supply** and further development of **low carbon economy in the State.**

THANK YOU

