Technological solutions for Water Challenges

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Water Scarcity : A Challenge to sustainable world

- 663 million people still need access to improved drinking water source . Drinking water source of 1.8 billion people fecally contaminated . 2.4 billion people need basic sanitation services
- More than 40% of the global population affected by water scarcity 1.7 billion people living in river basins where water use exceeds recharge. 70 % of all water abstracted used for irrigation. 16 % of electricity production is by hydro power.
- More than 80 % of waste water resulting from human activities discharged without any treatment
- Floods and water related disasters account for 70% of causalities due to natural disasters.

Water Sector : UN Sustainable Development Goals 2030

- Universal and equitable access to safe and affordable drinking water
- Improve water quality and reduce by half the proportion of untreated waste water
- Increase water use efficiency to ensure sustainable withdrawals and supply. Implement integrated water resource management. Protect and restore water related eco systems including wetlands, rivers, aquifers etc.
- Capacity building and community developmental programmes on water harvesting, desalination, water efficiency, waste water treatment, recycling and re use technologies.
- Enhance participation of local communities in water management.

Priority global intervention for sustainable water sector

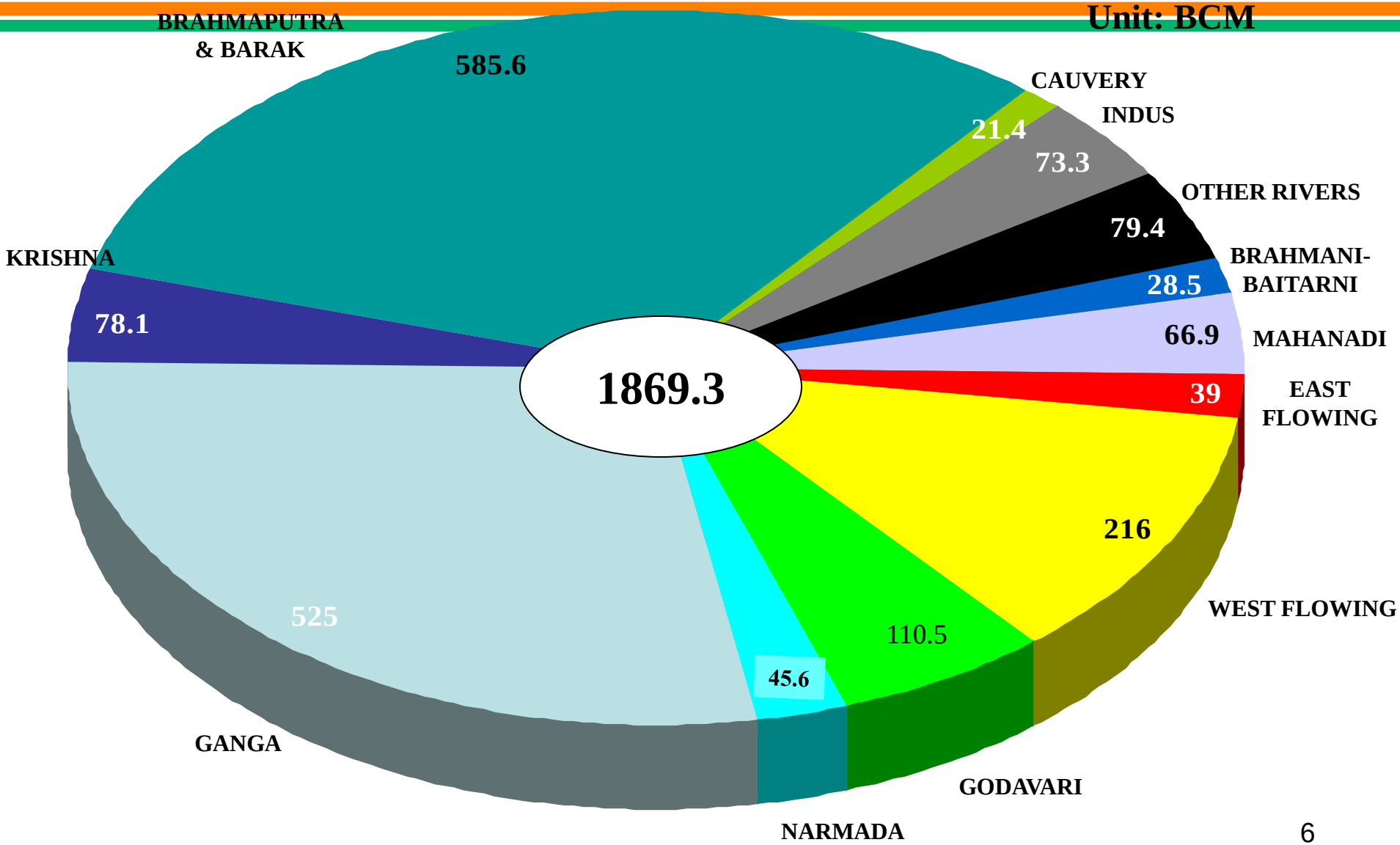
- Nurture ground water recharge harnessing rainwater . Water conservation and scientific rain water harvesting
- Water quality monitoring and promoting recycling and reuse. Water supply and environmental sanitation
- Converting saline to fresh
- Decentralised demand driven community managed water resources management

Water Availability – Indian Scenario

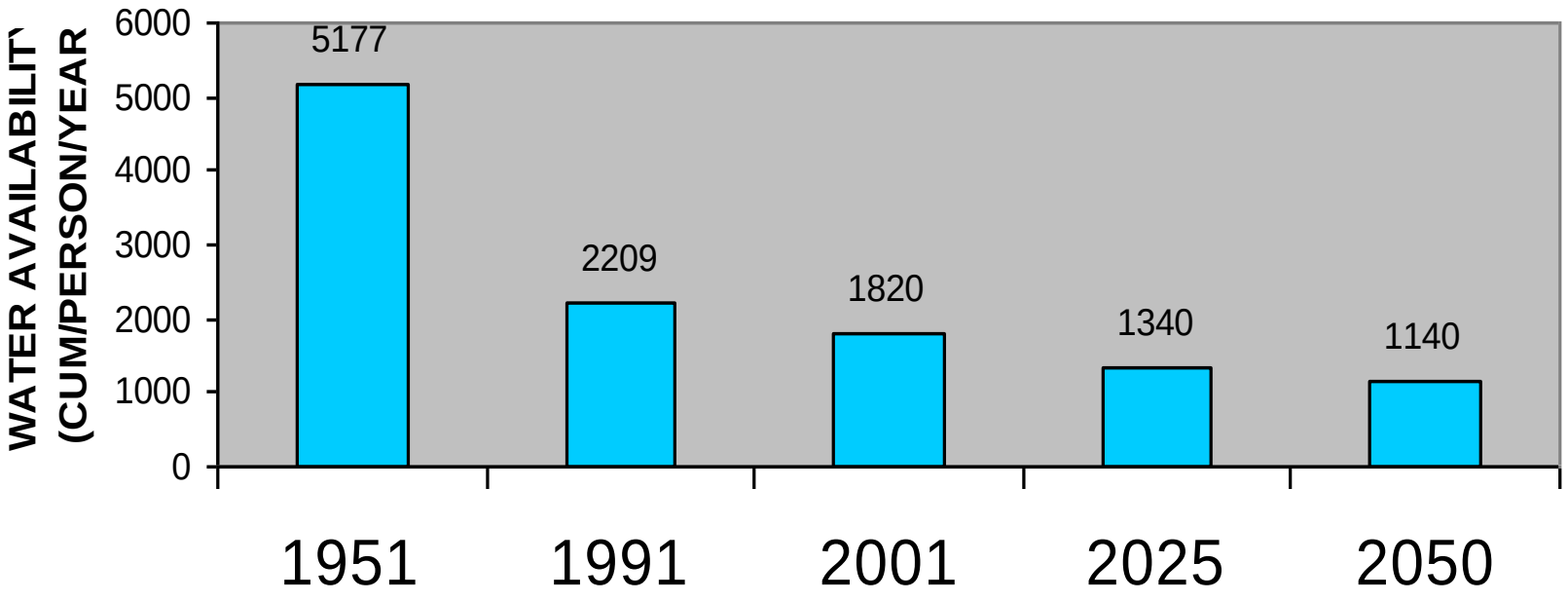
- India has 2.45 % of world area--4 % of global precipitation falls over it
- **17% of global population lives in India**
- 90% of precipitation falls in 100 days in approx 100 hours
- Spatial distribution of rainfall is highly uneven
- At least 9 River basins Water Scarce

River Basins –wise Water potential

Unit: BCM



PER CAPITA WATER AVAILABILITY



Total Utilisable Water	1123 bcm
Surface Water	690 bcm
Ground Water	433 bcm
Actual Utilisation	710 bcm

Water Stressed< 1700 m^3/yr
Water Scarce< 1000 m^3/yr
Present Status 1545 m3/yr

Water Quality Scenario in India

1. Physical

- High Turbidity in surface water, hardness, pH, Total Dissolved Solids

2. Chemical

- **Iron** ..... 23 States affected
- **Arsenic** ..... 5 States affected
- **Fluoride** .....19 States affected
- **Nitrate** ..... Almost all hydrogeological formations have nitrate concentrations
- **Salinity**

- Inland salinity: arid and semi-arid regions of 10 States affected
- Coastal salinity: 7,500 km long coast line affected

3. Bacteriological & Virological

- *E-coli* or Thermo tolerant bacteria (present in large number in open water bodies), Total Coliform Bacteria, Presence of Viruses

4. Water Pollution

- Organic Matter, Organic Micro-pollutant, Suspended Matter, Atmospheric Pollution

Critical Water issues

Quantum deficit of water

- Irrigation area tripled to 330 million Ha from 1970-1999
- Loss of ground water 109 km^3 from 2002 to 2008 in North West India
- 31% districts covering 33% land area and 35% population do not have adequate water available

Quality deficit of water

- 347 districts affected by biological and chemical contamination
- reducing availability of water for drinking, domestic use, irrigation, etc

Water Challenges

Problem	Solution
• Unavailability of Water	▪ Winning water from sustainable resources
• Poor quality of water for intended use	▪ Augmentation of quality of water from available and accessible sources
• Indiscriminate Use	▪ Renovation for recycle.

Translation of Research from lab to Field

- Oriented Fundamental Research
- Enabling Research & Development
- Precompetitive Technology Development
- Technology Assessment
- Customisation of Technologies
- Solution Design
- Solution implementation and sustenance

Role of S&T interventions

- Challenges require timely, urgent, cost effective, socially viable and sustainable techno-management solutions customised to socio-economic context.
- Challenges result of several social and managerial conflicts. Solutions would require more tools than what individual disciplines can offer.
- S&T can contribute in managing net demand and supply through making research based solutions available to community
- S&T can facilitate unbiased holistic assessment of intervention

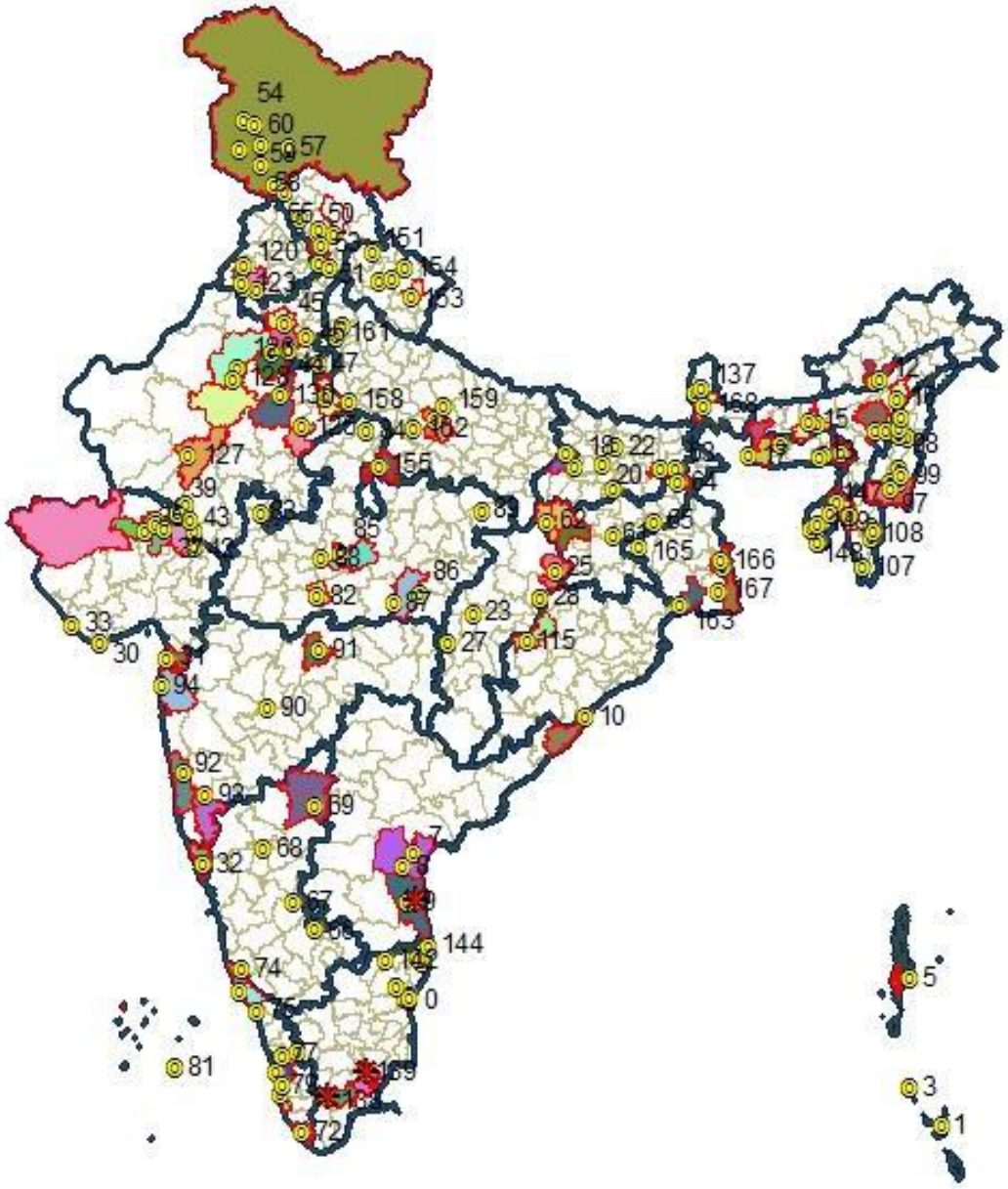
Approach for finding out SMART technological solutions

- **S**cale, scope and seriousness of the impact on natural resources especially water
- **M**apping the Challenge and Matching of technological solutions
- **A**ssessment, adaptation and absorption of technologies in different social context
- **R**ooting the selected solutions with the stakeholders' involvement
- **T**echno-economic feasibility ,Social viability and Environment Sustainability Analysis for solutions

Enlistment of Water Challenges facing the Country

Water Availability Challenges	Water Quality Challenges	Scientific Water Management Approach
Low per capita availability	Quality deficit of available water for specified uses	Storage capacity for seasonally available water and Water body disuse
Evaporation loss from water bodies	Contamination through Arsenic, Fluoride, Iron, multiple species, pesticides and other water derived residues	Surface run-off on account of nature of geological terrain
Water winning and mining in water starved areas	Biological contamination	Mismatched rates withdrawal and recharging capacity
	Alkali metal ion salinity and Alkaline earth metal salt salinity and hardness	Non-optimal use of water in agriculture and industries
	Sea water intrusion in coastal areas	River flood management
		Wetland management

Selection of water challenged locations



- 187 hotspots identified across the country
- 89 clusters shortlisted

Evaluation and Selection of SMART Technology solution

- **Technical Feasibility** - Product Definition, Capability to meet requirements consistently, system intelligence
- **Environmental sustainability** – Sustainability of source, disposal of rejects, if any
- **Energy requirement** - power availability / power back-up
- **Social acceptability** - capacity of community, socio-cultural factors affecting acceptance of proposed solution
- **Economic viability**- cost of delivered water

Scouting global solutions

- Adoption of non-conventional technologies proven abroad
- Customization of global best practices
- Cost -optimisation of solutions developed globally under real life conditions
- Co-investment for cogeneration of solution for India and other third world countries facing similar challenges
- Linkages developed with Finland, Germany, UK, US, Autralia, Netherlands, Canada, Israel, United States, Japan etc in the field of energy and water.

Water Solution complete with revenue model: Buja Buja

- Water Issues-Low per capita availability, Salinity, sea water intrusion, Iron, TDS
- Technology: Membrane Technology for drinking Water. Coagulation and Chlorination for domestic use. Settlement and Flocculation for Waste Water treatment.

- Waste Water treatment Plant –to reuse it for irrigation and to recharge the Ground water table.

- 125 kilo liters per day(KLPD) domestic water
- 75 KLPD drinking water
- 1 MLD treated wastewater
- 12170 beneficiary population
- 3000 families (drinking and domestic water)
- 2000 farmers (treated waste water to irrigate)
- Sustainability-Each household pays an amount of Rs 60-90 per month for O&M.

Membrane systems for water treatment

Similar Approach adopted in Mamsapuram and Thirupattur.

Technological Solution for Removing Excess Arsenic From Drinking Water

- Challenge
  - Cost effective user friendly system for Arsenic Removal
- Options
  - **Dual Stage- zerovalent iron**
- Outreach
  - Developed Systems demonstrated at 53 locations in various parts of Uttar Pradesh, Bihar, West Bengal and Assam
- Network
  - Indian Institute of Technology Bombay (IIT-B) local community, NGO's
- Outcome
  - Systems capable of consistently delivering drinking water< 10 ppb ready for replication.

Cost of delivered water is *Rs. 3.3 per cubic meter.*

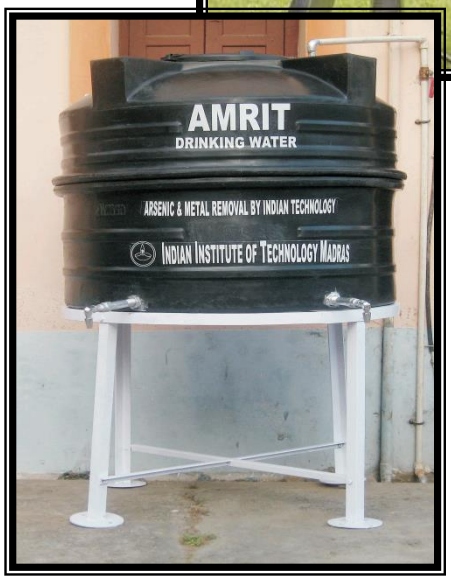
AMRIT-Arsenic and Metal Removal by Indian Technology

- A water purifier for arsenic and iron free drinking water, based on iron oxyhydroxide, a nanostructured material to remove arsenic has been developed by IIT Madras.

- The technology commercialised to Innonano Pvt Ltd. a start up incubated in IIT M. Arsenic Task Force of West Bengal government certified and approved the purifier.

- It has been implemented at various levels - homes, small communities and large scale water supply programs. 200 household units demonstrated in Yadgiri District in Karnataka, Murshidabad district in West Bengal and in Bihar.

- 160 units of community filter demonstrated in Villages spread across the districts of Murshidabad and Nadia, (West Bengal) Functions without electricity. Cost of domestic filter is Rs. 1500/- and community filter is Rs. 99,000/-



Amrit water purifier System

Augmentation of water resources through use of renewable energy at competitive cost

Solar MED Desalination

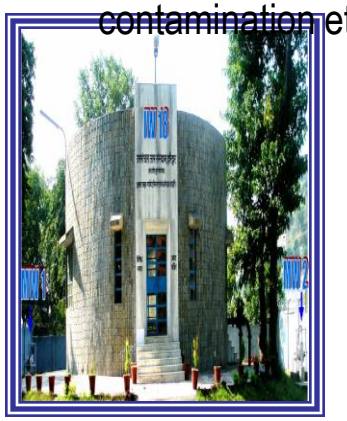
- *Utilisation of concentrated solar thermal energy for supplying potable water to costal community in Narippaiyur (Ramanathapuram, TN).*
- *Solar- Multi Effect Desalination (MED) System delivers 6000 LPH potable water.*
- *1850 families provided with drinking water besides ultra-pure industrial grade water.*
- *Learning from the experience paved the way for development of suitably up scaled cogeneration systems capable of producing power as well as water.*
- *Desalination technologies like MED can also be powered with Waste heat from thermal power stations, Nuclear power stations, oil refineries etc.*
- *The project has been conferred 'Grand Challenges: Top Solutions' Award of Technology Review (a Publication of Massachausetts Institute of Technology, USA and ' FICCI-HSBC Water Award (Innovation Category-1st Rank)' by Federation of Indian Chambers of Commerce and Industry (2013)*

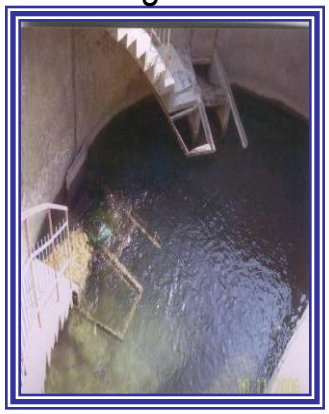
India's first indigenous Multi-Effect Distillation System Installed in Narippaiyur, Ramanathapuram, Tamil Nadu

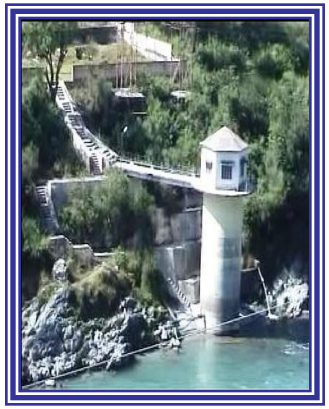
The people of the village receive water through this project developed and funded by the Department of Science and Technology, Govt. of India, and executed by Empereal-KGDS Renewable Energy Pvt. Ltd., Coimbatore, India.

Treating Water naturally : River Bank Filtration (RBF)

- A low cost energy effective pretreatment step to remove pathogens and organics from water bodies
- Addresses water challenges like surface run off , seasonal variations, biological contamination etc.







- *Reduction in biological regrowth by more than 60%*
- *Reduction of non-organic matter by more than 50%*
- *Reduces reliance on a single source water supply (storage)*
- *30-60 KLPH safe water at each place.*
- *15000 families served (drinking and domestic use)*

- RBF project demonstrated on a beneficiary population of 61,150
- Unit price of treated water-Rs 1.75 per cubic meter. (1/10 th of conventional systems)
- Needs 20 % area
- Replicated and upscaled on larger populations.

Treating without rejects : In-Situ Purification (ISP) for Water Supply

Challenges Identified:

- Presence of highly saline ground water with concentration of F and NO_3
- Ground water saline at all level,
- Water logging and water bodies with filled domestic wastewater.
- The sub surface lithology consists of clay, silt or silt with kanker with thin intercalation of fine sand.

Mechanism Adopted: ISP pushes the water through the membrane system. The processed (pure) water is discharged on the surface while the reject water is discharged into the deeper aquifers with higher salinity and therefore very environment friendly.

- *The cost of the Processed water is = 5-8 paisa/ litre*
- *Maintenance & operation cost = 2-3 paisa/litre*
- *At present water is available through private supplier and tanker has perpetual quality problem.*
- *300 villagers are the beneficiaries and ready to pay*

Senior Girls Higher Secondary School, Jhajjar

Member CGWB and other participants drinking water

Integrated Water Management in Water Scarce Region

Scientific Rain Water Harvesting : 137 lac liter water storage capacity at household level

- Ground Water Recharge : pouring more than 700lacs liter water back to ground
- Paani bhi Swachta bhi : 601 toilets for poorest of the poor.
- Sustainable agriculture practices : replacement of water intensive crops

Rain Water Harvesting Tanks at Chirawa

Complete Pond Site at Vill: Kishorpura

Convergent technology solutions on Conservation & *Harvesting*

• **Challenge** : Scanty Drinking Water Availability in lean periods due to hilly terrain and surface run off.

• **Intervention**: Rain Water Harvesting/Storage in Hilly terrains of Nagaland, Mizoram, Sikkim &Tripura and arid water scarce regions of Rajasthan.

• **Approach**: Develop a Water Management System through community Participation.

• **Solution Provider/Network**: S &T State Councils, NGOs &Local community.

RWHS in **Kijümetouma**

RWHS in Zhadima

Water Tanks & Catchment Area in Bicchiwara Cluster Dungarpur Dist.

Outcomes

- Technologically feasible solutions for 19 site-specific water challenges in 212 villages across 23 states with pathways for upscaling.
- Vibrant Water Quality Monitoring Networks in partnership with stakeholders.
- Support to 200 national and collaborative technological endeavors to develop research leads for addressing prevalent and emerging water quality and quantity related problems.
- Water Advanced Research Innovation (WARI) fellowship with US Collaboration. Bilateral research and Capacity Building programme with France, Netherlands and USA to tap global expertise

Way Forward

- Identification of priority areas based on national thrust and inherent strengths and development of R&D Roadmap
- Consortium based R&D Strategy based on innovative models such as Public- Private-Academia Partnership
- Establishing state-of-art research and testing facilities to promote innovative science and accelerate development of emerging technologies
- Collecting, collating, experimenting and building scientific information for facilitating rationale decision making
- Developing knowledge based strategies for catalysing innovations for energy applications
- Capacity building of R&D professionals and provision of state-of art infrastructure

Thank You