Institute of Geological Sciences
Hydrogeology Group

Freie Universität Berlin




# Seven years of applied groundwater research in India

## Optimization of natural treatment systems in urban areas

**Michael Schneider & Elango Lakshmanan**

# Natural Treatment Systems in Water Management

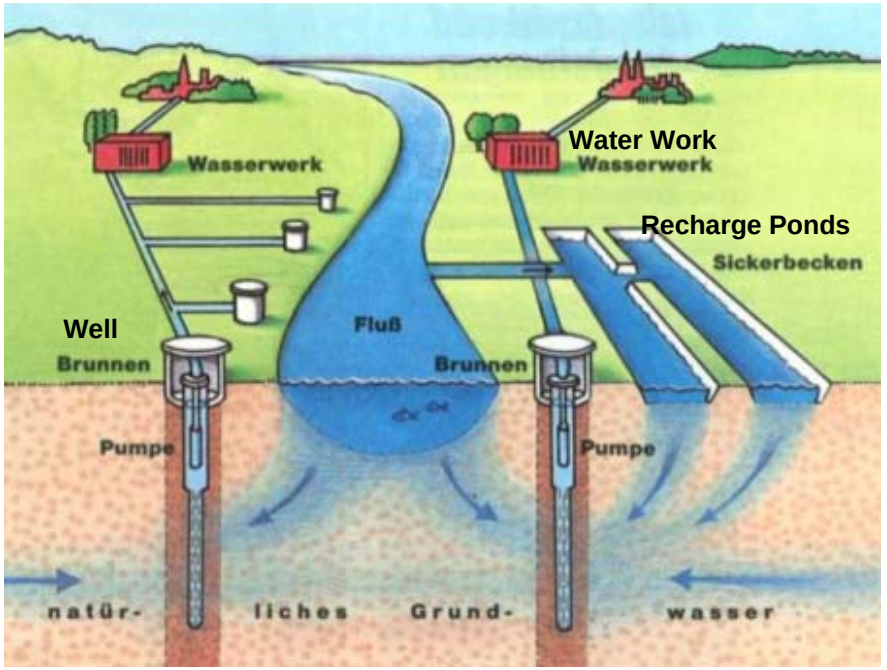
- Water/wastewater treatment systems in which the process of contaminant removal is not supported by the input of significant amounts of energy/chemicals

- Soil/aquifer-based systems: e.g. cleaning process through sand filtration; bank filtration (BF), managed aquifer recharge (MAR)
  vegetation-based systems:
  e.g. (constructed) wetlands

- Removal of suspended solids, organic matter, microorganisms, nutrients (N, P) and other contaminants possible

- cost-effective, environmental friendly, reduce stress on water resources;
  **in combination with or as an alternative to conventional treatment systems**

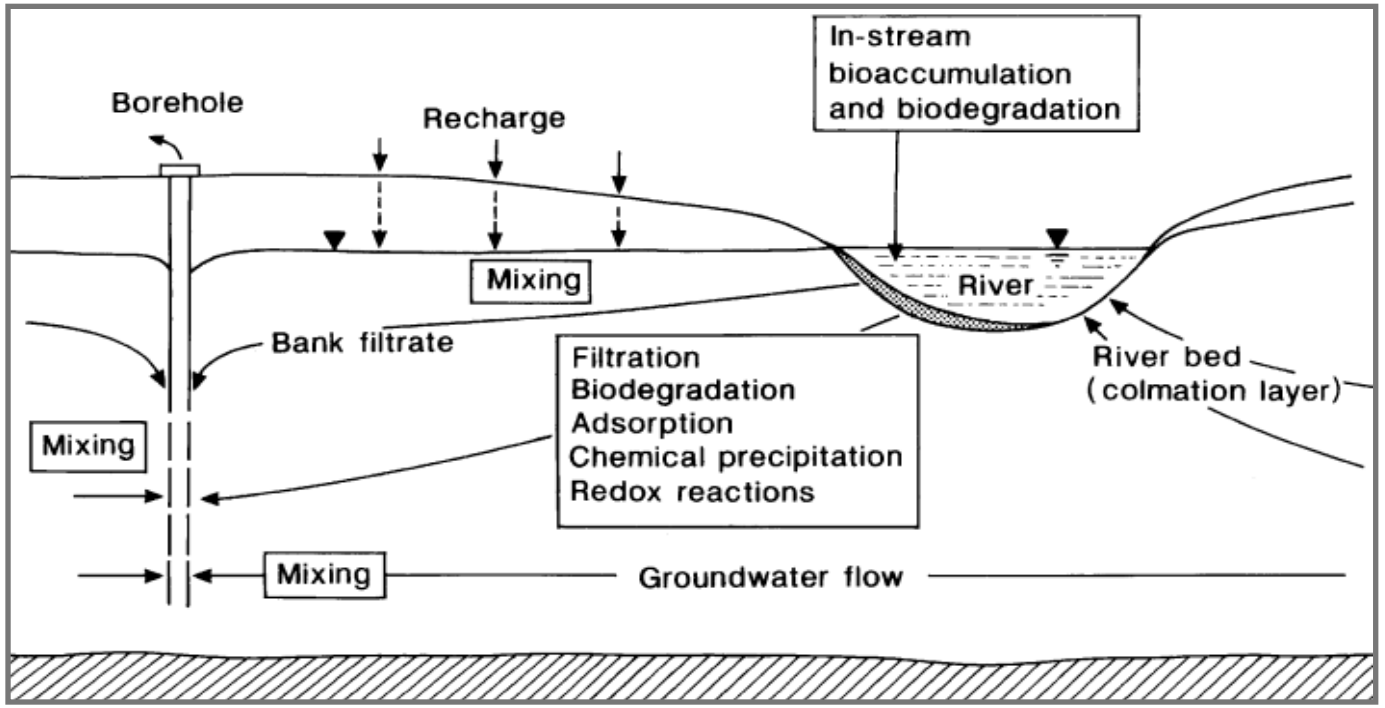
- Contribution to sustainable water management




BWB 2009

# Research is focussed on:

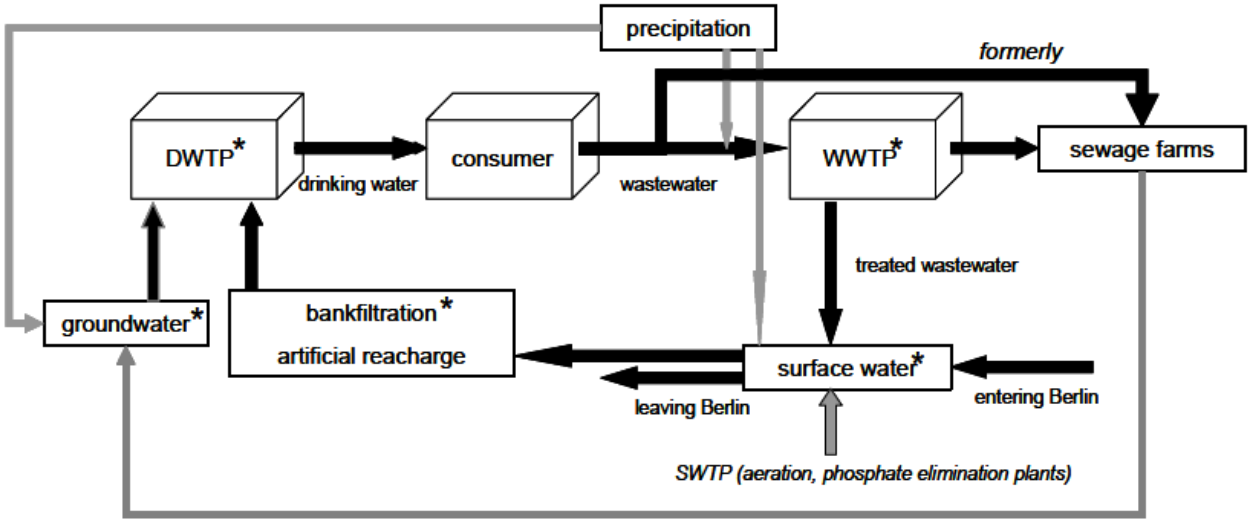
- Quantification of the infiltration process: Rivers, lakes, ponds
- Filtration and mixing processes in the aquifer
- Well ageing, optimized well management
- Impact of climate change on urban water management




***Hiscock & Grischek (2002)***

# The Urban Water Cycle in Berlin

- Semi-closed urban water cycle
- 9 waterworks in operation, about 800 water wells
- 60-70% bank filtrate in the well water
- Aeration in order to precipitate iron and manganese, filtration, no chemical treatment, no disinfection




- ***Water research in Berlin: Multidisciplinary research within a network of institutes and/or companies***
- ***Excellent research infrastructure available in the region Berlin-Brandenburg***

KWB – KompetenzZentrum Wasser Berlin

# Groundwater Research in India since 2005

- How can we promote research through the exchange of knowledge and experience at international level?
- What are the processes of BF & MAR considering different climate conditions and contamination scenarios?

2005 – 2006 **IDB India** – International Development of Bank Filtration – Case study India (funding: KWB); feasibility study previous to TECHNEAU

2006 – 2011 **TECHNEAU** – Technology Enabled Universal Access to Safe Water (funding: EU; 13 million €, 30 international partners); Function and relevance of bankfiltration, 2 case studies in Delhi

2011 **Urban water management of Raipur city** (funding: GIZ); Water balances of selected lakes/ponds; surface water/groundwater interaction

2011 – 2014 **Saph Pani** - (funding: EU)

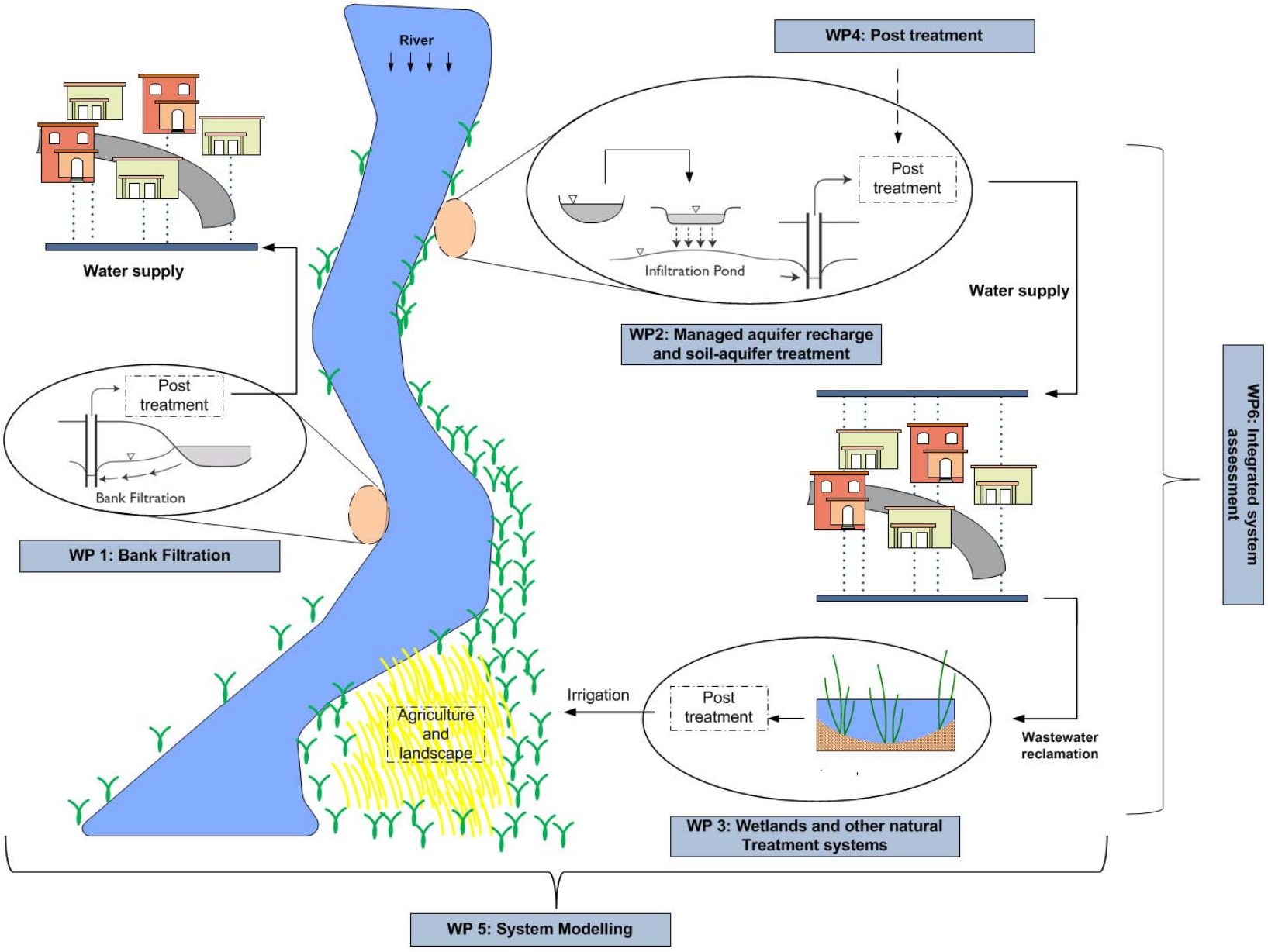
# Saph Pani - clean water

## Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India

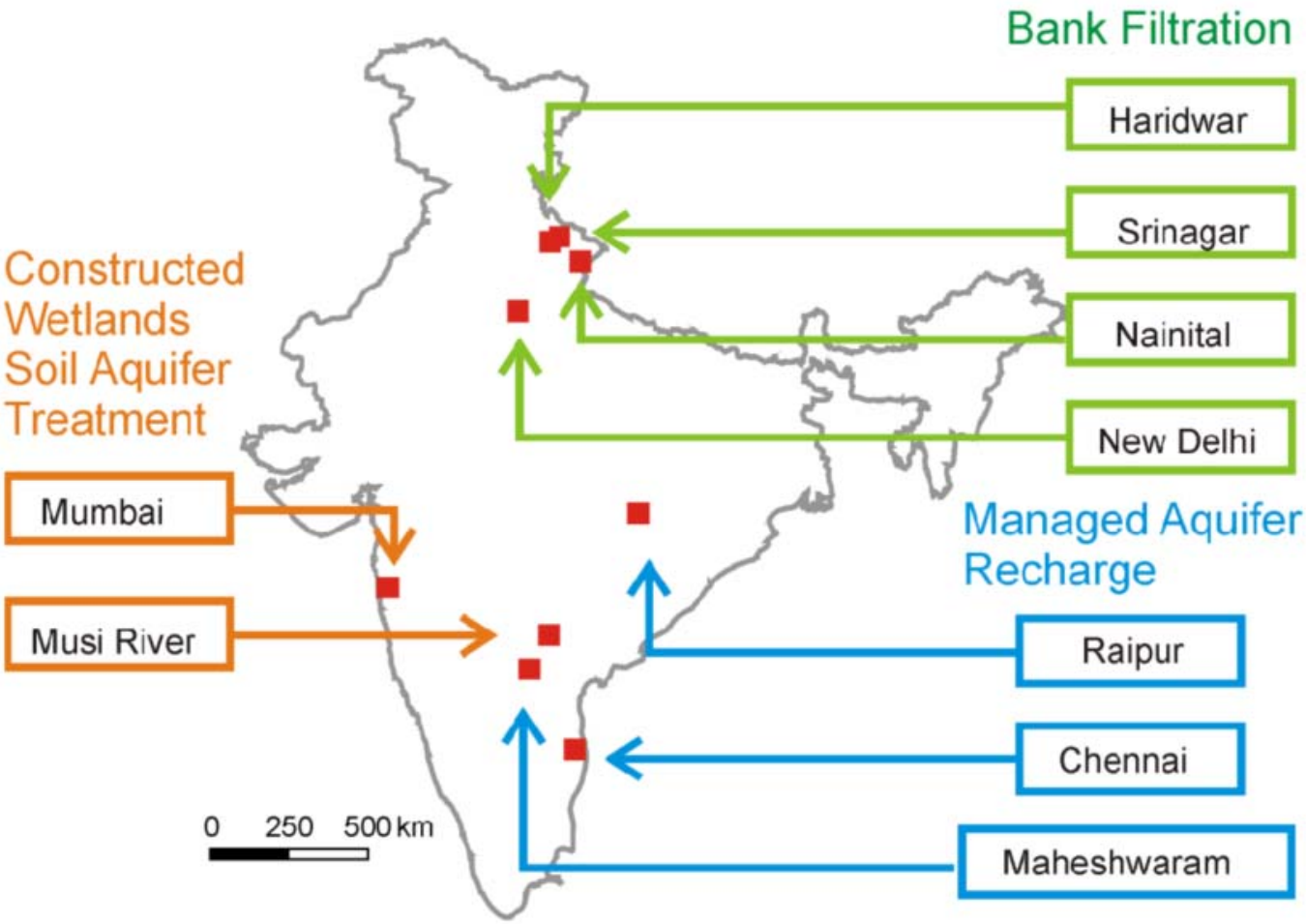
- a collaborative research project funded in the EU FP7 – sub-programme Cooperation/ ENV
- 20 project partners from academia, research centres and industry (>50% Indian partners)
- total budget ca. 4.7 million €, EU funding ca. 3.5 million €
- start 1 October 2011, 3 years duration

# The Saph Pani Project: Objectives

- Improve scientific understanding of the **performance-determining processes occurring in natural treatment processes** (bank filtration, managed aquifer recharge and wetlands)
- Study **removal and fate of important water quality parameters** such as pathogenic microorganisms and faecal indicators, organic chemicals, nutrients and metals
- Investigate **hydrological characteristics** (infiltration and storage capacity) and **eco-system functions**
- Improve **water resources management strategies** (e.g. by providing buffering of seasonal variations in supply and demand)
- Evaluate the **socio-economic value of natural water treatment**, taking into account long-term sustainability and comprehensive system risk management.


River
WP4: Post treatment
Post treatment
Infiltration Pond
Water supply
Water supply
WP2: Managed aquifer recharge and soil-aquifer treatment
Post treatment
Bank Filtration
WP 1: Bank Filtration
WP6: Integrated system assessment
Irrigation
Post treatment
Agriculture and landscape
Wastewater reclamation
WP 3: Wetlands and other natural Treatment systems
WP 5: System Modelling

# Study sites



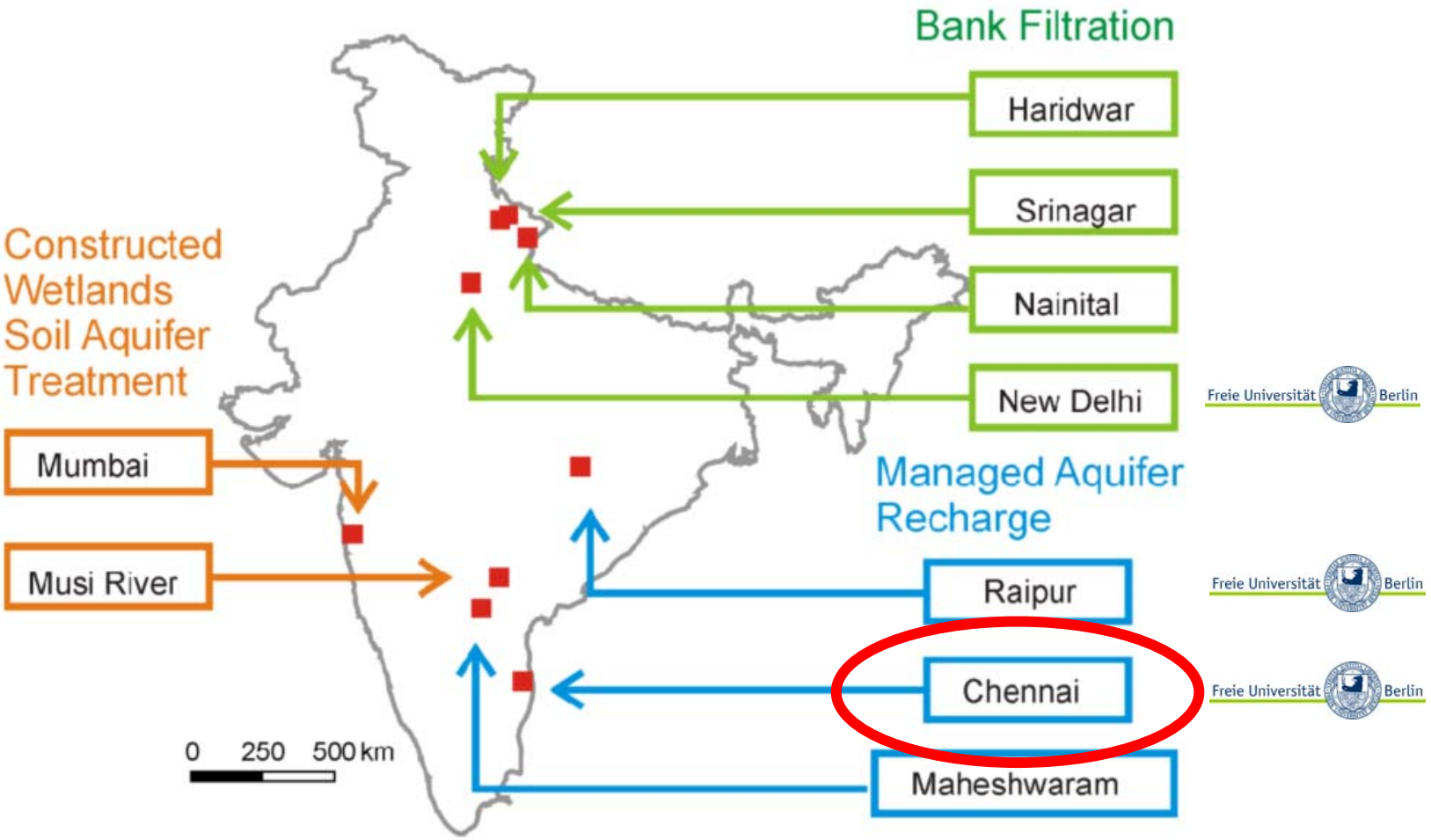

**> Please have a look at our posters!**

# Expectations - Outlook

- Accomplish scientific objectives: knowledge, results, publications, degrees
- Demonstrate successful EU-India cooperation
- Learn from each other
- Provide visibility to the project: dissemination, training, exploitation
- Provide the research support to solutions implemented in “real life”

- *Strengthening of cooperation between Anna University Chennai and Freie Universität Berlin in research and teaching*
- *Involving BSc, MSc, PhD theses*
- *Workshops for end-users and scientists (India Water Week, Delhi 2012; Teri Institute, Delhi 2011), training for students (UNESCO-IHE Delft, 2010)*

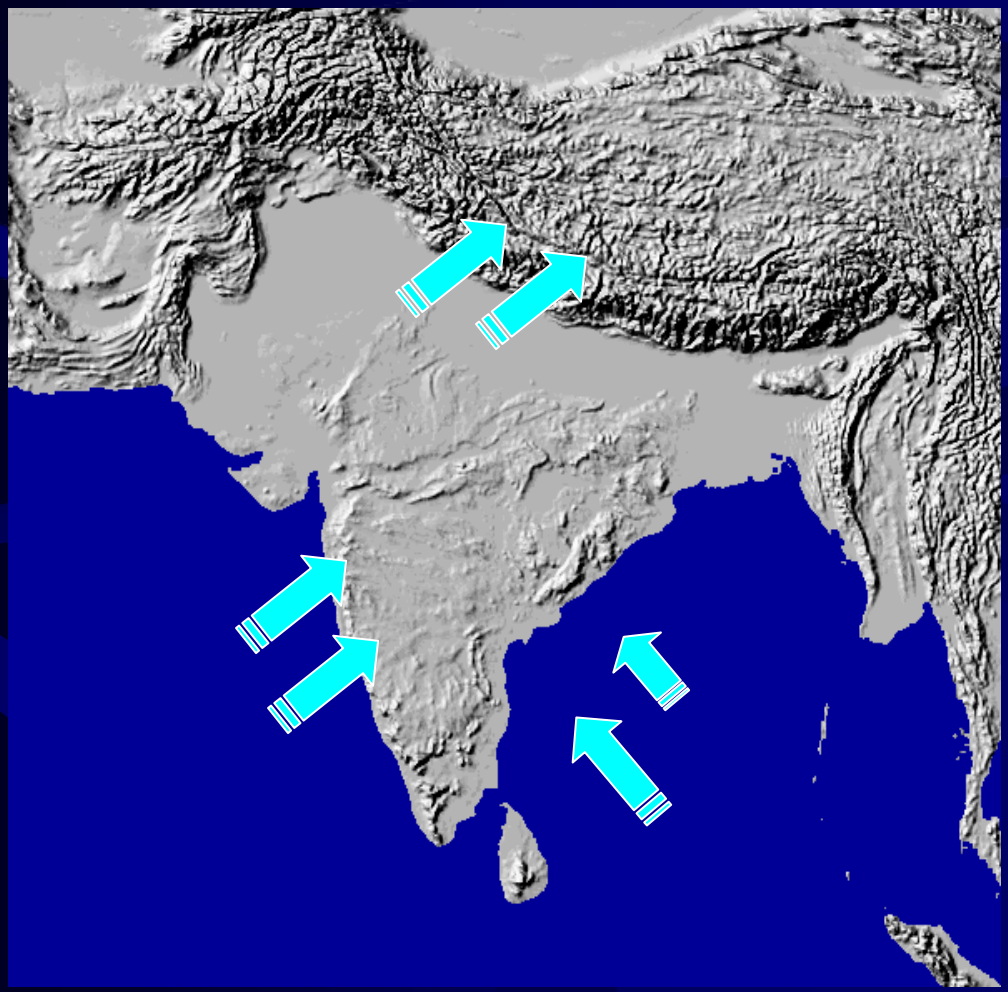
# Study sites

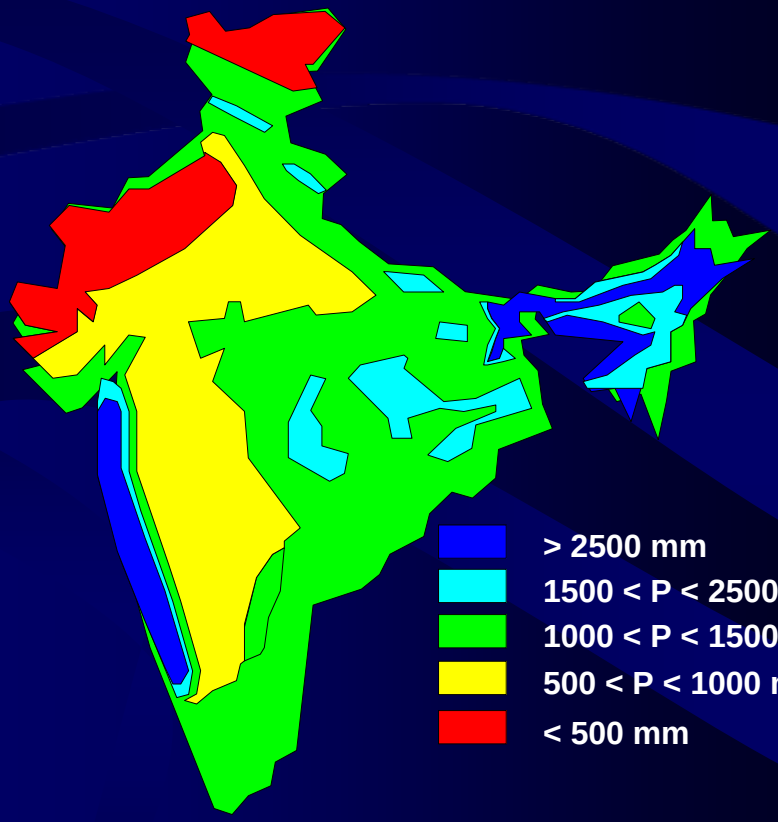



**> Please have a look at our posters!**

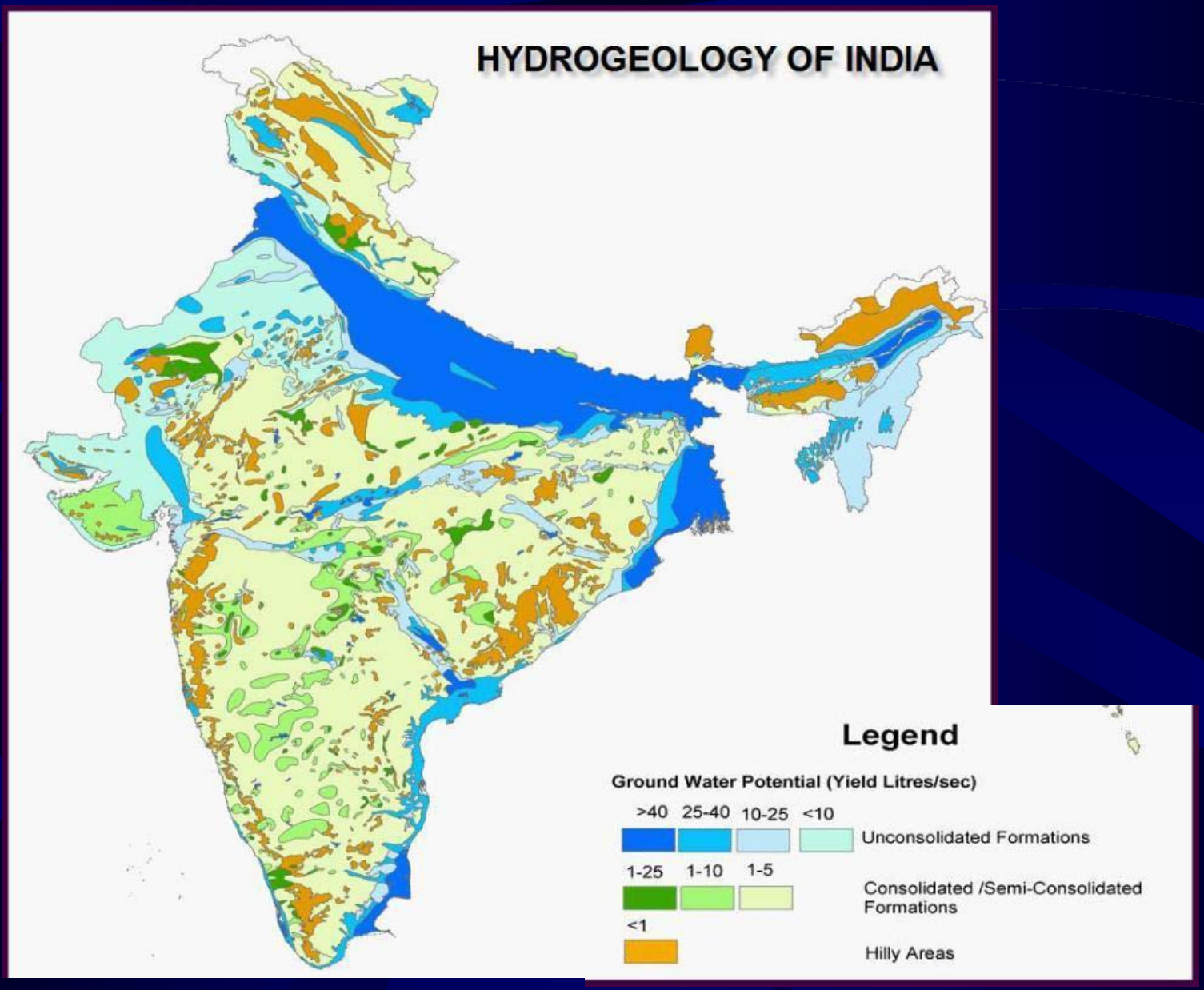
# Spatial and temporal variation in rainfall

**Annual Average Rainfall: 1200 mm**





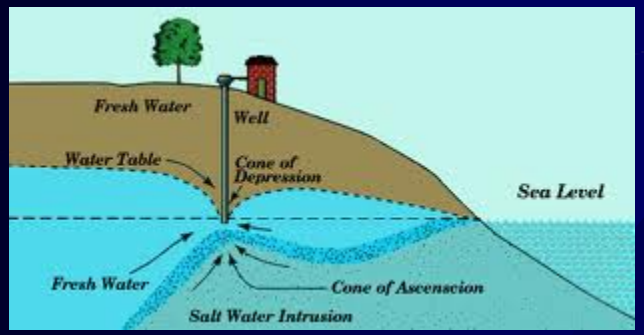
# Groundwater

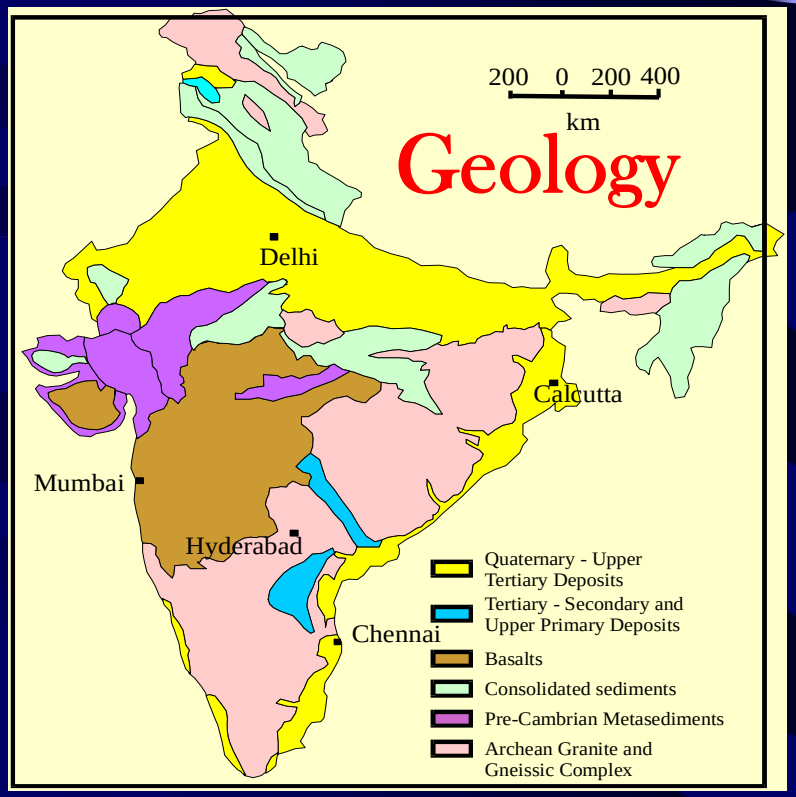





Source: CGWB

# Seawater intrusion in India




- 7000 km long coast line
- Sandy formation in most places
- Large population live on the coast
- Over pumping of groundwater
- Seawater intrusion a major problem

# Mitigation Methods to control seawater intrusion

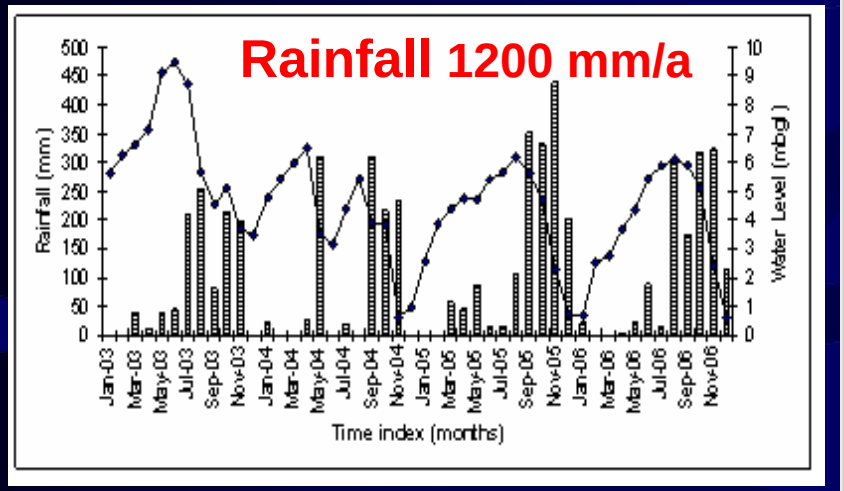
**Best option**

- Reduction of pumping
- Rearrangement of pumping wells
- Induced recharge (Ex: Ponding)
- Artificial injection wells parallel to coast
- Seawater pumping wells parallel to coast
- Subsurface barrier

**MAR**

**Increasing cost**

# Chennai's water scenario





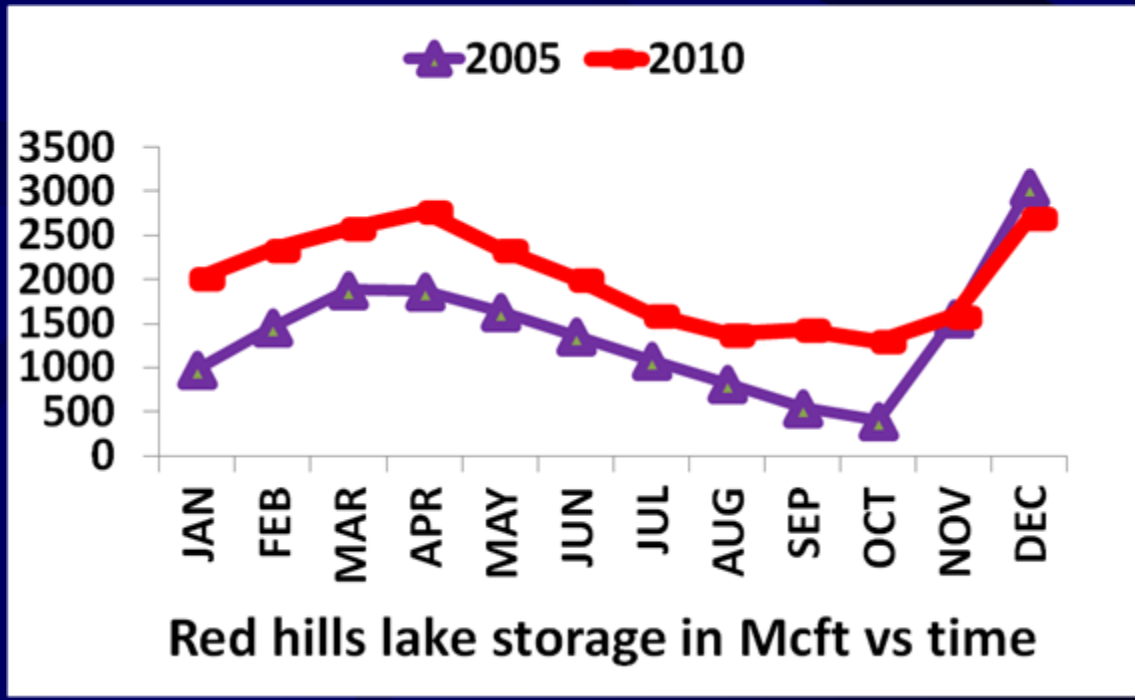
Water supply:

- Reservoirs (a few around and one at 160km)
- Groundwater – from North and South of city
- Two desalination plants coming up!


Chembarambakkam

# Chennai – Groundwater usage

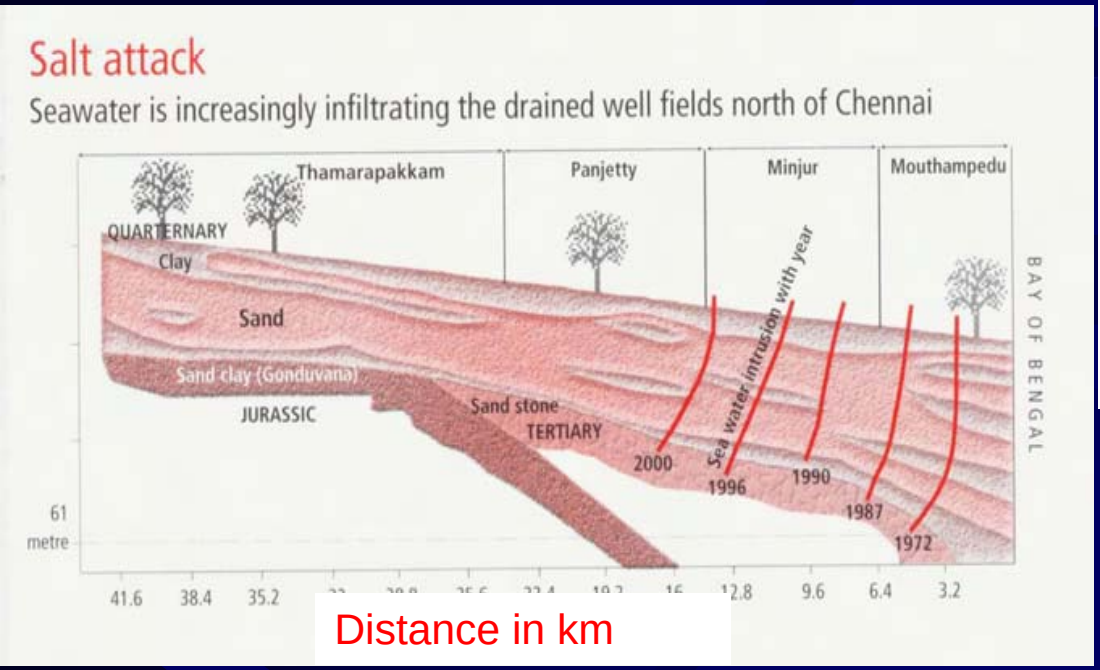
| Sources | Water supply in MLD | Water supply in % |
|---|---|---|
| Surface water | 590 | 95.93 |
| Northern well fields | 20 | 3.25 |
| Southern well fields | 5 | 0.82 |

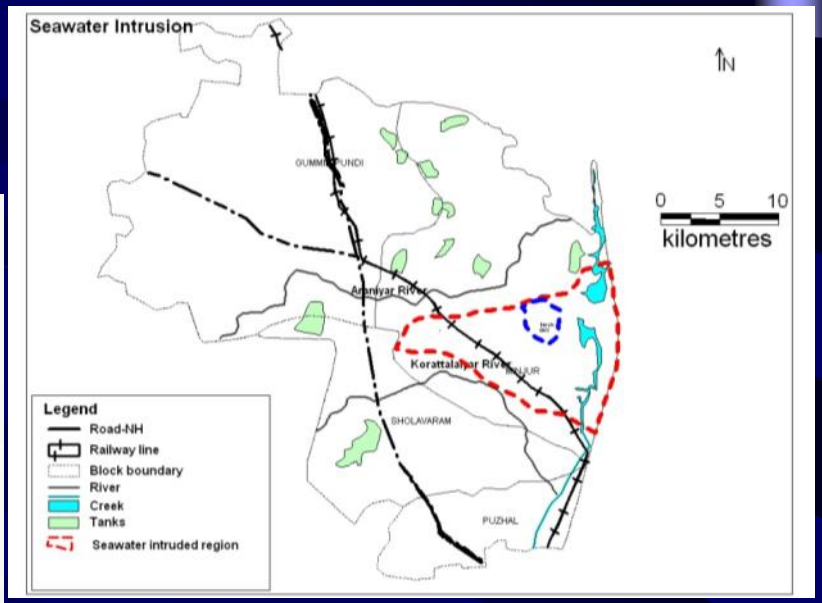


Red hills lake storage in Mcft vs time

# The problem

## Seawater intrusion




CGWB report (2011)

http://www.susana.org/docs_ccbk/susana_download/2-546-article-in-down-to-earth-water-scarcity-chennai-en.pdf

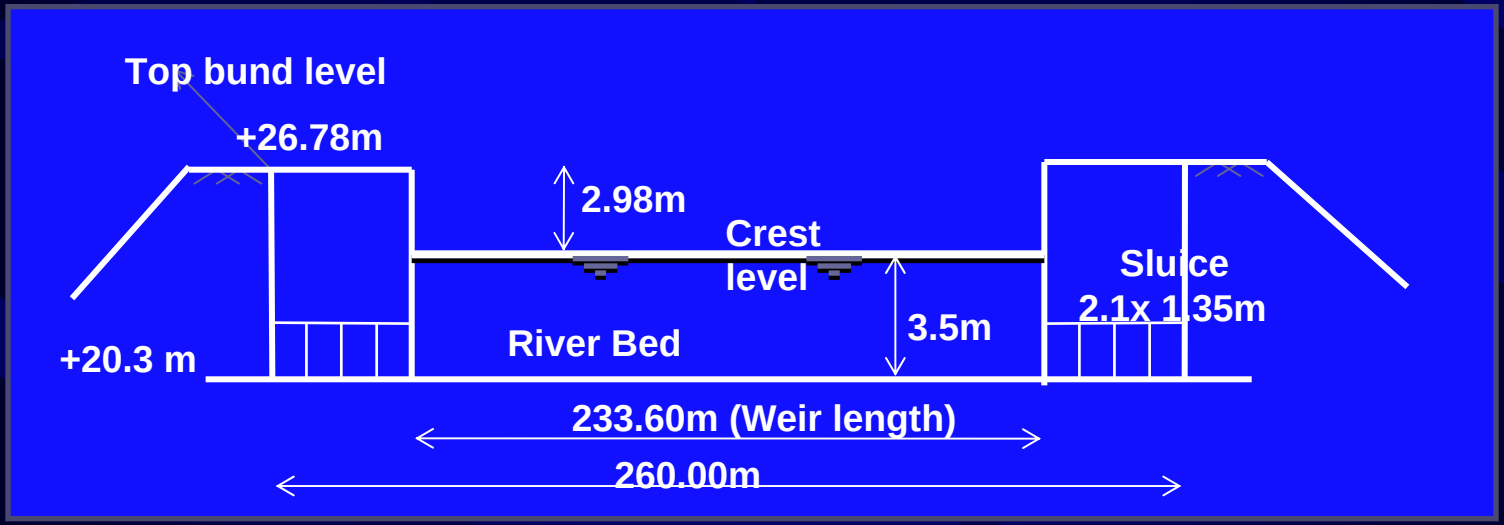
# Mitigation

- Managed Aquifer Recharge (MAR) by
  1. check dams and
  2. percolation ponds

- This is one of the aim of Saph Pani

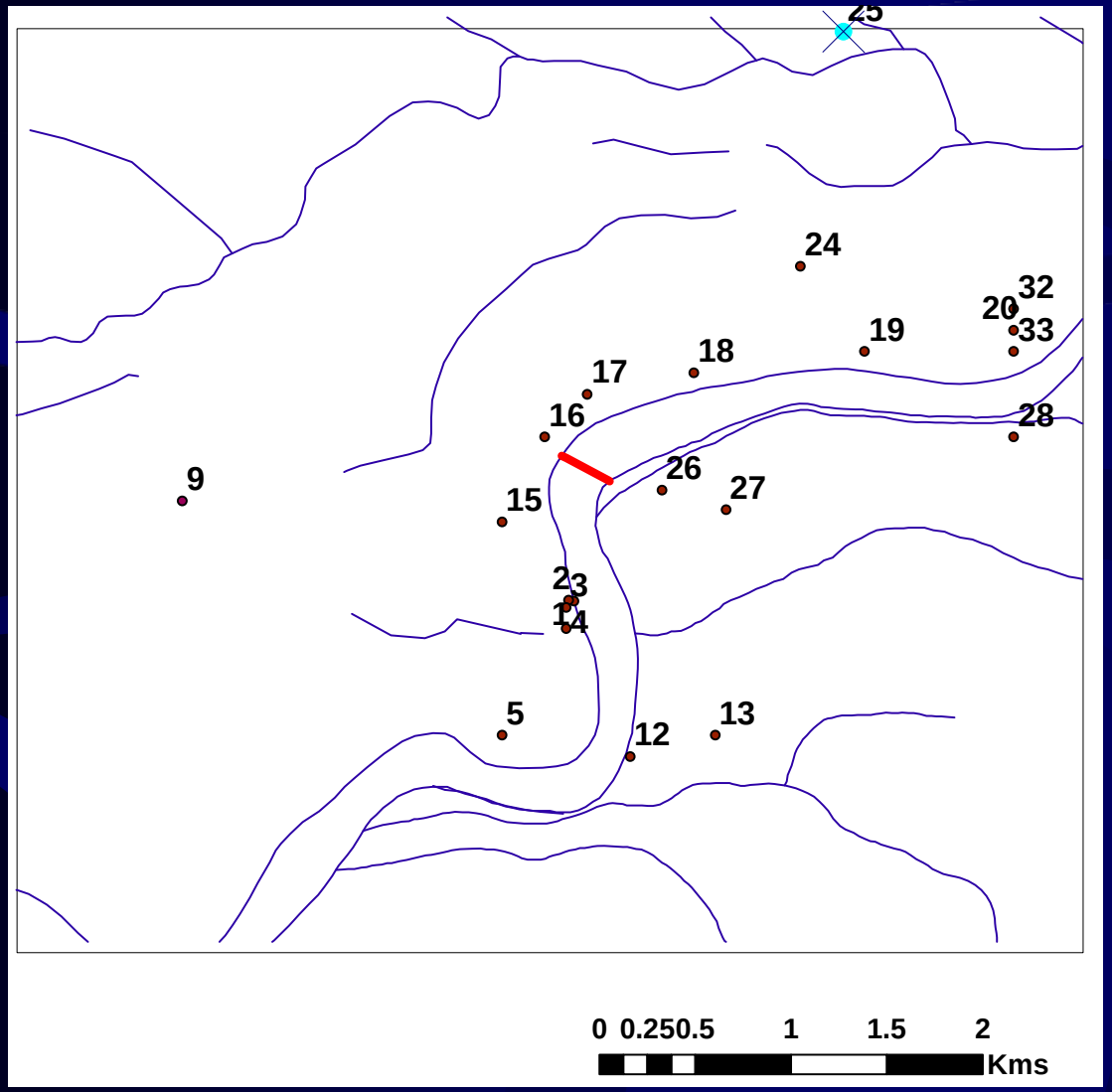
# MAR through check dams



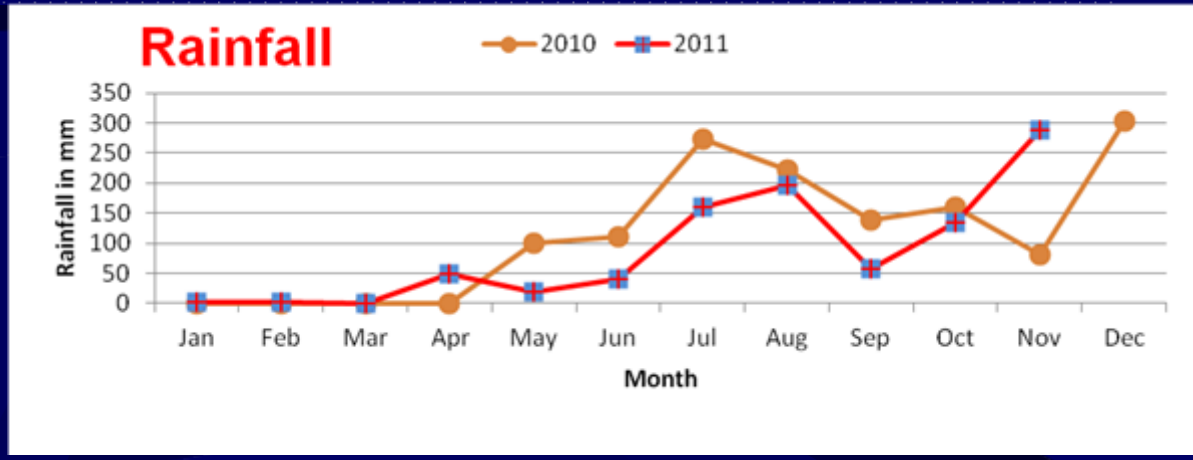


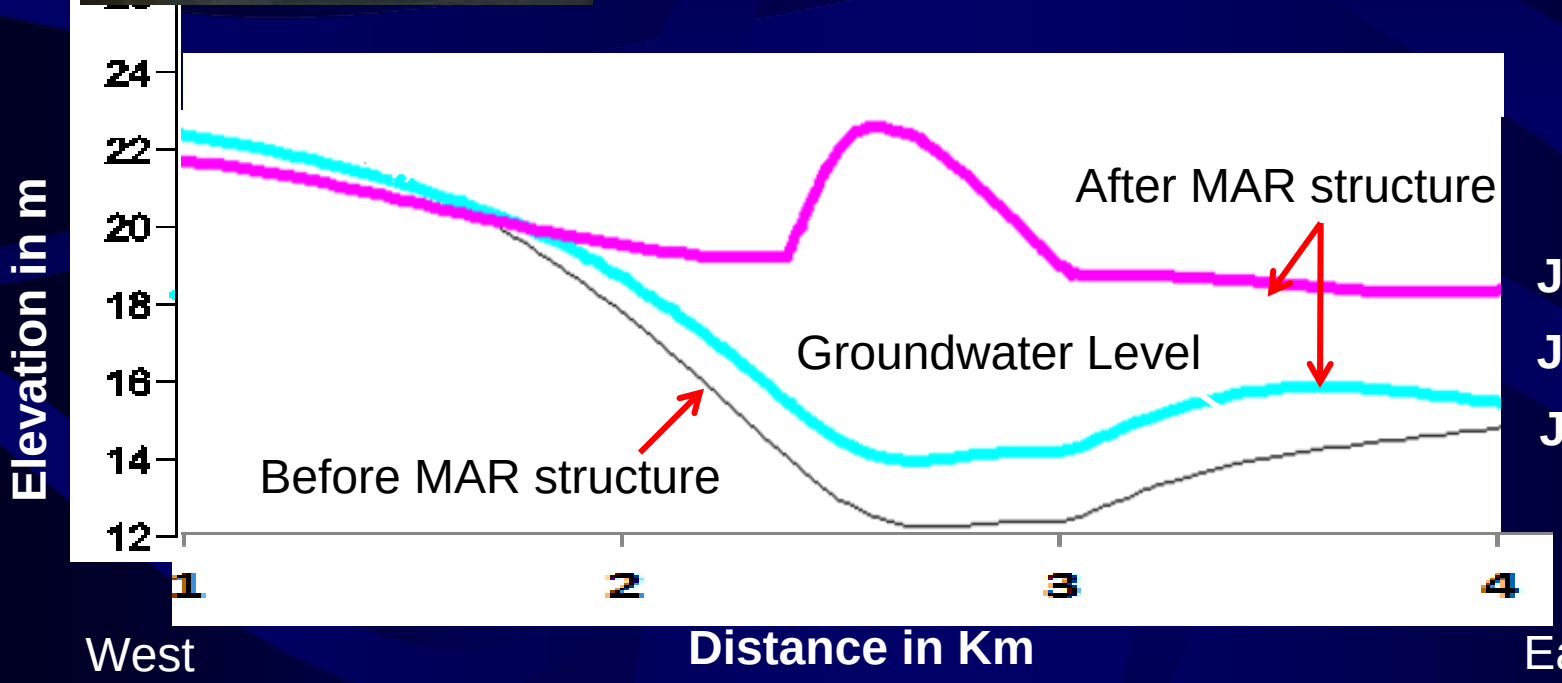

**Check dam completed in August 2010**

# Field work and water sampling

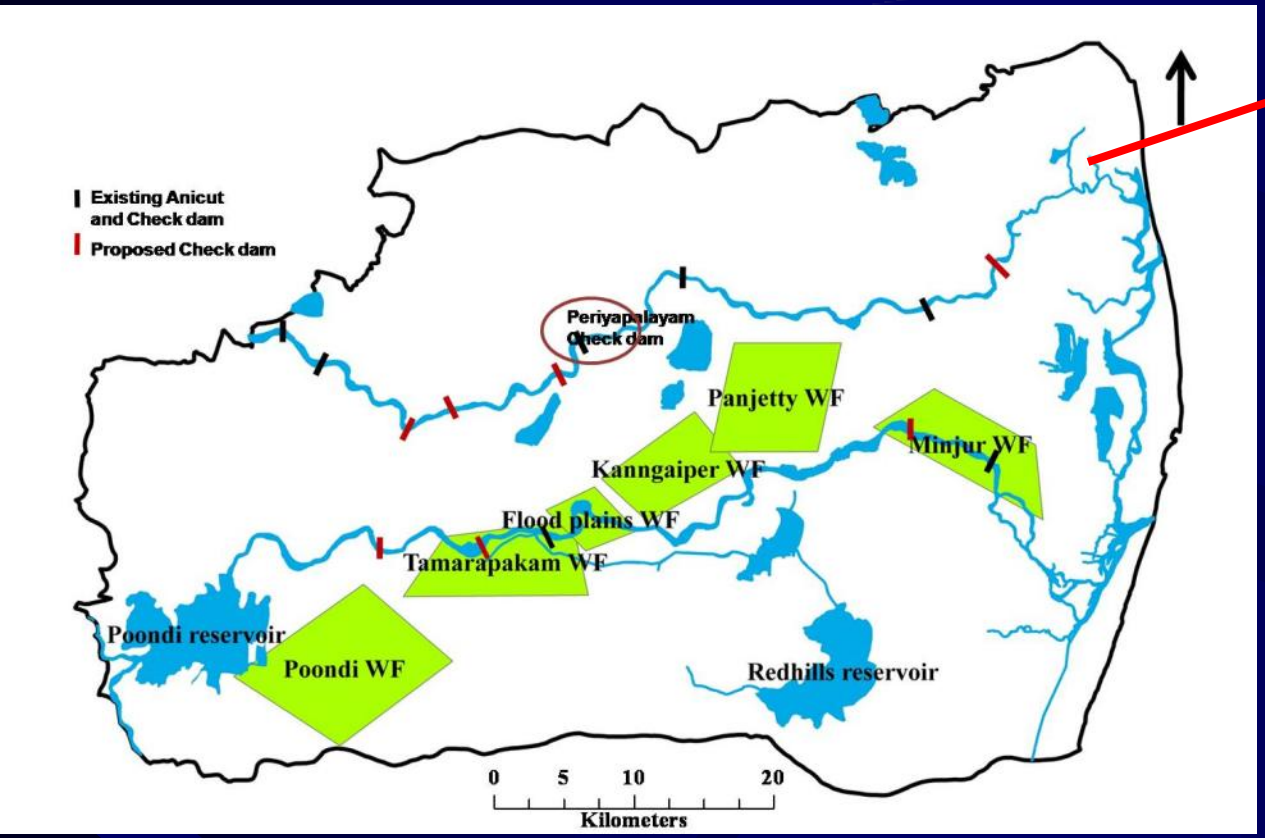



# Improvement in groundwater level

# MAR through Ponds



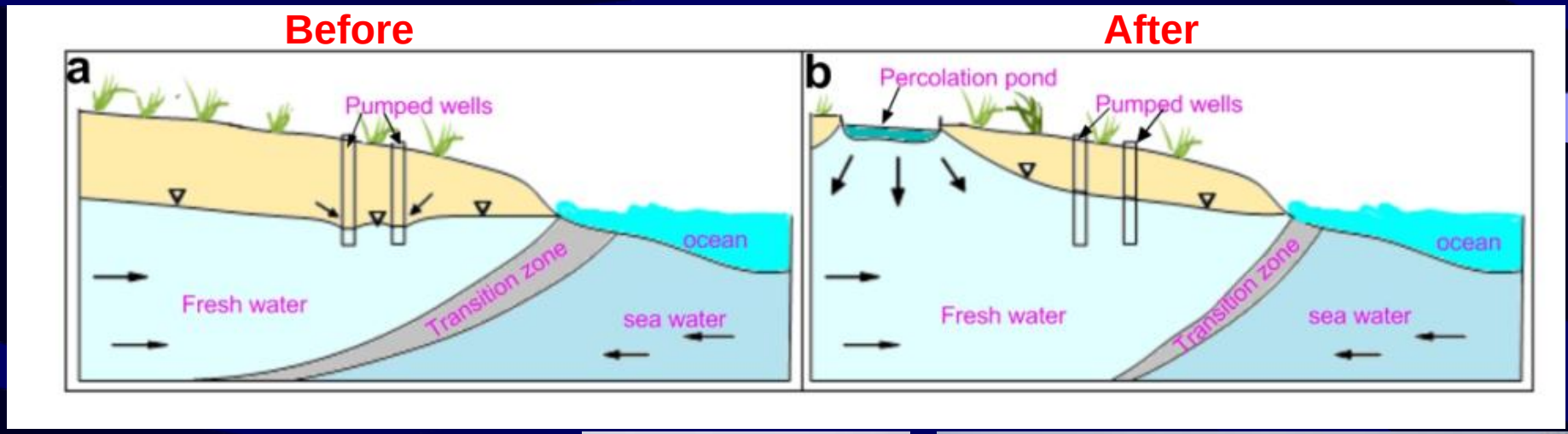

Pilot study site

Wind sensor

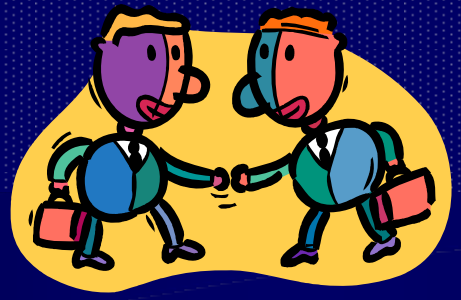
Rain sensor

Weather Station

# MAR through Ponds




# FUB ANNA



## FUB and Anna University intensify collaboration

A delegation of the FUB (Freie Universitaet Berlin) visited Anna University, Chennai on Friday the 24th February 2012. This meeting was possible due the existing collaboration between these universities under the Saph Pani project. The members of the delegation agreed to establish a Memorandum of Understanding in order to strengthen their cooperation.

Delegates of the Freie Universitaet Berli
vice chancellor of the Anna University
Jawahar (centre) and his staff.

THE HINDU

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CHENNAI, Mar

### Anna University starts pilot project to arrest seawater intrusion

STAFF REPORTER

SHARE · COMMENT · PRI

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PICS

ronmental issues

*The department plans to create awareness among farmers to small ponds in their lands to improve groundwater quality*

Even a small pond can make a difference to the quality of groundwater tha present, grossly affected by sea water intrusion. This is one of the plans proposed by the Department of Geology, Anna University, as part of a pilot study to restore the aquifer in northern localities along the coastline.

IAHS Newsletter

NL102 April 2012

International Commission on Water Quality, ICWQ

*New research project on "Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India"*

The Saph Pani (Hindi word meaning potable water) project "Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India" aims to study and improve natural water treatment systems, such as river bank filtration (RBF), managed aquifer recharge (MAR) and wetlands in India, building local and European expertise in this field. The project aims to enhance water resources and water supply, particularly in water stressed urban and periurban areas in different parts of the Indian sub-continent.

This project is co-funded by the European Union under the Seventh Framework (FP7) scheme of small or medium-scale focused research projects for specific cooperation actions (SICA) dedicated to international cooperation partner countries. Professor Thomas Wintgens, University of Applied Sciences Northwestern Switzerland, is the coordinator of this project. Professor Elango Lakshmanan, Vice President, ICWQ is a task leader and Co-Chair of the Steering Committee of this collaborative project. The following are the collaborating institutes/enterprises:

- University of Applied Sciences Northwestern Switzerland, Switzerland
- Uttarakhand Jal Sansthan, India
- National Institute of Hydrology, India
- IIT Roorkee, India
- Veolia Water India, India
- Anna University, India
- SPT consultium (SME), India
- Raipur Municipal Cooperation, India
- Akshaya Jaldhara (SME), India
- National Geophysical Research Institute, India
- IIT Bombay, India
- DHI (India) Water & Environment Pvt Ltd, India
- Cooperacion Centre for Water Berlin, Germany
- BRGM Service Eau, France
- Centre of Environmental Management and Decision Support, Austria
- University of Applied Sciences HTW Dresden, Germany
- UNESCO IHE Delft, Netherlands
- International Water Management Institute, Sri Lanka
- Commonwealth Scientific and Industrial Research Land and Water, Australia
- Freie Universität Berlin, Germany

METHODOLOGY

The project focuses on a set of specific case studies in India. These include a range of natural water systems and engineered treatment technologies investigated by different work-packages including RBF, MAR and constructed wetlands.

The field site investigations will include hydrogeological hydrological and geochemical characterisation and de pending on the degree of site development water quality monitoring or pre-feasibility studies for new treatment schemes. In addition to the natural treatment systems the investigation will recommend appropriate pre- and post- treatment steps to optimise production of potable water quality and to avoid operational issues such as clogging of aquifers. The experimental and conceptual studies will be supported by modelling to improve the conceptual understanding of the sites and enhance the transferability of results across India and to Europe.

A sustainability assessment will be performed for these sites, covering human health, environmental, economic institutional and social aspects. Water management plans f natural treatment systems will be developed and suitab policy frameworks established and promoted. The Indi sites will be linked to an "end-user pool" of European R and MAR sites to facilitate the information exchange operational experiences.

EXPECTED RESULTS

The expected results of Saph Pani are:

- Knowledge of optimal hydrological and hydro- geological settings and methodologies for extens RBF to other areas in India.
- A set of Indian MAR guidelines for aquifer rec and storage schemes covering different hydro- geological settings to cope with changing supp demand of groundwater.
- Strategies to make use of natural and construc wetlands for conserving the eco-balance of sp urban areas and recycling of wastewater for p agricultural production.

# Wir danken Ihnen für Ihre Aufmerksamkeit

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## Acknowledgement

Co-funding by the European Commission within the 7th Framework Programme

**www.saphpani.eu**