G20

भारत 2023 INDIA

वसुधैव कुटुम्बकम्

ONE EARTH • ONE FAMILY • ONE FUTURE

BEST PRACTICES FOR
WATER MANAGEMENT

JULY 2023

TECHNICAL DOCUMENT DEVELOPED FOR THE G20

Acknowledgement

This document is the result of sustained efforts of the Indian G20 Environment and Climate Sustainability Working Group (ECSWG) team on Water Management and the knowledge partner Council on Energy, Environment and Water (CEEW). The presidency would like to thank all G20 delegates who contributed to the production of this Compendium through discussions during the ECSWG meetings.

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Disclaimer: The study does not necessarily provide exhaustive documentation of all Water Management related activities by G20 members and guest countries, rather it documents and analyses their on-going efforts and best practices at the time of the conduct of the study.

Citation: MoJS & CEEW, 2023. Best Practices for Water Management. Ministry of Jal Shakti, New Delhi, India

Table of Content

List of Acronyms

ADCP	Acoustic Doppler Current Profile
AOC	Areas of concern
AUD	Australian dollar
BOT	Build Operate Transfer
BRGM	Peatland and Mangrove Restoration Agency
CaBA	Catchment Based Approach
CCMP	Comprehensive Conservation and Management Plan
CEWH	Commonwealth Environmental Water Holder
CNR	National Research Council
CO2	Carbon dioxide
CONAGUA	National Water Commission of Mexico
CREA	Council for Agricultural Research and Agricultural Economics
CREG	Chamber of Exceptional Rules for Hydro Energy Management
DBOT	Design Build Operate and Transfer
DHARMA	Dam Health and Rehabilitation Monitoring Application
DMP	Drought Management Plans
DMPG	Desa Mandiri Peduli Gambut
DNIT	National Department of Transportation Infrastructure
DPSIR	Driver-Pressure-State-Impact- Response
DRIP	Dam Rehabilitation and Improvement Project
DWS	Department of Water and Sanitation
ECF	Engineered containment facility
ECMWF	European Centre for Medium-Range Weather Forecasts
EPA	United States Environmental Protection Agency
EPC	Engineering, Procurement and Construction
EQI	Environmental Quality Index
EU	European Union
FCDO	Foreign Commonwealth and Development Office
FTK	Field-testing kits
GIS	Geographic information system
GLWQA	Great Lakes Water Quality Agreement
HAM-PPP	Hybrid Annuity Based Public Private Partnership
HWP	Healthy Watershed Program
ISPRA	National Institute for Environmental Protection and Research
ISTAT	National Institute of Statistics
IUCN	International Union for Conservation of Nature
IWMR	International Webinar on Multidisciplinary Research
JJM	Jal Jeevan Mission
KPI	Key Performance Indicators
MAPA	Ministry of Agriculture, Livestock and Supply
MASE	Ministry of Environment and Energy Security
MC	Management Conference
MDB	Murray-Darling Basin
MDP	Million Pesos
MDR	Ministry of Regional Development
ME	Ministry of Economy
MEWA	Ministry of Environment, Water and Agriculture
MINFRA	Ministry of Infrastructure
MLD	Million Litres per Day
MMA	Ministry of the Environment
MNE	Ministry of Mines and Energy
MoE	Ministry of Environment
MoEF	Ministry of Environment and Forestry
MoF	Ministry of Finance
MSM	Minimal Scientific Monitoring
NDVI	Normalized Difference Vegetation Index
NEP	National Estuary Program
NGO	Non-governmental organization
NMCG	National Mission for Clean Ganga
NWS	Saudi National Water Strategy
O&M	Operations and Maintenance
ONLIMO	Online Water Quality Monitoring
PHE	Strategic Waterway Plan
PND	National Development Plan

ONS	National Systems Operator
PDSI	Palmer Drought Severity Index
PHDI	Palmer Hydrological Drought Index
PNH	National Water Program
PNI	Percent of Normal Index
PoMs	Programmes of Measures
PROAGUA	Drinking Water, Drainage and Treatment Program
PROMARNAT	Environment and Natural Resources Sector Program
R&D	Research and Development
RBD	National Irrigation Association, National Hydropower Association, River Basin District
RWPF	Rural WASH Partners' Forum
SANS	South African National Standard for Drinking Water
SBI MCLR	State Bank of India Marginal Cost of Fund
Sc-PDSI	Self-Calibrating Palmer Drought Severity Index
Sc-PSDI	Self-Calibrating Palmer Hydrological Drought Index
SCALL	Rainwater Harvesting System
SDLs	Sustainable diversion limits
SGI	Standardized Groundwater Index
SIN	National Interconnected System
SIO	Saudi Irrigation Organization
SPEI	Standardized Precipitation, Evapo- transpiration Index
SPI	Standardized Precipitation Index
SPV	Special Purpose Vehicle
SRI	Standardized Runoff Index
STP	Sewage Treatment Plant
SWPC	Saudi Water Partnership Company
SWPP	Saline Water Conversion Corporation
TATUS	National Flood Forecasting and Early Warning System
TSE	treated sewage effluent
UGPL	Underground pipelines
UJVNL	Uttarakhand Jal Vidyut Nigam Ltd
UK	United Kingdoms
ULBs	Urban Local Bodies
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UT	Union Territory
VCI	Vegetation Condition Index
WASH	Water, Sanitatio and Hygiene
WEPA	Water Environment Partnership in Asia
WFD	Water Framework Directive
WHO	World Health Organisation
WMO	World Meteorological Organization
WQI	Water Quality Index
WTTCO	Water Technology and Transmission Company
ZMM	Monterrey Metropolitan Area

Introduction

This compendium has been developed through a synthesis of cases of best practices for water management in the G20 countries. For this purpose, a best practice template was developed by the Ministry of Jal Shakti, Government of India and shared with the G20 member countries to report programmes and interventions undertaken by them, across but not limited to the following thematic areas.

Universalisation of water and sanitation services

One of the major targets of Sustainable Development Goal 6 is to achieve universal access to safely managed drinking water and sanitation services by 2030 (United Nations, 2022). Access to clean and potable water has a positive public health impact too (Hutton and Chase, 2017). G20 member countries cover almost two third of the world population with every country having adopted different approaches to ensure drinking water security. For instance, India has embarked on a mission to provide functional tap connections within premises to every rural household by 2024. The G20 India Presidency took cognizance of such initiatives and invited G20 members to share cases on ensuring drinking water security.

Participatory groundwater management

Groundwater is the major source for meeting domestic, industrial, and irrigation demand in most of the G20 countries (Source: FAO AQUASTAT). Due to the adverse impact of climate variability and change on hydrology (particularly on the availability of surface water resources), reliance on groundwater for meeting sectoral water demands has increased. This has led to the withdrawal of groundwater beyond sustainable limits in many areas. The G20 India Presidency took cognizance of this and invited sharing of insights on sustainable management of this invisible resource, especially highlighting the role of local stakeholders in groundwater recharge and its efficient use.

Climate resilient water infrastructure

Climate variability and change are adversely impacting water availability through their influence on hydrology (Pörtner et al. 2022). The predicted hydrological changes pose a risk to water availability for agriculture, energy production, and industrial, domestic, and environmental needs (Bassi 2022). The G20 India Presidency took cognizance of these aspects and invited G20 members to share experiences, challenges, and ways to climate-proof water infrastructure and services.

Water use efficiency improvement

Water use efficiency in various sectors is low in many G20 countries (Braun et al., 2017). Given that many regions are facing water stress at present and many others are likely to face it in the near future, there is a need to improve water use efficiency at different scales to enable the productive use of water and reduce its wastage. The G20 India Presidency took cognizance of this and invited G20 members to share various approaches to optimise the returns per unit of water consumed in different sectors.

Any other water management programme or intervention

The G20 India presidency also invited innovative interventions on water management in G20 countries that have led to improved water governance, better data and information, models for financing water infrastructure, and capacity building of stakeholders.

The compendium on ‘Best Practices for Water Management’ includes 40 innovative case studies on best practices for water management received from the G20 member countries. The case studies cover an array of themes including water use efficiency, river rejuvenation, climate resilient infrastructure, safe drinking water, hydro energy management, water data and information, flood management, drought management, water body restoration, global knowledge partnerships on water management, water harvesting, water supply augmentation, efficient water governance, wastewater management, watershed management and civil society participation, and groundwater management.

Building on the outcomes from past G20 presidencies, the compendium on ‘Best Practices for Water Management’ under India’s G20 Presidency aims to provide a platform for greater knowledge sharing and learning towards achieving sustainable water resources management across the world.

Argentina

2,780,400
Total area in sq km

45,808
Population 2021 in thousands

21,527
Per capita GDP in PPP 2021 in USD

0.842
Human development index 2021-22

591
Average annual precipitation 2019 in mm

6,498
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Environment and Sustainable Development

Ministerio de Ambiente y Desarrollo Sostenible
Argentina

Safe Water Program

Responsible Agencies/Institutions

- Juan Cabandié

Summary

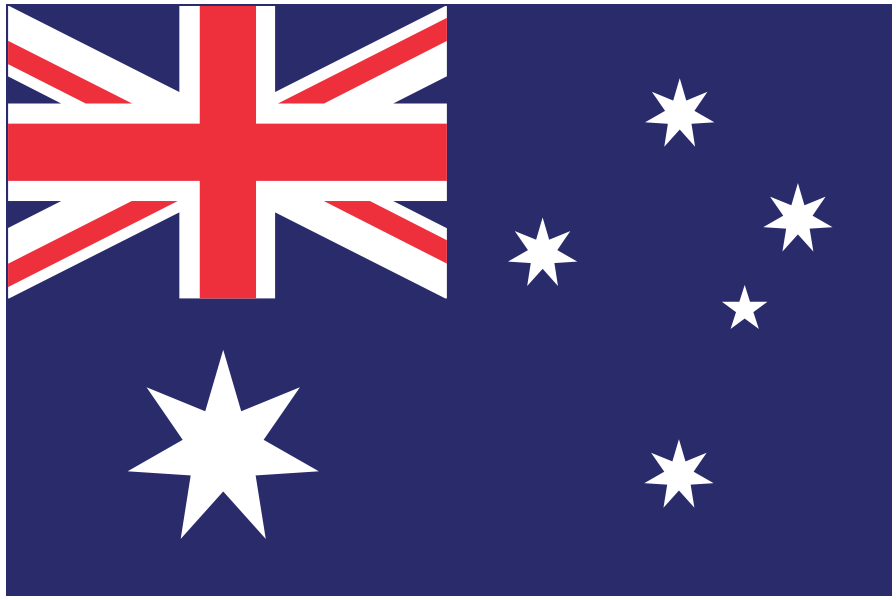
The Safe Water Program aims to provide technical and financial assistance for the supply of safe water; abatement of arsenic in water for human consumption; rainwater harvesting and use; and conservation, recovery and sustainable use of water bodies to provincial governments, municipalities, cooperatives, non-governmental organizations, rural populations, peasant communities, and indigenous people.

Description

- The Safe Water Program is an effective tool for self-management of water by beneficiaries, and promotes the human right of access to safe water; the equitable and sustainable use of water resources; and the conservation of aquatic ecosystems and associated lands.
- The Program supports activities aimed at technical training and resource management that contribute to improving the quality of life of participating communities. The activities are developed within a framework of respect for cultural diversity, considering differing worldviews of nature, to help strengthen community participation in the organization, management and sustainable use of natural resources and common goods.

The Safe Water Program leverages sustainable systems like renewable energy.

Australia



7,692,024
Total area in sq km

25,688
Population 2021 in thousands

49,774
Per capita GDP in PPP 2021 in USD

0.951
Human development index 2021-22

534
Average annual precipitation 2019 in mm

19,416
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Commonwealth Environmental Water Holder

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Environmental Flows

Responsible Agencies/Institutions

- Commonwealth Environmental Water Holder (CEWH)

Summary

- The CEW Holder is a world-leading institution responsible for managing environmental flows in a large river basin, governed by multiple jurisdictions.
- With over 10 years of experience, this unique water management program in the Murray-Darling Basin is underpinned by cooperation and coordination between federal and state governments; monitoring and research across borders and partnerships with land holders, First Nations people, irrigation corporations, scientists and community members concerned about the health of rivers and wetlands.

Description

- Covering 1/7th of the Australian continent, the Murray-Darling Basin provides water for 3 million people and supports 65% of Australia's irrigated agriculture.
- However, infrastructure and river regulation have interrupted the natural pattern of flows, affecting the health of rivers, wetlands, plants and animals.
- As part of its reforms to achieve sustainable levels of water use in the Basin, the Australian Government has recovered over 2000 gigalitres of water that was previously used to supply agricultural and other consumptive uses.
- This water is now managed by CEWH, an independent federal agency, to protect and restore the rivers, wetlands and floodplains of the Basin.
- Since its establishment in 2008, the CEWH has delivered environmental flows that have benefitted over 22,000 kilometres of rivers and inundated over 370,000 hectares of lakes, wetlands, estuarine ecosystems and floodplains. The flows have supported native animals to migrate, move between habitats and complete their life-cycles.
- Working alongside state government agencies, the CEWH partners with First Nations people, local landholders, community groups, the irrigation sector and scientists to plan, deliver and monitor environmental flows.
- This allows a myriad of perspectives and values associated with the Basin's rivers and wetlands to be incorporated as part of the decision-making process, and builds awareness and trust in this relatively new natural resource management approach.

Lessons Learned

- Key elements of the success of the program include managing across the Basin, but within a local context, a commitment to local engagement, and adaptive management, underpinned by science and knowledge.

References

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Aither (2018). Managing Water for the Environment: An Australian Perspective. Australian Water Partnership, Canberra. https://waterpartnership.org.au/wp-content/uploads/2018/03/HLPW-Guide-Managing-Water-Environment.pdf




Ministry/Agency/ Organization

Department of Climate Change, Energy, the Environment and Water

Australian Government
Commonwealth Environmental Water Office

Contact Details

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Basin Plan

Responsible Agencies/Institutions

- Australian Government Department of Climate Change, Energy, the Environment and Water; Murray-Darling Basin Authority; Inspector-General of Water Compliance; Office of Water Compliance; Bureau of Meteorology; State Governments of New South Wales, Queensland, South Australia, Victoria and the Australian Capital Territory

Summary

- The Murray-Darling Basin (the MDB) is Australia's largest and most complex river system, covering one million square kilometres (14% of Australia's land area) of interconnected rivers and lakes in south-eastern Australia as it traverses the states of Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory.
- The MDB has great economic, cultural and environmental value, with more than 2.3 million people calling it home, including 40 First Nations. First Nations people have lived in the MDB for over 50,000 years, with water playing an important part in indigenous cultural traditions. About 40% of Australian farms are in the MDB and produce AUD 22 billion worth of food and fibre every year.
- The landscape, water resources, plants and animals of the MDB form some of Australia's most unique habitats and ecosystems, hosting 120 waterbird species and more than 50 native fish species, with 16 internationally significant wetlands across 12 eco-regions. The MDB also provides a seasonal habitat for migratory birds.
- The Australian Government and communities have grappled with the complex issue of sharing the MDB water due to its interconnected systems and complex governance arrangements. Recognising the importance of maintaining the MDB as a healthy, working river system, the Australian Government passed the Water Act 2007 (Cth) (Water Act) to establish the legislative framework for managing the MDB in the national interest.
- Under the Water Act, the MDB Authority (MDBA) was established as an independent statutory agency responsible for developing the MDB Plan 2012 (Cth) (Basin Plan). The aim of the Basin Plan is to bring the MDB back to a healthier and sustainable state by ensuring enough water is available in the environment to support the rivers, lakes and wetlands and the plants and animals that depend on them, while continuing to support the communities that rely on the MDB.

Description

- The Basin Plan sets sustainable diversion limits (SDLs) for water that can be taken from the MDB for towns, farms and other consumptive uses.
- Water left in the river system, including water recovered for the environment by the Australian Government, is available to restore and maintain the health of rivers, wetlands and floodplains.
- The Basin Plan identified the need to reduce water extractions by 2,750 gigalitres per year (GL/y).
- This target was changed to 2,075 GL/y in 2018, subject to MDB governments achieving environmental outcomes with less water.
- The Basin Plan also includes an additional 450 GL/y water recovery target. Recovered water entitlements will be used for environmental outcomes to ensure the ongoing health of the system.
- Over 2,000 GL of water has been recovered for the environmental health of the system. The latest information on water recovery progress is available at: https://www.dcceew.gov.au/water/policy/mdb/progress-recovery".
- The Basin Plan needs water resource plans to set arrangements to manage water within the limits and during extreme events, to protect environmental water, maintain connectivity between rivers and with ground water, meet water quality targets, and develop strategies to manage climate change risks.
- The Basin Plan includes a series of adaptive management instruments to ensure its implementation can respond to improved science and knowledge.
- Adaptive management allows governments and communities to adjust their approach and future plans in response to evolving climate patterns, new information and local knowledge

Lessons Learned

- The MDB is complex, diverse and constantly changing in response to the climate and human activities. There is a need to adapt to these changes to preserve the unique environment of the MDB and continue the reliance of communities and industries on sustainable MDB water resources.
- The Australian Government is providing AUD 22.9 million to update the science to account for the impacts of climate change in managing MDB water resources. This includes AUD 6 million to reinstate the Sustainable Rivers

Audit; AUD 8.5 million to re-run the Sustainable Yield study; and AUD 3.5 million for a review of climate change impacts on Ramsar sites.

- Water is important to the spiritual and cultural traditions of First Nations people and it is important to use their knowledge to manage water resources. The Government has committed to improving the well-being and cultural connections of First Nations people by increasing their water holdings and ensuring that the cultural authority, deep knowledge and expertise of First Nations people is better incorporated into water decisions.
- More work is needed to enhance trust and confidence of communities and industries that water is being used in compliance with the rules underpinning Australia's water resource management. The Government has committed AUD 29 million to improve trust and transparency in Basin water management, including metering and monitoring of water use and a commitment to increase transparency and integrity of Basin water markets.
- MDB communities, economy and industries have endured years of droughts, floods and the COVID-19 pandemic. Government assistance is available for flood affected people either through the one-off Australian Government Disaster Recovery Payment or the Disaster Recovery Allowance.
- Assessing the effectiveness of Basin water management initiatives through regular monitoring, evaluating and reporting is critical to ensuring the way water is managed works and is on track.
- This needs regular decadal reviews of the Basin Plan, which could lead to changes in water limits or other water management arrangements. The next review is scheduled to occur by 2026.
- The Water Act requires the federal Productivity Commission to conduct five-yearly inquiries into the effectives of the implementation of the Basin Plan and water resource plans. The first assessment was undertaken in 2018, and the second is due in 2023.
- The success of the Basin Plan depends on understanding what is working well and areas which need improvement. Science and knowledge are core to MDB water resource planning and management. The Government has developed the following programs to enable better research, knowledge, data and analysis to inform water policy:
  - The Murray-Darling Water Environment Research Program, with AUD 20 million investment in scientific knowledge of the Basin.
  - The Integrated River Modelling Uplift Project, with AUD 65 million investment for a whole-of-Basin hydrological modelling capacity.
  - Basin Condition Monitoring Program, with AUD 7.5 million investment to develop and deliver new monitoring and reporting of economic, social, cultural, and environmental conditions in the MDB.

References

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https://www.mdba.gov.au/2020-basin-plan-evaluation
https://www.dcceew.gov.au/water/policy/mdb
https://www.mdba.gov.au/2020-basin-plan-evaluation
https://www.pc.gov.au/inquiries/completed/basin-plan/report
https://www.dcceew.gov.au/water/policy/mdb/progress-recovery

The spread of the Murray-Darling Basin (the MDB), Australia's largest and most complex river system.

Brazil

8,515,767
Total area in sq km

2,14,326
Population 2021 in thousands

14,592
Per capita GDP in PPP 2021 in USD

0.754
Human development index 2021-22

1,761
Average annual precipitation 2019 in mm

26,730
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Mines and Energy (MME)

Establishment of the Chamber of Exceptional Rules for Hydro Energy Management (CREG)

Responsible Agencies/Institutions

- Ministry of Mines and Energy (MME), Ministry of Economy (ME), Ministry of Infrastructure (MINFRA), Ministry of Agriculture, Livestock and Supply (MAPA), Ministry of the Environment (MMA) and Ministry of Regional Development (MDR).

Summary

The Chamber of Exceptional Rules for Hydro Energy Management, through Provisional Executive Order MP 1.055/2021, aimed at;

- establishing emergency measures for optimal use of hydro energy resources to cope with the situation of water scarcity
- ensuring the continuity and security of the hydro energy supply in Brazil
- preserving the multiple uses of water and ecosystem functions associated with hydroelectric reservoirs.

Description

- CREG's work was conducted through weekly technical and managerial meetings, which provided inputs for high-level inter-ministerial decision-making.
- The monitoring of the water scarcity and the impacts related to the decline of the power plants storage was based on daily reports of the National Systems Operator (ONS).
- CREG adopted several measures with direct impacts on water resources management, including:
  - Making the hydraulic restrictions more flexible, in order to ensure water availability for the functioning of the hydroelectric power plants of the National Interconnected System (SIN), especially those that are positioned in sequence on rivers (the so-called cascade plants) and other associated water uses.
  - Activation of thermal power plants and energy imports from neighbouring countries, in order to conserve the reservoir levels of hydro electric power plants.
  - Promotion of awareness campaigns for the population about rational water use.
  - Implementation of incentive programs for the voluntary reduction of energy consumption for both free and regulated consumers.
  - Creation of a specific tariff flag/label for water scarcity conditions.
  - Anticipation of the execution of energy generation and transmission works.
  - Discussion about long-term plans for the recuperation of strategic reservoirs of the country.
  - The design of the recovery plan for the regularisation of the reservoirs of hydroelectric power plants has been concluded. The actions to be executed in the period 2023-2032, as well as the global indicators for monitoring the plan, are in the final stages of drafting.

Lessons Learned

- The adoption of more flexible measures concerning operating rules of hydro electric power plants shows their effectiveness in the security and reliability of the supply of electric energy to the country, and ensuring water for various uses even in the face of water scarcity.
- The exceptional measures indicated by CREG were fundamental to meet the SIN's requirements and the water conservation in the reservoirs under unprecedented conditions of water scarcity experienced in the country. This allowed storage gains of 14 per cent of the maximum stored energy in the southeast/central-west subsystem which represents approximately 70 per cent of the total Brazilian energy reserve.

References

MP 1.055/2021 (Establishment of the Chamber of Exceptional Rules for Hydroenergy Management);

Ministry/Agency/ Organization

Ministry of Transport

National Department of Transportation Infrastructure (DNIT)

Directorate of Waterway Infrastructure

General Coordination of Waterway Constructions

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General-Coordinator of Waterway Constructions CGOB | DAQ

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Waterway Monitoring Program

Responsible Agencies/Institutions

- Directorate of Waterway Infrastructure
- General Coordination of Waterway Constructions

Summary

- DNIT is Brazil's federal agency responsible for managing rivers for navigation purposes.
- The Waterway Monitoring Plan, launched by DNIT in 2020, aims to provide extensive information about the hydrology, hydrography, and fluvial hydrodynamics of the main Brazilian rivers, offering technical support for decision-making on interventions such as dredging works, installation of navigation signage, and other types management decisions that support safe and reliable use of the river for navigation purposes.
- The Waterway Monitoring Program is an essential component of the Strategic Waterway Plan (PHE), prepared by the Ministry of Transport. The Waterways Monitoring Program supports two goals of the PHE:
  - Expand the Brazilian waterway network with an adequate level of service.
  - Develop a reliable inland waterway transport system with the implementation of new technologies and better operating conditions.
- The Waterway Monitoring Program is a source of up-to-date data, essential for the operation of the waterway, maximizing the reliability and sustainability of the route and, consequently, the safety of navigators.
- Successful execution of the Waterways Monitoring Program and Strategic Waterway Plan will support a more robust transportation system across Brazil by more effectively coordinating transportation across rivers, ports, roads, and rail.

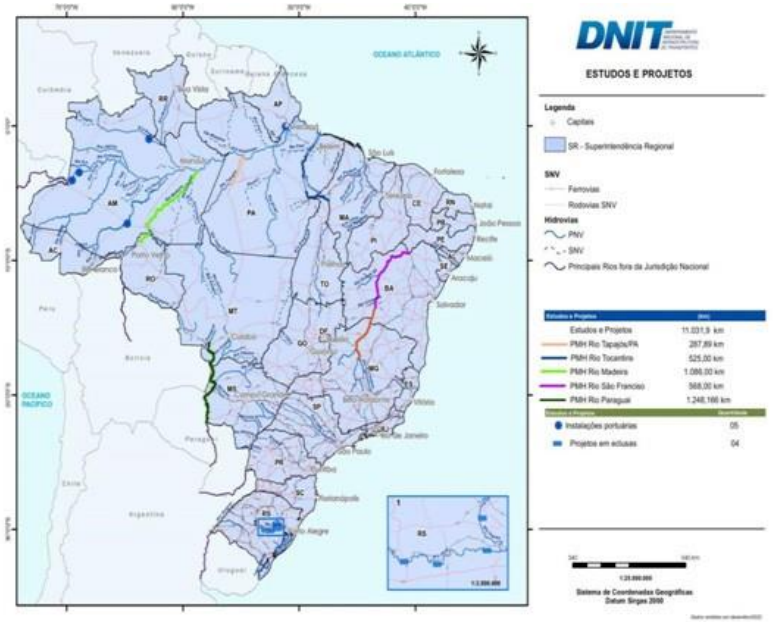

Figure 1. PMH Contracts

Description

- In the Waterways Monitoring Plan, the bathymetric, bed sediment mobility, Acoustic Doppler Current Profile (ADCP), and sediment data are collected that help us to model the rivers to understand their behaviour and support informed decision-making.

Lessons Learned

- The data are dynamic and constant monitoring is the most effective method to understand annual and inter-annual variability and river responses to droughts, floods, watershed changes, climate change, and engineering and management actions.

References

General-Coordinator of Waterway Constructions CGOB | DAQ

Canada

9,984,670
Total area in sq km

38,246
Population 2021 in thousands

47,893
Per capita GDP in PPP 2021 in USD

0.936
Human development index 2021-22

537
Average annual precipitation 2019 in mm

75,795
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Environment and Climate Change, Canada

Environment and Climate Change Canada

Water Management in Canada: Success Stories from the Great Lakes

Responsible Agencies/Institutions

- Environment and Climate Change, Canada

Summary

- Canada has 20 percent of the world's surface fresh water, more than two million lakes and rivers, and more inland waters than any other country.
- Responsibility for water management is shared by the federal, provincial, territorial, and municipal governments and indigenous people.
- Many waterbodies cross or form the Canada-U.S. border (which is 40 percent over water). Among them, the Great Lake system is the largest (Figure 1).

Figure 1. The North American Great Lakes

- Recognizing the importance of the Great Lakes, Canada and the U.S. signed the Great Lakes Water Quality Agreement (GLWQA) in 1972.
- The GLWQA identifies shared priorities and actions needed to restore and protect the Great Lakes.
- Under the GLWQA, Canada and the U.S. work in cooperation and consultation with other levels of government, indigenous people, non-governmental entities and the public.

Description

- The Canada-U.S. GLWQA celebrated its 50th anniversary in 2022.
- To date under the GLWQA, Canada and U.S. have:
  - Reduced toxic substances in the environment that are harmful to fish and wildlife, some by more than 90 percent.
  - Restored and continue to restore degraded areas on both sides of the border.
  - Implemented measures that have resulted in the return of important species, including Bald Eagle and Lake Trout, to the Great Lakes region.
  - Reduced the establishment of new non-native aquatic species.
- Priorities and challenges addressed by the GLWQA include areas of concern (AOC), lake-wide management, chemicals of mutual concern, nutrients, discharges from vessels, aquatic invasive species, habitat and species, ground water, climate change impacts, and science.
- A key GLWQA success story is the remediation of Randle Reef in Hamilton Harbour which is an AOC under the GLWQA as it is the largest contaminated sediment site on the Canadian side of the Great Lakes.
  - The project started in 2015 which will end in 2024, involves placing a multi-layered environmental top on the engineered containment facility (ECF) to create new valuable port lands (Figure 2).

Figure 2. Project Execution in Randle Reef, Hamilton Harbour (Lake Ontario)

- As of 2022, all contaminated sediment (over 615,000 m3) has been safely managed.
- Once completed, the project will generate approximately US$ 167 million in economic benefits for the local community, create jobs, grow business development, and generate tourism.
- The US $139 million project is funded by the Government of Canada, Ontario, local municipalities, the Port Authority, and Stelco.

Lessons Learned

- Science-based decision making is an essential element.
  Science underpins everything we do to implement the GLWQA.
- Collaboration with partners at multiple scales and on both sides of the border is critical.
- Identification of Great Lakes Areas of Concern has helped focus resources and efforts in areas of greatest environmental harm.
- Sometimes, complex challenges call for new approaches/innovations and multi-disciplinary expertise.
- Target setting and regular public reporting increase accountability and build a constituency of support for action.
- The return on investment for freshwater restoration projects can be significant.

References

Environment and Climate Change, Canada

China

9,706,961
Total area in sq km

1,412,360
Population 2021 in thousands

17,603
Per capita GDP in PPP 2021 in USD

0.768
Human development index 2021-22

645
Average annual precipitation 2019 in mm

1,998
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Water Resources

Contact Details

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Comprehensive Treatment of Groundwater Overdraft in North China

Responsible Agencies/Institutions

- The State Council has set up a Coordination Group with members from relevant government departments and persons responsible from the people's governments of Beijing, Tianjin and Hebei provinces, headed by the Vice Premier, for comprehensive treatment of groundwater overdraft in North China.
- The Ministry of Water Resources leads the program, supported by the Ministry of Finance, the National Development and Reform Commission, and the Ministry of Agriculture and Rural Affairs.

Summary

The Coordination Group, led by the Ministry of Water Resources, studied, formulated, and issued the Action Plan for the Comprehensive Treatment of Groundwater Overdraft in North China, comprising the guidelines, treatment objectives, key initiatives and safeguard measures, in January 2019 with the approval of the State Council.

Description

- Since the 1970s, long-term large-scale exploitation of groundwater led to serious over exploitation, resulting in ecological and environmental problems such as declining groundwater levels, shrinking water surface of rivers and lakes, land subsidence, and seawater intrusion.
- The Action Plan adopts a problem-oriented approach with the emphasis on Beijing-Tianjin-Hebei region, and provides ideas, treatment objectives, key initiatives and safeguard measures for the comprehensive treatment of ground water overdraft in North China with long and short-term considerations, integrated policies and pilot implementation, with the aim to balance ground water extraction and replenishment.
- The process of treatment focuses on implementing measures and tasks like "conservation", "control", "exchange", "replenishment" and "management" to achieve the objectives.
    - "Conservation" refers to strengthening water conservation in key areas of groundwater overdraft, through efforts to tap the potential of water conservation; promote water saving and efficiency gains in agriculture; accelerate water-saving transformation in irrigation areas and construct high-efficiency water-saving irrigation projects in fields; promote agronomic water-saving agricultural measures and drought-tolerant crop varieties; promote water conservation in industries and cities and towns; curb the development of water-intensive industries; and reduce groundwater extraction.
    - "Control" involves strictly controlling the scale and intensity of development through measures such as adjusting the structure of agricultural planting; adopting farmland regeneration system to reduce groundwater extracted for agricultural irrigation; curbing the scale, layout and structure of urban and industrial development; and managing the development of water-intensive industries.
    - "Exchange" aims to increase water supply via multiple channels by making the most of local water, especially unconventional water sources, through efforts to harness externally diverted water such as water from the Yangtze and Luanhe Rivers; enhance the capacity of water source regulation and storage; expand water supply pipe networks; replace groundwater exploited in cities, industrial areas and rural centralized water supply areas; promote replacement of agricultural water sources; and reduce groundwater extraction.
    - "Replenishment" of the ecological water of major rivers and lakes to gradually restore these systems, and increasing groundwater recharge and filling depleted groundwater in North China is done within the premise to ensure normal water supply.
    - "Management" of groundwater utilization is done via efforts to tightly manage areas where groundwater extraction is prohibited and restricted; shut down independently dug urban wells and agricultural irrigation wells; put rigid constraints on the carrying capacity of water resources; improve monitoring and measurement systems; and promote the reform of water rights, water prices and water resource tax.
- The implementation of the Action Plan, led by the Ministry of Water Resources with relevant departments and local governments, involved adopting and promoting comprehensive treatment measures for groundwater overdraft; reducing groundwater extraction; promoting groundwater recovery; and improving the ecological environment of rivers and lakes.
- The Action Plan has achieved remarkable results.
    - Completion of supporting projects for continued construction and water-saving renovation in six large-scale irrigation areas has led to break-throughs in water conservation and water pressure control, including the addition of 557,442 hectares (ha) of new high-efficiency water-saving irrigation area, twice the recent treatment objective; addition of 273, 526 ha with a new planting structure; shutdown of 279,000 motor-pumped wells; and greater efforts to replace water sources.
    - In 2022, groundwater extraction in the treatment area was reduced by ~4 billion cubic meters (bcm) compared to 2018, and over-exploited groundwater volume was reduced by 2.62 bcm, outperforming the Plan's short-term treatment goals.

- Water transfer and replenishment has been promoted; by 2022-end, the Plan completed the overall planning for local water, reclaimed water, and water diverted from the Yangtze and the Yellow Rivers; and implemented ecological water replenishment of 24 bcm for rivers and lakes.
- The cumulative amount of groundwater infiltrated by replenishing rivers exceeded 10 bcm. In 48 rivers and lakes, including the Yongding, Chaobai, Baiyangdian, Hutuo, Fuyang and South Juma Rivers, the Plan has continued routine water replenishment and concentrated summer water replenishment, and promoting groundwater recharge and ecological recovery of rivers and lakes.
- The overall groundwater level rebounded by 2022-end, reversing the trend of declining since the 1980s, through continuous improvement in groundwater levels starting from a slowdown in decline, to bottoming out, to recovery.
- Compared to 2018-end, the average shallow underground level in the Beijing-Tianjin-Hebei treatment region had rebounded by 2.25m, and the average deep confined groundwater level had been elevated by 6.72m. The recovery and stabilization area of shallow groundwater and deep confined groundwater reached 92% and 97% respectively, with~90% of the treatment area initially achieving a balance in groundwater mining and extraction.
- The ecology of rivers and lakes in the treatment area has been significantly improved. In 2022, the length of water-replenished rivers and lakes increased to 2,284 km with water surface area of 736 sq-km, 2.5 times and 2.1 times respectively before water replenishment in 2018.
- Full-length water supply has been achieved in main river systems such as Yongding, Chaobai, Daqing and South Canal. The entire Yongding River has had full water supply for two consecutive years; the ecological water level guarantee rate of the Baiyangdian has reached 100%; and the Beijing-Hangzhou Grand Canal has full-length water supply for the first time in a century and achieved confluence with the Yongding River.
- The water quality of rivers and lakes has generally improved, and aquatic biodiversity is improving.

Lessons Learned

- Cooperation between departments and local governments at all levels provides strong guarantee of program success.
- Collaborative treatment measures have proved to be effective and feasible.
- The key initiatives are the ecological replenishment of rivers and lakes, and groundwater recharge.

References

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European Union

3,996,449
Total area in sq km

447,200
Population 2021 in thousands

44,138
Per capita GDP in PPP 2021 in USD

0.896
Human development index 2021-22

3,039
Per capita annual renewable water 2019 in cu m

Czech Republic

Ministry/Agency/ Organization

The district Nový Lískovec of the city of Brno

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Brno – Rainwater Management in Pod Plachtami Park

Responsible Agencies/Institutions

- The Brno – NovýLískovec district is responsible for operations and management, through contractor Cooptel, Stavebnía.s. The project is funded by the Statutory city of Brno – city district Brno-NovýLískovec, the State Environmental Fund, the EU Cohesion Fund, and the European Regional Development Fund.

Summary

The Pod Plachtami Park, located in the district NovýLískovec of the city of Brno, has found a solution for rainwater management and overloaded sewerage. This adaptation measure is providing a green recreational space for citizens and improving local biodiversity.

Description

- In 2006, the NovýLískovec district of Brno started developing a plan to help the area respond to multiple challenges with green infrastructure, by reducing stress on the sewage system, mitigating the urban heat island effect, improving biodiversity, and providing citizens with a recreational area.
- During torrential rains, the district suffered from overloaded sewerage. The in sufficient capacity of the rainwater sewage system prevented further housing construction in the district, and increasing its capacity was extremely costly. The district authorities collaborated with the residents develop green infrastructure – a park with a lake, to retain the rainwater from the housing.
- The lake has an operating level of 630 sq.m and receives rainwater flowing off the roofs of the three neighboring blocks of flats through a system of tubes, with the last 50 meters of these tubes opening into a canal. During torrential rains, the lake's operating level can reach up to 890 sq.m.
- The quality of the water, indicated by the oxygen level and the presence of nutrients, was measured during the first two years of the lake's operation to ensure the safety of citizens. Now, given the high level of biodiversity that characterizes the water basin, there is no need to continue water quality monitoring as it is a safe and healthy environment for residents and animals.
- The NovyLiskovec area also faces frequent droughts and increased heat due to its location on a southern slope. The park and the lake have also enhanced resilience and comfort by lowering the temperature generated by the housing estates.
- Besides establishing an innovative rainwater management solution in an urbanized area, thus reducing the stress on the sewage system, the project has produced a range of environmental and social benefits, including the creation of a microclimate with humidity, lower temperatures and dust, and a home for a wide range of flora and fauna such as pink and white waterlilies, birds, amphibians, insects and small mammals.
- The park is a completely natural habitat in which the water is oxygenated when flowing through a rocky trough and purified by the organisms in and around the lake. The water does not need technical equipment to clean, and in case of water shortage, is replenished from a deep well near the park.
- The Pod Plachtami Park has become a recreational space for its residents, with a nature trail with information boards on the park's biodiversity, the composition and history of the area, and the project's solution to rainwater management, with QR codes through which smartphone users can connect to the website for details. The park has a children's playground and hosts sports events such as the charity 'Run in Colours' with over 2,000 participants.

Information: Pod Plachtami Park in Brno – Adapterra Awards

Lessons Learned

- The park was created to control the local biodiversity and help balance invasive species. During the first year after the lake was built, the invasive fish species of Stone Moroko and Prussian Carp multiplied rapidly and destroyed much of the park's biodiversity. This was solved by introducing predatory fish species.
- The park's sluice was damaged during its fifth year of operation. To fix this, the lake was emptied, the fish and other fauna were rescued, the sluice was repaired, and the lake was cleaned and refilled. The plants and biodiversity of the park quickly recovered.

- At the start of the project, the district organized workshops with locals to discuss their expectations for the park and address their concerns that constructing a lake near their homes could bring mosquitoes and unpleasant odors. Once the infrastructure was completed, the lake and the resultant biodiversity became very attractive among children and the elderly.

References

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Publication type: Case Studies
Publication year: 2020
Link:202006_CoMo_CaseStudy-Brno_EN.pdf (europa.eu)

Slovakia

Ministry/Agency/ Organization

Krasnohorska Dlha Luka

Contact Details

Coordinating beneficiary: Statny geologicky ustav Dionyza Stura Bratislava
Contact person: Peter Malik peter.malik@geology.sk

Implementation of Sustainable Groundwater Use in the Underground Karst System of Krsnohorsk Jaskya Cave

Responsible Agencies/Institutions

- The Statny Geologicky Ustav Dionyza Stura Bratislava for maintenance and operations, and the EU LIFE+ Programme and Ministry of Environment of the Slovak Republic for financing.

Summary

The KRASCAVE project aimed to reduce the risk of contamination of a key drinking water source Krsnohorsk Cave ecosystem by implementing innovations that contribute to local requirements of the Water Framework Directive, and helping reduce risks to the fragile karst ecosystem that depends on the quantity and quality of groundwater.

Description

- Slovakian groundwater resources have experienced significant depletions (by as much as 35%) since 1980, with the problem being particularly acute in the Slovak Karst area.
- Intensification of agriculture and forestry have led to destabilizing traditional hydrological systems, landscape changes and flooding issues, affecting natural heritage sites such as the Domnica Cave.
- The KRASCAVE project focused on a protected area within the Slovak Karst National Park which includes a part of the UNESCO World Cultural Heritage List site at the Caves of Slovak Karst and Aggtelek Karst to introduce preventive measures to protect and sustainably develop this sensitive area.
- The Karst of Krsnohorsk Cave has a unique stalactite and stalagmite decoration, and it is also the only source of drinking water for local commune of Krsnohorsk Dlh Lka. Before the project, exploiting this water source was considered a threat to the long-term sustainability of the stalactite and stalagmite and the karst's other features.

- Specific objectives of the KRASCAVE project included:
  - Comprehensively assessing each component of the underground landscape, comprising water sampling; quantitative and qualitative monitoring of water samples; tracing tests using environmental tracers; and field mapping with detailed documentation on 3 GIS maps;
  - Creating models to record the functionality of groundwater resources and the interacting factors which affect groundwater and illustrate the impact of different scenarios on the groundwater;
  - Developing and testing a prototype facility to secure drinking water supply for Krsnohorsk Dlh Lka village, and protect the water from turbidity problems by developing a turbidity detection device with an early warning system to control the quality of drinking water from karst sources;
  - Delineating environmentally sensitive sites (hot spots) and drawing up management rules for these environmentally sensitive sites accounting for factors affecting water quality near the Krsnohorsk jaskya Cave; and
  - Monitoring the project's effects on groundwater quality and water use patterns by the local community.

Lessons Learned

- The KRASCAVE project helped reduce the risk of contamination of drinking water source in the ecosystem of Krasnohorska Cave, while also addressing risks to the fragile karst ecosystem, by:
  - Developing calibrated computer models of interactions of biotic and abiotic components of the Krasnohorska Cave;
  - Designing, testing and demonstrating for about two years a monitoring prototype to protect drinking water from the effects of turbidity by providing real-time online data on water quality and early warning in case of water quality deterioration;
  - Outlining environmentally sensitive sites, or hot spots, and proposing changes to their management to avoid contamination of ground water and the karst ecosystem; and
  - Raising public awareness through stakeholder events and publications, including for children and youth.
- The monitoring prototype device and implementation of land protection measures for the special natural heritage site of Krasnohorska Cave has great demonstration potential.
- The online monitoring of water quality with an automatic warning system is an innovative approach that allows prompt reactions in case of water deterioration and evidence-based information for the public and authorities.
- The project had a positive impact on tourism and local businesses, with growing number of visitors and interest in the region, and the number of households connected to the municipal water supply system increasing from 54% in 2014 to 66.6% in 2018.
- Recent information indicates that the proposed protection and improvement measures will be reflected in forest and agriculture land management plans, which is promising in terms of policy support and long-term environmental benefits.

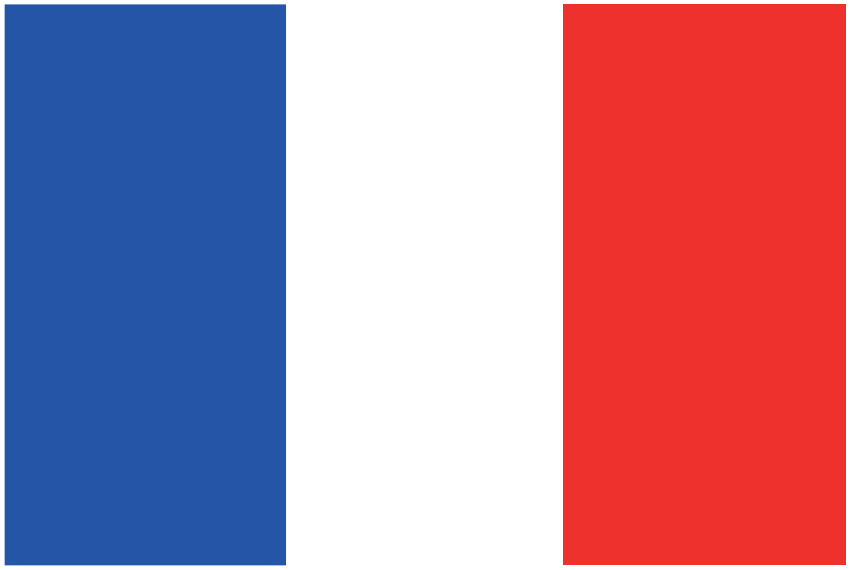
References

Project information is noted in the layman report and After-LIFE Communication Plan at LIFE 3.0 - LIFE Project Public Page (europa.eu)

Publication type: Final Report

Publication year: 2019

France



551,695
Total area in sq km

67,750
Population 2021 in thousands

44,993
Per capita GDP in PPP 2021 in USD

0.904
Human development index 2021-22

867
Average annual precipitation 2019 in mm

2,968
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

French Biodiversity Agency (OFB)

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Adaptative Management of River Restoration: The Demonstration Sites Network

Summary

- Hydro morphological restoration (i.e. restoring altered rivers to their natural state and functioning) is key to achieving good status water quality, and ecosystem services.
- In France, 40 per cent of rivers are altered due to morphology changes. Along with the awareness of the overall positive effect of restoration, the precise effects of restoration works are needed as well.
- The principle of the demonstration site networks was to put in place a network of 45 sites in which standardised monitoring was implemented to evaluate the effects of restoration, provide sound and harmonized data, and give local stakeholders the tools to implement adapted, and more efficient restoration policies.

Description

- Since 2010, the French Biodiversity Agency has been designing a unique network of 45 demonstration sites (Figure 1).
- The network covers the whole metropolitan territory and represents diverse demography (rural, urban, and peri-urban sites) and interventions (re-meandering, bio-engineering to restore river beds, barriers removal, by passing of artificial ponds, etc.).
- A standardized monitoring method, Minimal Scientific Monitoring (MSM), is applied on the whole network in order to acquire long-term homogeneous data, with a two-fold objective:
  - At the scientific level: draw scientific conclusions that can be used for other works, and improve knowledge on ecosystems functioning at the local and national level.
  - At the ground level: anticipate the efficiency of restoration work, communicate well-documented good practices, improve restoration techniques, elaborate monitoring strategies adapted to local contexts, and anticipate the impact of restoration at the societal level.
- The network allows for providing data, monitoring strategies, and resources to local and regional operators, with awareness-raising campaigns, technical guides, scientific studies, etc.

Figure 1. Remeandering of the Echandon river, one of the demonstration sites © Michel Bramard OFB

Lessons Learned

River restoration demonstration sites provide a database of test sites, useful to provide local stakeholders (elected representatives, citizens, farmers, etc.) with concrete examples of restoration works and results, hence fostering support for such operations.

References

https://professionnels.ofb.fr/fr/node/358

Germany

357,114
Total area in sq km

83,196
Population 2021 in thousands

53,180
Per capita GDP in PPP 2021 in USD

0.942
Human development index 2021-22

700
Average annual precipitation 2019 in mm

1,288
Per capita annual renewable water 2019 in cu m

Ministry

Federal Ministry for Environment, Nature, Conservation, Nuclear Safety and Consumer Protection

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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Alina Ruppel: alina.ruppel@z-u-g.org
Mara Hinrichs: mara.hinrichs@z-u-g.org

German Centre for Micropollutants

Responsible Agencies/Institutions

- German Environment Agency and Federal Ministry for the Environment

Summary

- The German Centre for Micropollutants has been founded in 2021 at the German Environment Agency to comprehensively protect water bodies and raw water for drinking water production in Germany from micropollutants as part of the German Trace Substance Strategy. This strategy was embedded in the national water strategy of the country.
- The centre gathers relevant information inside and outside the German Environment Agency concerning micropollutants in water bodies.
- The tasks include the identification of relevant micropollutants, possible voluntary reduction measures, and the connection of these with the various chemicals' legislatives and national and international initiatives.

Description

- Freshwater bodies are subjected to chemical pollution.
- On entering the water environment, they may pose a risk to the aquatic ecosystem and/or drinking water production.
- Furthermore, climate change increases the pressure on freshwater resources, e.g. due to decreasing freshwater resources, higher concentrations of micropollutants, and also a higher proportion of waste water treatment plant effluents are expected in surface waters.
- The main goal of the Centre is to protect water bodies and raw water for drinking water production in Germany in a comprehensive and precautionary manner and in cooperation with all stakeholders and affected parties.
- The main tasks include the evaluation of the toxicological and ecotoxicological of micropollutants, coordination of the multi-stakeholder dialogue, and management of the office of a Committee for the identification of relevant micropollutants. The members of this committee include up to 15 experts from public authorities, industry, environmental and water associations.
- They hold meetings at regular intervals to consider proposals by the German Centre for Micropollutants and issue final evaluations of the environmental relevance of micropollutants for waterbodies.
- If the committee classifies a substance as relevant, stakeholders can be brought together in 'round tables' to discuss and decide on measures to reduce emissions from the production processes and to promote greater producer responsibility.
- Three such round tables have already been established within the framework of the former project 'Multi-Stakeholder Dialogue on the Trace Substance Strategy of the German Federal Government' on the substances diclofenac, benzotriazole, and X-ray contrast agents.
- All measures along the life cycle of micropollutants should always be considered in a coordinated approach to achieve the protection of our water bodies.
- The Centre is also responsible for substance priority-setting and the derivation of environmental quality standards in the context of the European Water Framework Directive 2000/60/EC (WFD) and the Surface Water Ordinance.

Lessons Learned

- 'Round Table' has proven as a suitable instrument for manufacturer-oriented measures and creates a common understanding of complex interests. It also establishes a network among the stakeholders.
- The round table usually ends with the exchange of information and the initiation of projects, awareness campaigns, consumer information, etc.
- Not every substance or substance group is suited for the 'Round Table'. Therefore, appropriate measures should be established by the authorities in joint actions with producers or affected third parties, like establishing an incentive system for the development and use of water-compatible substances (plant protection products, pharmaceuticals, etc.) or post-authorisation monitoring.

References

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https://www.bmuv.de/en/topics/water-resourceswaste/water-management/national-water-strategy

Stakeholder Dialog Germany:

https://www.bmuv.de/en/download/recommendations-from-the-muliti-stakeholder-dialogue-on-the-tracesubstance-strategy-of-the-german-federalgovernment

Werse Intercommunity Development Plan – Flood Protection and Ecological Development

Responsible Agencies/Institutions

- State authorities of North Rhine-West phalia, Warendorf
- District, Town of Beckum, Town of Ahlen, Flick Engineering Association, ARGE Water Agency, farmers, land owners, tenants, water and soil management association, nature conservation organisations, private individuals

Summary

- After the devastating flood of 2001, the district of Warendorf together with the towns of Ahlen and Beckum implemented flood-protection measures in the region in connection with the ecological development of the Werse River water body.
- During the multi-year project, many different aspects such as flood control, biotope development, and local recreation were considered.
- Implementation of the measures also serves adaptation to climate change by counteracting a possible increase of highwater run-off in the future.
- The project was implemented from 2002 to 2015. It was divided into four planning and six construction phases.

Description

- Between Ahlen and Beckum towns, a natural aquatic landscape with flood plains was created over a 10 km stretch.
- The channel straightening of the 1960s and 70s was corrected and numerous natural restoration measures were carried out (e.g. bringing in dead wood, removal of bed drops, new plantings, etc.).
- Within the towns, measures such as the installation of sand traps, planting of greenery, the conversion of drop structures to rocky slopes or ramps, and widening of the channels were carried out (Figure 1).
- Even during heavy rainfall events, there is now sufficient retention area in the natural flooding areas.
- Additional water can be held in a 240,000 cubic meter large flood water retention basin before being fed back into the Werse in a controlled manner.

Figure 1. Reactivation of a near-natural floodplain is one element of flood protection on the Werse

Lessons Learned

- Acceptance, legal status, financing, and data availability were constraints in implementing the measures. To overcome potential obstacles, early-stage open discussions were held with the affected parties (owners, residents, and tenants) and support agencies, and the implementation of measures was linked to a municipal pool of mitigation sites and anticipatory compensation measures Ökokonto).
- The purchase and exchange of property were largely carried out voluntarily. Information on progress was continuously available and public relations work was carried out regularly.
- The effectiveness of the measures was demonstrated during the high-water event of 2010. The water level in Ahlen was significantly lower than previously measured values.
- The measure conforms with the standards of the EU WFD and has resulted in a permanent reduction of maintenance expenses for the water and soil management association.

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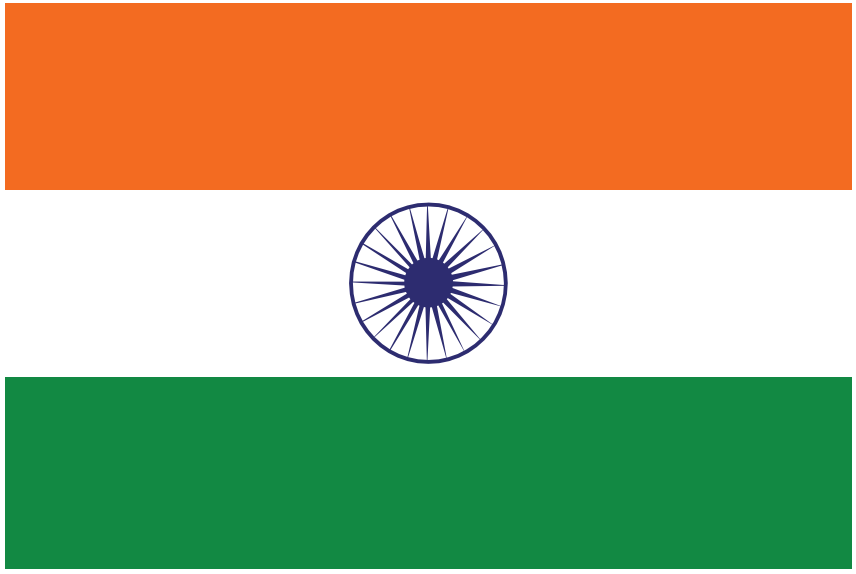
India



3,287,590
Total area in sq km

1,407,563
Population 2021 in thousands

6,592
Per capita GDP in PPP 2021 in USD

0.633
Human development index 2021-22

1,105
Average annual precipitation 2019 in mm

1,486
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD&GR), Ministry of Jal Shakti, Government of India

Government of India
Ministry of Jal Shakti
Department of Water Resources, River Development & Ganga Rejuvenation

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Ashok S Goel, Commissioner (SPR), DoWR, RD&GR, New Delhi.
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Use of the Underground Pipeline for the Conveyance of Irrigation Water

Responsible Agencies/Institutions

- State Governments and project implementing agencies

Summary

- Underground pipelines (UGPL) have the potential to increase the conveyance efficiency of irrigation water from 45 percent to 90 percent. Considering this, it has been identified as a major intervention for doubling water use efficiency in irrigation from the present 35-40% to 70% as envisaged in Vision @2047, i.e., vision after 100 years of independence of the country.

Description

- The conventional conveyance of irrigation water is through unlined/lined open canals. The conveyance efficiency of such canals is 35-50 per cent for unlined canals, and 55-60 per cent for lined canals. Apart from the low efficiency, there are issues of possible theft or unauthorized diversion of water from the open canals.
- In addition, land acquisition for laying canals is a major hurdle, primarily because of the complex procedures. Not only a substantial cost is involved for land acquisition, but such acquisition also debilitates the land owner permanently, who loses part of his land. As a result, his recurrent income is reduced, though he may get a handsome amount as a one time compensation.
- Underground pipelines, either pressurised or gravity based, have emerged as a viable alternative to the open canals whereby the challenges related to land acquisition are addressed (Figure 1). Apart from possible enhancement of efficiency to 90-95 per cent, water thefts are reduced. Nevertheless, one crop compensation may have to be paid to the farmers for loss of work in the field during the laying of the pipeline.

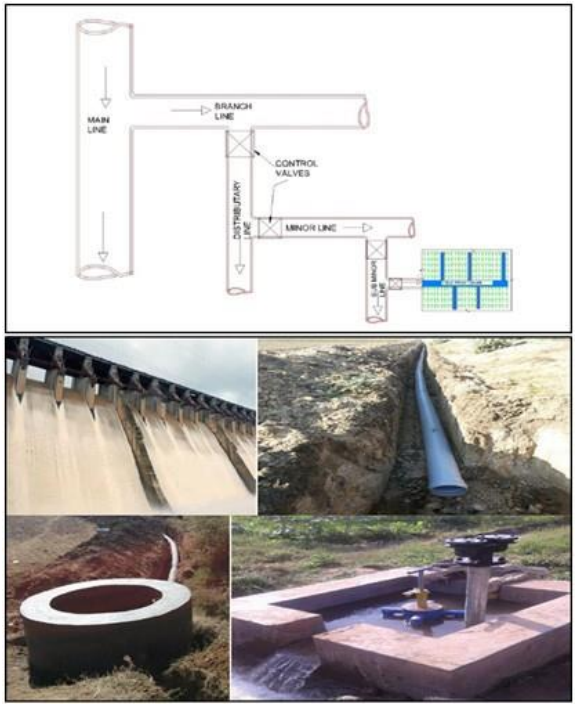

Figure 1. The layout of the UGPL in one of the canal command areas

Considering savings in land acquisition costs, underground pipelines are cheaper and also have fewer maintenance costs as compared to open canals (Table 1).

Table 1. Life cycle cost analysis

Methods	Piped vs. open earthen canal	Piped vs. lined canal
Benefit-cost ratio	+ 37%	+ 10%
Net present value	+ 50%	+18%
Payback period	- 42%	-13%

Further, it is future ready, in terms of integration with micro-irrigation and the internet of things, with soil moisture sensors, mid-term rainfall prediction, etc. (Figure 2).

Figure 2. UGPL is a future-ready innovative irrigation system

In India, conveyance of water through underground pipelines has emerged primarily during the last 8 years. So far, more than 40,000 km of underground pipeline has been implemented in the country, with favourable results (Table 2).

Table 2. Details of some of the pipeline implementation in India for irrigation water

Sl. No	State	No. of Projects in with PDN	Length of PDN (in Km.)	Total land acquisition avoided (in ha)	Cost saving thereof (Rs. in Crore)	CCA under UGPL (in ha.)
1	Assam	1	64	960	-	5,918
2	Goa	1	34	41	129	1,617
3	Gujarat	1	30,792	17,683	5,686	11,52,261
4	Jharkhand	1	49	116	24	1,000
5	Maharashtra	14	7,673	5,842	2,430	2,20,677
6	Manipur	1	76	48	15	3,316
7	Odisha	3	947	2,748	683	71,300
8	Punjab	2	1,444	55	9	40,904
9	Rajasthan	1	7,640	458	12	2,46,000
	Total	25	48,719	27,951	8,988	17,42,993

- A detailed guideline for planning and design of piped irrigation network by Central Water Commission, the premier technical organisation under the Ministry of Jal Shakti, Government of India has been able to drive the widespread adoption of the technology. States like Maharashtra and Rajasthan have made it mandatory to implement irrigation projects only through underground pipeline.
- Advantages of UGPL
  - Conveyance efficiency is around 90 per cent and hence less water loss
  - Land acquisition is not required, minimum disruption in work
  - No losses on account of pilferage from the distribution network
  - Efficient in distributing water in undulating topography
  - Very low maintenance required (only after every 10 years)
  - Adequate distribution of water to tail-ends
  - Water auditing can be easily done to increase productivity
- Disadvantages of UGPL
  - Not suitable for water with high sediment load
  - Not suitable if the driving head available is less

Lessons Learned

- Piped irrigation network is a techno-economically viable option for carrying irrigation water, with much higher efficiency.
- It is not suitable where the sedimentation load is high and needs to be pressurised if the driving head is less.

References

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Estimating Life Cycle Cost of Improved Field Irrigation Canal by Ahmed H. Elyamany&Walaa Y. El-Nashar, Water Resource Management Journal, Septemeber 2015

Ministry/Agency/ Organization

Central Water Commission, D/o Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti

Government of India
Ministry of Jal Shakti
Department of Water Resources, River Development & Ganga Rejuvenation

Contact Details

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Dam Rehabilitation and Improvement Project (DRIP)

Responsible Agencies/Institutions

- DRIP Phase I: Water Resources Department/ State Electricity Boards of the seven participating States and one Central Agency, i.e., Damodar Valley Corporation.
- DRIP Phase II & Phase III: Water Resources Department/ State Electricity Boards of the 19 participating States and two Central Agency, i.e., Bhakra Beas Management Board and Damodar Valley Corporation.
- Overall project co-ordination and supervision: Central Water Commission.

Summary

- The maintenance, repair, and upkeep of water resources infrastructure are very important from the point of view of providing resilience against the impacts of climate change, as storage plays an important role in alleviating the adverse impacts of temporal and spatial variability in rainfall.
- DRIP is an externally funded State Sector Project, to ensure long term safety and operational performance of existing selected dam assets along with institutional strengthening of participating states in dam safety areas.
- In the Phase I of this Project (2012-2021), rehabilitation work of 223 dams (located in 7 States) was done at the cost of INR 2,567 Crore. The works were targeted to address hydrological, structural, and operational safety concerns for these dams.
- Phase II & III (2021-2031) of the DRIP scheme was started in the year 2021. These phases envisage comprehensive rehabilitation of 736 dams (in 19 states of India) at an estimated budget outlay of INR 10,211 crore. External funding involved is US$ 1 billion.
- The DRIP Phase II and III envisage an additional component of innovative financing for sustainable O&M of dams also.

Description

- The various key interventions, besides improving the health and safety of the given dams, attempt to improve the climate resilience of these assets as well as downstream communities. It is one of the most successful programs globally, and unique in terms of size.
- New initiatives under the project include (Figure 1 and 2):
  - Underwater investigations using state of art remotely operated vehicles (RoVs). The outcome guided the dam owners to rapidly make key decisions concerning the repair, maintenance, and safety of the structure. Examples:
    - Hirakud Dam, Odisha Water Resource Department.
    - Malaprabha Dam, Karnataka Water Resource Department.
    - Konar, Maithon, and Panchet Dams of Damodar Valley Corporation.
    - Kaki and Kakkayam Dams, Kerala State Electricity Board.
  - Application of advanced technologies in repair materials for dam rehabilitation. Examples:
    - Cementitious repair mortar using crystalline technology/ polyironite ceramic cementitious: Sathanur and Krishnagiri Dam, Tamil Nadu Water Resource Department; Sabarigiri dam, Kerala State Electricity Board; and Hidkal dam, Karnataka Water Resources Department.
    - Grouting with a mix of cement, micro silica, and materials using crystalline technology: Almatti dam, Karnataka Water Resources Department; and Konar dam, Damodar Valley Corporation.
    - High strength concrete M60 and M90: Maneri dam, Uttarakhand Jal Vidyut Nigam Ltd (UJVNL) (M90 with and without steel fibres); and Ichari dam UJVNL (M60).
    - Geo-membrane: Servalar and Upper Bhawani, Tamil Nadu Generation and Distribution Corporation.
  - Automation in dam operations through special types of gate installation. Examples:
    - 17 Godbole-type automatic tilting gates (Dual operation – automatic and with hydraulic cylinder) of size 4.5m (w) x 1.5m (h) were installed at the additional spillway of Chandpatha dam, located in the territory of state of Madhya Pradesh.
  - Application of geophysics in seepage analysis of dams. The outcome was mainly used for deciding weaker sections for prioritizing grouting requirements to minimize the water seepage through the dam body.

Examples:

- Electrical resistivity tomography: Kuttiyadi, Kanhirapuzha, and Malankara dam of Kerala.
- Sonic/Seismic tomography methods: Chimoni and Sholayar dam of Kerala.

Figure 1. Glimpses of a few important hydrological safety measures

Figure 2. Glimpses of a few important structural safety measures

- Key achievements of DRIP include:
  - Design flood review of about 250 dams completed.
  - Inspection by state-specific dam safety review panels conducted for about 250 dams.
  - Physical rehabilitation completed and dam break analysis and inundation maps prepared for 223 dams.
  - Emergency action plan published for 216 dams.
  - Operation and maintenance manuals published for 221 dams.
  - 13 guidelines/manuals published in dam safety areas. 191 trainings were conducted, wherein about 5500 officials trained in various areas of dam safety (Figure 3).

Figure 3. Topic-wise total number of trainings imparted under DRIP

- Dam instrumentation at 118 dams completed.
- Web-based tool Dam Health and Rehabilitation Monitoring Application (DHARMA) operationalised and licenses issues to all states (Figure 4).

Figure 4. DHARMA training, Odisha

- MoU signed with eight academic institutes and two central agencies for capacity building in dam safety areas.
- Sediment management measures such as catchment area treatment and de-siltation were undertaken at a few dams.

Lessons Learned

- Slow progress was observed during the preparatory stage due to the non-availability of standardised formats. The project at its later stage put in place standardised formats in advance that helped in early operationalisation of Phase II of the DRIP.
- Regular dam safety inspection by dam owners to pinpoint the deficiencies and take timely corrective actions for remedial works to improve the health and safety of dams.
- To deal with various matters pertaining to dam safety, in addition to customised training programs, post-graduate degree program in dam safety has been started by IIT Roorkee and IISc Bangalore.
- For adapting the advances in dam engineering across the world and developing technologies relevant to Indian conditions, DRIP Phase II and III envisage the establishment of two Centre of Excellences in dam safety areas.
- Further, an International Centre of Excellence for Dams (ICED) is envisioned as a world-class state-of-the-art centre, and the first of its kind to provide leadership, best practices, research, and support and training in dam engineering.

References

https://damsafety.cwc.gov.in/

Ministry/Agency/ Organization

National Mission for Clean Ganga, Ministry of Jal Shakti, Government of India

Government of India
Ministry of Jal Shakti
Department of Water Resources, River Development & Ganga Rejuvenation

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Hybrid Annuity Based Public Private Partnership Model

Responsible Agencies/Institutions

- National Mission for Clean Ganga, Ministry of Jal Shakti, Government of India

Summary

- The Government of India's flagship initiative - Namami Gange mission works for the conservation, protection, and rejuvenation of the Ganga river basin. The National Mission for Clean Ganga (NMCG) is appointed as its implementing agency.
- Launched in 2014-15, it has undertaken various projects under five strategic areas of intervention – Nirmal Ganga (unpolluted flow), Aviral Ganga (unrestricted flow), Jan Ganga (strengthening river people connect), Gyan Ganga (research, policies and knowledge management) and Arth Ganga (boosting economy and livelihood).
- In the face of rising concerns due to lack of accountability and operations and maintenance (O&M) post the construction phase of sewerage infrastructure, NMCG introduced the Hybrid Annuity Based Public Private Partnership (HAM-PPP) model in 2017.
- Under the HAM-PPP model, the concessionaire's revenue over the O&M period is linked to adherence to pre-defined key performance indicators, ensuring the treatment of wastewater to the required quality standards.
- The technology-neutral bidding process ensures efficiency in energy consumption and promotes the entry of global technologies into the Indian wastewater market.
- This was complemented by the One City One Operator model which paved the way for a one-stop solution for city-wide sewage treatment, introducing single ownership and accountability as well as assured and continued performance for both existing and new sewerage infrastructure.
- In this manner, the HAM model ensures a paradigm shift – with a transition from purely construction based to a performance delivery frame work.

Description

- During the early years of the Namami Gange mission, a unique challenge emerged wherein it was observed that despite the allocation of significant resources over the years, there was no tangible impact on the pollution levels in Ganga. There was a need for the identification of a sustainable and dependable solution that addressed four basic requirements:
  - Assurance of the desired level of performance
  - Sustainability of performance levels
  - Distinct accountability at the entity level
  - Technical and financial sustainability of the solution
- Against this backdrop, the HAM-PPP model was developed in 2017. The model comprises 100% central government funding through NMCG, for both development as well as operation & maintenance of the STPs for a period of 15 years.
- Unlike the conventional Design Build Operate and Transfer (DBOT)/ Engineering, Procurement and Construction (EPC) contracts, the exclusivity of HAM stems from the various advantages it offers, such as assured government funding, continued performance, distinct accountability, and ownership for performance over an extended period of time.
- Salient features of the model have been elucidated below:
  - A Special Purpose Vehicle, created by the selected bidder for exclusive project development, will handle all aspects of the project.
  - 40 per cent of capital cost will be paid during the construction period of 2 years, in 4 or more instalments on achievement of construction mile stones
  - 60 per cent of capital cost will be paid over a period of 15 years as quarterly annuities along with interest on the balance outstanding at a rate of SBI MCLR +3% and O&M expenses. Payments are subject to achievement of Key Performance Indicators (KPIs)
  - Both capital cost and O&M costs are indexed to adjust for inflation

- To instill confidence among the bidders and financial institutions a payment security mechanism has been set up for payment for 2 construction milestones during the construction period and two-year annuity payments, interest, and O&M cost during the operations period, in a separate escrow account opened by NMCG for the purpose.

- As of date, 32 sewage treatment projects have been taken up with a total investment of over INR 110 billion in the five Ganga main stem states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal (Figure 1).

a) 68 MLD STP in Jagjeetpur Haridwar, Uttarakhand

b) 210 MLD Bhingawan STP in Kanpur, Uttar Pradesh

Figure 1. Some commissioned STPs in states sharing Ganga Basin

- Encouraged by this, most of the major projects, including those funded by the World Bank, are now being taken up under the HAM-PPP model.
- The novelty in the HAM-PPP model which sets it apart from other investment models, is its accountability and ownership, as the concessionaire is not only creating an asset but also operating it for its entire life cycle.
- Moreover, the HAM-PPP model complements the efforts undertaken by the Urban Local Bodies (ULBs) which lack financial, technical, and manpower capacities for the design, development, and operation of the STPs using the latest technologies.
- HAM has also paved the way for fair responsibilities allocation between the government and the private developers, with the latter bearing increased responsibilities including financial (up to 60 percent of project cost is recovered by private developers over the 15 years of operations).
- Learning from the experience of the first set of projects, NMCG has moved one step ahead by adopting the 'One City One Operator' concept, by assigning the responsibility of construction of new STPs, rehabilitation of existing STPs and their O&M under HAM in a city to a single agency.
- NITI Aayog, a government policy think tank, has endorsed the bid documents prepared by NMCG as standard bidding documents for liquid waste management under HAM for state governments and ULBs.

Lessons Learned

- Singular accountability and ownership for the operation of entire sewage treatment assets of a city by integration of existing assets and new assets and long-term ensure sustained long-term operations.
- Key performance indicators for both existing and new infrastructures ensure that treated water meet the prescribed quality standards.
- The model with its payment security mechanism has instilled confidence among the bidders and financial institutions. For instance, the number of participants in HAM tenders has increased from 3 to 19, including large and small-scale sewage players, indicating better market response and increased competition. This has been complemented by financial institutions such as IFC, Bank of Austria, etc. funding the project SPVs, along with Indian Banks.
- Better control by ULBs/Jal Nigam on performance monitoring.
- Development of opportunities for exploring possibilities for the reuse/ recycling of treated wastewater.

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https://nmcg.nic.in/

Safe Drinking Water to all under Jal Jeevan Mission

Responsible Agencies/Institutions

• Water Supply/Water & Sanitation/Public Health Engineering Departments of respective State Government/UT Administration

Summary

This case study presents interventions for ensuring the provision of safe drinking waterin rural areas affected by Arsenic and Fluoride contamination in water sources.

Description

- Major issues
  - A large number of habitations are affected by Arsenic and Fluoride contamination in drinking water sources (mainly groundwater). In 2017-18, about 31,750 habitations having a population of 27.8 million people had contaminated groundwater.
  - Lack of awareness among the local community about the quality of water being supplied in their houses and their limited participation in protecting the water quality.
  - Standardisation of water quality testing laboratory network.
  - Making water quality testing laboratory network easily accessible to the general public.
  - Prevalence of waterborne diseases.
- Steps taken
  - The government of India, in partnership with the states, is implementing Jal Jeevan Mission (JJM) to make provision for potable water supply to every rural household in the country through the functional household tap connection by 2024.
  - Here, functionality consists of three broad parameters including quantity, quality, and regularity of water supply. The estimated outlay of the mission is INR 3,600 billion.
  - The provision of safe drinking water for all households inquality-affected areas including those affected by Arsenic and Fluoride contamination in drinking water sources is one of the priorities of the Government of India under the Jal Jeevan Mission. The priority is given to the population residing in habitations affected by chemical contaminants to provide safe drinking water by ensuring fund availability and effective implementation.
  - In certain cases, planning, implementation, and commissioning of piped water supply schemes based on a safe water source may take time. For such cases, as an interim measure, implementing agencies have been advised to install community water purification plants that can supply 8–10 litre per capita per day for meeting drinking and cooking requirements.
  - As of now, safe drinking water is now available in all 27,544 quality-affected habitations (Figure 1).

Figure 1. Safe water is available in all the water quality-affected habitations

  - Under JJM, the Bureau of Indian Standards' IS:10500 for ensuring drinking water quality has been adopted.
  - Water supply agencies in states have been advised to carry out testing of water quality on a periodic basis, i.e. once a year for chemical and physical parameters, and twice a year for bacteriological parameters, and take remedial action wherever necessary to ensure that the supplied water meets the prescribed standard.
  - To sensitise the rural community on the importance of water quality, the responsibility for water quality surveillance at the local level has been given to them. Trainings are imparted to them to make use of field-testing kits (FTKs) to test water samples for basic contaminants (Figure 2).

Figure 2. Community training on water quality testing using the FTKs

- Further, there are 2,078 drinking water quality testing laboratories at different administrative levels, i.e., state, district, sub-division, and block levels in the country. The general public can access these laboratories for getting the water samples tested at a nominal rate.
- A dedicated JJM – Water Quality Management Information System (WQMIS) portal has been developed to report results from the water quality testing undertaken in the laboratories and by using the field testing kits that can be used for monitoring and surveillance purposes.
- For strengthening of water quality testing laboratory network, implementing agencies have been advised to accreditation of all drinking water quality testing laboratories as per IS/ISO/IEC:17025 at least for the basic water quality parameters, and explore the possibility of using digital potable water quality testing devices as a viable option for increasing their testing with existing human resources.
- Under JJM, a Rural WASH Partners' Forum (RWPF) has been set up with the participation of 38 national and international organizations working in the country in the WASH sector. The RWPF aims to serve as a platform where development partners and civil society organizations can discuss their views, share WASH knowledge, and provide targeted assistance to support states Inter Alia water quality management, improving WQMIS, awareness generation, and capacity building of stakeholders at all levels.

- Impacts
  - Except for seven Arsenic affected habitations, safe drinking water has become available in all water quality affected habitations, benefitting around 27.8 million people.
  - 1.9 million women (70.38 percent of the total) have been trained for water quality testing using FTKs at the village level.
  - The number of drinking water samples tested during 2022-23 was 14.3 million which is almost three times those tested in 2017-18.
  - Since 2019-20, there is a more than 20-fold increase in the number of accredited/recognized drinking water quality testing laboratories.
  - WQMIS, adedicated portal for reporting water quality testing data, has immensely helped in regular and effective surveillance of water quality.
  - Incidences of waterborne disease have come down in 2021 in comparison to 2017. The reduction is about 70 percent for Bacillary Dysentery, 48 percent for Cholera, 80 percent for Typhoid fever, and 72 per cent for Viral Hepatitis A.

Lessons Learned

- Prioritisation, standardization of laboratories, and participation of the local community at the village level are very vital for effective drinking water quality surveillance, and ensuring the quality of water being supplied to the people.

References

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- WQMIS portal: https://ejalshakti.gov.in/WQMIS/Main
- JJM Dashboard: https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx

Indonesia

1,904,569
Total area in sq km

273,753
Population 2021 in thousands

11,858
Per capita GDP in PPP 2021 in USD

0.705
Human development index 2021-22

2,702
Average annual precipitation 2019 in mm

7,488
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

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Enhancing Local Government's Water Quality Management Performance through Environmental Quality Index Program

Responsible Agencies/Institutions

- Ministry of Environment and Forestry

Summary

- Recognizing that environmental quality data is essential for the improvement of environmental quality, Indonesia has developed an Environmental Quality Index Program that utilizes adequate methodologies, covers all significant media (air, land, marine, peat and especially water), as well as readily accessible for public.
- The composite value of Environmental Quality Index (EQI) represents environmental quality as a whole. It also measures the impacts of local government's performance in environmental quality management, including water, which will be considered in portioning their share of profit-sharing funds for the utilization of natural resources.

Description

- Indonesia's environmental quality issue is of supreme importance in the midst of increasing pressures that could potentially change environmental conditions, both as a result of economic growth and an increase in population. Recognizing that environmental quality data is essential for the improvement of environmental quality, Indonesia has developed an Environmental Quality Index (EQI) Program that utilizes adequate methodologies, covers all significant media (air, land, marine, peat and especially water), as well as is readily accessible for public.
- The water portion of EQI or Water Quality Index (WQI) is a composite value of water quality parameters in an area at a certain time, depicting the state of water quality. The WQI value is formulated based on the data generated from direct water quality monitoring in water bodies, carried out by the Central Government, Provincial Governments, and/or Regency/City Governments. WQI is calculated using 8 parameters in rivers (BOD, COD, TSS, DO, T-phos phate, Fecal coli, pH and Nitrate) and 10 parameters for lakes (BOD, COD, TSS, DO, T-phosphate, fecal coli, pH, Brightness, Chlorophyll-a and total Nitrogen). A sample report from the Nanggroe Aceh Darussalam Province and their response index is shown in Figure 1.

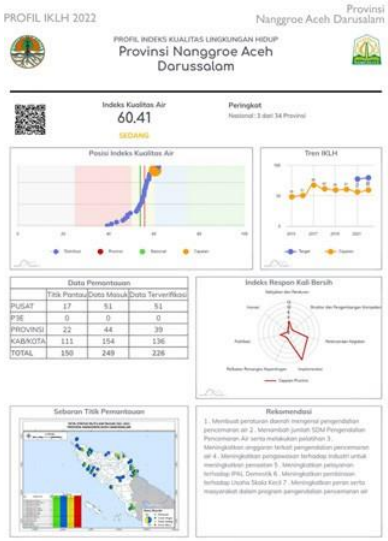

Figure 1. Sample Report of Water Quality Index in Nanggroe Aceh Darussalam Province and their Response Index

- EQI is implemented in accordance with the Driver-Pressure-State-Impact-Response (DPSIR) approach and aims to provide data and information needed to determine the "State" of the continuum. Now that the responsibility to protect and manage the environment, which includes prevention, control, restoration, and/or monitoring are bestowed to the Local Governments, EQI used the relation between "State" and "Response" to influence and stimulate local governments' interventions to improve their environmental quality, which in case of water, is implemented within the over-arching "Program Kali Bersih" or Clean River Programme (Figure 2).

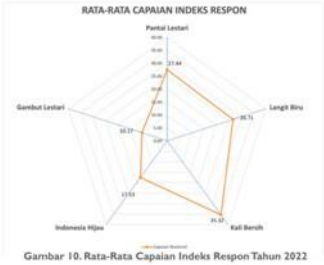

Figure 2. Local Government's Response Index on average in 2022. "Kali Bersih" or Clean River Program is higher than any other programs (air, peat, land, as well as coastal and marine)

- Local governments must demonstrate leadership and introduce innovation in regulation, technology and sustainable water management practices in order to achieve their respective WQI targets.The trends of Water Quality Index target achievements from 2015-2022 are shown in Figure 3.
- In 2022, the MoEF in cooperation with the Ministry of Finance (MoF), established a mechanism that incentivize these innovations by integrating the EQI achievement into the portioning of local governments' share of profit sharing funds for the utilization of their natural resources. The profit-sharing fund is defined as a fund allocated for local governments based on the percentage of state revenues for their contribution to avoid central-local fiscal gaps, and for other non-contributing local governments to address negative externalities and increase fair distribution.

Figure 3. Trends of Water Quality Index Target Achievements from 2015-2022 in Indonesia

Lessons Learned

- Within a year of implementation, the MoEF-MoF mechanism has increased local governments' participation in the EQI Program as well as the number and quality of environmental quality data generated.
- Although it is too early to mention that there is an increase or enhancement in local government's responses in their water quality management, but these initiatives are now better identified and compiled.

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Ministry/Agency/ Organization

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Automated, Continuous, and Online Water Quality Monitoring (ONLIMO) for Effective Water Pollution Control

Responsible Agencies/Institutions

- Ministry of Environment and Forestry

Summary

The decline in environmental quality is a serious threat to ecosystem services, particularly in the provision of water, which is critical for all livelihood activities. Under the overarching program of Environmental Quality Index, Indonesia conducts Automated, Continuous, and Online Water Quality Monitoring (ONLIMO).

Description

- Environment quality improvement has been carried out through various measures to control pollution and environmental degradation, both by the central government and local governments. The Ministry of Environment and Forestry (MoEF) has a specific mandate tocarry out the management and improvement of environmental quality, through the implementation of comprehensive pollution and degradation control measures, including improvement of water quality.
- In order to formulate effective policy and management interventions, water quality monitoring and assessment is indispensable in identifying water quality status, trends and critical impacts. Monitoring provides the objective evidence necessary to make sound decisions on managing water quality for the present and future. Indonesia therefore is committed to scale-up the implementation of ONLIMO monitoring program.
- ONLIMO is an online and real-time water quality monitoring system using sensors integrated with data logger units, data transmission units and a soft ware system that is compatible for water quality monitoring in rivers, lakes, reservoirs, beaches and sea waters and even industrial wastewater. Measurements were made on the following parameters: Salinity, NO3, ORP, pH, NH4, Conductivity, COD, TDS, BOD, SWSG, DO, Turbidity, and Regularity.

- The technical considerations used for monitoring under ONLIMO are:
  - Representing sources of pollution (point and non-point source);
  - Located in the main outlets of watersheds;
    Located in the intake point of drinking water processing facilities;
  - Located in the upstream with less to no influence of human intervention;
  - Number of sampling units must represent a balance of upstream, mid, and downstream.
- Indonesia declared 15 priority watersheds to be rehabilitated in its 2015-2019 Mid-term Development Plan. Until 2022, at least 73 units of ONLIMO have been installed and fully operational in 13 priority watersheds using the central government's budget. Whereas, additional 127 units have been installed from 2017-2022 using Special Allocation Fund for the local governments. The entire units are also fully integrated with the MoEF system and is expected to be integrated in the National Environmental Quality Assessment starting from 2023 to produce Environmental Quality Index.
- The online and real time water quality data generated from the ONLIMO system is expected to make up the wider Water Quality Index composition, in order to:
  - Rapidly demonstrate the trend of water quality changes/fluctuations;
  - Provide early warning system in case of pollution events (emergency);
  - Reduce the cost and time of sampling and lab analysis;
  - Raise awareness of the general public; and
  - Reduce the risk of danger, accident and human error in sampling and lab analysis.

Lessons Learned

The monitoring has been the basis for interventions undertaken in order to improve the health and productivity of the community, supporting food and energy security, as well as ultimately supporting the achievement of SDG 6 by improving access to safely managed drinking water and sanitation services.

References

https://ppkl.menlhk.go.id/onlimo-2022/

Ministry/Agency/ Organization

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Restoration of Peatland Ecosystem: Peatland Hydrological Restoration

Responsible Agencies/Institutions

- Ministry Of Environment and Forestry

Summary

- Peatlands are vulnerable ecosystems in a wider landscape and drainage can have a significant impact and lead to irreversible degradation of the peatland site. Canal construction can also have an impact on lowering the groundwater level, increasing the risk of peatland fires during the dry season. It sometimes correlates with changes in land cover on peatlands and exacerbates existing problems of water.
- In the face of these challenges, Indonesia has been carrying out management and improvement of environmental quality, through the implementation of comprehensive pollution and degradation control, to improve water quality as well as sustainably manage and restore peatland ecosystems.

Description

- Indonesia is the custodian of the biggest tropical peatland in the world which houses vital biodiversity, while also helping mitigate climate change as highly effective carbon sinks.
- In many parts of Indonesia, peatlands supply food and other ecosystem services that sustain economies. However, peatlands are vulnerable ecosystems in a wider landscape. Drainage can have a significant impact and lead to irreversible degradation of the peatland site, including reducing the quality of drinking water, according to IUCN. Canal construction can also have an impact on lowering the groundwater level, increasing the risk of peatland fires during the dry season.
- Restoring peatland ecosystems involves efficient peatland management in degraded peatland areas with a target of new 25,000 hectares in 2023 and an additional 30,000 hectares in 2024. Additionally, Indonesia has established Peatland and Mangrove Restoration Agency (BRGM) to strengthen

coordination and facilitate the acceleration of peatland restoration and improve peatland-adjacent communities' livelihoods in seven priority provinces in Indonesia. BRGM has implemented efforts to restore peatlands with a total restoration area in 2021 of 300,346 hectares. According to its establishment mandate, the total restoration target from its establishment till 2024 is at 1.2 million hectares.

- In a strong, coordinated and collaborative manner, there have been considerable management measures carried out by both MoEF and BRGM, including data and information collection through inventory and mapping peatland functions, increasing effectiveness of protection and management plans, and increasing effectiveness of the restoration of peatland hydrological units. The measure follows the three main pillars of restoration approach of Rewetting (R1), Re-vegetation (R2), and Revitalization (R3) or best known as the 3Rs:
  - Rewetting aims to maintain the soil moisture and reduce and/or minimize the drainage rate through the construction of rewetting infrastructures such as canal blocking, deep well, and canal backfilling.
  - Re-vegetation is an action to restore land cover in peatland ecosystems through replanting activities on peatlands. Replanting is carried out for several purposes, including replanting endemic plants and adaptive plants on open peatlands, enrichment planting in degraded peat forest areas, and enhancing and applying seed dispersal techniques to stimulate regeneration of peatland vegetation.
  - Whereas the R3 stands for revitalization of economic activities for peatland-adjacent communities to improve livelihoods. This pillar is implemented on village-based programs to strategically engage villages in the protection and sustainable management of peatland ecosystems, as well as proactive contribution to its restoration. The objective is to establish village-owned enterprises that sustainably utilize peatlands beyond ecological purposes, but also to support economic welfare of the communities.

Lessons Learned

- The 3R strategy of peatland ecosystem restoration is evidently effective in achieving water conservation (increasing the water level) by reducing the surface run-off and increasing the water retention in the canal and the surrounding areas.
- These water conservation efforts will prevent ground water level to decrease drastically. The peat will not become dry and prone to fire occurrence, which can otherwise lead to smog disaster and increase the release of carbon dioxide (CO_2). Another impact of decreased ground water level is the increased subsidence rate due to oxidation, consolidation, and compaction of peat. Increased peat subsidence rate can further lead to increased risk of flood in the long run and render the peatland to become unproductive.
- The engagement of multi-stakeholders in the Self-Sustaining Peatland Protecting Villages Program or Desa Mandiri Peduli Gambut (DMPG) has played a crucial role. In 2021, Indonesia has established 119 DMPGs and empowered additional 28 DMPGs specifically for post-pandemic economic recovery. DMPG provides a framework to integrate restoration and protection of peat land ecosystems into the development of villages. It serves as a social and institutional enabler to ensure the sustainability of restoration efforts in the field. It advances innovation in the development of demonstration sites, strengthens institutional capacity of the village, provides an innovative financing mechanism to rehabilitate rewetting infrastructures, controls forest and land fires, and creates and/or strengthens local cooperative enterprises to support sustainable peatland-based economies through education, dissemination, and training for no-burning land preparation.

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Italy

301,336
Total area in sq km

59,109
Population 2021 in thousands

41,929
Per capita GDP in PPP 2021 in USD

0.895
Human development index 2021-22

832
Average annual precipitation 2019 in mm

3,055
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Environment and Energy Security (MASE)

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National Network of Observatories for Water Resource Uses

Responsible Agencies/Institutions

- Ministry of Environment and Energy Security (MASE), Ministry of Agriculture, Ministry of Infrastructures, National Department of Civil Protection (DPC), National Institute for Environmental Protection and Research (ISPRA), National Research Council (CNR), Council for Agricultural Research and Agricultural Economics (CREA),National Institute of Statistics (Istat), National Irrigation Association, National Hydropower Association, River Basin District (RBD) Authorities, large reservoir managers, water utilities, and regional administrations.

Summary

- Italy has faced severe drought events of increasing frequency and intensity in recent decades due to climate change having modified hydrological patterns and temporal and spatial water availability.
- In 2016, a network of RBD Observatories (Osservatoridistrettualipermanenti pergliutilizziidrici), each coordinated by the respective RBD Authority, was setup as per the River Basin Management Plans (RBMPs) to support RBD-level water governance, including monitoring and forecasting of drought and water scarcity events, and help manage the impacts of these events on the quality and use of water resources.
- Each RBD Observatory includes all key water governance actors at local, regional and national levels (including economic sectors) and are considered Measures within the European Water Framework Directive (WFD) Programmes of Measures (PoMs) of the RBMPs, adopted and approved in 2016.
- The RBD Authorities plan integrated water resource management at the RBD level as per national legislation to sustainably manage water, protect aquatic ecosystems, mitigate flood risks, and manage droughts.
- A National Technical Coordination Committee of the Network of Observatories (Comitatotecnico dicoordinamentonazionaledegli Osservatori), coordinated by MASE,was set up to provide guidelines for drought and water scarcity monitoring; harmonize monitoring activities nationwide; and define the national criteria for indicator calculation (including thresholds) for bulletins and dissemination.
- The Committee includes ISPRA, DPC, Istat, the seven RBD Authorities, CREA and CNR, with ISPRA leading its technical Working Groups. The Committee publishes national and RBD-level Drought Severity Reports.

Description

- Drought monitoring and drought impact assessment are performed at several levels from regional to national, based on legal responsibilities for hydro-meteorological monitoring and water resource management.
- The 19 Italian Administrative Regions and 2 Autonomous Provinces (Trento and Bolzano) must provide hydro-meteorological services for their territories, including drought monitoring. Some of their "regional hydrological offices" also publish monthly online drought and/or hydrological bulletins based on local monitoring.
- The DPC and ISPRA provide national hydrological services: the DPC in cases of water crisis; and ISPRA, through standardized hydrological characterization and analysis of Italy's territory, including time-and-space evaluation of water balance and the hydrological cycle and its extremes (drought and flood). Other research institutions also provide drought-related services (e.g. Istat) and/or field research (e.g. CREA, CNR).
  - ISPRA publishes an online monthly drought bulletin and provides, via publications like the ISPRA Environmental Data Year books, indicators and trends related to natural and anthropogenic hazards.
  - ISPRA provides technical-scientific support to MASE on water resources, hydrometeorology and hydromorphology.
  - ISPRA coordinates the Italian National Board on Hydrological Services that federates the "regional hydrological offices", the DPC, the Italian Air Force (which represents Italy in WMO and ECMWF), and ISPRA itself.
  - The Board's objective is the progressive construction of a federated national system to guarantee the activities of a national hydrological service and to achieve a homogeneous national level of quality and functionality, consistent and compliant with EU directives, communications and standards, and the World Meteorological Organization (WMO) resolutions.

Lessons Learned

- The RBD Observatories have helped organize efforts to manage, and prevent where possible, drought events and related impacts through regular meetings of ley actors from relevant Ministries, economic sectors like water utilities, farmers, irrigation and hydropower, citizens and NGOs.
- This is building a common understanding of water scarcity problems and concerted, shared solutions on the sensitive issue of water allocation among competing users.
- The Committee helped develop a national guideline with a common minimum set of drought indicators, which the Observatories are using to facilitate a national homogeneous characterization of drought events, and to modify/ integrate the tools used for drought monitoring.

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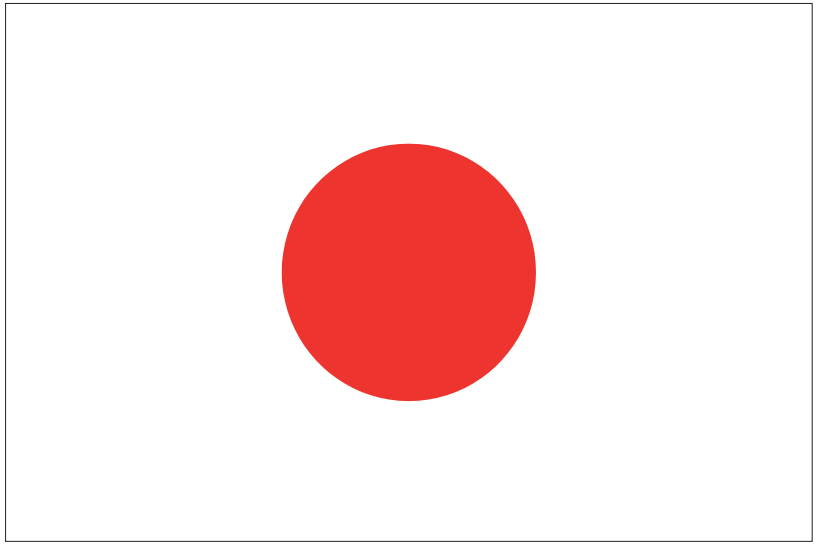
Japan



377,930
Total area in sq km

125,681
Population 2021 in thousands

40,784
Per capita GDP in PPP 2021 in USD

0.925
Human development index 2021-22

1,668
Average annual precipitation 2019 in mm

3,396
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of the Environment

環境省
Ministry of the Environment

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The Water Environment Partnership in Asia (WEPA)

Responsible Agencies/Institutions

- Ministry of the Environment, Japan

Summary

- The Water Environment Partnership in Asia (WEPA) is a knowledge net work program established in 2004, with 13 countries in Asia as partners.
- WEPA aims to improve the water environment in Asia by strengthening water environmental governance.

Description

- WEPA is an initiative proposed by the Ministry of the Environment, Japan in 2003 at the Third World Water Forum held in Kyoto-Shiga-Osaka, Japan, and it became official in 2004.
- This program aims to improve the water environment in Asia by providing partner countries with necessary, relevant information, and knowledge to strengthen water environmental governance.
- WEPA has 13 countries as its partners. They include Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Nepal, Philippines, The Republic of Korea, Sri Lanka, Thailand, and Vietnam. The partnership activities run on five-year cycles.
- The first phase of WEPA (April 2004 to March 2009) involved developing a web-based information platform covering the state of the water environment and management in the partner countries.
- In the second phase (April 2009 to March 2014), WEPA further facilitated in formation and knowledge-sharing on key thematic areas of water environmental management, including 'domestic waste water treatment' and 'climate change and the water environment'.
- In the third Phase (April 2014 to March 2019), WEPA focused on waste water management.
- WEPA started its 4th Phase of activities with a special focus on 'compliance with regulations' in April 2019 (Figure 1).

Figure 1. The 18th WEPA Annual Meeting, 8 Feb 2023

Lessons Learned

- There is no "one size fits all" solution to solve the challenges across the region, thus appropriate solutions need to be based on local contexts – and where feasible, holistic approaches should be adopted to minimize or prevent pollution at source while maximizing the effective and efficient reuse and recycling of water throughout its life cycle.

References

The website of the Water Environment Partnership in Asia
http://wepa-db.net/en/index.html

Promoting Efforts to Maintain or Recover Sound Water Cycle

Responsible Agencies/Institutions

- Headquarters for Water Cycle Policy, Cabinet Secretariat, Government of Japan

Summary

- In Japan, based on the Basic Act on Water Cycle Policy, the Basic Plan on Water Cycle was formulated. The government promotes efforts to 'maintain or restore sound water cycle'.
- Progress has been made in solving serious issues in the water cycle such as floods, droughts, water pollution, and land subsidence, but many issues still remain. There are also concerns over the increased risk of drought and flooding from abnormally low rainfall and wide fluctuations in precipitation due to global warming, as well as the fact that new issues may arise.
- The Basic Act on Water Cycle was enacted to share the goal of 'maintaining and recovering a sound water cycle' and promote water cycle mea|sures in a comprehensive and integrated manner. The Headquarters for Water Cycle Policy was established in the Cabinet based on the act.
- Another point of concern in the water cycle process is that implementing a measure to solve one problem may negatively affect another aspect of the environment. For this reason, when clarifying the effects and impacts of any measure, it is essential that wide stakeholders related to a river basin are involved in considering the ideal state of a community's water cycle, and that actions for its realization are taken in a comprehensive and integrated manner.

Description

- Enactment of Basic Act on Water Cycle: For water cycle maintenance, various measures had been implemented separately. However, there remained a need for implementing them in a coordinated form for the shared goal of 'maintaining or restoring sound water cycle'. This circumstance led to clarifying the basic doctrine on water cycle related policy in April 2014, and the enactment of the 'Basic Act on Water Cycle Policy' in July of the same year as a means to promote sound water cycle policies in a compre hensive and integrated manner. At the same time, the Headquarters for Water Cycle Policy was established to promote water cycle related measures. The Prime Minister was appointed as the Director General and all the Cabinet Ministers were appointed as members (Figure 1).

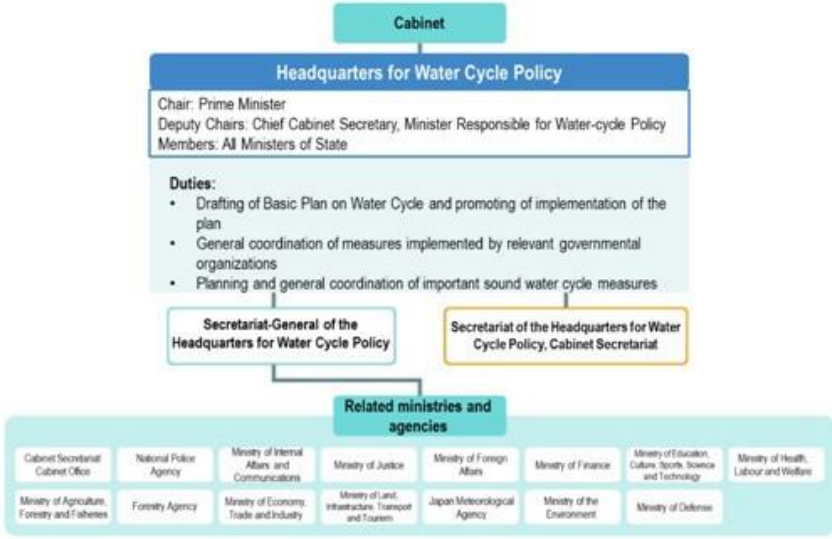

Figure 1. Organogram of Headquarters for Water Cycle Policy

- Formulation of Basic Plan on Water Cycle: In July 2015, about a year after the enactment of the Basic Act on Water Cycle Policy, the Cabinet approved the Basic Plan on Water Cycle to serve as a guideline for water cycle measures. In July 2020, the new Basic Plan was formulated. Part 1 of the Basic Plan describes the basic policy on water cycle measures. In its first paragraph, it states the need for 'river basin management in a comprehensive and integrated manner.' Part 2 sets forth nine specific measures to be comprehensively and systematically implemented, and Part 3 describes items necessary to promote measures in a comprehensive and systematic manner.
- Promoting Water Cycle Management in River Basins: Water-related measures implemented to date have had their own independent objectives and goals, and have succeeded in achieving their aim to some degree. However, in some cases, information is not adequately shared with other relevant parties carrying out measures. From this point of view, it is important to implement cross-sectoral measures based on comprehensive and integrated management of the river basin in order to ensure efficient and effective implementation through coordination with all stakeholders involved. In the Basic Plan on Water Cycle, 'Water Cycle Management in River Basins' refers to activities carried out in coordination between river basin stakeholders by implementing water cycle measures intended to improve or maintain human activity, water volume, water quality, and favorable conditions in the natural environment surrounding water, especially in forests, rivers, farmlands, cities, lakes, and shore areas.

- Formulation of River Basin Water Cycle Plans: In the Basic Plan on Water Cycle, the 'River Basin Water Cycle Council' is established to a size appropriate to the goals and based on the basin scale, followed by the formulation of a River Basin Water Cycle Plan. The Council is formed by bringing together people from local government, local branch offices of national institutions businesses, organizations, and residents who work together to formulate a comprehensive River Basin Water Cycle Plan, cross-functioning individual measures while sharing current issues, future challenges, and goals. As for the various water cycle measures aimed at forests, rivers, farmland, sewerage, environment, and the like, stakeholders cooperate with each other to ensure organic cooperation under the basic policy set forth in River Basin Water Cycle Plan.

Lessons Learned

- Implementation of activities for maintaining and recovering a sound water cycle contributes to the sustainable development of the world's socio-economy and the stable improvement in peoples' livelihood

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https://www.kantei.go.jp/jp/singi/mizu_junkan/english/index.html

Mexico

1,964,375
Total area in sq km

126,705
Population 2021 in thousands

19,086
Per capita GDP in PPP 2021 in USD

0.758
Human development index 2021-22

758
Average annual precipitation 2019 in mm

3,270
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

National Water Commission of Mexico (CONAGUA)

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Rainwater Harvesting System (SCALL) and Basic Sanitation at Housing Level in Rural Areas, Implemented under the Drinking Water, Drainage and Treatment Program (PROAGUA).

Responsible Agencies/Institutions

- National Water Commission of Mexico (CONAGUA), through the Deputy Director General's Office for Drinking Water, Sewerage and Sanitation.

Summary

- The program began in 2016 and uses the rainwater harvesting system (SCALL) to supply water to the rural population of Mexico where there are technical and economic difficulties in providing water by conventional methods.
- The aim of SCALL is to reduce the number of people who lack water services and have to travel long distances to gain access to a vital resource.
- The second component of the programme is to provide basic sanitation services with bio-digester or dry toilets. The programme makes use of low-cost technology to hygienically eliminate excreta and waste water for a clean and healthy environment within the dwelling and in the surroundings of the users.
- The implementation of SCALL and basic sanitation is in line with the priority objectives of the Government of Mexico to 'promote water as a pillar of well-being, managed by transparent, reliable, efficient, and effective institutions that ensure a healthy environment and where a collaborative society is involved in its management' and 'progressively guarantee the human rights to water and sanitation, especially for the most vulnerable population'.
- During 2016-2021, 19 states in Mexico benefited through 1,145 actions, covering 133,519 beneficiaries of which 98,643 are the indigenous population.
- As of the latest information, a total of 10,033 SCALL, 14,691 biodigesters, and 11,247 rural toilets were installed at a cost of about US$ 100 million, benefitting a total of about 2,031 million persons.

Description

- The rainwater harvesting system (SCALL) allows the interception, collection, and storage of rain that falls on a surface to a storage device for later use.
- The elements of SCALL include (Figure 1):
  - Roof of the house
  - Gutter(s)
  - First rain filter and leaf separator
  - Storage tank (built or prefabricated)
  - Manual Pump
  - Purifier
  - Disinfection system inside the tank

Figure 1. Elements of the SCALL

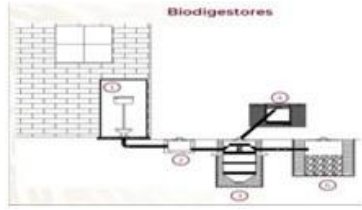

Figure 2. Elements of the basic sanitation services

- The second component of the project, basic sanitation with biodigester or septic tank, consists of:
  - A room with a sink and WC
  - Manhole
  - Biodigester or self-cleaning septic tank
  - Sludge tank
  - Grease trap
  - Absorption well

Lessons Learned

- Increase in the social development of communities in the most marginalized rural areas through access to water.
- Active involvement of rural communities.
- Reduce multidimensional poverty in the field of basic services.

References

SCALL System: https://www.gob.mx/conagua/documentos/sistemas-decaptacion-de-agua-de-lluvia-scall-y-saneamiento-basico-a-nivel-viviendaen-zonas-rurales

Technical guidelines SCALL 2023:https://www.gob.mx/cms/uploads/attachment/file/791594/LINEAMIENTOS _TECNICOS_SISTEMA_DE_CAPTACI_N_DE_AGUA_DE_LLUVIA.pdf

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Ministry/Agency/ Organization

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National Water Program (PNH) 2020-2024

Responsible Agencies/Institutions

- CONAGUA

Summary

- The National Water Program (PNH) is the governing document of the national water policy, which establishes the objectives, strategies, and specific actions to be implemented by the Government of Mexico over a six-year period to manage water resources more effectively and efficiently.
- In Mexico, sustainable and coordinated management of water is carried out with the participation of citizens, private institutions, and the three tiers of government.
- The PNH is a multisectoral program that is also aligned with the fulfillment of different international agendas such as the Sustainable Development Goals (SDGs), particularly SDG 6 and human rights, as well as various multilateral environmental agreements.

Description

- The present National Water Program (PNH) was published on December 30, 2020 and has five main objectives, 20 strategies and 87 specific actions. Its preparation process was quite innovative.
- 44 specific public forums were held with the participation of more than 3,000 people from all over the country, under the Integrated Water Resources Management (IWRM) approach (Figure 1).

Figure 1. Public consultations with stakeholders and international cooperation partners

- The PNH derives from the National Development Plan (PND) and the Environment and Natural Resources Sector Program (PROMARNAT).
- The guiding principles of this policy are ‘for the good of all’, ‘first the poor people’, ‘leave no one behind, leave no one out’, and ‘integrity and honesty’. Its main objectives are:
  - Progressively guarantee the human rights to water and sanitation, especially for the most vulnerable population.
  - Efficient use of water to contribute to the sustainable development of productive sectors.
  - Reduce the vulnerability of the population to floods and droughts, with emphasis on indigenous and Afro-Mexican people.
  - Preserve the integrity of the water cycle in order to guarantee the hydrological services provided by basins and aquifers.
  - Improve conditions for water governance to strengthen decision-making and combat corruption.
- 13 regional water programs have been developed for each of the 13 hydrological administrative regions in which the Mexican territory is divided. The programmes emphasise participatory and regulatory instruments that are congruent with the national strategy of managing water in accordance with the specific needs of each region. The integration was achieved with the collaboration of the stakeholders involved in the administration and management of water resources in each region.
- Given that the PNH is a public program with the objective of reviewing the progress in the fulfillment of the specific actions and indicators it comprises, an annual evaluation exercise is carried out. This also offers insights into the progress since its implementation and areas of opportunity.

Lessons Learned

- In the preparation of the PNH 2020-2024, the participation of all interested parties was promoted that include water users, civil society, private initiatives, academia, government actors, indigenous people, etc.
- The public consultation allowed the involvement of less advantaged groups, such as the most vulnerable communities, women, youth, and indigenous and Afro-Mexican communities, among others.
- The exercise was repeated in each of the 13 hydrological administrative regions into which the national territory is divided, to determine the priority actions that need to focus on.
- The PNH indicators were aligned with the indicators of Sustainable Development Goal 6 (SDG 6). Further, it has placed special emphasis on compliance with the Human Rights to Water and Sanitation, without compromising economic development and the ecological balance.
- Finally, one of the priority objectives of the program is focused on the fight against corruption and accountability, which are sensitive and relevant issues.

References

National Water Program 2020-2024: https://www.gob.mx/cms/uploads/attachment/file/553479/PNH_Resumen_Imp renta_v200311.pdf

Summary of the National Water Program 2020-2024: https://www.gob.mx/cms/uploads/attachment/file/553479/PNH_Resumen_Imp renta_v200311.pdf

Advances and outcomes: https://www.gob.mx/cms/uploads/attachment/file/730640/AVANCE_Y_RESULT ADOS_PNH_FINAL_070622.pdf

Regional Water Programs: https://www.gob.mx/conagua/documentos/programas-hidricos-regionales2021-2024

Ministry/Agency/ Organization

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Promoting Efforts to Maintain or Recover Sound Water Cycle

Responsible Agencies/Institutions

- CONAGUA

Summary

- Since 2015, the State of Nuevo León, particularly its capital Monterrey, has suffered a historic drought with adverse impacts on its population and its economic and productive activities.
- During 2022, the Federal Government of Mexico strengthened the support actions for the Monterrey Metropolitan Area (ZMM), which was affected by a drop in the flow of drinking water as a result of the decrease of surface water available in the dams.

Description

- Monterrey is located in the foothills of the Sierra Madre Oriental in the north western region of Mexico.
- Since 2015, the rainfall has been below the annual average, which has contributed to the depletion of water reserves in the state. The dams that supply the ZMM are mainly 'El Cuchillo', 'Cerro Prieto' and 'La Boca' dams.
- The support activities, coordinated by the Federal Government of Mexico in collaboration with the state and municipal governments, were implemented under five main actions: the financing of 'El Cuchillo II' aqueduct and the 'Libertad' dam; the connection of the 'Chapotal' canal to the Linares-Monterrey aqueduct; support for the supply of drinking water through tank cars; and a Presidential Decree formalizing this support actions (Figure 1).

Figure 1. Aspects of the federal attention and coordination in Nuevo León.

- With respect to the financing for the construction of 'El Cuchillo' aqueduct to reduce the water deficit, which at the time corresponded to 3 cubic meters per second, the Federal Government, through the National Bank of Public Works and Services (Banobras), allocated 7,850 million pesos (MDP), 4,710 MDP from the state government and 3,140 MDP from the municipalities, for a total amount of 15,700 MDP.
- In the case of the 'Libertad' dam, which is currently under construction and is expected to be completed this year, would provide a little more than 1,500 liters per second. There is a federal investment of 3,301 MDP between 2019 and 2022 on this dam.
- One of the most important actions to attend the emergency was to establish an agreement with the citrus-growing area near the ZMM for up to 1,000 liters per second.
- Another action taken by the Federal Government was to facilitate the water utility the perforation of emergency wells, needed to increase the volume of water for urban public use, an action in which 385 MDP were invested.
- In addition, there were provisional arrangements with some industrial groups in the city to supply water for public use from the concessions they have been granted.

Lessons Learned

- In order to achieve progress, the need to strengthen efficient water management has been highlighted, including:
  - Inter-institutional coordination with the distinct agencies and with the different users of national waters, in order to promote and implement optimal management of water resources.
  - Maintenance and continuous supervision of the works in the drinking water network (by the water utility), in order to reduce physical losses such as leaks.

- The agricultural sector should optimise irrigation to gradually reduce the use of important volumes of water for food production, and increase the availability of water for human consumption.
- It is necessary to reach a common awareness with respect to the conscious use of water resources.

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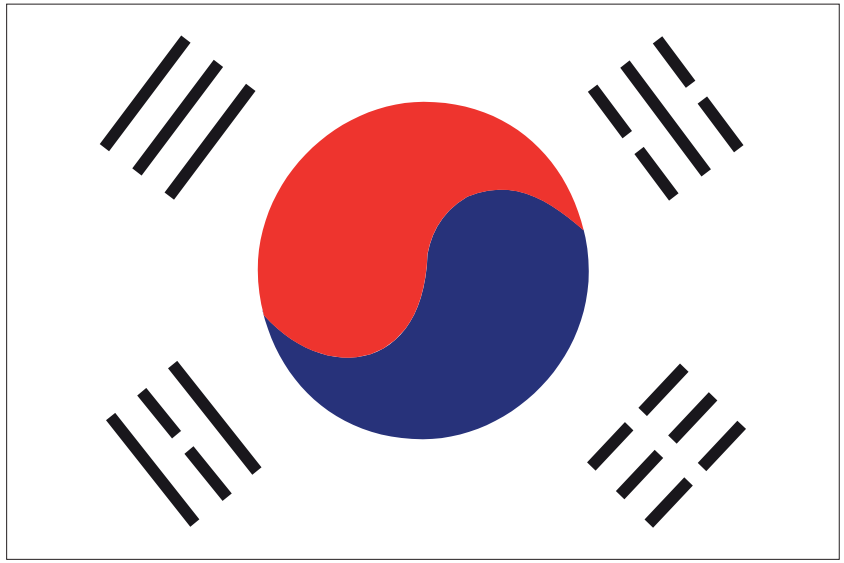
https://www.gob.mx/cms/uploads/attachment/file/706203/Comunicado_de_Prensa_0132-22.pdf.

CONAGUA press release (No. No. 0533-22, July):

https://www.gob.mx/cms/uploads/attachment/file/748696/Comunicado_de_Prensa_0533-22.pdf.

Republic of Korea



100,210
Total area in sq km

51,744
Population 2021 in thousands

44,232
Per capita GDP in PPP 2021 in USD

0.925
Human development index 2021-22

1,274
Average annual precipitation 2019 in mm

1,253
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Environment (MoE)

환경부
Ministry of Environment

Flood Damage Prevention Through Survey and Management of Flood-Vulnerable Areas

Responsible Agencies/Institutions

- Ministry of Environment (MoE)

Summary

- Preemptive and systematic management of flood hazards and prevention of flood damage by surveying flood-vulnerable sections of tributaries influenced by backwater and national rivers.
- Sharing of survey results with local governments and residents for timely response and evacuation in case of floods.

Description

- The Ministry of Environment (MoE) designated and managed flood-vulnerable areas before each flood season help prevent and respond to flood damage.
- To identify flood risk factors, the MoE conducted joint surveys with local governments and environmental offices, while K-water held joint surveys on tributaries influenced by backwater and national rivers. (Figure 1)

Figure 1 Inspection of flood-vulnerable areas, 1 September 2022

- The MoE use flood damage history to classify common vulnerability types in three sections: Structural Vulnerability, River Works, and other risks as designated by river management agencies. The Structural Vulnerability section includes:
  - Sections with overflow risk due to lower height of embankment than design flood level,
  - Sections with connection parts of crossing facilities located below the embankments,
  - Tributaries influenced by backwater with lower levels than embankments of national rivers,
  - Culverts for drainage or passage without floodgates,
  - D or E safety class river facility or structure with collapse risk,
  - Sections with possible flooding or stream flow disruption due to riverbed sediments,
  - Flood control areas, and
  - Sections without planned or any other embankments.
- River Works section includes:
  - Construction sites for river maintenance or restoration of flood damage, and
  - Construction sites of non-management agencies.
- Based on the survey, the MoE established short-and long-term solutions against risks. Short-term measures include traffic control, storing flood protection products, planning evacuations and emergency restoration works like staffing and mobilizing equipment. Long-term measures include incorporating building of flood barriers and embankments in the Comprehensive Maintenance Plan of National Rivers.
- The MoE has set upways to provide timely flood information, including setting risk water levels for flood-vulnerable areas such that automatic text messages are sent to local governments when water reaches the pre-set levels.
- The MoE organizes meetings of Regional Consultative Groups for local governments and residents of flood-vulnerable areas to help them identify risk factors and be aware of response plans to minimize casualties and property damage. These Groups share survey results, provide flood information, and help prepare response plans.

Lessons Learned

- Cooperation between river and dam management agencies, flood information providers, and local governments is critical to systematically control flood risks.
- The MoE raised flood risks awareness and reduced flood damage by actively informing residents of risk factors and developing response plans before flood seasons.
- Leveraging quick and easy-to-use systems like text messages is key to efficiently providing flood information to local governments and facility administrators.

Ministry/Agency/ Organization

Ministry of Environment (MoE)

환경부 Ministry of Environment

Alleviating Droughts in the Southern Area of Korea

Responsible Agencies/Institutions

- Ministry of Environment (MoE)

Summary

- Nationwide in Korea, accumulated precipitation stands at 86.7% (1,150.4 mm) of the normal annual precipitation (1,331.7 mm), but in the southern area, it is severely low at 60.9% (854.5 mm), the third lowest of all time.
- If this trend continues, major cities and industrial complexes in the southern area are likely to face reduced supply of domestic-industrial water.
- The MoE has set demand reduction, supply management and solutions for island areas as short-term measures and taken fundamental steps as long-term measures.
  - Demand reduction includes implementing "Water Demand Adjustment System by Voluntary Water Saving" to help reduce domestic water use by subsidizing water rates, changing plant maintenance schedules, and running desalination facilities in factory sites to lower industrial water use.
  - Supply management involves using water for power generation and agriculture for domestic and industrial use; conjunctively operating water distribution network; and installing pipelines to supply downstream water as domestic water.
  - Solutions for island areas include using groundwater dams and desalination vessels to supply water, and implementing emergency systems to provide water supply vessel services and bottled tap water.

Description

- Status quo and projections
  - Nationwide, the imbalance of rainfall has worsened (heavy rain in Metropolitan area, droughts in the southern area), and there is extreme rainfall shortage since the 2021 flood season (after October 2021) in the southern area.
  - In 2022, rainfall at the five major dams was 68% (949 mm) of 2021: Juam Dam (949 mm, 66%), Pyeonglim Dam (808 mm, 59%), Seomjin River Dam (937 mm, 71%), Sueo Dam (1,300 mm, 70%), and Jangheung Dam (918 mm, 63%).
  - Due to the decrease in soil moisture due to spring drought sand dry monsoons, the inflow of the five dams was only 5.54 million tons in 2022, 38% of 2021.
  - In terms of frequency, it was a 200-year record for the Juam and Pyeonglim Dams, and less than 30 years for Seomjin River, Sueo, and Jang heung Dams.
  - Regional droughts have occurred annually, with increasing frequency, since 2012 due to regionally concentrated rainfall caused by climate change.The frequency has increased from 35 times from 1904 to 2000 (0.36/year) to 16 times from 2001 to 2022 (0.73/year).
  - If these trends continue, the major dams will reach the low-water level before the end of June 2023, the flood season, which raises the concern of emergency water supply. Therefore, solutions are needed.
- Short-term measures include demand reduction, supply management, and measures for island areas.
  - The MoE concluded the Agreement of Water Demand Adjustment System by Voluntary Water Saving with the southern area local government to incentivize residents to save water voluntarily by reducing water rates, thus reducing domestic water use.
  - Plant maintenance schedule in major industrial complexes in the southern area was adjusted with the extreme drought season to reduce industrial water use by partially or entirely halting the operation of the plants.
  - The MoE reduced industrial water use by utilizing desalination facilities (30,000 tons/d) and operating production plants with sufficient water more frequently.
  - The MoE implemented the emergency water supply system in which dam water for power generation and agriculture is used for domestic and industrial purposes by conjunctively operating the water supply network of adjacent dams (with the same water purpose) to lessen the water supply of dams with insufficient water.

- The MoE installed emergency conduct pipelines in upstream water purification plants to use downstream water for domestic purposes, thus reducing dam water supply.
- Groundwater dams were constructed in the islands with restricted water supply. The MoE used desalination facilities developed through its R&D to supply water; it also constructed permanent desalination facilities, supplied bottled tap water, and used water supply vessels during emergencies.

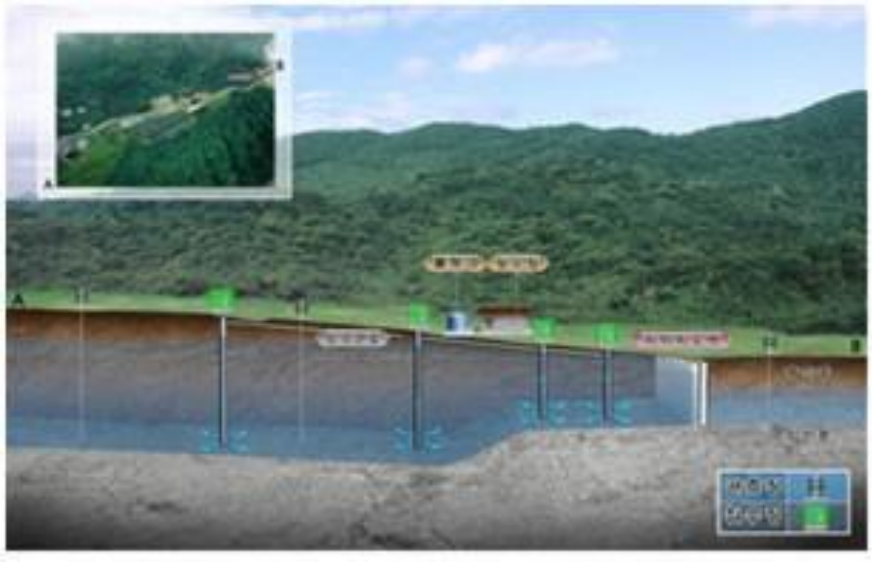


Figure 1 Groundwater dam blueprint of Daeijakdo Island, Incheon

- Middle and long-term measures undertaken by the MoE include:
  - Constructing conduct pipelines to conjunctively operate major dams in the southern area to relieve the burden of water supply.
  - Establishing wastewater or treated water reuse facilities and strengthening the capability to respond to droughts.
  - Doing pipeline maintenance work to minimize loss of tap water and increase revenue water ratio.
  - Connecting river water, agricultural dams, and domestic-industrial dams to supply water in emergencies, after considering water quality and reservoir status.

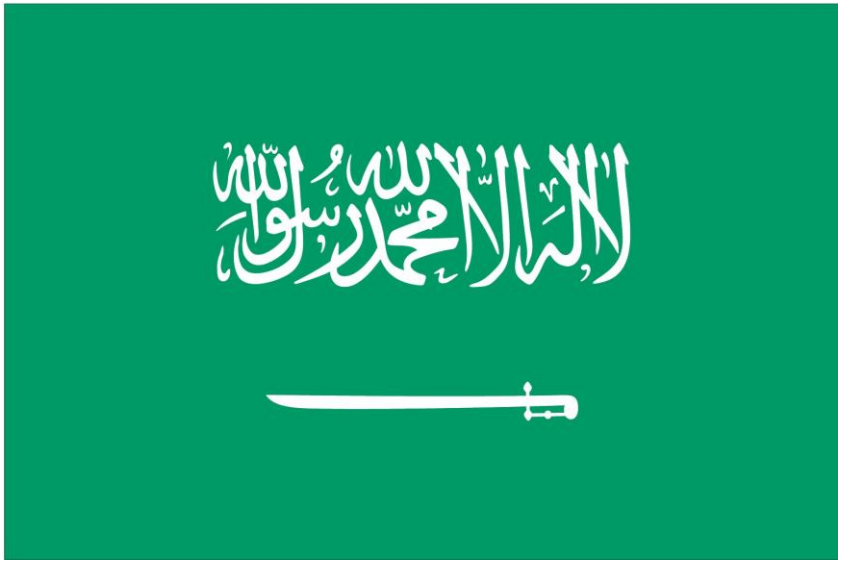
Lessons Learned

- Initially, it was projected that emergency water supply for the southern area would be needed in April or May when dam water levels are low, but it now appears to be needed after June due to reduced water demand and supply management. Some dams are not likely to reach their lowest water levels until monsoon.
- As Korea no longer has safe zones from droughts due to climate change, the water supply system needs to be reassessed to seamlessly implement drought management measures.

References

- Drought Status and Measures in the Southern Area of Korea (MoE, Nov. 22, 2022)
- Detailed Implementation Plan of the Measures for Droughts in the Southern Area or Korea (MoE, Jan.19, 2023)

Saudi Arabia



2,149,690
Total area in sq km

35,950
Population 2021 in thousands

44,339
Per capita GDP in PPP 2021 in USD

0.875
Human development index 2021-22

59
Average annual precipitation 2019 in mm

67
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Environment, Water and Agriculture

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Saudi National Water Strategy 2030

Responsible Agencies/Institutions

- Ministry of Environment, Water and Agriculture (MEWA)

Summary

- The Saudi National Water Strategy 2030 (NWS 2030) has been developed based on an integrated water resource management (IWRM) approach.
- The vision statement for NWS 2030 is 'A sustainable water sector, safeguarding the Kingdom's natural resources and environment while providing cost-effective supply and high-quality services, efficiency contributes to economic and social development'. (Figure 1)

Figure 1. Saudi water strategy

- Objective dimensions are attaining water availability and compliant quality, achieving environmental and economic sustainability, and affordability.
- It aims to reform the water and wastewater sectors to ensure the sustainable development of the Kingdom's water resources while providing affordable, high-quality services.
- The NWS 2030 has been developed based on a structured approach split into three stages: current status assessment and identifying gaps; strategy definition; and an implementation plan with well-defined Key Performance Indicators (KPIs).
- Since approving the strategy in 2018, the government has worked relentlessly to achieve its goals by restructuring the water sector to increase efficiency, setting regulations, building capacity, and increasing reliability.
- MEWA is managing the Saudi water sector based on IWRM approach, which includes a comprehensive water strategy that integrates directions, policies, regulations, and practices at the national level with the principal objective of addressing the key challenges and restructuring the sector.
- The strategic objectives of the NWS 2030 include ensuring continuous access to adequate quantities of safe water; enhancing water demand management across all uses; delivering cost-effective and high-quality water and waste water services; safeguarding and optimizing the use of water resources while preserving the local environment; and ensuring water sector competitiveness and a positive contribution to the national economy.
- The NWS 2030 development was based on several components, including stakeholder engagement and an assessment of the sector's current state along several dimensions, such as water demand, water resources, sector operations, and enablers. It identified the nature and scale of the gap between supply and demand and sector economics under different scenarios (Figure 2).

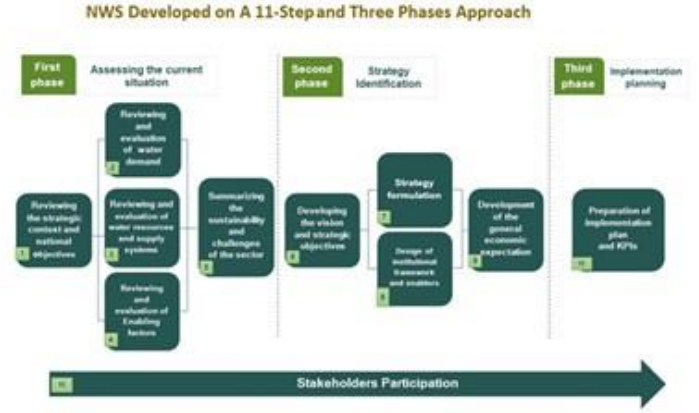

Figure 2. NWS development approach

- NWS 2030 strategic programs and initiatives include:
  - Water Act and water resources management regulations program
  - Water resources management program
  - Sector readiness for the emergency management program
  - Research, development, and capacity building program
  - Supply chain efficiency and service quality program

- Water services regulations program
- Restructuring of the saline water conversion corporation program
- Participation of the private sector in the production and treatment of waste water programs
- Distribution restructuring and privatization program
- Restructuring of the Saudi irrigation organization and the irrigation improvement program

- All programs and associated initiatives are either completed or in progress. The outcomes of implementing the NWS 2030 are promising and significant, including the following:
  - Adapting comprehensive water Act based on IWRM principles and as sociated with comprehensive regulations and guidelines
  - Institutional restructuring of the water sector towards optimizing performance and economic efficiency
  - Agriculture use of non-renewable groundwater resources for water from 20.6 billion cubic meters in 2017 to 9.7 billion cubic meters in 2022
  - Increase in reuse from 17 per cent of total treated waste water to 24 per cent in 2022

Lessons Learned

- On a global scale, the approach used in developing NWS 2030 based on the practice of IWRM proved a robust role model for national-level water strategies, especially in arid regions
- The political will and the NWS 2030 KPIs being monitored by the supreme committee are critical to a resilient water sector in KSA
- The national strategy helped increase the water sector's competitiveness and positive contribution to the national economy by promoting effective governance, private sector participation, localization of capabilities, and innovation.
- Key to the NWS 2030 is privatization which improves services and economic sustainability as well as climate compliance
- Data sharing between different sector entities is vital to manage water resources, particularly in cost recovery efficiently

References

https://shorturl.at/hsCY3

Ministry/Agency/ Organization

Ministry of Environment, Water and Agriculture

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Restructuring the Saudi Water Sector to Enhance Performance and Economic Efficiency

Responsible Agencies/Institutions

- Ministry of Environment, Water and Agriculture

Summary

- Restructuring the water sector is one of the main pillars of the Saudi National Water Strategy 2030 to achieve sustainable governance in the water sector.
- To increase the water sector's efficiency and sustainability, the Saudi government, through an initiative led by the Ministry of Environment, Water, and Agriculture (MEWA), has comprehensively assessed the existing institutional capability, thoroughly evaluated the sector's performance, and reformed it into a comprehensive horizontally integrated structure.
- The new structure is based on the supply chain: production, transmission, and strategic storage; a water supply network; a waste water network and treatment; and treated sewage effluent (TSE) reuse.
- Restructuring the water sector has increased the sector's efficiency and sustainability and incentivised private sector investments, research and development, and institutional capacity.

Description

- The Kingdom of Saudi Arabia is characterized by a high population and economic growth rate coupled with very limited natural water resources.This status called for an innovative institutional structure toward sustainable water resources and services management in the Kingdom.
- Historically, MEWA, the Saline Water Conversion Corporation (SWCC), and the National Water Company (NWC) were the key institutions in the Kingdom. MEWA was responsible for sector planning and managing the natural water resources. SWCC was responsible for desalinated water production and transmission to major urban areas. The NWC company was

depend mainly on public funds to cover capital and operational expenses, which is considered unsustainable.

- Furthermore, such a structure did not promote economic and financial efficiency or the adoption of new technology. Therefore, through MEWA, Saudi Arabia restructured its water sector to increase efficiency and sustainability and increase the private sector's participation in job creation. The new structure of the water sector in Saudi Arabia is as follows (Figure 1):
  - MEWA will be in-charge of sector strategy, managing surface, and groundwater resources, and ensuring that all its subsidiaries work together.
  - SWCC will be the bulk water supply agency.
  - The Water Technology and Transmission Company (WTTCO) is a new entity that will own and operate the long-distance water transmission network.
  - The National Water Company (NWC) is the national water and waste water utility.
  - The Saudi Water Partnership Company (SWPC) puts out Build Operate Transfer (BOT) contracts for desalination plants, waste water treatment plants, transmission lines, and water storage facilities.
  - The Saudi Irrigation Organization (SIO) is in-charge of building up Saudi Arabia's irrigation infrastructure and developing the waste water reuse sector in the future.
  - The water regulator is responsible for regulating most activities within the sector, including setting tariffs.

Figure 1. The new structure of the water sector in Saudi Arabia

Lessons Learned

- With the new structure, it would be easier for the Saudi government to reflect the actual cost of water production, transmission, distribution, collection, and treatment on the water tariff through the supply chain, which would help the sector's financial sustainability.
- Having entities specialized in each part of the supply chain helps increase financial efficiency by calculating total cost and revenue, and increasing transparency and efficiency. Moreover, specialisation in a specific part of the supply chain will increase expertise in the field and enhance research and development.
- Cost recovery in the water sector has encouraged the private sector to invest heavily in water production, water supply, and treatment.

References

https://shorturl.at/hsCY3 and the websites for each entity

South Africa

1,221,037
Total area in sq km

59,392
Population 2021 in thousands

13,312
Per capita GDP in PPP 2021 in USD

0.713
Human development index 2021-22

495
Average annual precipitation 2019 in mm

771
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Water and Sanitation

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REPUBLIC OF SOUTH AFRICA

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Rehabilitation of an Existingearly Warning Gauging Weir in the Keurbooms River, Bitou Municipality, Western Cape Province, Republic of South Africa

Responsible Agencies/Institutions

- Department of Water and Sanitation

Summary

- Chapter 14 of the National Water Act lays an obligation on the Minister to establish a national monitoring and information system.
- Measuring run-off is important for statistics and planning, therefore it is monitored all over the world. Accurate water measurement helps in the distribution thereof.
- More information on historical flow occurrences (statistics), yields better estimations for future planning.
- Using artificial gauging controls (structures), water levels (stage) are recorded and converted through office calibration to flow records.
- Keurbooms river gauging weir K6H019 is an asset of DWS. The flow measurements at the weir started on 31 October 1997. The structure is located approximately 12 km north of the Plettenberg Bay Central Business district.

Description

- A gauging station is a site on a river that has been selected, equipped, and operated to provide the basic data from which systematic records of water level and discharge may be derived.
- Essentially it consists of a natural or artificial river cross-section where a continuous record of the stage can be obtained and where a relation between stage and discharge can be determined (Lambie, 1978).
- Real-time river flow information, essential for effective flood management, needs to be seen as a core strategic asset, in the same way as dams, pipelines, and transfer schemes.
- The Keurbooms river is a major source of water supply to the Plettenberg Bay area in the Bitou Municipality. The existing water license of the Bitou Municipality stipulates that no water may be abstracted if the flow rate in the river, as measured at the DWS gauging weir located 900 m downstream of the abstraction works, is less than 300l/s.
- Two major flood events occurred in the Keurbooms river in 2011 and 2012. The flood studies estimated that the flood peaks of both flood events coincide with floods with return periods ranging between 1:80 years and 1:100 years.
- The access road to the gauging weir was seriously damaged during the above-mentioned events (Figure 1). The left bank flank wall and the erosion protection works downstream of this wall were damaged threatening the stability of the entire weir.

Figure 1. Keurbooms river gauging weir in August 2013 after the 2011 and 2012 flood events, showing damage to the left flank.

- Remedial work to address the unsafe conditions that exist at the cut-off wall to prevent the potential loss of life downstream of the gauging weir and/or the loss of functionality of the gauging weir was required.
- The total cut-off wall was reconstructed (Figure 2). The erosion problems were addressed to restore the integrity of the wall.

Figure 2. Reconstruction of left flank damaged wall

Lessons Learned

- Poor infrastructure design leads to catastrophic disasters and increased costs for reconstruction

References

N/A

Ministry/Agency/ Organization

Ministry of Water and Sanitation

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

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Blue/Green Drop Incentive Based Regulatory Programme

Responsible Agencies/Institutions

- Department of Water and Sanitation (DWS)

Summary

- The Department introduced the Blue and Green Drop Certification as an incentive-based regulation programme to encourage Water Services Institutions (WSIs) to achieve excellent drinking water and waste water quality management.
- This incentive-based regulation seeks to induce changes in behaviour of individuals and institutions to facilitate continuous improvement and adoption of best practice management of treatment systems.
- Consequently, progressive improvement and excellent performance are recognised and rewarded. It should however not be construed as a weaker form of regulation but rather an alternate approach, as it is under pinned by a strong legislative mandate in the Water Services Act.
- The assessments do not only focus on water quality compliance but also include water safety and waste water risk abatement planning which are risk-based approaches dealing with associated risks and mitigation there of; asset management which focuses on operation and maintenance including design capacity versus operational capacity; technical skills availability for operation of the plants as well as sludge management.

Description

- The Department introduced the incentive-based regulation in 2008 to proactively measure all aspects contributing to a sustainable water services business, protection of the water resources, and provision of safe water to the citizens of South Africa.
- The Green Drop and Blue Drop incentive-based regulation promotes transparency and accountability and allows the department to measure, monitor and publish information about the quality of water services, based on legislative standards or industry good practices. It seeks to identify risks and to ensure responsible authorities implement control measures to prevent failure.
- This programme incorporates waste water risk abatement planning and the World Health Organisation's (WHO) Water Safety Planning Concept as the basis for a proactive, risk-based approach to water quality management from catchment to consumer.
- DWS has been measuring and monitoring the risk of each water supply and waste water system based on performance against the Blue and Green Drop criteria (respectively) enabling the WSIs, and DWS to identify, prioritise and implement targeted and specific interventions to improve performance.
- This risk-based approach includes compliance with the South African National Standard for Drinking Water (SANS 241) which is the minimum requirement for drinking water that is considered safe for human consumption and compliance to water use authorisation for waste water effluent.
- SANS 241 requirements include the microbiological, aesthetic, chemical, and physical parameters and acceptable levels that do not pose a risk to human health over a lifetime of consumption whilst water use authorisation focuses on microbiological, chemical, and physical parameters to ensure the protection of the water resources. The Green and Blue Drop programme also provides direction on the evaluation of effluent and water quality risks from catchment to consumer, monitoring and verification of waste water and drinking water quality to enable the management of any identified risks, and assurance that the water resources are protected.

Lessons Learned

- Lack of skills and operations and maintenance contribute to the infrastructure that does not operate optimally which poses a risk to the effluent quality and drinking water quality.

References

N/A

Türkiye

783,562
Total area in sq km

84,775
Population 2021 in thousands

31,467
Per capita GDP in PPP 2021 in USD

0.838
Human development index 2021-22

593
Average annual precipitation 2019 in mm

2,719
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Ministry of Agriculture and Forestry / General Directorate of Water Management

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Water Use Efficiency Practices

Responsible Agencies/Institutions

Ministry of Agriculture and Forestry/General Directorate of Water Management

Summary

- Türkiye, a country located in the Eastern Mediterranean region, is expected to be adversely affected by the impacts of climate change.
- One of the most important impacts of climate change will be observed on water resources. Recent studies show that by 2050 amount of overall available freshwater in Türkiye will decrease by ~21 per cent.
- The development of climate change adaptation strategies for water resources becomes highly significant to prevent possible risks regarding drought and water scarcity.
- Water efficiency practices are highly important to improve the adaptation capacity of environmental and societal systems against climate change.
- Water efficiency action plans for three main sectors, namely municipal water use, agriculture, and industry, as well as individual water use are prepared by the Ministry of Agriculture and Forestry, Türkiye.

Description

- For three main sectors, 2050 targets for water use efficiency are determined through relevant legislation and national strategies which include:
  - Reduce water losses in drinking water supply systems to 15 per cent.
  - Increase water use efficiency in irrigation systems to 65 per cent.
  - Improve water use efficiency in industrial facilities to 50 per cent.
- Roadmap for implementing relevant practices to reach these targets is determined through National Water Efficiency Strategy Document and Action Plan.
- Besides raising awareness, the water efficiency campaign is being conducted. Studies for the improvement of the relevant legislative framework are still ongoing.

Lessons Learned

Preliminary analysis suggests that if relevant water efficiency practices are applied and the sectoral water efficiency targets are achieved by 2050, at least 23 per cent of the water will be saved which will counterbalance the water lost through the impact of climate change.

References

https://www.tarimorman.gov.tr/SYGM/Link/13/Su-Verimliligi

Ministry/Agency/ Organization

General Directorate of Water Management, Ministry of Agriculture and Forestry, Republic of Türkiye

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Drought Management Plan of Ceyhan Basin Project General Directorate of Water Management

Summary

Drought Management Plans (DMPs)

- In Mediterranean countries such as Türkiye, adverse impacts of global climate change are being observed, and frequent occurrences of droughts are becoming a serious problem.
- Though no comprehensive historical analysis of drought is available at the country scale, severe droughts in 1804, 1876, and 1928 led to the loss of crops and livestock and the migration of farmers.
- During the Republican era, especially in 1928, 1973, 1989, 1990, 1993,1998, 1999, 2000, 2001, and 2008, extensive droughts were observed. The drought in 1876 led to a loss of about 200,000 lives by causing famines and diseases. Whereas, the drought in 2008 caused drop in water levels at the dams of Ankara by 3.8 percent which led to a serious water scarcity problem.
- The inefficient use of surface water in agriculture, and increasing pollution of natural water bodies, will further lead to increased severity of the drought.
- Though it is not possible to control the occurrence of drought, the outcomes of drought can be reduced by proper monitoring and management strategies. The DMPs prepared by the general directorate of water management at the basin level are one such instrument to minimise the negative impacts of possible drought risks and be better prepared for droughts.
- The aim of DMPs is to mitigate and prevent the negative impacts of droughts by determining the measures to be taken during water scarcity and the measures to be taken before, during, and after the drought periods in order to have a timely response.
- As of 2022, DMPs have been prepared for 15 basins in Türkiye, and the target is to have them for all 25 basins by the end of 2023. For the drought database, a web application has been developed that enables users to examine data related to drought status.

Description

- The Ceyhan basin DMP was completed in 2019. As per the scope of the plan, meteorological, hydrological, and geological data of the basin were examined to select indicators and indices that represent different types of drought (Table 1).

Table 1. Indicators and indices used for drought analysis in the Ceyhan Basin (MGM, 2017)

Index / Indicator	Meteorological Drought	Agricultural Drought	Hydrological Drought
Percent of Normal Index (PNI)	•	•	
Decimals Index	•		
Standardized Percipitation Index (SPI)	•	•	•
Standardized Percipitation, Evapo-transpiration Index (SPEI)	•	•	•
Standardized Runoff Index (SRI)			•
Standardized Groundwater Index (SGI)			•
Palmer Drought Severity Index (PDSI)	•	•	
Self-Calibrating Palmer Drought Severity Index (sc-PDSI)	•	•	
Palmer Hydrological Drought Index (PHDI)		•	•
Self-Calibrating Palmer Hydrologi-cal Drought Index (sc-PHDI)		•	•
Normalized Difference Vegetation Index (NDVI)		•	
Vegetation Condition Index (VCI)		•	

- The indices selected for the detection of drought events were brought to the time period (1970–2016) that is the same as that considered for the plan and ranked on monthly basis.
- Using the estimates on the area-weighted average of each index for the basin and its own parametric drought classification, it was calculated whether the overall basin experienced drought above normal. This analysis only helped determine the occurrence of drought but not its severity.
- The periods showing common drought were determined by cross-index comparisons and examined further. The determined drought periods of various lengths for the Ceyhan Basin are 1972, 1973, 1974, 1984, 1985, 1986, 1989, 2001, 2007, 2008, 2014, and 2016 (Figure 1).

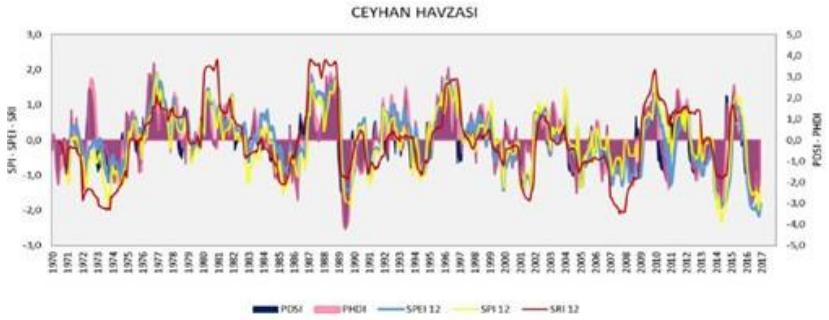

Figure 1. Comparison of Ceyhan Basin drought indices

- Risk analysis was undertaken and drought incidence rates were calculated. For the SPEI-6, SPEI12, sc-PDSI, and sc-PHDI indices, station-based calculated values were interpolated and the incidence of drought severity was prepared as shown in Figure 2.

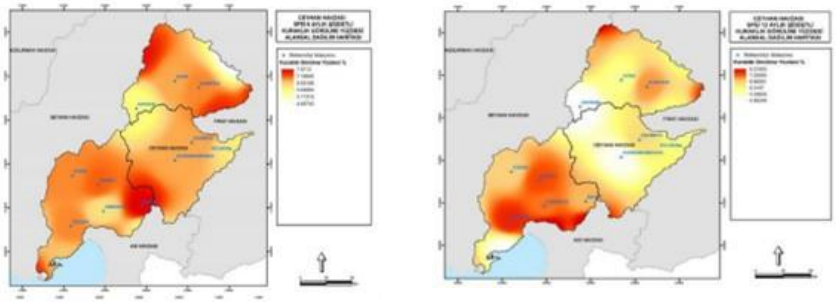

Figure 2. Drought risk maps

- Runoff simulation was performed by HEC-HMS hydrological model to determine the rainfall-runoff relationship for Ceyhan Basin. For the modeling, sub-basin level meteorological data were used as input. Using the model, two different runoff time series for 2018-2098 under the RCP4.5 and RCP8.5 scenarios were developed (Table 2).

Table 2. Projections of surface water potential in the Ceyhan Basin

Sub - Basins	Average Surface Water Potential (hm3/year)							
	RCP4.5			RCP8.5			RCP4.5 Trend	RCP8.5 Trend
	2018 - 2050	2051 - 2075	2076 - 2098	2018 - 2050	2051 - 2075	2076 - 2098	2018 - 2098	2018 - 2098
Yukari Ceyhan	1.327,8	1.411,2	1.371,6	1.377,9	1.331,2	1.552,6	No Trend	No Trend
Orta Ceyhan	2.728,8	2.648,6	2.593,5	2.882,1	2.450,9	2.480,6	No Trend	No Trend
Asagi Ceyhan	2.829,2	2.785,1	2.6556,0	2.899,3	2.497,5	2.497,5	No Trend	No Trend
Ceyhan Basin	6.885,8	6.844,8	6.621,1	7.159,3	6.279,5	6.530,7	No Trend	No Trend

- Further, the water budget of the basin was calculated. Sectoral water usage for the current and the projection period was calculated. The results show that there will be an overall increase in water needs from 2016 to 2099.
- Using the findings, the action plan for reducing the impacts of drought and water scarcity was prepared. It covers the identification, evaluation and prioritisation of cost-effective, environmentally sensitive, and technically feasible measures as per the level of disaster and in line with the objectives set out in the legislation.
- As per the analysis, 4 drought classes for 7 sectors (agriculture, industry, drinking and domestic water, ecosystem, energy, health, and tourism) were evaluated and the measures to be taken before, during, and after drought were determined. Each measure has been matched to the relevant target and has been determined on the basis of provinces, sub-basins, and basins within the scope of the Ceyhan Basin DMP (Table 3).

Table 3. Ceyhan Basin Emergency Action Plan

Indicator	Measure Level	Terms	Action (Measure No.)
Normal Status	-	Water resources are sufficient, water quality is good.	The measures planned for the pre-drought conditions specified in Table 6.3 should be carried out in the Normal Situation. These measures will increase the area's capacity to adapt to emergencies in the event of an emergency.
Pre-alert Status	Level 1	Percipitation is below the annual average, with stream flow, reservoir and groundwater level insufficient.	11,12
Alert Status	Level 2		
Emergency Status	Level 3	A steady decline water quantity and quality is observed.	

- The level of disasters and measures are:

  Normal status represents normal and above drought severity. It is the stage where hydrological planning takes place and where strategic and long-term measures are implemented. These measures stand out as water efficiency, expansion of the hydraulic infrastructure to improve the storage and regulation capacity of the river basin, reuse of treated water, and other measures that can be realized in long run.

  Pre-alert status represents mild severe drought severity. It is the stage that aims to prevent damage to water resources by meeting water demands while simultaneously activating special drought management measures. These include mostly informative and control measures, as well as voluntary water conservation measures.

  Alert status represents moderate drought severity. In the event of an alarm, the recommended measures for the pre-alarm condition should be intensified. The measures are focused on water saving. Vulnerable groups need to be identified and prioritized.

  Emergency status represents severe drought severity. Drought status is at critical level and water supplies are insufficient to meet significant water demands. In addition to the implementation of all previously mentioned measures, additional measures need to be implemented to minimize the impacts on water bodies and ecological systems.

Lessons Learned

Drought impacts vary according to its severity. It is important to establish a drought management cycle by prioritizing the measures to be taken according to the degree of severity. For determining the measures and recommendations, the strategies implemented by different institutions and organizations in various countries of the world and the opinions of stakeholders should be evaluated.

References

"Drought Management Plan of Ceyhan Basin Project" was executed by T.R. Ministry ofForestry and Water Affairs, General Directorate of Water Management and all rightsreserved.

Ministry/Agency/ Organization

Ministry of Agriculture and Forestry General Directorate of Water Management

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Flood Management Plans

Responsible Agencies/Institutions

- Ministry of Agriculture and Forestry General Directorate of Water Management

Summary

- Basin Flood Management Plans are prepared based on Flood Management Plan Preparation, Implementation, and Flood Management Plans Regulation on Monitoring (Official Gazette dated 12 May 2016 and numbered 29710) and EU 2007/60/EC Flood Directive.
- The plan includes preliminary flood risk assessment, flood hazard maps, flood risk maps, measures to be taken to manage the risk under flood risk, and evacuation routes.

Description

- It is a management plan that includes the determination of the measures to be taken to manage the risk in areas under flood risk, considering the preliminary flood risk assessment, flood hazard maps, and flood risk maps.
- In 23 basins, flood management plans have been completed. The plan is currently being prepared in two basins. In addition, flood management plans for five basins have been updated (Figure 1).

Figure 1 . Status of Flood Management Plans

Lessons Learned

- For Türkiye, it is very important to switch from flood disaster management to flood risk management.
- Basin flood risk management approach is necessary in order to achieve the desired result.

References

All information and completed projects can be downloaded from the link below.
https://www.tarimorman.gov.tr/SYGM/Sayfalar/Detay.aspx?SayfaId=53

Ministry/Agency/ Organization

The Ministry of Agriculture and Forestry/ General Directorate of Water Management

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National Flood Forecasting and Early Warning System (TATUS)

Responsible Agencies/Institutions

- General Directorate of Water Management

Summary

• The system aims to predict possible flood events in advance by using hydraulic models and informs to relevant institutions.

Description

• 15 sub-basins are covered for any possible danger of flood. More than 100 models have been established, and these hydrological models work simultaneously with data coming from numerical weather forecasting models (Figure 1).

Figure 1. TATUS interface

Lessons Learned

- The system is still under construction. The principles of hydraulic and hydrological models were learned.

References

All information and completed projects can be downloaded from the link below.

https://www.tarimorman.gov.tr/SYGM/Sayfalar/Detay.aspx?SayfaId=53

United Kingdom

242,900
Total area in sq km

67,326
Population 2021 in thousands

44,979
Per capita GDP in PPP 2021 in USD

0.929
Human development index 2021-22

1,220
Average annual precipitation 2019 in mm

2,169
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

Foreign Commonwealth and Development Office (FCDO)

Foreign, Commonwealth & Development Office

Contact Details

Andrew Roby

Fair Water Footprints

Responsible Agencies/Institutions

- FCDO

Summary

- The Glasgow Declaration for Fair Water Footprints is a unique partnership comprised of government, the private sector, financial institutions, and civil society. By harnessing the power of trade, enterprise, and communities, the stakeholders are working together to help deliver sustainable water and sanitation for all by 2030.
- The UK is supporting the Glasgow Fair Water Footprints initiative to enable new market-based drivers of the change via supply chains, establishing the political commitment and the framework for partnership between businesses, investors, government, and civil society necessary for success.

Description

- At UNFCCC COP26, the UK helped launch the Fair Water Footprints Partnership, a Declaration signed by 28 countries, businesses, and organisations committed to working together in new ways to ensure that by 2030 supply chains associated with water risk demonstrate sustainable water with drawal, zero pollution, universal access to safe water, and sanitation, promotion of nature, and effective planning for climate-related disasters.
- The UK has also committed to taking action to reduce its own unsustainable water footprint. As a signatory of the Partnership, UK's delivery plan looks at its water footprint and seeks to support commitment as a signatory to zero pollution, sustainable and equitable withdrawals, universal access to safe water sanitation and hygiene, the protection and promotion of nature, and resilience to floods, droughts and water conflict within the water footprints over which it has control and influence by 2030.
- The UK is focusing our delivery plan on the following key sectors:
    - Food: the UK is a major food importer with a long list of supplier countries. The Waste and Resources Action Programme's (WRAP) Water Roadmap has already established a governance scheme and set of delivery projects for stewardship in at-risk catchments that brokers collaboration across multiple businesses along the food chain and other stakeholders.
    - Textiles: addressing consumer concerns around abstraction for cotton and pollution from processing.
    - Critical minerals: driven by increased demands for batteries, magnets and renewable technologies more generally, and Artificial Intelligence.
    - Additionally, the UK is working with businesses and the investment community across different supply chains on drivers of change.

Lessons Learned

- 50 per cent of the UK's water footprint is from unsustainable sources. It is critical to close evidence gaps and understand our global water footprints (not just domestic) in order to be able to ensure fair and equitable water management for people and the planet.
- Need to overcome various barriers to reform including the increase in political leadership globally on water security, greater collaboration in water planning, reducing capacity gaps, strengthening accountability, addressing transboundary and climate-related water issues, and responding to growing demand.
- Lack of public and private finance and investment, driven partly by systemic market failure. Important to address the governance systems and unlock the barriers to the market.

References

Home - Fair Water Footprints

Ministry/Agency/ Organization

Department for Environment, Food and Rural Affairs (Defra)

Department for Environment Food & Rural Affairs

Contact Details

Ashley Holt

The Catchment Based Approach (CaBA)

Responsible Agencies/Institutions

- Defra
- Environment Agency

Summary

- The Catchment Based Approach (CaBA) is an inclusive, civil society-led initiative that works in partnership with the Government, Local Authorities, Water Companies, businesses, and more, to maximise the natural value of our environment.
- CaBA was established in 2013 as a mechanism to foster collaborative management of water. Government funds 'catchment hosts', normally a non-governmental organization (NGO), to act as convenors for the organisations and interests in each catchment to come together to identify and tackle issues.
- Groups develop plans for their catchments and deliver projects as dictated by local issues and geography. There is also a national-level support structure that also works to address thematic issues such as urban environments, marine, and the use of data.

Description

- Now in its 10th Anniversary year, CaBA partnerships are actively working in all 100+ river catchments across England and cross-border with Wales (Figure 1). The CaBA partnerships undertake integrated management of land and water, addressing each river catchment as a whole, and delivering cross-cutting practical interventions on the ground.

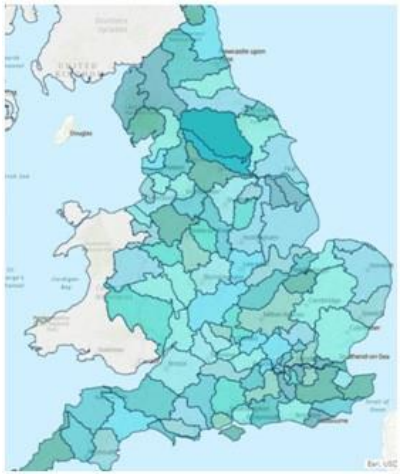

Figure 1. CaBA partnerships in 106 river catchments encompassing the whole of England

- These result in multiple benefits including improvements to water quality, enhanced biodiversity, reduced flood risk, resilience to climate change, more resource-efficient and sustainable businesses, and health and well-being benefits for local communities as they engage with and take ownership of their local river environment.
- For example, as part of the Severn Vale Partnership, there is ongoing work with landowners to use trees and other natural flood defence features to reduce flood risk in the Stroud valleys, with over 80 individual natural flood defences built so far.
- Due to the diversity of the partnerships, the technical expertise there in, and the development of catchment plans – underpinned by robust data and evidence – CaBA partnerships have proven adept at securing project funds from multiple sources. To date, CaBA achieves 2-3 times the leverage on the government's investment in it. CaBA has delivered:
  - Created 1238 hectares of habitat
  - Mitigated 78 barriers to fish migration
  - Controlled over 700 km of riverbank for invasive species

Lessons Learned

- The CaBA has created a new operating space for collaborative action on the water. It is a catalyst for integrated action.
- It creates an environment for innovation, co-creation of projects and ideas, and an effective mobiliser of action. Participants often carry actions through into their own work, beyond and outside of CaBA.

- Multiple agencies and institutions participate, and a number are now funding additional projects and activities due to the value it is demonstrating. Partners in a river catchment can secure funding that they may not have access to as individual organisations.
- Integrated water management is an outcome that is primarily realised at the local and operational levels.
- Partnerships enable the views of local communities and businesses to be taken into account and can achieve multiple benefits – flood risk reduction, better water quality, more biodiversity, and enhanced green spaces for the whole community to enjoy.

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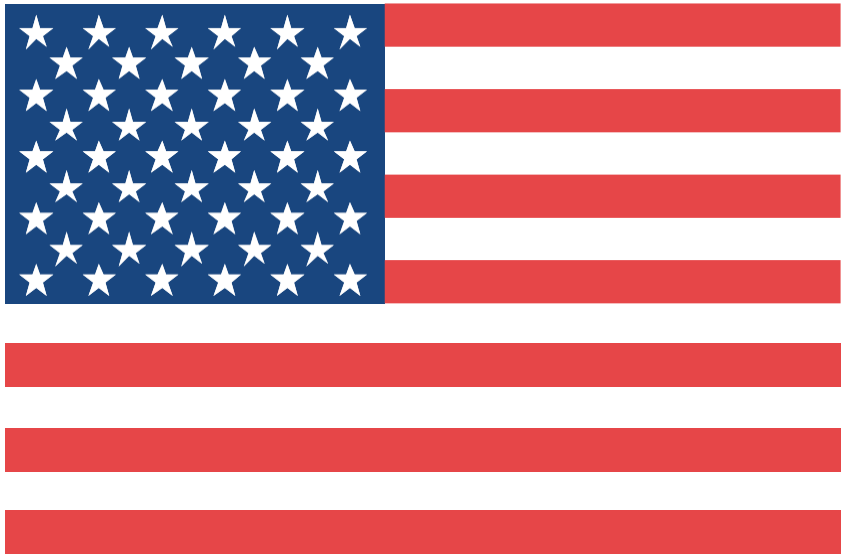
United States



9,372,610
Total area in sq km

331,893
Population 2021 in thousands

63,670
Per capita GDP in PPP 2021 in USD

0.921
Human development index 2021-22

715
Average annual precipitation 2019 in mm

8,583
Per capita annual renewable water 2019 in cu m

Ministry/Agency/ Organization

United States Environmental Protection Agency

Contact Details

Toni Harmer (harmer.toni@epa.gov)

National Estuary Program

Responsible Agencies/Institutions

- United States Environmental Protection Agency (US EPA)

Summary

- EPA's National Estuary Program (NEP) is a non-regulatory program that improves the waters, habitats, and living resources of 28 estuaries across the country.
- Each NEP develops and implements a long-term plan, referred to as a Comprehensive Conservation and Management Plan (CCMP) based on local priorities to guide their efforts.
- The NEPs involve community members in the decision-making process

Description

- The National Estuary Program (NEP) is a EPA place-based program to protect and restore the water quality and ecological integrity of estuaries of national significance.
- Currently, 28 estuaries located along the Atlantic, Gulf, and Pacific coasts and in Puerto Rico are designated as estuaries of national significance (Figure 1). Each NEP study area includes the estuary and surrounding watershed.

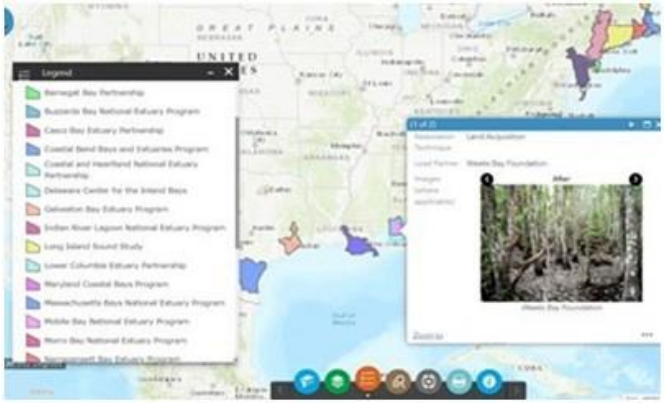


Figure 1. NEP map and NEP story map

- The NEPs are located in a variety of institutional settings, including state and local agencies, universities, and individual non-profits. In overseeing and managing the national program, EPA provides annual funding, national guidance and technical assistance to the local NEPs.
- The 28 NEPs develop and implement Comprehensive Conservation and Management Plans (CCMPs), which are long-term plans that contain actions to address water quality and living resource challenges and priorities. The NEP challenges and priorities are defined by local, city, state, federal, private, and non-profit stakeholders.
- Each NEP has a Management Conference (MC) that consists of diverse stakeholders and uses a collaborative, consensus-building approach to implement the CCMP. Moreover, each MC ensures that the CCMP is uniquely tailored to the local environmental conditions and is based on local input, thereby supporting local priorities.

Lessons Learned

Successful watershed management and lessons learned from EPA's National Estuary Program

https://www.epa.gov/nep/successful-watershed-management-and-lessons-learned-epas-national-estuary-program

References

https://www.epa.gov/nep

Ministry/Agency/ Organization

United States Environmental Protection Agency (US EPA)

Contact Details

Toni Harmer (harmer.toni@epa.gov)

Responsible Agencies/Institutions

- U.S. Environmental Protection Agency

Summary

- The Urban Waters Federal Partnership supports the protection and restoration of urban watersheds toward water quality goals while also reconnecting urban communities, particularly those that are overburdened and underserved, with their waterways by improving coordination among federal agencies.
- The Partnership also collaborates with community-led revitalization efforts to improve Nation's water systems and promote their economic, environmental, and social benefits.

Description

- The Urban Waters Federal Partnership began with seven urban waters pilot locations in June of 2011, with the goal of working closely with local partners to restore these urban waterways.
- Cleaning up and restoring local water resources is essential to protecting Americans' health and improving their overall quality of life. The Partnership is now active in 20 urban watersheds (Figure 1).

Figure 1. Local success of Urban Waters

- Revitalizing urban waterways also reconnects citizens to nature and local biodiversity, and open spaces (Figure 2), and will have a positive economic impact on local businesses, tourism, and property values, as well as spur private investment and job creation in these communities.

Figure 2. Flood control meets open space opportunities

Lessons Learned

- https://www.epa.gov/system/files/documents/2021-10/uwprogress-report_10.8.21_508.pdf
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Ministry/Agency/ Organization

Environmental Protection Agency (EPA)

Contact Details

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Healthy Watershed Program (HWP)

Responsible Agencies/Institutions

- U.S. Environmental Protection Agency

Summary

- The Healthy Watersheds Program (HWP) provides a strategic framework and tools for holistic watershed protection for state, tribal, and local programs.
- The program integrates both systems-based healthy watershed protection into EPA's Clean Water Act program, and promotes the development of state, tribal, and large healthy watershed protection strategies.
- These strategies leverage programs and resources of land and aquatic ecosystem protection agencies, and of other partners.
- The HWP takes a non-regulatory, collaborative approach to maintaining clean waters.

Description

- EPA acknowledged the need to increase protection of healthy watersheds in Coming Together for Clean Water: EPA's Strategy to Protect America's Waters.
- EPA created the Healthy Watersheds Program to enhance our ability to protect healthy aquatic ecosystems and their watersheds. The program goals are:
  - Support states and tribes in their efforts to identify, protect, and maintain healthy watersheds across the United States.
  - Further integrate the protection of healthy watersheds into EPA Clean Water Act programs.
  - Promote the aquatic protection component in partnering with other government, non-government, and private entities involved in landscape conservation.
  - Increase awareness of the value of protecting healthy watersheds and improve understanding of the range of management actions needed to avoid adverse impacts.
- Key program elements include:
  - Establishment of partnerships to identify and protect healthy watersheds.
  - Identification of healthy watersheds by states and tribes with their partners using scientifically sound, integrated assessments.

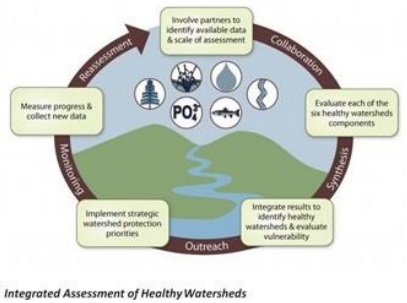

Figure 1. Process of integrated assessment of healthy watershed

- Listing, tracking, and maintenance, leading to an increase in the number of healthy watersheds.
- Protection of healthy watersheds and, if applicable, their enhancement using the best regulatory and non-regulatory tools.
- Measurement of the progress on protecting healthy watersheds, tied to securing and raising the overall goals of EPA's Water Program, including direct support of the public health and environmental goals established in EPA's Strategic Plan.

Lessons Learned

- One major challenge facing efforts to protect healthy watersheds is insufficient information about healthy watersheds, their condition, and vulnerability in many parts of the nation. Although public and private efforts have made, progress in identifying and protecting exceptional watersheds in some areas, a better and more consistent information base from which to consider and act on protection is needed.
- EPA has collaborated with several state governments and watershed groups in developing healthy watershed assessments that can aid their future protection efforts. Currently, EPA is developing watershed assessment data and analyses at a national scale to assist a broader array of healthy watershed protection partners.

References

- Key Documents of the Healthy Watersheds Program: https://www.epa.gov/hwp/key-documents-healthy-watersheds-program
- Watershed Index Online (WSIO): A National Watershed Data Library and Tool: https://www.epa.gov/wsio/watershed-index-online-wsio-nationalwatershed-data-library-and-tool
- The Healthy Watersheds Program Conceptual Framework: https://www.epa.gov/hwp/technical-elements-epas-healthy-watershedsprogram
- Watershed Data and Services: https://www.epa.gov/wsio/wsio-indicator-data-library
- How's My Waterway (a place to learn about your waters): https://mywaterway.epa.gov/

Way Forward

Water resources management has traditionally been a challenging sector. With the onset of the 21st century, the plummeting per capita water availability due to ever growing population and rising water demand coupled with uneven distribution of resources, low water use efficiency, and the impact of climate change have rendered multi-hued complexity. It is a widely accepted fact that the holistic management of water resources requires collective global efforts. G20 extends a great platform for exchange of knowledge and the India G20 Presidency has further strengthened this aspect. The G20 India Presidency appreciates the valuable work, successful programmes, and innovations in the field of water resources by G20 members. During the G20 India Presidency, we have demonstrated our commitment to this cooperation in water resources development and management through sharing of the technical experiences, best practices, usage of state-of-the-art tools and technology and case studies of successful interventions in the water sector for mutual benefits. The G20 India Presidency is thankful to all members for contributing numerous best practices enabling peer-learning amongst G20 members. G20 Members also participated wholeheartedly in the various sessions specifically designed for knowledge sharing.

We encourage convening of study tours, workshops and exposure visits for the delegations of G20 members to the rotating Presidency countries for building stronger partnerships and collective benefits in the field of water resources. The upcoming G20 Presidencies may take this journey to a new level by collating thematic grouping of best practices for specific areas of water resources such as drinking water & sanitation, flood management, irrigation management, basin planning, water quality etc.

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HDI 2021-22: https://hdr.undp.org/data-center/country-insights#/ranks

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