A Presentation given by Auroville Water Harvest Center for water Resource Management

OVERVIEW of WATER PROBLEMS in COASTAL INDIA and SOLUTIONS PROMOTED by AUROVILLE WATER HARVEST
Goal

The goal of Auroville Water Harvest is to create an enabling body at the watershed level involving all stakeholders in rural, urban, peri-urban and industrial areas that will own, manage and maintain the water resources through a comprehensive water resource management plan.

Objective

The major objective is to fight saline water intrusion and to restore and sustain the water resources with users and stakeholders active participation.
Strategy

Capacity building of communities to maintain resources in a sustainable manner through hardware and software aspects.

Activities

- Rainwater harvesting in rural, urban, and peri-urban areas
- Tank Rehabilitation
- Ecological Sanitation
- Water resource investigation
- Environmental awareness & education
- Community mobilization
- Social extension
- Income generation
- Wastewater
- Drinking water
- Water supply
- Sustainable agriculture
- Eco-friendly solutions to industries
- Moisture conservation and run-off water management
- Spill over control
- Pollution control measures
- Advocacy
- Networking
Recognition

- UNESCO endorsed HELP Basin Program in 2004
- International seminar on Sustainable Water management for the bioregion – Sept 2004
- Visit of the President, His Excellency, Dr. A.P.J. Abdul Kalam in November 2004
Objectives
study the water resources and water quality evolution of a multilayered aquifer/aquitard along the Bay of Bengal.
Reasons for implementing projects in the area

- Region representative of coastal situation in India
- Population motivated for improvement of water management
- Livelihood affected by water scarcity and lack of sanitation
- Recharge zone for deep aquifers
- Appropriate run-off for water harvesting
- Main aquifer for the region and water supply to Tindivanam city
Problems and threatening

- Lack of water resource management
- Heavy groundwater depletion
- Poor natural recharge
- Weak regulation
- Rapid groundwater quality degradation
- High risk of sea water intrusion
- Massive wastage of freshwater
- Pollution
- Lack of acting authority
Need for an integrated global approach

- Watershed scale management
- Groundwater coastal management
- Agriculture development
- Rural/ Peri urban/ Urban impact and interface
- Water supply and sanitation
- Pollution
- Sustainability!
Context Background

- Semi-arid region
- Average annual rainfall 1250 mm
- Monsoon pluviometry mode
- Existing groundwater potential
- Intensive irrigation for agriculture
**METEOROLOGY: Networks**

- **Climatic station (monthly):**
  Aurodam 1972-1983

- **Climatic station (30 min):**
  Vanur 2002-…

- **Rain gauges (daily):**
  Pondy 1968-1999,
  Sugar Mills 1984-2002,
  Harvest 1996-…,
  Harvest network (14)

- **Rain gauges (monthly):**
  Pondy-Hindu 1911-…,
  Pondy-PWD 1940-1997,
  Vanur 1951-1995,
  Cuddalore 1990-2002
  Villupuram 1997-1998
### Weather Parameters

#### Water balance 1972-1981

<table>
<thead>
<tr>
<th></th>
<th>Input mm/year</th>
<th>Output mm/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>1216</td>
<td></td>
</tr>
<tr>
<td>Real EvapoTranspiration</td>
<td></td>
<td>810</td>
</tr>
<tr>
<td>Effective rainfall</td>
<td></td>
<td>407</td>
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</tbody>
</table>

#### Water balance 2003

(calculated for 9th to 20th November 2003, and extrapolated for the whole year)

<table>
<thead>
<tr>
<th></th>
<th>Input (mm)</th>
<th>Output (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>RET</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Effective rainfall</td>
<td>103</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Input (mm)</th>
<th>Output (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>1097,3</td>
<td></td>
</tr>
<tr>
<td>RET</td>
<td></td>
<td>771,3</td>
</tr>
<tr>
<td>Effective rainfall</td>
<td></td>
<td>376</td>
</tr>
<tr>
<td>Runoff</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>34</td>
<td></td>
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<tr>
<td>Infiltration</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Input (mm)</th>
<th>Output (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>Infiltration</td>
<td>245</td>
<td></td>
</tr>
</tbody>
</table>

Monthly PET was calculated thanks to Thornthwaite formula.
HYDROLOGY

- no perennial river
- drainage of surface water by inter-connected tanks
- four main outlets
Watershed Area: 755 sq.km
Number of tanks: 196

- 160 villages
- 3,50,000 People

KALUVELLY WATERSHED
History of Irrigation Tanks

- Most of the Tanks in Tamilnadu and Pondicherry were constructed by the Pallava Kings during 500-900 A.D.
- Bahour Lake, the second largest tank in Pondicherry was in existence before the Chola Period.
- Usteri, the largest lake in Pondicherry was built by the Vijayanagar Rulers around 1110 A.D.
- French have connected these tanks with feeder canals and constructed offtake structures in rivers.
Change in water table in Pondicherry

During the last 1000 years

- 1500 AD
  - run-off tanks
  - river diversions

- 1859
  - Caisses communes

- 1911
  - Syndicate agricole

- 1975
  - Commune Panychat/PWD

- 1990

- 2003
  - TRPP
  - TRPP
  - submersible pump
  - motor pump
  - green revolution

- 60 - 50 - 40 - 30 - 20 - 10 m

natural ground level

water table

rule of Pallava’s
Potential Sources of Environmental Degradation

And Also:

- Non Source Pollution
- Solid waste
- Wastewater
- Major infrastructure development
- Endemic plant species eradication
Scientific investigations

HYDROGEOLOGICAL STUDY
KALUVELLY / PONDICHERRY COASTAL SEDIMENTARY BASIN

Groundwater potential quantification
Run-off quantification
Infiltration quantification

Supports:
- CNRS “ACI-EAU” (00/01) – NEB – UMR-Sisyphe
- UNESCO help basin program
Kaluvelly- Pondicherry
Sedimentary coastal basin
1400 Sq.km

Aquifers: Sand dune
- alluvium
- Cuddalore s.st
- Kaddaperikuppam
- Vanur s.st
- Ramanathapuram

Aquitards: Manaveli clay
- Ottay clay
GEOLOGICAL MODEL
3D View
Showing bore wells location and depth
The extraction is evaluated to be 15 times the recharge on Vanur aquifer.
Groundwater extraction estimate

Survey of 6000 bore wells over 250 sq.km
Many crops are irrigated with up to 15 times the water requirement.

Agriculture choices not adapted to water resources availability.

The extraction is evaluated to be 15 times the recharge on Vanur aquifer.
HYDROGEOLOGY: Evolution of Extraction on Vanur Aquifer

2001-2010: Extrapolated consumption
\[ \equiv 20 \times NR \]

1991-2000: Consumption
\[ \equiv 8 \times NR \]

1981-1990: Consumption
\[ \equiv 2 \times NR \]

Natural Recharge estimation:
5 Mm$^3$.y$^{-1}$
\[ \equiv 50 \text{ Mm}^3.10\text{y}^{-1} \]
HYDROGEOLOGY: Vanur aquifer, main aquifer of the area

Vanur outcrop area
water level
1975: +7 m msl
2005: -47 m msl
>drawdown ~54 m

Piezometric map result of an over exploitation of the Vanur aquifer
Electroconductivity as an indicator of salinity in Vanur aquifer in Feb - 2005

Water electroconductivity limit for drinking purpose: 1000 microsiemens per cm / World Health Organization
Water electroconductivity limit for irrigation purpose: 2500 microsiemens per cm

Source: HARVEST Field Surveys / Groundwater quality monitoring program
Area covered: 140 Sq km
Salt Water Intrusion in Coastal Areas

Excess pumping of fresh water

Well contaminated with salt water

Lowered water table

Fresh groundwater aquifer

Salt water intrusion

Original salt water interface
HYDROGEOLOGY: modelling of the saline intrusion in Vanur aquifer

\[ w = 15\% \]

- Whole aquifer saline in 2010

\[ w = 30\% \]

- Whole aquifer saline in 2020

Steady state till 1980

Steady State till 1990
GEOCHEMISTRY: conclusion about salinisation

Evaporation

⇒ Impact cannot be neglected

Surface-sea water mixing

⇒ Not assessed YET (2000)

Water-rock interaction

⇒ Water-rock interaction + mixing with sulphate-rich waters (Ramanathapuram aquifer)
Monitoring the resources
Present situation of land and communities
State of Water Structures in the Area

- Damaged weir
- Weir covered by vegetation
- Erosion
- Silted check dam
- Breach
DIFFICULTIES FACED BY THE POPULATION

- Land degradation
- Sanitation
- Water access
- Social structure
- Gender issue
- Public health
- Income generation
Local resource problems affecting communities

Salt Water Intrusion in Coastal Areas

- Excess pumping of fresh water
- Well contaminated with salt water
- Lowered water table
- Fresh groundwater aquifer
- Salt water intrusion
- Original salt water interface
- Salt Water
Salinity Increase After Tsunami
WATER SCARCITY
SAFE WATER HANDLING PROBLEMS
IDINTHAKARAI
TIRUNELVELI
DISTRICT
## Drinking Water Accessibility

<table>
<thead>
<tr>
<th>Location</th>
<th>Population</th>
<th>Over all water supplied from OHT / Day (Liters)</th>
<th>Distribution Timings</th>
<th>Total Water Available for users Liters/day</th>
<th>Liters / capita /day</th>
<th>Total water wastage Liters/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kottakarai Village</td>
<td>951</td>
<td>120,000</td>
<td>30 min</td>
<td>48,500</td>
<td>51</td>
<td>71,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 times/day</td>
<td>40.42%</td>
<td>59.58%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 h / day</td>
<td>19,900</td>
<td>49.75%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Morning</td>
<td>45</td>
<td>50.00%</td>
<td></td>
</tr>
<tr>
<td>Kottakarai colony</td>
<td>445</td>
<td>40,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Water Usage

Drinking + Bathing + Washing + Cooking And… Gardening and Animal husbandry!
## Water Supplied in the Villages

<table>
<thead>
<tr>
<th>Village Name</th>
<th>Number of Household</th>
<th>Total water supply/day</th>
<th>Total water wastage / day</th>
<th>Liters / day / Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acharampattu</td>
<td>120</td>
<td>60,000</td>
<td>30,300</td>
<td>48</td>
</tr>
<tr>
<td>Akasampattu</td>
<td>60</td>
<td>30,000</td>
<td>15,150</td>
<td>48</td>
</tr>
<tr>
<td>Alanguppam</td>
<td>515</td>
<td>261,000</td>
<td>131,805</td>
<td>49</td>
</tr>
<tr>
<td>Bommayrpalayam</td>
<td>800</td>
<td>90,000</td>
<td>45,450</td>
<td>11</td>
</tr>
<tr>
<td>Chinnakalapet</td>
<td>300</td>
<td>96,000</td>
<td>48,480</td>
<td>31</td>
</tr>
<tr>
<td>Chinnakoluvanari</td>
<td>140</td>
<td>60,000</td>
<td>30,300</td>
<td>41</td>
</tr>
<tr>
<td>Edayanchavadi</td>
<td>750</td>
<td>260,000</td>
<td>131,300</td>
<td>33</td>
</tr>
<tr>
<td>Irumbai</td>
<td>200</td>
<td>60,000</td>
<td>30,300</td>
<td>29</td>
</tr>
<tr>
<td>Kalapet</td>
<td>800</td>
<td>364,000</td>
<td>183,820</td>
<td>44</td>
</tr>
<tr>
<td>Kanagachettykulam</td>
<td>500</td>
<td>284,000</td>
<td>143,420</td>
<td>55</td>
</tr>
<tr>
<td>Mounaiampet</td>
<td>160</td>
<td>60,000</td>
<td>30,300</td>
<td>36</td>
</tr>
<tr>
<td>Nesal</td>
<td>200</td>
<td>30,000</td>
<td>15,150</td>
<td>14</td>
</tr>
<tr>
<td>Rauthankuppam</td>
<td>210</td>
<td>30,000</td>
<td>15,150</td>
<td>14</td>
</tr>
<tr>
<td>Rayapettai</td>
<td>200</td>
<td>30,000</td>
<td>15,150</td>
<td>14</td>
</tr>
<tr>
<td>Rayapudupakkam</td>
<td>200</td>
<td>60,000</td>
<td>30,300</td>
<td>29</td>
</tr>
</tbody>
</table>

Average Consumption per head per day in liters: **33**
# Sanitation in the Villages

<table>
<thead>
<tr>
<th>Village Name</th>
<th>NUMBER OF PRIVATE TOILETS (%)</th>
<th>NUMBER OF COMMON TOILETS</th>
<th>NO. OF BENEFICIARIES</th>
<th>SEATS</th>
<th>REASON FOR NOT USING IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akasampattu</td>
<td>20</td>
<td>1</td>
<td>75</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Alanguppam</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bommayrpalayam</td>
<td>30</td>
<td>1</td>
<td>150</td>
<td>10</td>
<td>no maintenance</td>
</tr>
<tr>
<td>Chinnakalapet</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Chinnamudaliarchavaday</td>
<td>20</td>
<td>1</td>
<td>100</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Edayanchavadi</td>
<td>20</td>
<td>1</td>
<td>100</td>
<td>6</td>
<td>no maintenance</td>
</tr>
<tr>
<td>Irumbai</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Kottakarai</td>
<td>2</td>
<td>2</td>
<td>100</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>
Presence on the Ground

Tank Rehabilitation Program & Network of Water User Association

Harvest is present in 50 Villages Daily
Involving important stakeholders on Water Resources Management through active participation
Soil, crop and water management

- An attempt to convert the polluted soil into living soil to stabilize the water cycle
- Protecting groundwater overexploitation by regulating the irrigation
AQUACULTURE IN VILLAGE PONDS
(Rain water storages)

Objectives

1. To Prolong water storages for more recharge
2. To Involve women in water harvesting practices
3. To create an opportunity among women to make additional income to the family
Construction of sanitation facilities

- Compost pits
- Improvement of Community Toilets
- Construction of model individual Eco San Toilets
- DEWATS
Projects along the tsunami affected coast

- Ground Water Recharge along the coast
- Water and Sanitation Project in the interim shelters of Tsunami affected area of Villupuram funded by Unicef
- Sustainable Sanitation Infrastructure in Nagappattinam, Karaikal, Kanyakummari (toilet blocks, Dewats) in association with CSR - 10 villages
- Impact assessment studies
## Some of Our Partners

### Indian Organizations
- Ministry of Water Resources
- Central Ground Water Board
- Indian Space Research Organization (ISRO)
- TWAD
- Tamilnadu PWD Water Resources
- DRDA
- PWD Pondicherry
- Agriculture Department Tamilnadu
- Pasic
- Neivelly Mine Corporation
- Tata Trust
- EID Parry
- ITC
- DCL
- Swaminathan Foundation
- Dawn Fondation
- Scope

### Outside agencies
- Fondation Ensemble, France
- Université Pierre et Marie Curie, France
- Université Paris-Sud, France
- École des Mines de Paris, France
- Université de Tour, France
- École Nationale du Génie Rural des Eaux et des Forêts, France
- Water resources planning, Water Commission of Israel
- Aqua for All, Netherlands
- Vitens, Netherlands
- Steeching de Saaier, Netherlands
- City of Hilden, Germany
- InWent, Germany
- Borda, Germany
- MIT, USA
- Smithsonian Institute, USA
- Zukunftsstiftung Entwicklungshilfe, Germany

### International agencies
- UNESCO
- UNICEF
- UNDP
Working together for a sustainable future