



International Water
Management Institute



IWRA Online Conference

Addressing Groundwater Resilience under Climate Change

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Community's Response to Revive Depleting Groundwater in Arid Region of Kachchh

*A Self-propelled Movement for the Managed Aquifer
Recharge Through Private Defunct Borewells*

Praharsh M. Patel

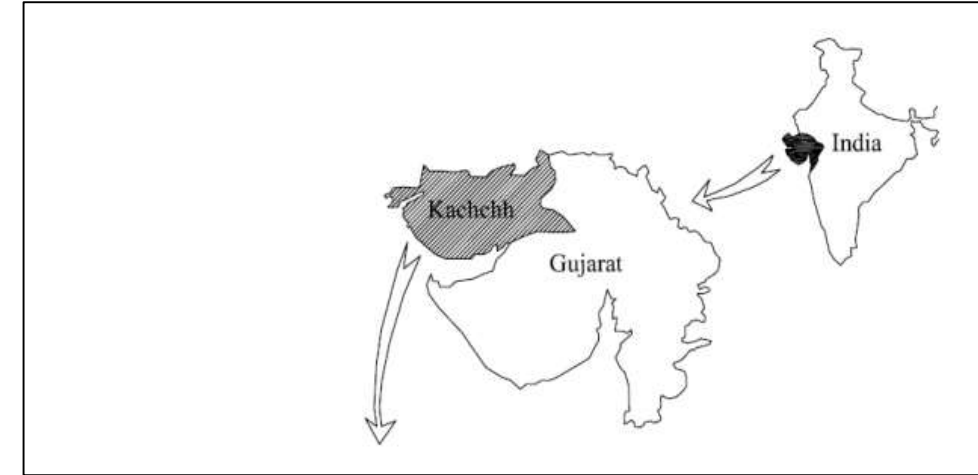
Innovative water solutions for sustainable development

Food · Climate · Growth

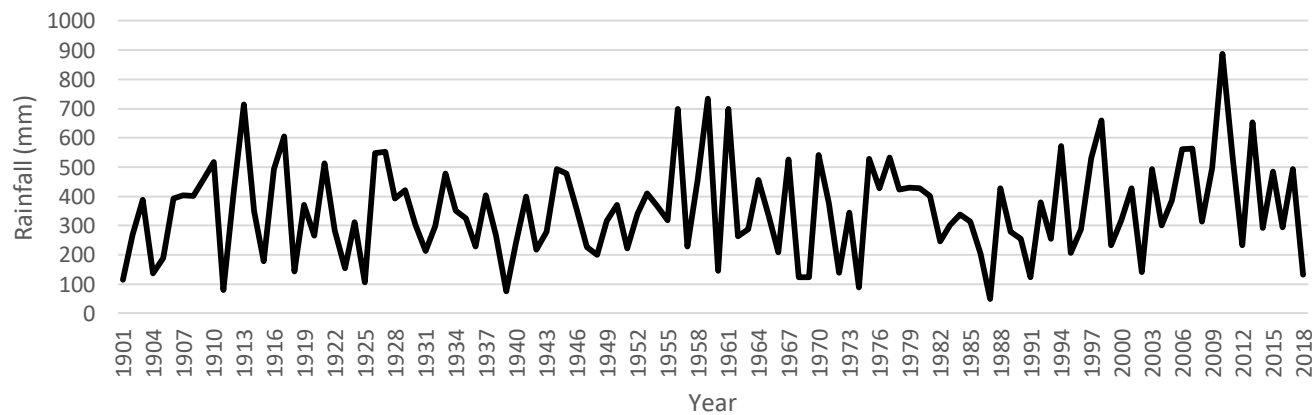


Kachchh Region & Water Woes

- Scanty Rainfall with high variability: **Mean (450 mm), Coefficient of Variation (45 %)**
- Lack of perennial source of water such as river or large fresh water body.
- Prolonged dry spells with below average rainfall.
- Frequent drought-like conditions leading to catastrophic water deficit.
- **Sweet water deposits** in Kachchh Mainland's Alluvial Aquifers.



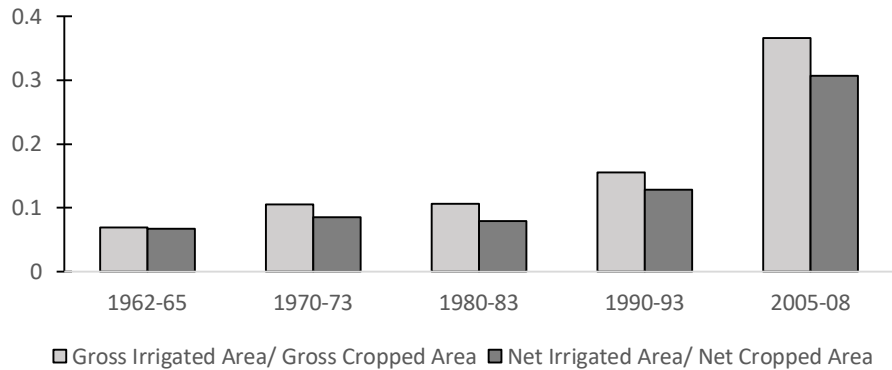
Annual Rainfall in Kutch



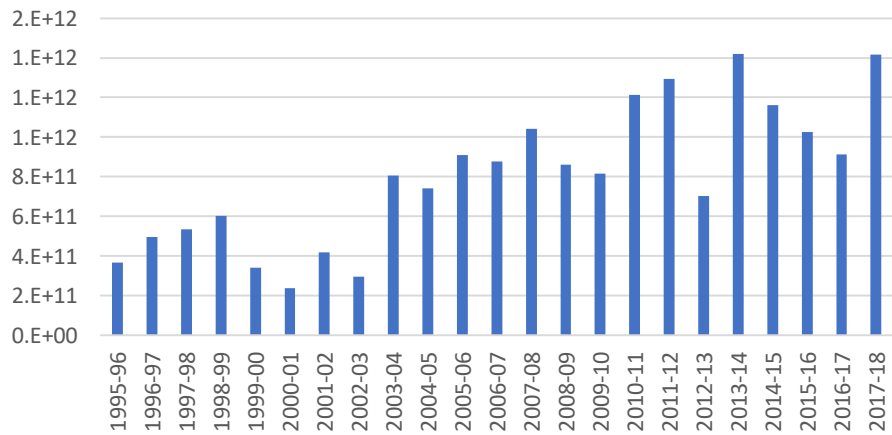
(Patel, 2019)

Groundwater Based Development in Kachchh

Irrigation Availability



Agriculture Value of Production

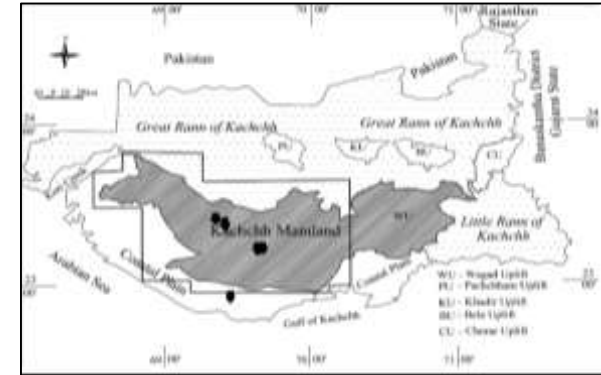


Type of Crops	Time Period	Avg Area Under Crop ('00 ha)	Avg Production ('00 MT)	Avg Yield (kg/ha)	Increase (%)
Cereals	2001-02 to 2005-06	945	1064	1163	80%
	2011-12 to 2015-16	693	1389	2096	
Pulses	2001-02 to 2005-06	662	276	359	15%
	2011-12 to 2015-16	764	322	413	
Oil Seeds	2001-02 to 2005-06	1520	1810	1218	47%
	2011-12 to 2015-16	2266	4088	1793	

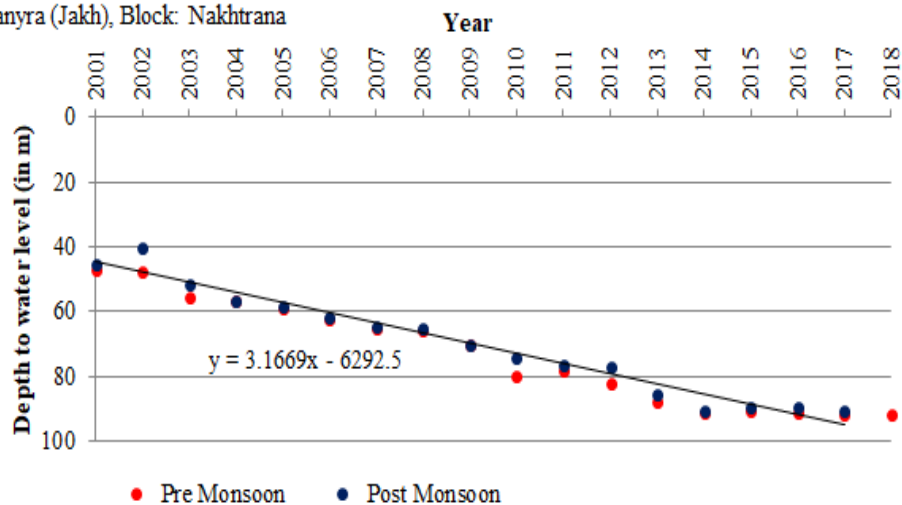
- Groundwater provides **90% of total water requirements** of the region.
- **Majority (93%)** of the groundwater utilized for the agriculture activities.
- Post-2001 the regions has observed unprecedented growth across sectors. Agriculture, Minerals, Production, and Services.
- The Groundwater has played pivotal role in providing water requirements in Kachchh.

(Patel & Saha, 2020)

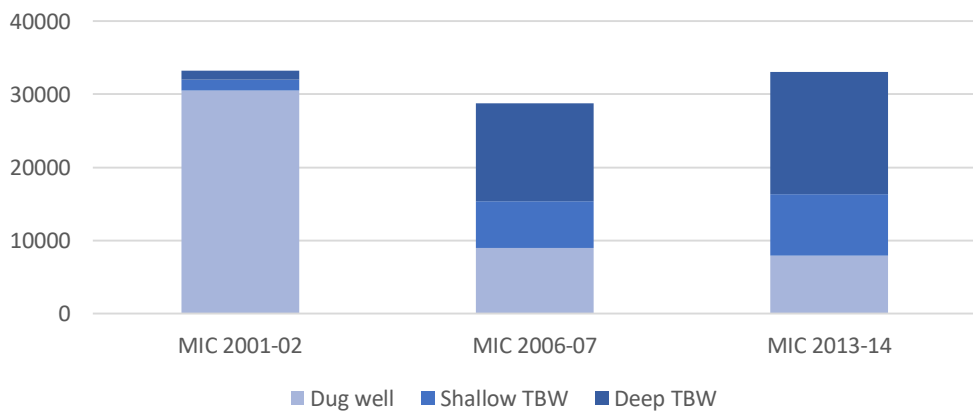
Groundwater Situation in Recent Years



Sanyra (Jakh), Block: Nakhtrana



Number of Operational Groundwater Structures



Village	Mankuwa	Sukhpar	Dhavda	Sanyara	Bidada
Groundwater Level (m) (Below Ground)	90-110	75 – 90	90 – 120	90 – 120	180 - 200
Total Diluted Salts (mg/L)	1000-1200	1000-1500	800-1000	700-800	3500-4000
Long-term Groundwater Depletion	25 m in 5 yrs	30 m in 15 yrs	30 m in 10 yrs	30 m in 10 yrs	60 m in 5-7 yrs

- Rapid Groundwater Depletion (10-15 ft/year)
- Bhuj Aquifer declined from **49.41 m bgl** in 2014 to **70.03 m bgl** in 2018.
- **103.61 mcm** as recharge during the same year the total volume of groundwater extracted is **1058.84 mcm**.
- Pushed multiple Deep borewell of average depth 100 m to be dry and defunct.
- 6 villages surveyed had on an average 100 defunct boreholes.
- GW salinity has increased rapidly.

(Saha & Gor, 2020)

Aquifer Recharge Strategies



Direct Recharge

- Direct transfer of surface water storage or Rainfall to the aquifers through infiltration.
- Can be used where defunct groundwater extraction structures or large scale excavation sites (mines etc) are available.
- Eg. Diverting flood water into aquifers through tube wells



Indirect Recharge

- Installation of groundwater pumping facilities near hydrologically connected active surface water bodies.
- Eg. Seepage from lake or river bed, irrigation tanks. Distributed Small check-dams or contour bunds for recharging the groundwater



Through Integrated Water Resource Development

- Groundwater Recharge as a by-product of an integrated water resources development scheme.
- Eg. Increasing GW level by way of reservoir and canal seepage, injection or infiltration of return flow from irrigation etc.

- Kachchh has over the years experienced “Indirect Recharge” strategy through government supported micro irrigation structures such as check-dams, farm ponds, contour bunds etc. This was in place due to government’s financial support and collective nature of the work.
- In recent years the Direct Recharge through defunct borewells has seen sharp rise as 1) plenty of defunct borewells in each village 2) direct benefit to the farmer from the recharge.
- The freshwater injected into ground directly helps with better yield as well as reduced salinity of groundwater.
- Each farmers normally have at least one defunct borewell near functional and deeper borewell on their field.

Groundwater Recharge through Defunct Borewells



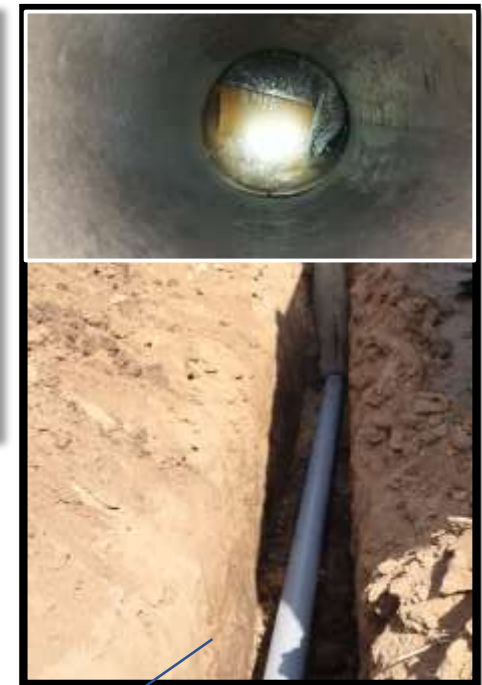
Sink Point. (Also known as “Kundi” or “Collection Point”)



Slitted Pipe to be Placed under a pit that is covered by ballast and sand at the sink point to divert the rainwater flowing out of the fields.



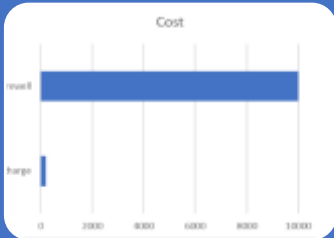
Covered pipeline to connect the sink point with the defunct borewell



Defunct Borewell Casing

Cost & Benefits

Why defunct borewell recharge is preferred?



Reduced Alternative Investment Required

- An alternative is to invest in new borewell (costs ~ \$7,000-10,000)
- Recharge improves the life of nearby functional borewell by 5-10 years. (costs ~ \$200-\$300 < 5%)



Direct Benefit to Owner

- Unlike indirect recharge methods, the BW recharge method provides better yield and less TDS water for irrigation in the functional borewell next to the defunct one on the same field directly.
- No tragedy of commons!!



More Suitable Water Storage Method

- Kachchh has high evaporation rate due to prolonged sun exposure and hot climate.
- Existing infrastructure developed for the groundwater abstraction in the region so groundwater irrigation is more viable.

Major Early Findings

- The early survey results from 3 villages show community investing their own resources in recharging GW through defunct borewell. Each village has enlisted at least 100 borewells to be utilised as recharge apparatus.
- Average cost with **community driven** recharge activities comes out to be ~ **\$200** as community delivers the labour for free and judiciously utilise the resources. Whereas efforts by **government** department for similar type of work increases the cost to ~**\$500**.
- With good (>500 mm) of rainfall, the with help of the defunct borewell recharge, **the yield from the nearby functional borewell increases**. Most beneficial aspect is the high **salinity in the groundwater is reduced** due to additional freshwater entering the deeper aquifers. This helps with better soil health and better productivity.
- Additional irrigation made possible even during the summer crops.

Ongoing/Future Research Scenarios

Currently a survey has to be conducted in 3 large scale recharge movement villages (Bidada (Mandvi Block), Kotada (Jadodar) (Nakhatrana Block), Kanakpur (Abdasa Block)) for recharge structures with recharge structure level data to be collected on Recharge Structure Specifications, Demography, Farmers' Economic Condition, Groundwater Condition & Depletion, and Cost Incurred as Cost Sharing by community, Irrigation Cycle and Cropping Pattern.

Specific Questions to be Answered.

- Is defunct borewell recharge is more economical in long term as compared to long distance inter-basin transfer for Kachchh region?** (Probabilistic model of utility from Borewell Recharge and Inter-basin water transfer)
- Does installation of defunct borewell as recharge structure reduces the irrigation cost for the farmer and/or energy subsidy?** Does investment by government on defunct borewell recharge return better social good for the region? (eg. factors of investment against returns on better agriculture output and livelihood sustenance)
- Analyse private vs social benefit at different scales** (Farmer/Community/Village scale) of interventions.



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Thank You.

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