Status and importance of traditional water conservation system in present scenario

Dr. Sameer Vyas
Smt. Beena Anand
Dr. SN Sharma

Central Soil and Materials Research Station, New Delhi
TRADITIONAL WATER HARVESTING SYSTEMS OF INDIA
Where is Earth's Water?

- Total global water: 96.5%
  - Oceans: 96.5%
  - Other saline water: 0.9%

- Freshwater: 2.5%
  - Groundwater: 30.1%
  - Glaciers and ice caps: 68.7%

- Surface water and other freshwater: 1.2%
  - Lakes: 20.9%
  - Ground ice and permafrost: 69.0%

- Atmosphere: 3.0%
- Living things: 0.26%
  - Rivers: 0.49%
  - Swamps, marshes: 2.6%
  - Soil moisture: 3.8%
Earth’s Freshwater Resources

- Glaciers, Permafrost, and Perennial Snow: 69.56%
- Fresh Subsurface Water: 30.10%
- Freshwater Lakes: 0.25%
- Atmosphere: 0.04%
- Soil Moisture: 0.05%
- Swamps, Marshes, and Wetlands: 0.03%
- Rivers: 0.006%
GLOBAL WATER SCENARIO

Total 14000 Million BCM

OCEAN WATER 97.3%
FRESH WATER 2.7%

WATER SOURCES

GROUND WATER
(< 800m deep) 10%

GROUND WATER
(800-4000m deep) 13%

POLAR ICE & GLACIER 75%

OTHER SOURCES 2%
# Water Scenario

<table>
<thead>
<tr>
<th>Present (2016)</th>
<th>Year 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>Population</td>
</tr>
<tr>
<td>- 1.299 Billion</td>
<td>- 1.64 Billion</td>
</tr>
<tr>
<td>Water Resources</td>
<td>Water Resources</td>
</tr>
<tr>
<td>- 1869 BCM</td>
<td>- 1869 BCM</td>
</tr>
<tr>
<td>Water Availability</td>
<td>Water Availability</td>
</tr>
<tr>
<td>- 1439 Cum/Person</td>
<td>- 1140 Cum/Person</td>
</tr>
</tbody>
</table>
Water Availability (उपलब्धता)

Total Precipitation
4000 BCM

Total water availability
1869 BCM

Total utilisable water resources
1123 BCM

Surface water
690 BCM

Current utilization of SW
450 BCM (65.21%)

Ground Water
433 BCM

Current utilization of GW
243 BCM (56%)

Presently meets the demand but is inadequate for future demand
# Per Capita Water Availability

<table>
<thead>
<tr>
<th>Year</th>
<th>Population (in million)</th>
<th>Per Capita water availability (in cubic metre) wrt 1869 BCM</th>
<th>Per Capita water availability (in cubic metre) wrt 1123 BCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>361</td>
<td>5177</td>
<td>3110</td>
</tr>
<tr>
<td>1955</td>
<td>395</td>
<td>4732</td>
<td>2843</td>
</tr>
<tr>
<td>1991</td>
<td>846</td>
<td>2209</td>
<td>1327</td>
</tr>
<tr>
<td>2001</td>
<td>1027</td>
<td>1820</td>
<td>1093</td>
</tr>
<tr>
<td>2025</td>
<td>1400 (projected)</td>
<td>1341</td>
<td>802</td>
</tr>
<tr>
<td>2050</td>
<td>1600 (projected)</td>
<td>1140</td>
<td>702</td>
</tr>
</tbody>
</table>
भारत  INDIA

- 2.45% of World’s Land Area - जमीन
- 4% of World’s Fresh Water Resource - असमुद्री जल
- 17% of World’s Population - जनसंख्या

Per Capita (प्रति व्यक्ति) Availability

![Graph showing Water Availability over years with Water Stress and Scarcity Lines](image)

- Water Stress Line (1700)
- Water Scarcity Line (1000)

<table>
<thead>
<tr>
<th>Year</th>
<th>Water Availability (Cubic metre per capita per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>6000</td>
</tr>
<tr>
<td>1991</td>
<td>5000</td>
</tr>
<tr>
<td>2001</td>
<td>2000</td>
</tr>
<tr>
<td>2025</td>
<td>1000</td>
</tr>
<tr>
<td>2050</td>
<td>1000</td>
</tr>
</tbody>
</table>
बारिश की स्थानिक विभिन्नता

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td></td>
<td>1,170</td>
</tr>
<tr>
<td>Max.</td>
<td></td>
<td>11,000</td>
</tr>
<tr>
<td>Min.</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>
WATSAN Quantity & Quality Issues

Figure 3: Water Availability versus Population Growth

- Per capita water availability (per cubic meter)
- Population (million)

Source: PCRWR (2002)

FJK 2007
➢ Water: A prime life sustaining natural resource; cannot be created like other commodities.
➢ A nature’s gift to all living beings on the earth.
➢ Is is the elixir of life.
➢ In India: Stress on availability of water is due to population explosion & improved standard of living.
➢ The scarcity is compounded further because of massive agricultural and industrial development coupled with improper and indiscriminate exploitation of groundwater resources.
➢ Only handful of countries in the globe can boast of such an extensive river network that our country has.
➢ The mighty Indus-Ganga-Brahmaputra in the North, the Narmada-Tapi-Mahanadi in the Central region and Godavari-Krishna-Cauvery in the South have been symbols of existence and growth of our country right from its inception.
➢ Yet, the availability of water resources in India has its unique complexities.
Post-independence, the population of India has increased almost nearly fourfold and growth is expected to continue up to 2050.

Thereafter it will stabilize sometime during 2060.

What is required is an integrated planning, development and management of the water resources with the involvement of all stakeholders and taking into consideration the multi-sectoral needs and the judicious distribution of the water resources amongst various sectors based upon certain priorities.

With a view to achieve this vision, the country adopted the National Water Policy in 1987 for the first time, updated in the year 2002 and last revision took place in 2012.

Since then many new challenges have emerged in the water resources sector which further needs the revision in the existing National Water Policy.
WATER AVAILABILITY AND DEMAND

- Each year, rains bring in 4500 km³ of water in India
- Of this,
  - 250 km³ gets stored in Dams & Reservoirs
  - 440 km³ of water flows into river and is available as surface water
  - 432 km³ gets stored in aquifers
  - Rest flows into seas & oceans
- Giving total fresh water availability of 1122 km³ a year

<table>
<thead>
<tr>
<th>Natural runoff (Surface water and ground water from the river basins of India)</th>
<th>1869 km³/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated utilisable surface water potential</td>
<td>690 km³/year</td>
</tr>
<tr>
<td>Ground water resources</td>
<td>432 km³/year</td>
</tr>
<tr>
<td>Available ground water resource for irrigation</td>
<td>361 km³/year</td>
</tr>
<tr>
<td>Net utilisable ground water resource for irrigation</td>
<td>325 km³/year</td>
</tr>
</tbody>
</table>

Source: Central Water Commission of India and IIT Kharagpur
WATER CONSUMPTION PATTERN IN CITIES

- Delhi has the highest domestic water demand followed by Mumbai
- These two metros have more than 50% of Indian cities’ demand
- The demand in urbanized cities are much higher than any other city
  - More the urbanization, higher the consumption
- Of the total demand, around 35 – 40% is lost due to leakages

Water Demand in MLD/year

[Bar chart showing water demand in MLD/year for different cities]

Source: Central Pollution Control Board, 2005.
DOMESTIC WATER USE

- The Domestic Sector consumes 56 M\(^3\) of water every year
  - Of this majority is consumed by the Urban Sector
- This demand is estimated to increase by 4 folds in the next 20 years due to greater urbanization of Indian population
- About 500 Million urban Indians consume 135 – 196 liters of water per day per person
- 24 x 7 water supply is limited to just 15 – 20% of the urban population
- Domestic Water Supply is mostly not metered and a lump sum charge is levied
- With rural Indians, the consumption varies widely from just sustenance to less than 80 liters per day per person

Issues with domestic water supply in major Indian cities:
- Water leakages and lack of proper distribution main bane of the Urban population
- Lack of metering
- Inequitable supply of water between Urban and Rural Indians

Source: Food and Agriculture Organization Statistics - Aqaustat
Source: Frost & Sullivan

28-Sep-19 6th IWW-SNS-27/09/2019
✓ By 2025 it is predicted that large parts of India will join countries or regions having absolute water scarcity.
✓ Water stress occurs when water availability is between 1000 and 1600 cubic meter per person per year.
✓ A Niti Aayog report released last year predicts Day Zero for 21 Indian cities by next year. Day Zero refers to the day when a place is likely to have no drinking water of its own.
✓ According to the Niti Aayog's Composite Water Management Index (CWMI), Bengaluru, Chennai, Delhi and Hyderabad are among the most susceptible. The government has created a new Jal Shakti ministry to deal with drinking water crisis.
About 89 per cent of groundwater extracted in India is used for irrigation making it the highest category user in the country. Household use comes second with 9 per cent share of the extracted groundwater followed by industry that uses only two per cent of it.

Overall, 50 per cent of urban water requirement and 85 per cent of rural domestic water need are fulfilled by groundwater.

This kind of use has caused a reduction in groundwater levels in India by 61 per cent between 2007 and 2017, according to report by Central Ground Water Board (CGWB), presented in the Lok Sabha last year.

The report prepared under the ministry of water resources cited rising population, rapid urbanisation, industrialisation and inadequate rainfall as reasons for sharp decline in groundwater volume in the country.

It is estimated that while 81 per cent of all households have access to 40 litres of water per day
Water is not properly distributed where it is supplied through pipes. Mega cities like Delhi and Mumbai get more than the standard municipal water norm of 150 litres per capita per day (LPCD) while others get 40-50 LPCD.

The World Health Organization prescribes 25 litres of water for one person a day to meet all basic hygiene and food needs. Extra available water, according to the WHO estimates, is used for non-potable purposes like mopping and cleaning.
Wastage of water

✓ Arithmetically, India is still water surplus and receives enough annual rainfall to meet the need of over one billion plus people. According to the Central Water Commission, India needs a maximum of 3,000 billion cubic metres of water a year while it receives 4,000 billion cubic metres of rain.

✓ But the problem is India captures only eight per cent of its annual rainfall - among the lowest in the world. The traditional modes of water capturing in ponds have been lost to the demands of rising population and liberal implementation of town planning rules.

✓ India has been also poor in treatment and re-use of household wastewater. About 80 per cent of the water reaching households in India are drained out as waste flow through sewage to pollute other water bodies including rivers and also land.
loss of wetlands, water bodies

Almost every single city and village in the country has lost its wetlands, water bodies and even rivers to encroachment to meet the needs of rising population. Chennai that is facing acute water shortage had nearly two dozen water bodies and wetlands but most of them are out of use today. A recent assessment found that only nine of them could be reclaimed as water bodies.

The main causes of disappearance of traditional water conservation structures are:

- Urbanization
- Population
- Encroachments
- Poor sewerage structures
- Blocking of the recharging path ways
- Poor maintenance and negligence from civic authorities
- Pollution
The United Nation's (UN) World Water Development Report of 2018 harks back to the traditional nature-based solution to address water crisis. It particularly highlights two examples.

One is the good old experiment by India's waterman Rajendra Singh in Rajasthan which restored water resources in Alwar district through construction of small-scale water harvesting structures. This brought water back to 1,000 drought-hit villages, revived five rivers which had gone dry, increased farm productivity by 20 to 80 per cent, increased forest cover by 33 per cent and also brought back antelopes and leopards.

The other is from Jordan where an experiment in reviving traditional land management system, called 'Hima'- which basically consisted of setting land aside to allow for the land to naturally regenerate itself - that led to increase in economic growth (through cultivation of indigenous plants of economic value) and conservation of natural resources in the Zarqa river basin. It has now become Jordan's national policy.
History tells us that floods and droughts both were regular phenomenon in ancient India. Perhaps this was the reason for the every region of country; for having its own traditional water conservation and management techniques depending upon the geographical peculiarities and cultural uniqueness. The basic concept underlying all these techniques is that rain should be harvested whenever and wherever falls.
Archaeological evidence shows that the practice of water conservation and management is deep rooted in the science of ancient India. Excavations show that the cities of the Indus Valley Civilization had excellent systems of water conservation, harvesting and drainage system.

The settlement of Dholavira, laid out on a slope between two storm water channels, is a great example of Water Engineering.

Chanakya’s Arthashashtra mentions irrigation using water harvesting systems. Sringaverapura, near Allahabad, had a sophisticated water harvesting system that used the natural slope of the land to store the floodwaters of the river Ganga.

Chola King Karikala built the Grand Anicut or Kallanai across the river Cauvery to divert water for irrigation (it is still functional) while King Bhoja of Bhopal built the largest artificial lake in India.
Drawing upon centuries of experience, Indians continued to build structures to catch, hold and store monsoon rainwater for the dry seasons to come. These traditional techniques, though less popular today, are still in use and efficient. Drawing upon centuries of experience, Indians continued to build structures to catch, hold and store monsoon rainwater for the dry seasons to come.

Water has been conserved and managed in India since antiquity, with our ancestors perfecting the art of water management. Many water conservation structures and water conveyance systems specific to the ecoregions and culture has been developed.
Encroachment of water bodies has been identified as a "major cause" of flash floods in Mumbai (2005), Uttarakhand (2013), Jammu and Kashmir (2014) and Chennai (2015) in the past one-and-half decades.
Their revival and better management assume even more significance if the Niti Aayog's warning is to be taken seriously: Groundwater levels in 21 major cities, including Delhi, Bangalore and Hyderabad, will dry up completely by 2020 (next year), affecting 100 million people.
Everyday experiences and studies have shown that more and more water bodies are disappearing from the urban and rural landscapes due to uncontrolled urbanization leading to their encroachment for construction activities; dumping of sewage, industrial waste water, deposition of debris and last but not the least a shift from community-based water-use system to groundwater dependent system, etc.
According to the 4th MI census, carried out during 2006-2007, there were 5,23,816 water bodies - declining by 32,785 from 5,56,601 water bodies identified during the 3rd MI census of 2000-2001.

Of these 5,23,816 water bodies, 80,128 (or 15 per cent) were found "not in use" any more.

Most such water bodies in disuse were found in Karnataka (51 per cent of its total water bodies), Rajasthan (40 per cent), Andhra Pradesh (32 per cent), Tamil Nadu (30 per cent), Uttarkhand (29 per cent) and Gujarat (23 per cent).
REPURPOSING REPAIR, RENOVATION AND RESTORATION SCHEME

Realizing the seriousness of problem confronting water bodies, the Centre had launched the Repair, Renovation and Restoration (RRR) of Water Bodies' scheme in 2005 with the objectives of comprehensive improvement and restoration of traditional water bodies, including increasing tank storage capacity, ground water recharge, increased availability of drinking water, improvement of catchment areas of tank commands, etc.
Water conservation is a key element of any strategy that aims to alleviate the water scarcity crisis in India.

With rainfall patterns changing almost every year, the Indian government has started looking at means to revive the traditional systems of water harvesting in the country. Given that these methods are simple and eco-friendly for the most part, they are not just highly effective for the people who rely on them but they are also good for the environment.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Ecological Region</th>
<th>Traditional Water Management System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Trans - Himalayan Region</td>
<td>Zing</td>
</tr>
<tr>
<td>2.</td>
<td>Western Himalaya</td>
<td>Kul, Naula, Kuhl, Khatri</td>
</tr>
<tr>
<td>3.</td>
<td>Eastern Himalaya</td>
<td>Apatani</td>
</tr>
<tr>
<td>4.</td>
<td>North Eastern Hill Ranges</td>
<td>Zabo</td>
</tr>
<tr>
<td>5.</td>
<td>Brahmaputra Valley</td>
<td>Dongs / Dungs/ Jampois</td>
</tr>
<tr>
<td>6.</td>
<td>Indo-Gangetic Plains</td>
<td>Ahars – Pynes, Bengal’s Inundation Channels, Dighis, Baolis</td>
</tr>
<tr>
<td>7.</td>
<td>The Thar Desert</td>
<td>Kunds, Kuis/beris, Baoris / Ber/ Jhalaras, Nadi, Tobas, Tankas, Khandins, Vav/Bavadi, Virdas, Paar</td>
</tr>
<tr>
<td></td>
<td>Region</td>
<td>Examples</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>Central Highlands</td>
<td>Talab, Bandhis, Saza Kuva, Johads, Naada/Bandh, Pat, Rapat, Chandela Tank, Bundela Tank</td>
</tr>
<tr>
<td>9</td>
<td>Eastern Highlands</td>
<td>Katas / Mudas / Bandhas</td>
</tr>
<tr>
<td>10</td>
<td>Deccan Plateau</td>
<td>Cheruvu, Kohli Tanks, Bhandaras, Phad, Kere, The Ramtek Model</td>
</tr>
<tr>
<td>11</td>
<td>Western Ghats</td>
<td>Surangam</td>
</tr>
<tr>
<td>12</td>
<td>West Coastal Plains</td>
<td>Virdas</td>
</tr>
<tr>
<td>13</td>
<td>Eastern Ghats</td>
<td>Korambu</td>
</tr>
<tr>
<td>14</td>
<td>Eastern Coastal Plains</td>
<td>Eri / Ooranis</td>
</tr>
<tr>
<td>15</td>
<td>The Islands</td>
<td>Jack Wells</td>
</tr>
</tbody>
</table>
Great Bath of Mohenjodaro
Jhalara

**Jhalaras** are typically rectangular-shaped step wells that have tiered steps on three or four sides. These step wells collect the subterranean seepage of an upstream reservoir or a lake. Jhalaras were built to ensure easy and regular supply of water for religious rites, royal ceremonies and community use. The city of Jodhpur has eight jhalaras, the oldest being the Mahamandir Jhalara that dates back to 1660 AD.
TALAB

Talabs are reservoirs that store water for household consumption and drinking purposes. They may be natural, such as the pokhariyan ponds at Tikamgarh in the Bundelkhand region or manmade, such as the lakes of Udaipur. A reservoir with an area less than five bighas is called a talai, a medium sized lake is called a bandhi and bigger lakes are called sagar or samand.
Bawaris are unique stepwells that were once a part of the ancient networks of water storage in the cities of Rajasthan. The little rain that the region received would be diverted to man-made tanks through canals built on the hilly outskirts of cities. The water would then percolate into the ground, raising the water table and recharging a deep and intricate network of aquifers. To minimise water loss through evaporation, a series of layered steps were built around the reservoirs to narrow and deepen the wells.
Bawari
Taanka

Taanka is a traditional rainwater harvesting technique indigenous to the Thar desert region of Rajasthan. A Taanka is a cylindrical paved underground pit into which rainwater from rooftops, courtyards or artificially prepared catchments flows. Once completely filled, the water stored in a taanka can last throughout the dry season and is sufficient for a family of 5-6 members. An important element of water security in these arid regions, taankas can save families from the everyday drudgery of fetching water from distant sources.
Johads, one of the oldest systems used to conserve and recharge ground water, are small earthen check dams that capture and store rainwater. Constructed in an area with naturally high elevation on three sides, a storage pit is made by excavating the area, and excavated soil is used to create a wall on the fourth side. Sometimes, several johads are interconnected through deep channels, with a single outlet opening into a river or stream nearby. This prevents structural damage to the water pits that are also called madakas in Karnataka and pemghara in Odisha.
Ahar Pynes are traditional floodwater harvesting systems indigenous to South Bihar. Ahars are reservoirs with embankments on three sides that are built at the end of diversion channels like pynes. Pynes are artificial rivulets led off from rivers to collect water in the ahars for irrigation in the dry months. Paddy cultivation in this relatively low rainfall area depends mostly on ahar pynes.
Khadin

**Khadins** are ingenious constructions designed to harvest surface runoff water for agriculture. The main feature of a khadin, also called dhora, is a long earthen embankment that is built across the hill slopes of gravelly uplands. Sluices and spillways allow the excess water to drain off and the water-saturated land is then used for crop production. First designed by the Paliwal Brahmins of Jaisalmer in the 15th century, this system is very similar to the irrigation methods of the people of ancient Ur (present Iraq).
A kund is a saucer-shaped catchment area that gently slope towards the central circular underground well. Its main purpose is to harvest rainwater for drinking. Kunds dot the sandier tracts of western Rajasthan and Gujarat. Traditionally, these well-pits were covered in disinfectant lime and ash, though many modern kunds have been constructed simply with cement. Raja Sur Singh is said to have built the earliest known kunds in the village of Vadi Ka Melan in the year 1607 AD.
Baoli

Built by the nobility for civic, strategic or philanthropic reasons, baolis were secular structures from which everyone could draw water. These beautiful stepwells typically have beautiful arches, carved motifs and sometimes, rooms on their sides. The locations of baolis often suggest the way in which they were used. Baolis within villages were mainly used for utilitarian purposes and social gatherings. Baolis on trade routes were often frequented as resting places. Stepwells used exclusively for agriculture had drainage systems that channelled water into the fields.
Nadi

Found near Jodhpur in Rajasthan, nadis are village ponds that store rainwater collected from adjoining natural catchment areas. The location of a nadi has a strong bearing on its storage capacity and hence the site of a nadi is chosen after careful deliberation of its catchment and runoff characteristics. Since nadis received their water supply from erratic, torrential rainfall, large amounts of sandy sediments were regularly deposited in them, resulting in quick siltation. A local voluntary organisation, the Mewar Krishak Vikas Samiti (MKVS) has been adding systems like spillways and silt traps to old nadis and promoting afforestation of their drainage basin to prevent siltation.
Bhandara Phad

Phad, a community-managed irrigation system, probably came into existence a few centuries ago. The system starts with a bhandhara (check dam) built across a river, from which kalvas (canals) branch out to carry water into the fields in the phad (agricultural block). Sandams (escapes outlets) ensure that the excess water is removed from the canals by charis (distributaries) and sarangs (field channels). The Phad system is operated on three rivers in the Tapi basin – Panjhra, Mosam and Aram – in the Dhule and Nasik districts of Maharashtra.
TRADITIONAL WATER CONSERVATION METHODS:

- The knowledge of hydrology is deep rooted in the science of ancient India. Our ancestors applied the knowledge in water resource engineering. Every region of our country had its own water harvesting techniques, reflecting the geographical peculiarities and cultural uniqueness of different communities.
INCREASE WATER SOURCE – CAPTURE THE LOSS

Rainwater Harvesting

Groundwater Recharge

Groundwater Flow

Make Checkdams

28-Sep-19

6th IWW-SNS-27/09/2019
Waste Water Generation and Its Use

- India generates 18 Billion M³ of waste water every year
- Not all waste water from Domestic and Industry is treated
- Only 30% & 7% of sewage from Tier I & II cities is treated
- Rest is discharged untreated into rivers and fields
- Untreated water is contaminating surface and ground water resources
- Treatment and Recycle will
  - Save precious natural resources from pollution
  - Generate additional 32 Billion M³ water for reuse annually both for industry and domestic sectors

Source: Central Pollution Control Board

Waste Water Recycle and Reuse can be new water resource and help reduce water stress.
For want of adequate sewerage network and treatment facilities, domestic sewage from the catchment settlements freely flows into the water bodies, which is a basic challenge for management.
THANK YOU
Addressing the urban drivers of river health in the Ganga River Basin

27 Sep 2019
Project Concept

Pollution
- Solid waste
- Liquid waste

Indiscriminate Abstraction & Restriction of Natural Flow

Encroachments

Flooding

Other Activities
Project Concept

- Treatment Plants
- Sewer Networks
- Cleanliness Drives
- Ghat development
- Water body conservation
- Research and Innovations
Project Concept

Need to integrate river health management into the long-term planning for a city
Project Objectives

OBJECTIVE 1: Develop Strategic Guidelines to mainstream urban river management into a city’s Master Plan
OBJECTIVE 2: Supporting the city of Kanpur in the development of an Urban River Management Plan
1. Click on this icon to insert a new photo.

2. Reset the slide.

3. Where necessary, change the section using the "Crop" function.

River Basin Planning
Water Strategy, Planning and Delivery – Overview

Dr Martin Griffiths

Support to Ganga Rejuvenation
Implementation of the India EU-Water Partnership | New Delhi 27.09.2019
Water Protection and Improvement Programmes are developed via a River Basin Planning and Management Cycle.
Example - EU Water Strategy
The Water Framework Directive

European Commission, DG Environment

United Nations Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOAL 6
Ensure availability and sustainable management of water and sanitation for all

water.europa.eu
Outcomes in the Environment - UK
Outcomes in the Environment - India
Setting Outcome Based Targets

• Strategic Questions

  • What does India want from the Ganga
  • What is realistic and achievable
  • What are the significant management issues
  • What timeframes should be set
  • What are the costs
    • Capital
    • Operational
  • What are the benefits
  • Who will deliver these

• What is the most cost effective way to achieve these Outcomes

• River Basin Planning provides a process to determine this
River Basin Planning and Management Cycle
Inner Cycle – Technical Process
Planning and Setting Objectives
Clear Governance

• United Nations Road-Mapping recommends creating
  • Enabling Environment
  • Clear Institutional Structures
  • Management Instruments
  • Infrastructure Development

• EU introduces the concept of ‘Competent Authority’
  • A clear and empowered organisation to lead and deliver the RPM plan
  • In England this is the Environment Agency
  • On the Rhine and the Danube
    • International Commission for the Protection of the Rhine River (ICPR)
    • International Commission for the Protection of the Danube River (ICPDR)
  • For the Ganga this will be ???
Characterisation

Risk Based Approach

- Understand the characteristics of the Basin/Sub-basin
- Identify Significant Management Issues
- Use Driver-Pressure-State-Impact-Response (DPSIR) Model
Risk Based Approach

- Risk Based Monitoring
- Risk Based Modelling
- Risk Based Regulation
- Risk Based Enforcement
Monitoring

• Risk Based

  • Assess current Water Quality
  • State of Environment reporting
  • Essential to set realistic River Quality Objectives
  • Data to calibrate and run models
  • Assess remediation options
  • Ensure correct infrastructure development and operation
  • Optimise regulatory environment and assess delivery

• Very cost effective when compared with infrastructure capital and operational costs

• All infrastructure options are modelled to ensure certainty of improvement and that benefits are realised
Monitoring

• A sample of Ganga Water 15 April 1987 taken by me
• Its been on my desk for over 30 years!
Environmental Monitoring - Programmes

Biological Elements

Chemical Elements

Hydromorphological Elements

Physico-chem Elements
From Monitoring Information

- Assess Current Quality
- Undertake modelling of options and interventions
- Set realistic Objectives
- Develop improvement Programme
- Feed this into Implementation Programme
River Quality Objectives are progressively improved according to an Environmental Improvement Programme.
EU - Good Ecological Status Objective

- HIGH
- GOOD
- MODERATE
- POOR
- BAD

Classes

No or minimal
- Slight
- Moderate
- Major
- Severe

Non-deterioration
Restoration

Courtesy Peter Pollard, Scottish Environment Protection Agency
Must agree a Timetable for Improvement – EU WFD Example
Don’t Forget the Groundwater!
Integrated options for ecological improvement

What is the most cost efficient combination of interventions
Integrated options for ecological improvement

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Integrated options for ecological improvement

What is the most cost efficient combination of interventions
Must consider Regulatory Options to Implement Improvement Programme – The Regulatory Cycle

The Regulatory Cycle (adapted from IMPEL Environmental Inspectors Handbook 1999)
Permit standards are progressively tightened
Permit Conditions must reflect the Environmental Objectives!

The Regulatory Cycle (adapted from IMPEL Environmental Inspectors Handbook 1999)
Permits drive water resource Improvement Programmes
Regulation for Water Quality - Book

Free to download at http://www.fwr.org/WQreg/

Or Hard Copy from Foundation for Water Research
River Basin Planning
Public Participation and Consultation
Public participation in the Water Framework Directive

- supply of information
- consultation
- active involvement
Publish - River Basin Management Plans

• Implementing Water Framework Directive
  River Basin Plans

Water for life and livelihoods

River Basin Management Plan
Thames River Basin District
Thank You!

Support to Ganga Rejuvenation
Implementation of the India EU-Water Partnership