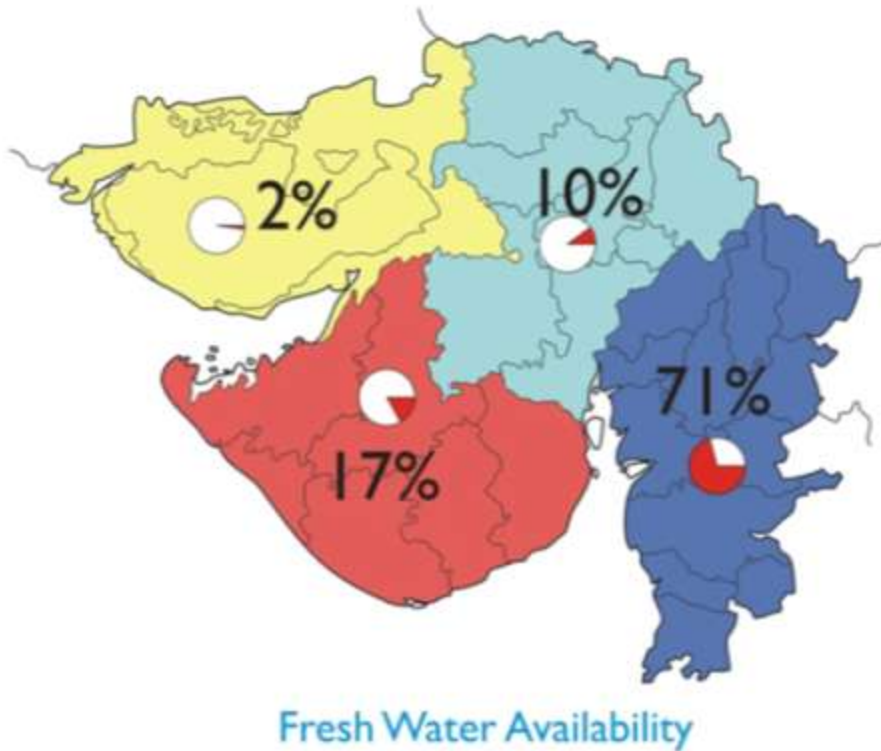




Ground Water Augmentation and Remediation of Water quality issues – Gujarat state

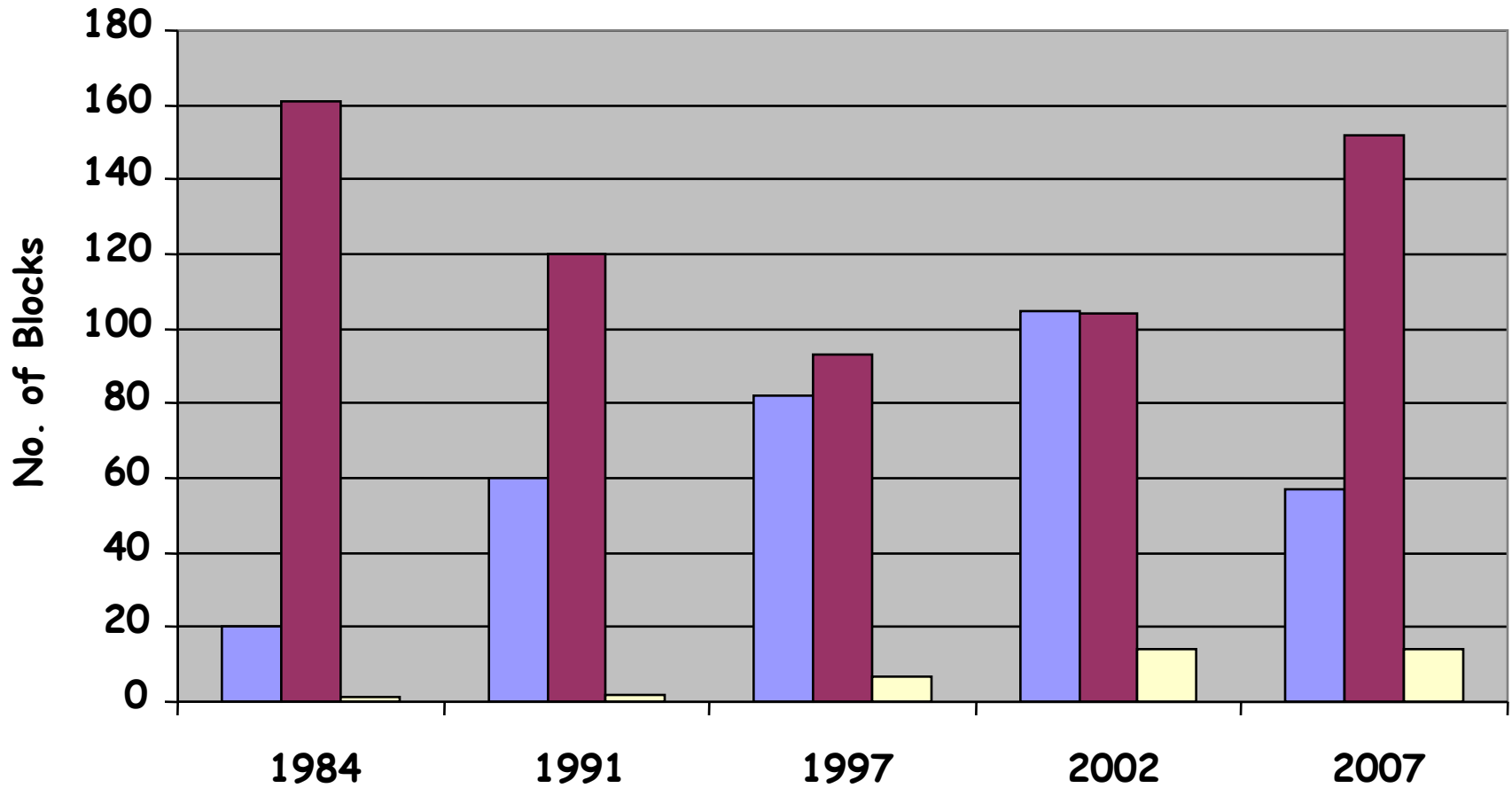
**I. K. Chhabra
WASMO, Gujarat**

Freshwater availability



- Uneven water availability in the State (Cum/ person/ annum)
 - India 2,000
 - Gujarat 1,137
 - South & Central Gujarat 1,932
 - North Gujarat 342
 - Saurashtra 734
 - Kutch 875
- Except South Gujarat, paucity of water in rest of the State
- Drinking water scarcity felt in almost 2/3rd part of the State

Status of Groundwater Development in Gujarat



Over Exploited to Semi Critical zone

Safe- White zone (<70%)

Salinity affected (>2500ppm)

Paradigm Shift

- Inter-Basin Bulk Water Transmission
- Catch Water Where it Falls
- Effective Water Resource Management and Recharge
- Community Participation
- Conservation in Use- More Crop Per Drop

Initiatives for Macro-level sustainability

- State-wide Drinking Water Grid
- Sujalam Suphalam Yojana
- Spreading channels
- Interlinking of rivers and check dams in rivers
- More than 106000 Check dams
- Filling of ponds

Initiatives for Micro-level sustainability

- Revival of traditional structures like step wells- mission
- De-silting and deepening of ponds
- Small check dams
- Underground/ Sub-surface check dams
- Bori bandh
- Filtration wells on ponds
- Linking of ponds and diversion channels
- Roof-top Rain water harvesting
- Recharge/injection wells, bore wells
- Hydro-fracturing of sick bore wells
- Bore blasting to develop secondary porosity

Conservation Strategy

- Involvement of community in adopting WRM technologies
- Judicious use of ground water.
- Revival and development of local sources
- Recharging of local sources through appropriate cost effective technologies
- Switching over from ground water to surface water
- Water auditing through conjunctive use of ground and surface water.
- Use of solar system for regulated withdrawal of ground water
- Recycling of waste water through sewerage treatment plants
- Roof rain water harvesting to meet drinking water requirement in quality problem and difficult areas
- Adopting 24 x 7 water supply management to minimise water wastage.

Water Resource Management

- Surface Water Interlinking
- Appropriate Recharging Technologies
- Water Conservation
- Quality Remediation
- WRM Impact Assessment
- Overall Improvement in Ground Water Status
- Involvement of grassroots – empowerment of community to own manage and operate their water resources

State-wide Drinking Water Supply Grid



Water resource management

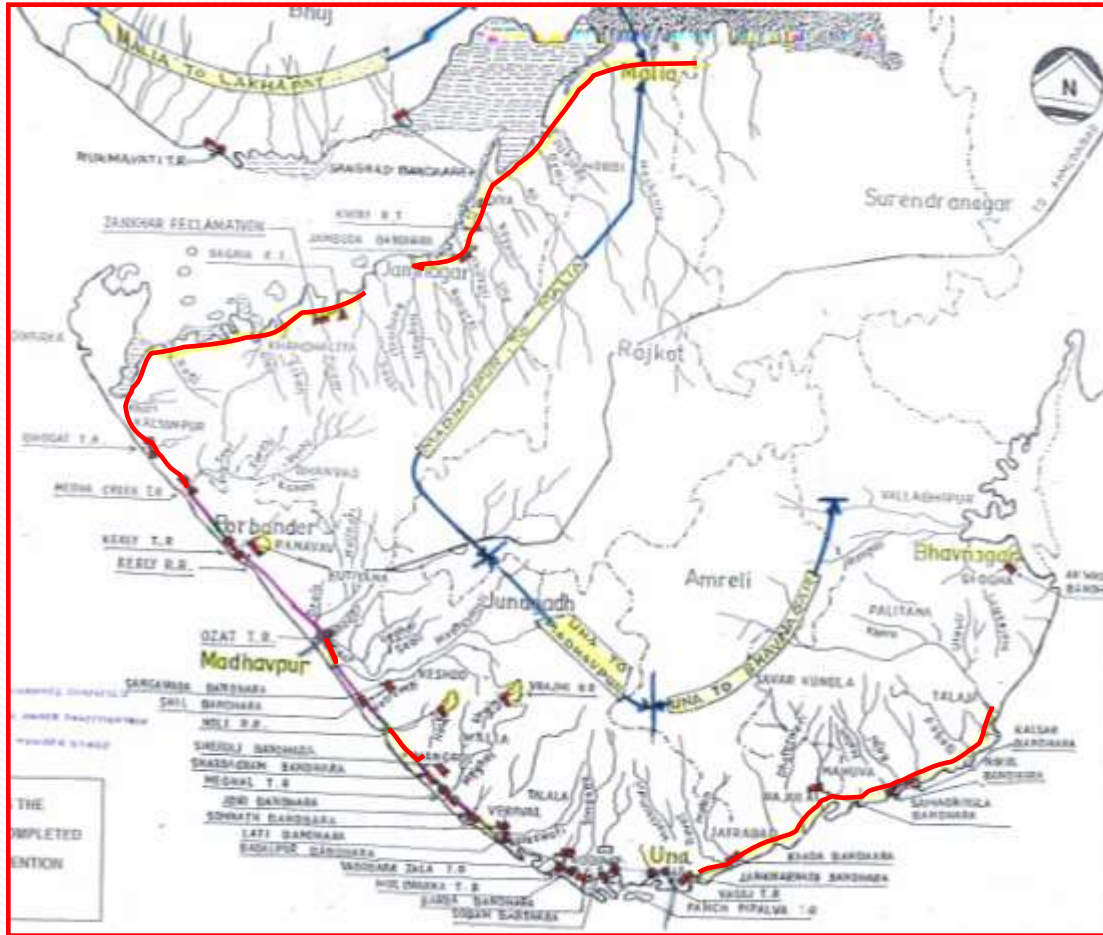
Check Dams	Boriband	Khet-talavdi	Pond deepening
1,06,648	80,479	1,71,400	12,589



Inter linking of rivers



Interlinking of coastal rivers by Spreading channels



Joins two river basins where tidal regulator/ bandhara have been completed across mouth of the sea and rivers.



Check dams



Bori bandh & Khet Talawdi (Farm pond)



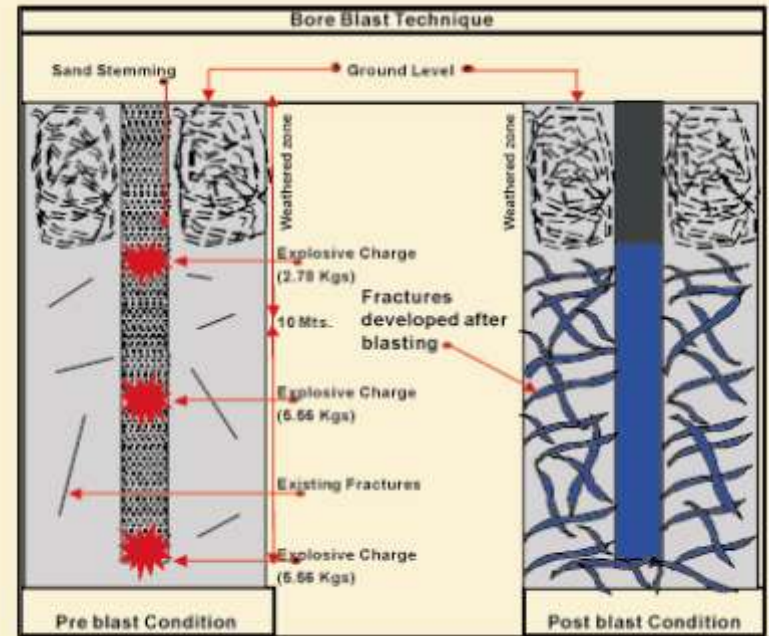
**Percolation Tank –
Kalyanpar (Khadir)**



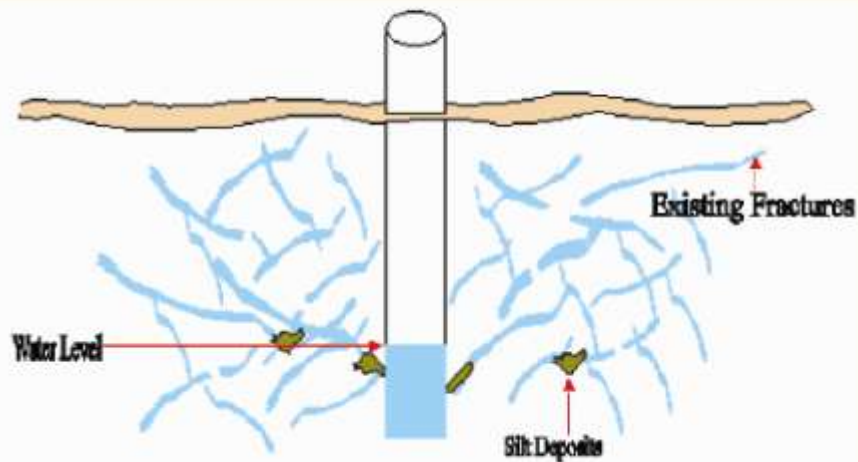
**Percolation Tank Village
Godhara Tal. Mandvi**

Roof-top rain water harvesting

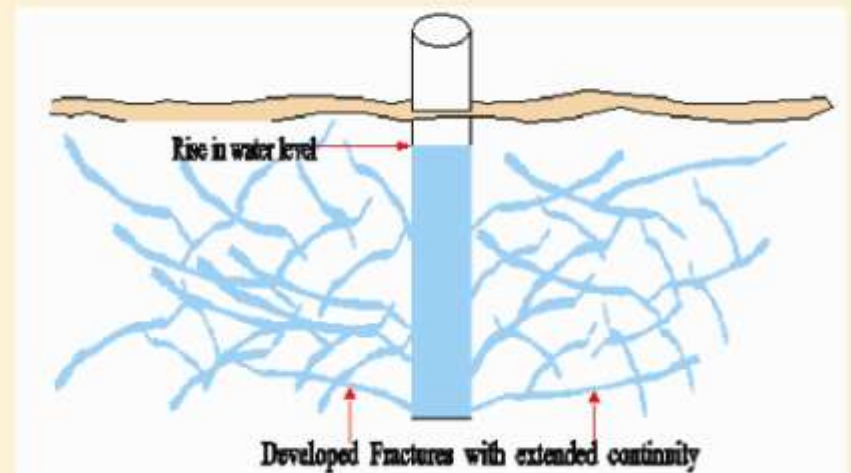




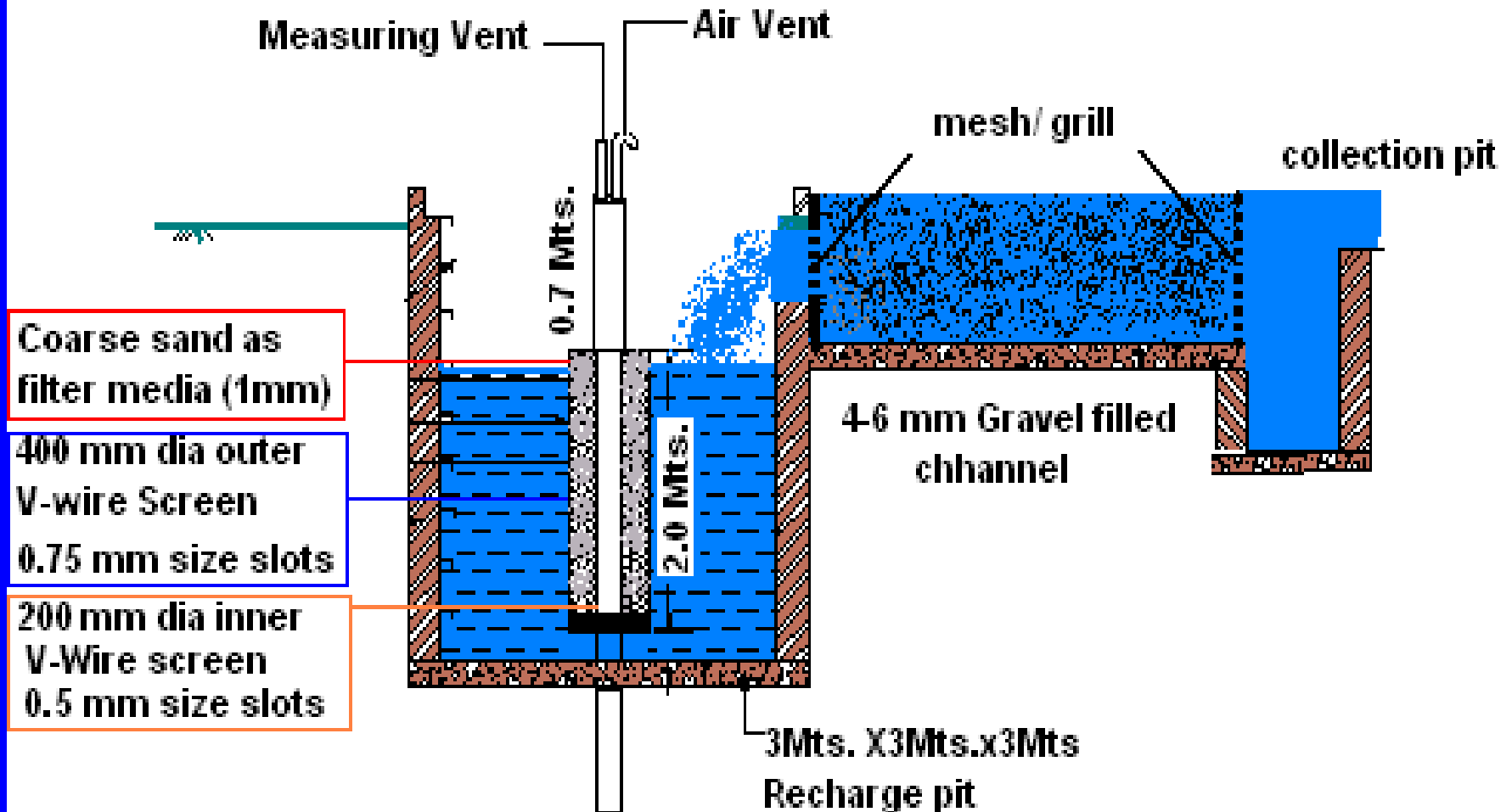
Pre fracturing water level



Post fracturing water level

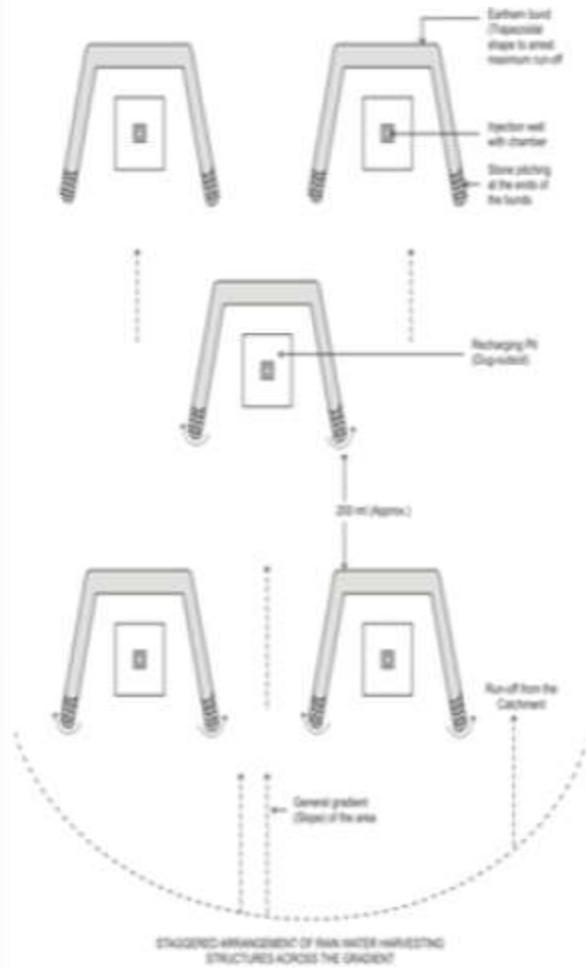


SCHEMATIC DIAGRAM OF RECHARGE TUBE WELL (NEW CONCEPT)

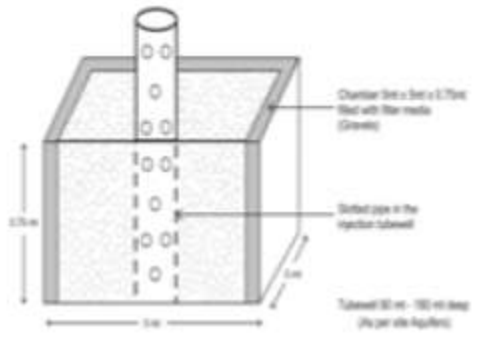
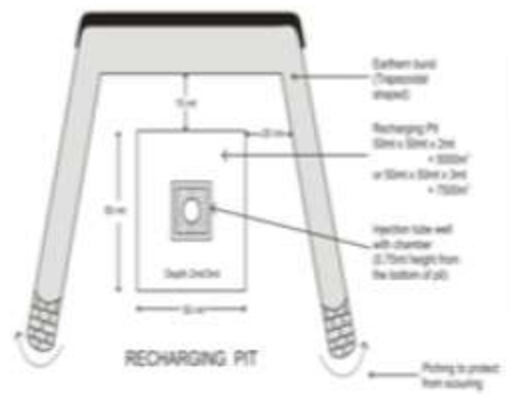




SYSTEM OF
ZONAL RECHARGING OF SOURCES
IN
PRAJAU (KONYARA) AREA
(ABDASA TALUKA IN KACHOH DISTRICT)



RECHARGING PITS
(DESIGN AND MEASUREMENT)



ARTIFICIAL RECHARGING
THROUGH INJECTION TUBE WELLS

Artificial Recharging through Recharge Bore with surrounding filter arrangement





Recharging Tube well - Ramvav

Diversion of rain water in tubewell benefitted water supply to five villages of Rapar taluka, district Kutch

Conservation of water through solar system

- Helps in limited withdrawal of ground water and hence it helps in maintaining in static water level.
- The quality of water does not get deteriorated.
- Constant water pumping helps to establish 24x7 systems in the village.
- Limited capacity of motor helps in reduction of over exploitation of water



Village : Dadampar, Naliya

Population : 110 people

Installation : Feb' 2007

System : 640 wt, 5000 lt/hour

Before : The village was fetching the water from the open well by diesel pump. The diesel machine can be operated for only one hour, because after that water level drops down, leading to inadequate water supply.

After : Due to consistent pumping through solar pump, the water level also remained steady, giving adequate water supply to the whole village.

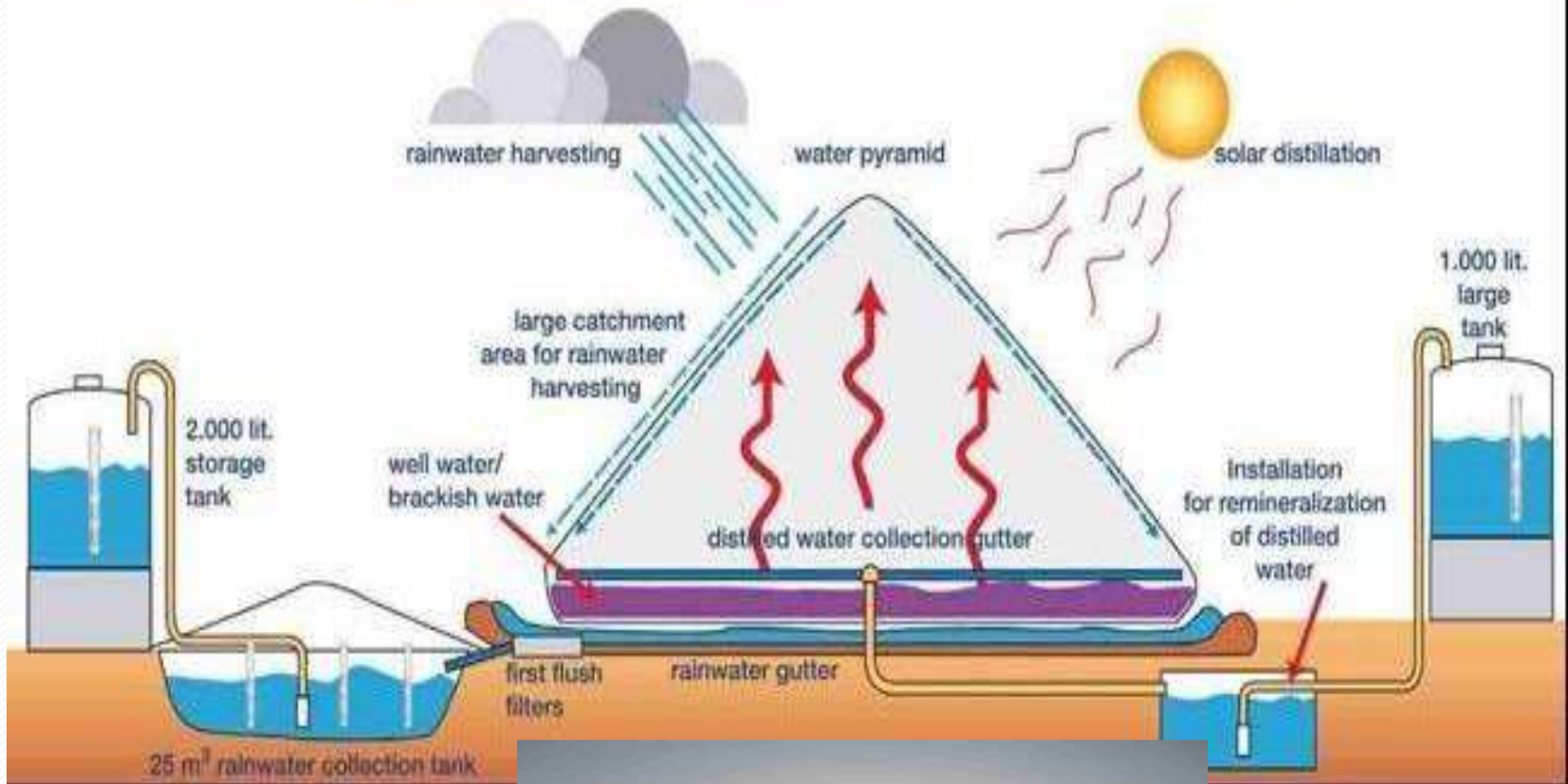
Benefit : The water level of the open well remained steady and needless to say that the village people had found a permanent source.

O&M : The whole system is maintained by local operator, who is trained by Sahjeevan .



WaterPyramid: The Hybrid Water Factory

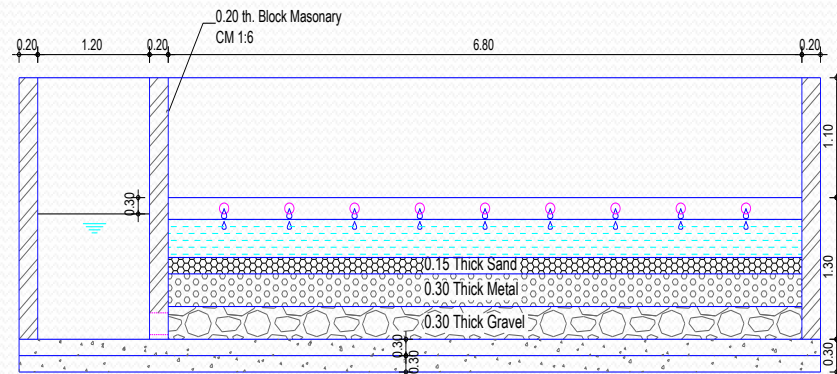
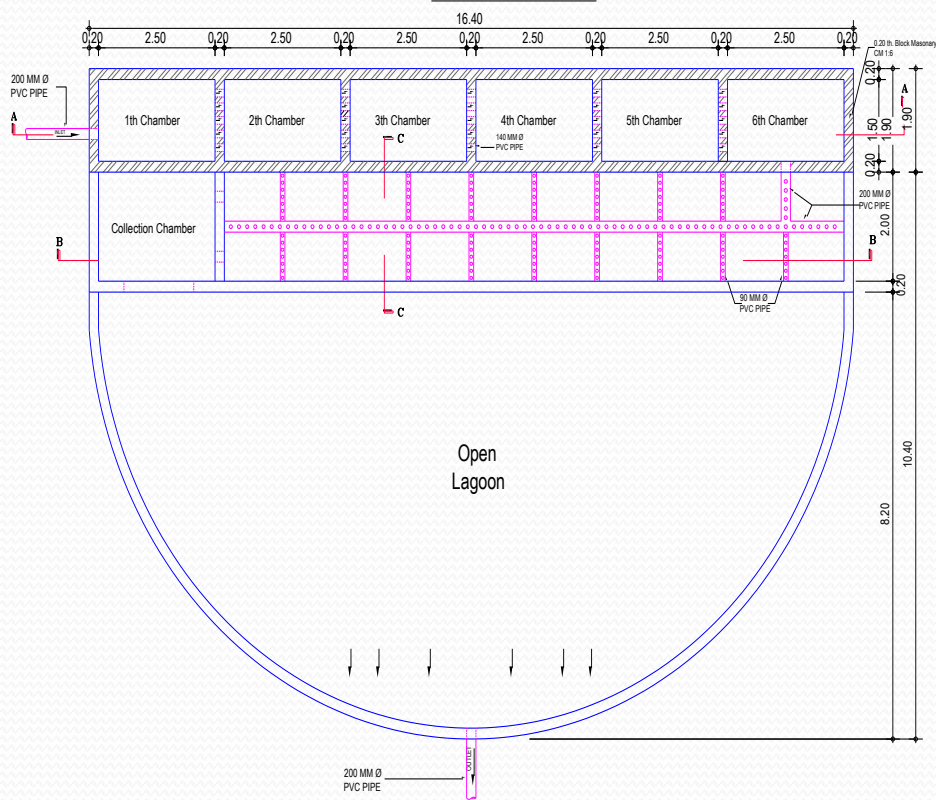
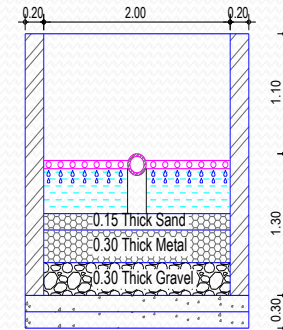
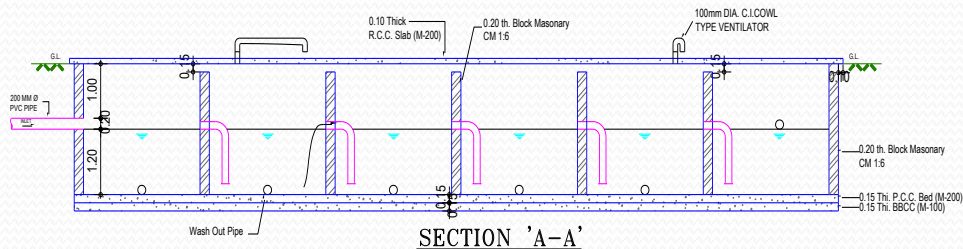
Large-scale Solar Distillation and Rainwater Harvesting



Reuse of treated waste water....

- Less dependency on ground water
- The water can be reused in agriculture and gardening
- Less exploitation of ground water which helps in sustainability of sources
- Reduction in usage of conventional energy for withdrawal of ground water
- The collection and treatment of waste water is done at one point, cleanliness of in-village and surrounding areas can also be improved
- This ultimately helps in river conservation by releasing safe water after treatment

WASTE WATER TREATMENT PLAN - A SIMPLER METHOD



SECTION 'B-B'

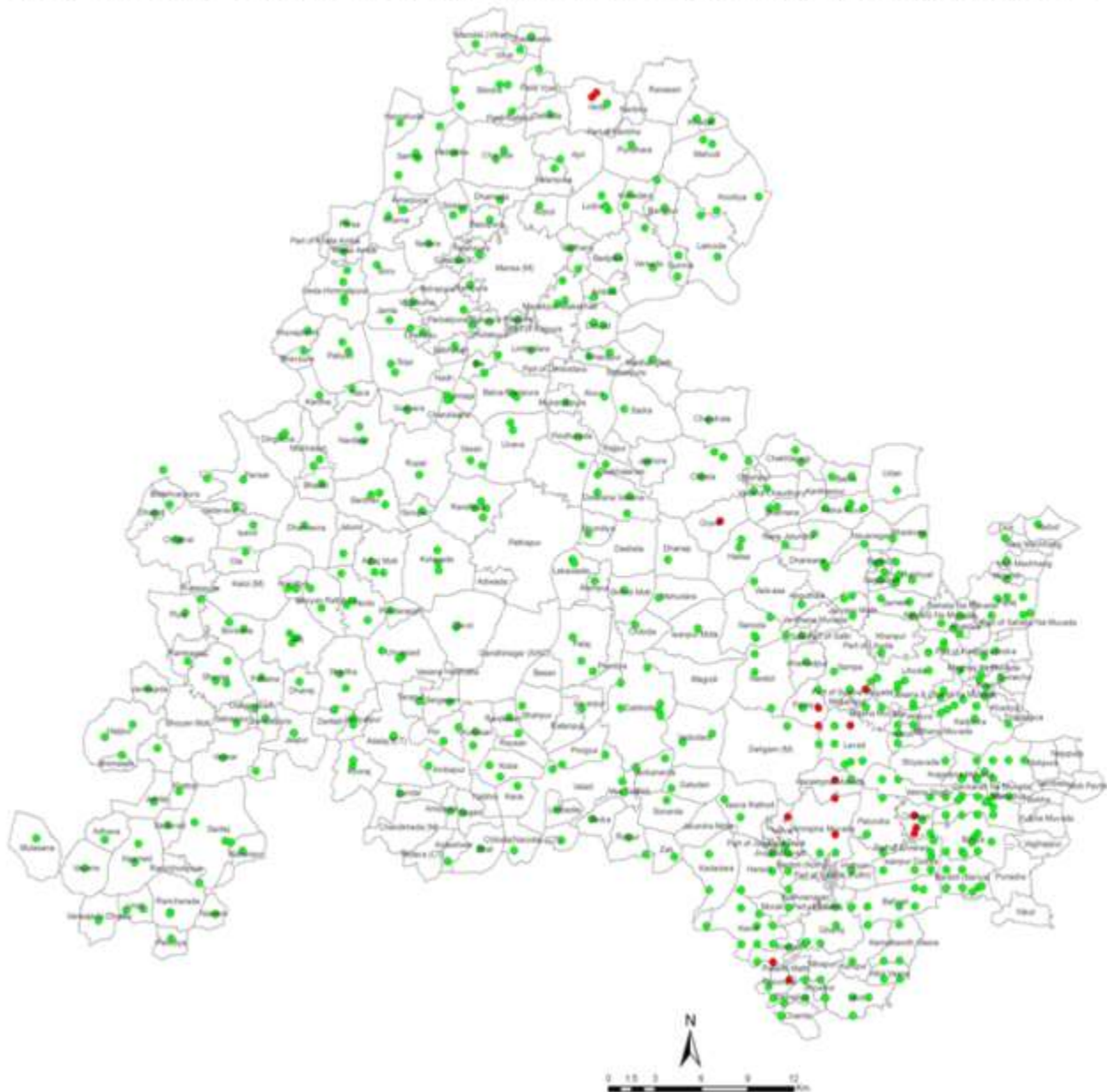
Capacity building, training and HRD activities for WQMS

Particulars	No.
Training to Water quality team members	76,931
Gram mitra	22,321
Anganwadi workers	3,765
ASHA workers	747
School Teachers	8,437
Bore operators	643
Nagarpalika officials	268
Total	1,06,101

Comparison of survey programs

WQMS Programme	% unfit for Fluoride	% unfit for Salinity	% unfit for Nitrate
2003	14.3	8.5	4.4
2003 UNFIT SAMPLES	4187/34845	2508/34845	1335/34845
2008-09 AVERAGE	6.5	2.7	1.9
2008-09 UNFIT SAMPLES	4198/83066	3720/83066	804/83066

Map showing Bacteriological FIT/UNFIT samples(GIS project) for Gandhinagar District



Legend

Water quality point

BACTERIOLOGICAL PARAMETER

- Fit
- Unfit
- Village boundary

Data Source : (1) Settlement Commissionerate & Land records
GoG.Gandhinagar
(2) WASMO Survey Data

Prepared for : WASMO Prepared by : 
Department of Science & Technology
Govt. of Gujarat,
Gandhinagar

Map showing Chemically FIT/UNFIT samples(GIS project) Gandhinagar district



Legend
Water quality point
Chemical parameter

- Fit
- Unfit
- ▭ Village boundary

Data Source: (1) Settlement Commissioner & LAND records
Govt Gandhinagar
(2) WASSMO Survey Data

Prepared for : WASSMO Prepared by :



Department of Science & Technology
Govt. of Gujarat
Gandhinagar

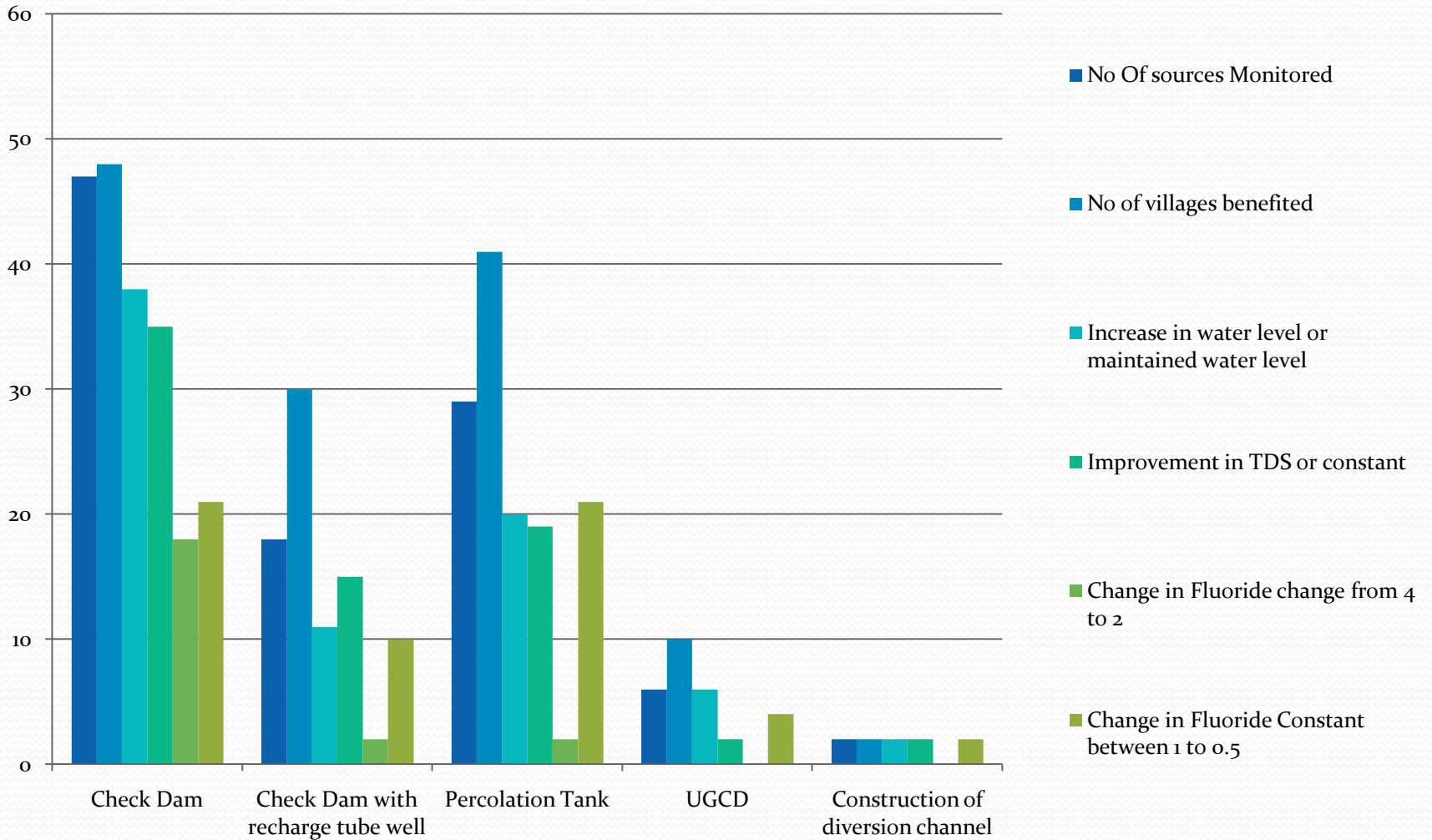


WRM Impact on Drinking Water Sources (Pre-monsoon data) in Kutch district from year 2005 to 2008

S. No	Type of structures	No. of sources Monitored	No. of villages benefited	Increase in water level or maintained water level	Improvement in TDS or constant	Change in Fluoride		Change in PH	
						change from 4 to 2	Constant between 1 to 0.5	8 to 7.0	7.5 to 6.5
1	Check Dam	47	48	38	35	18	21	5	36
2	Check Dam with recharge tube well	18	30	11	15	2	10	6	12
3	Percolation Tank	29	41	20	19	2	21	3	26
4	UGCD	6	10	6	2		4	0	6
5	Construction of diversion channel	2	2	2	2		2	1	1
Total		102	131	77	73	22	58	15	81

Note:- Figure shows that there 22 to 25 source where no positive change has been observed these sources are of RWSS or of IWSS which are having higher exploitation rates than the recharging rates.

Quality Remediation



Improvement in ground water table in different regions

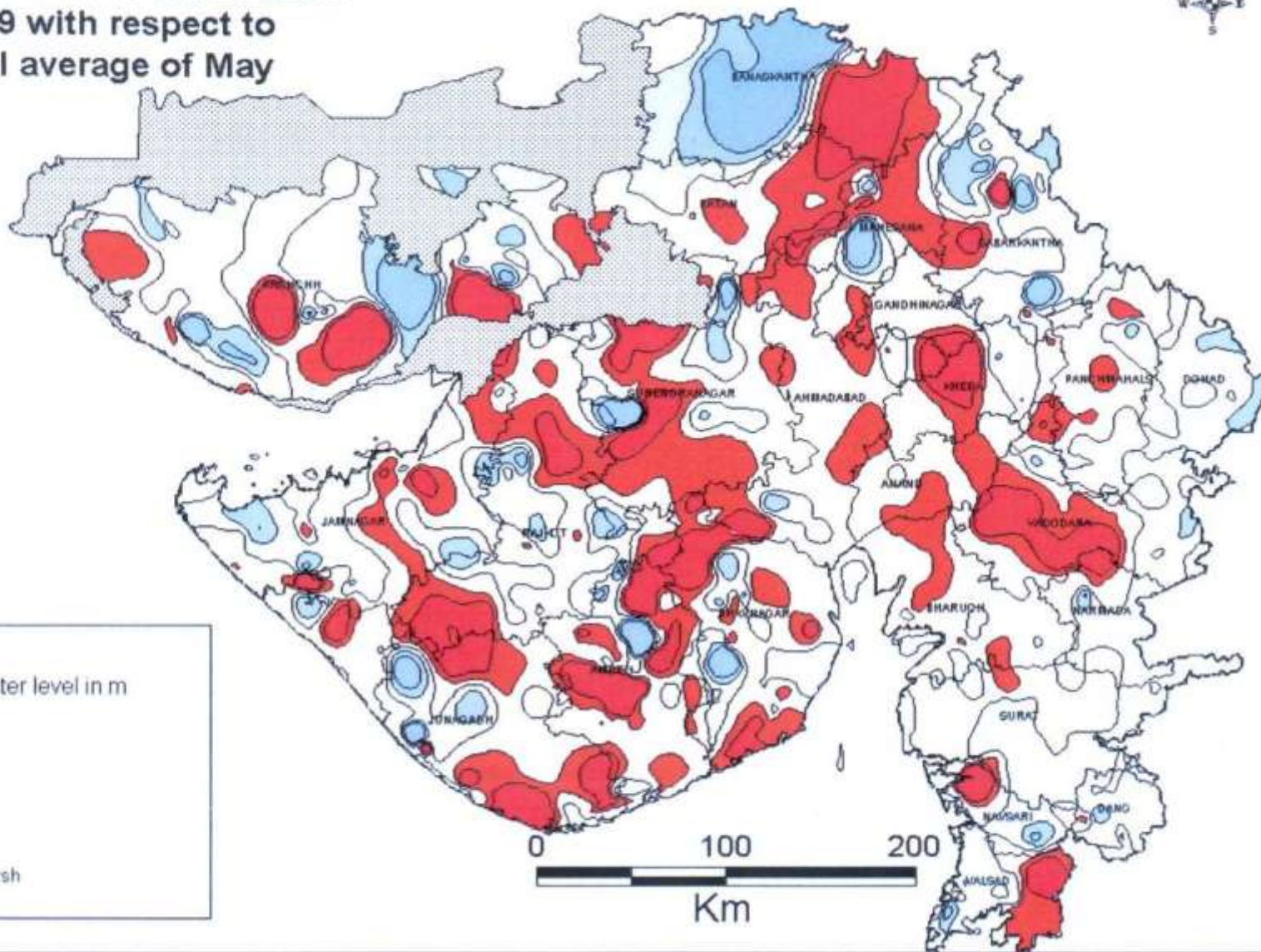
Region	No. Of Observation Wells	Avg. Increase in ground water table (Oct. 2001-Oct. 2007) (m)
Central Gujarat	574	4.71
Kachchh	391	0.10
North Gujarat	1088	1.08
Saurashtra	1894	6.82
South Gujarat	467	0.68
Gujarat State	4414	3.17

Decrease in emergency management through tankers



**Gujarat and UT of Daman & Diu
Decadal Variation of Water Level
May 2009 with respect to
Decadal average of May**

Plate - 5



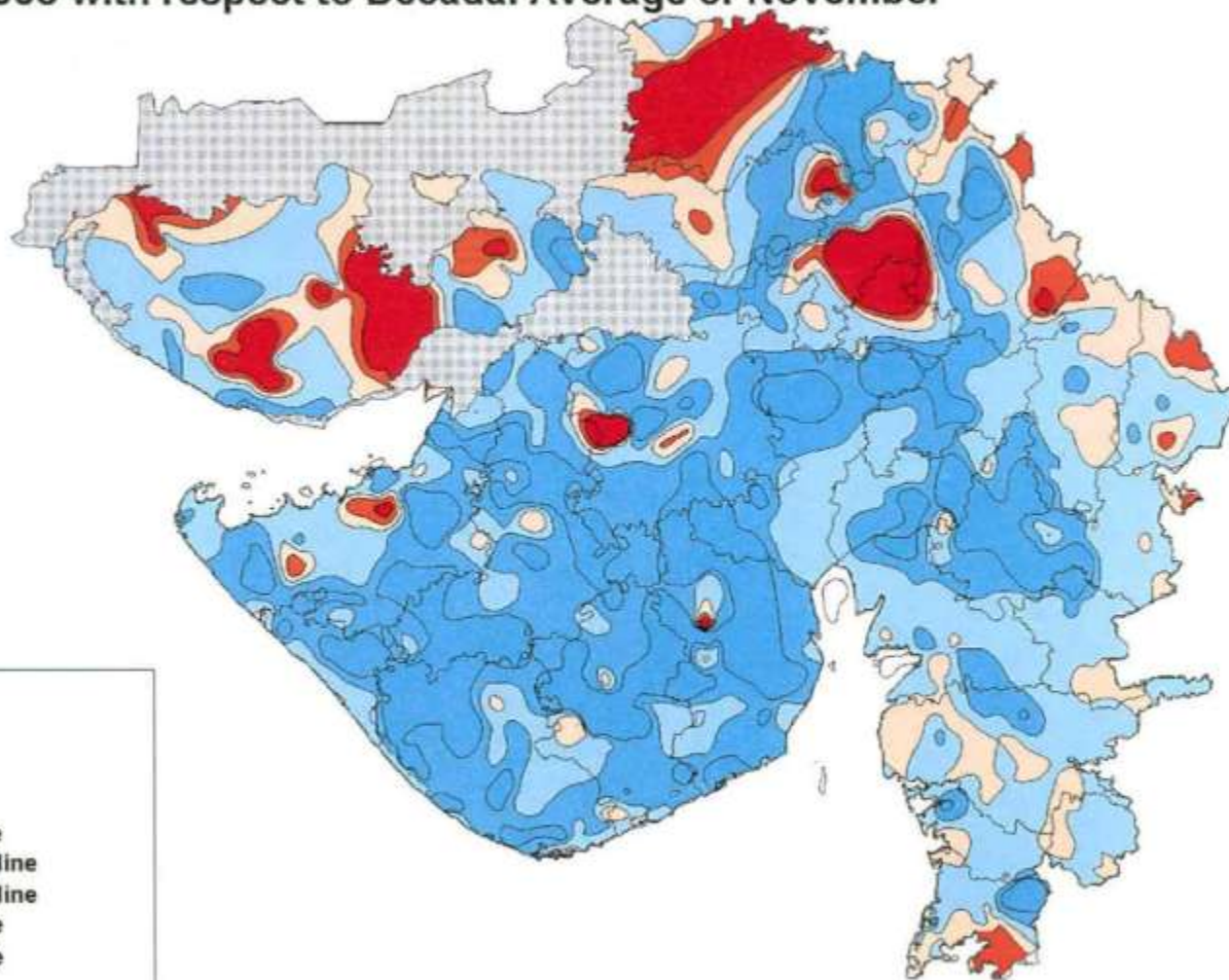
LEGEND

Fluctuation of water level in m

- > 4 m Fall
- 2 to 4 m Fall
- 0 to 2 m Fall
- 0 to 2 m Rise
- 2 to 4 m Rise
- >4 m Rise
- Rann & Marsh

**Gujarat and UT of Daman & Diu
Decadal Variation of Water Level
November 2008 with respect to Decadal Average of November**

Plate - 5



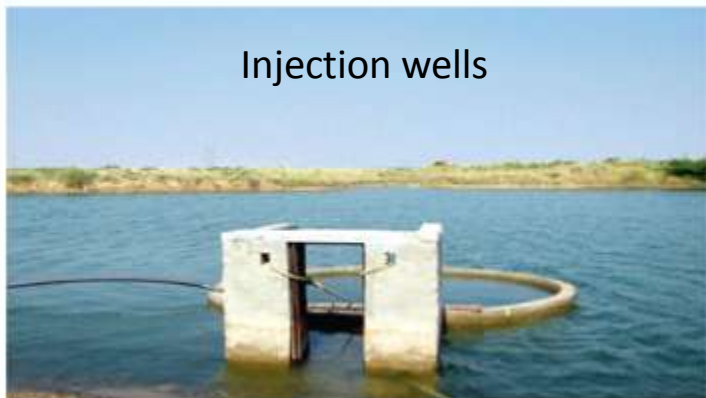
LEGEND

Fluctuation

-  >4 m Decline
-  2 to 4 m Decline
-  0 to 2 m Decline
-  0 to 2 m Rise
-  2 to 4 m Rise
-  >4 m Rise
-  Rann & Marsh

Community Initiatives for Sustainability

- Conjunctive use of water
- Dual Water Supply Systems - piped supply and local source; 24*7 supply
- Catchment Protection - Water sanctuary concept, pond protection
- Community led water resource management - immense impact
- Ground/surface water regulation



Community Initiatives for Sustainability

- Roof top rain water harvesting - more capacity than support (16,202 units)
- Conservative use - even fines for wastage
- Community managed solar pumping systems (30 units)
- Community managed Reverse Osmosis systems (48 units)
- Revival of traditional systems like Vavs (step-wells)



Innovations

- Gravity based schemes (spring based systems)
- Sameep Hand pump
- Cluster storage systems
- Waste water use- Excess water in trough and then to soak pit
- Waste water use for kitchen garden

Tapping perennial springs



Sameep hand pump

Kitchen garden through waste water



Use of spillage from stand post



Cluster Storage Systems



Excerpts from letter of Secretary, DDWS, GoI – 28th May, 2009

“The approach followed by WASMO has been widely acknowledged and it has been awarded the Prime Minister’s Civil Service Award as well as United Nations Public Service Award. You may like to use this validated approach/model with suitable modifications to meet the special requirement of your State to ensure that GPs/ VWSCs/ Pani Samitis/ local community start shouldering the full responsibility of drinking water, local water resource management, improved sanitation, hygiene etc. thus bringing in long-term sustainability in the sector.”





