Role of Japanese Water Experts in Developing Asian Countries

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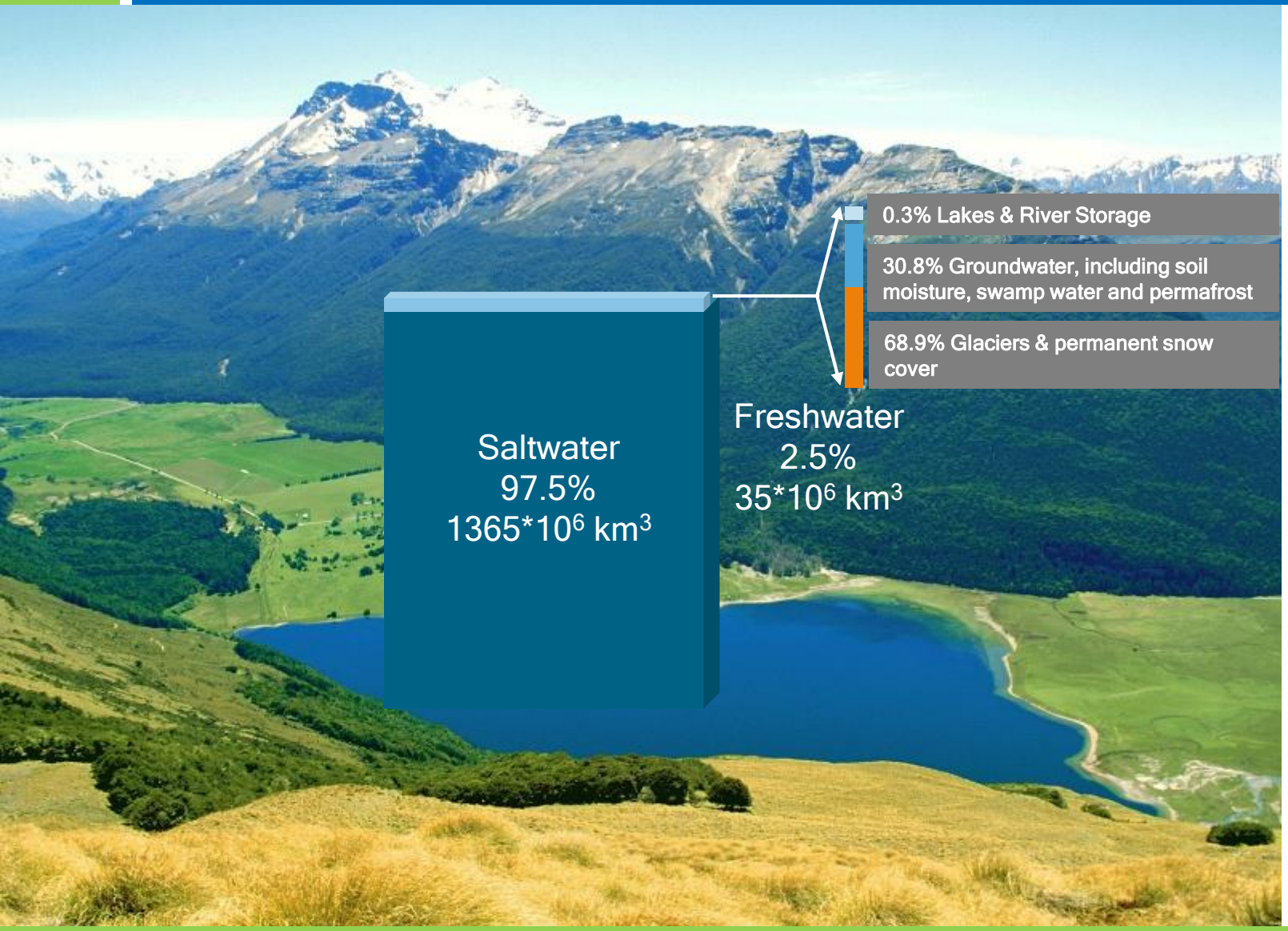
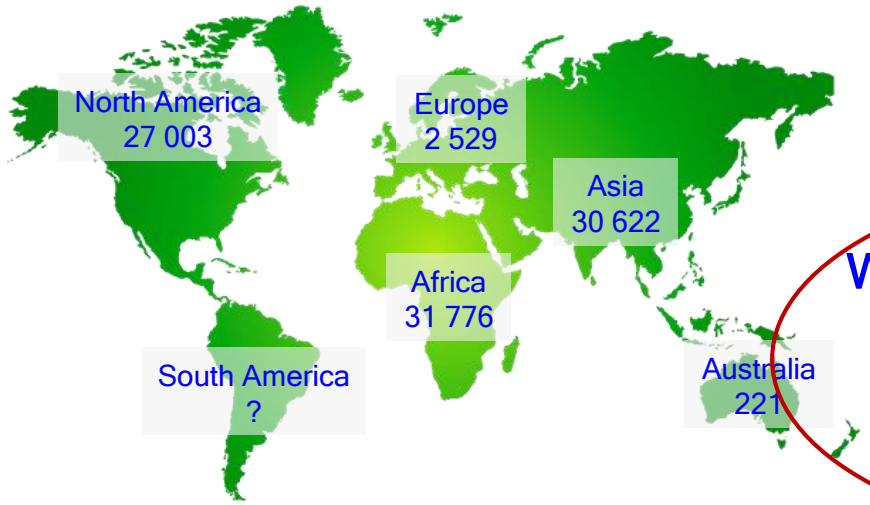
Water ! Water ! Everywhere " But Only Drops to Drink "



- Earths total water vol. ~1.4 billion km^3.
- Freshwater resources ~ 2.5% of the total volume
- Total usable freshwater supply for ecosystems and humans
  - ~ < 1% of all freshwater resources, and
  - only 0.01% of all the water on earth
- Erratic distribution and availability of freshwater resources in different geographical and geo-political regions

Freshwater Resources: Volume by Continent

Wetlands, Large lakes, reservoirs and rivers (Km^2)



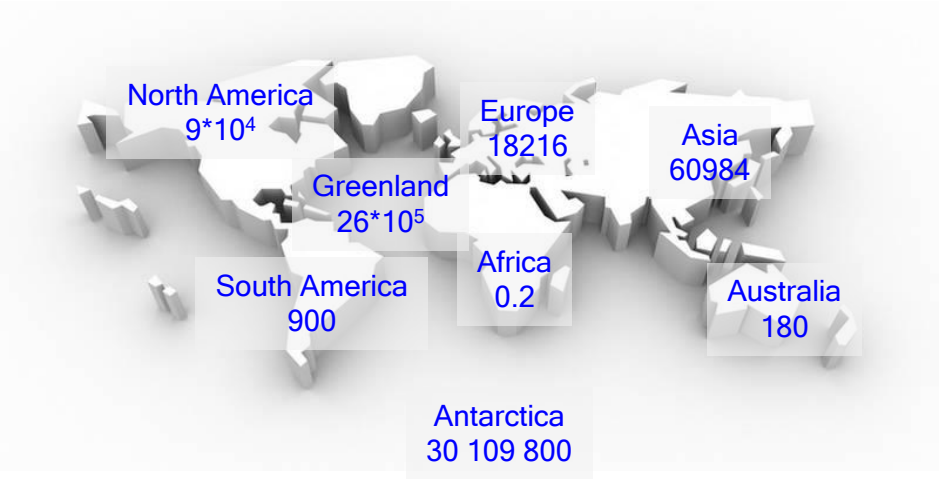
Is it enough ?

Asia

Water reserve : 30 622 Km^2

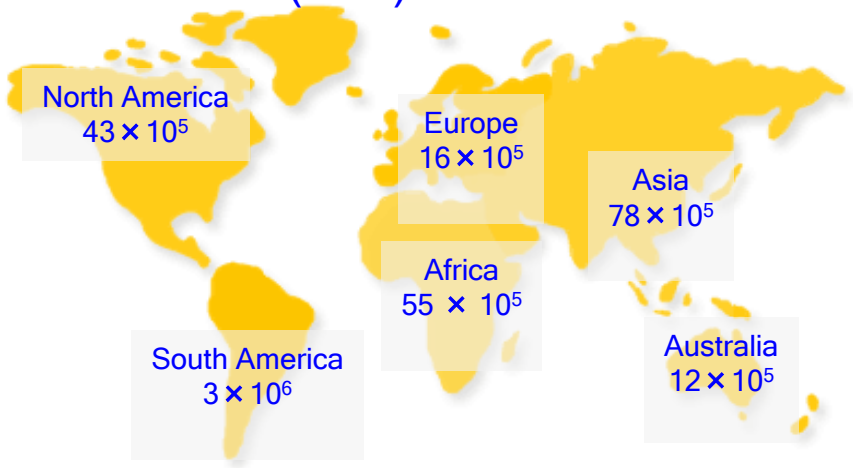
Hosting 60% of world's current human population

Glaciers and permanent ice caps (km^3)



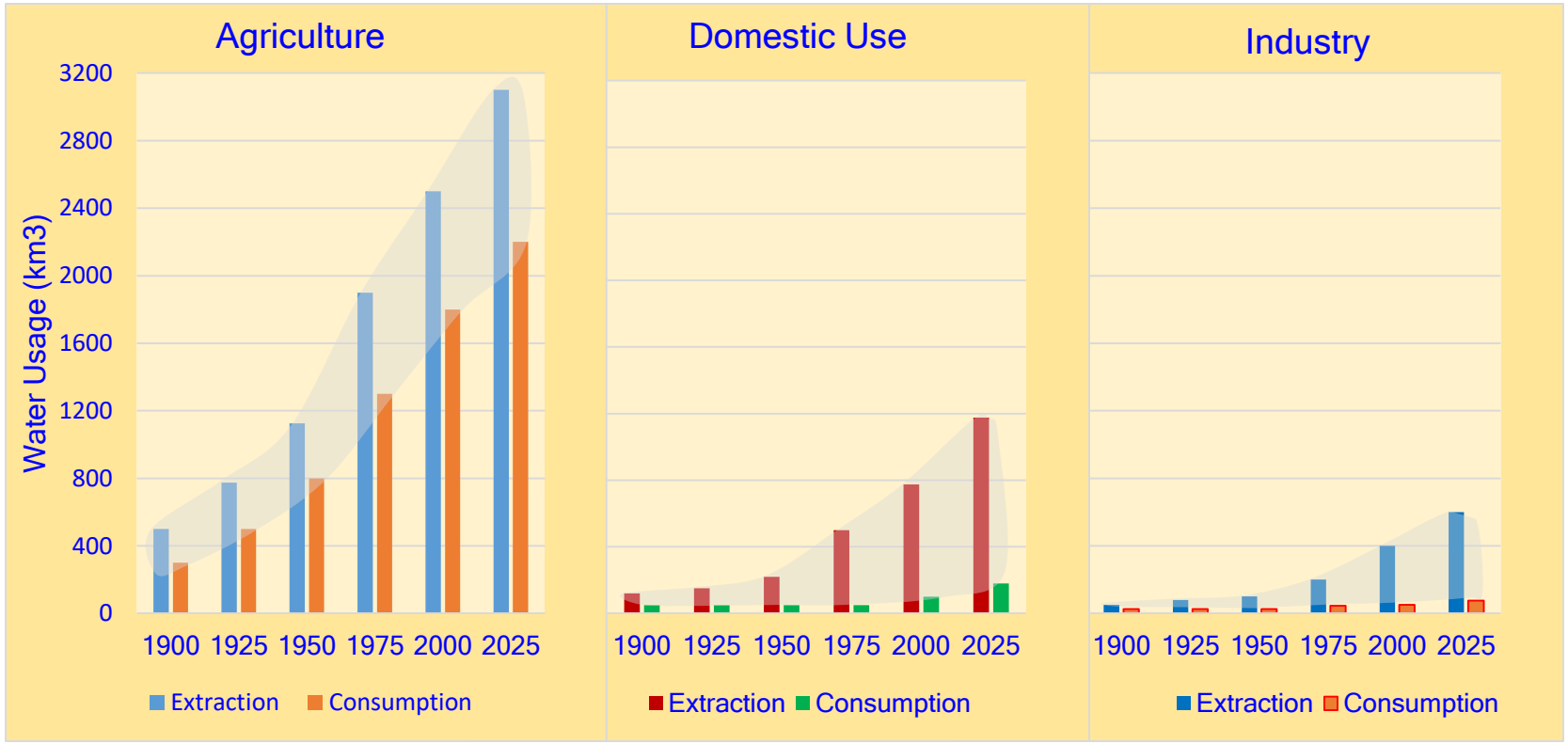
70% Freshwater

Ground Water (Km^3)



Groundwater represents over 90% of the world's readily available freshwater resource

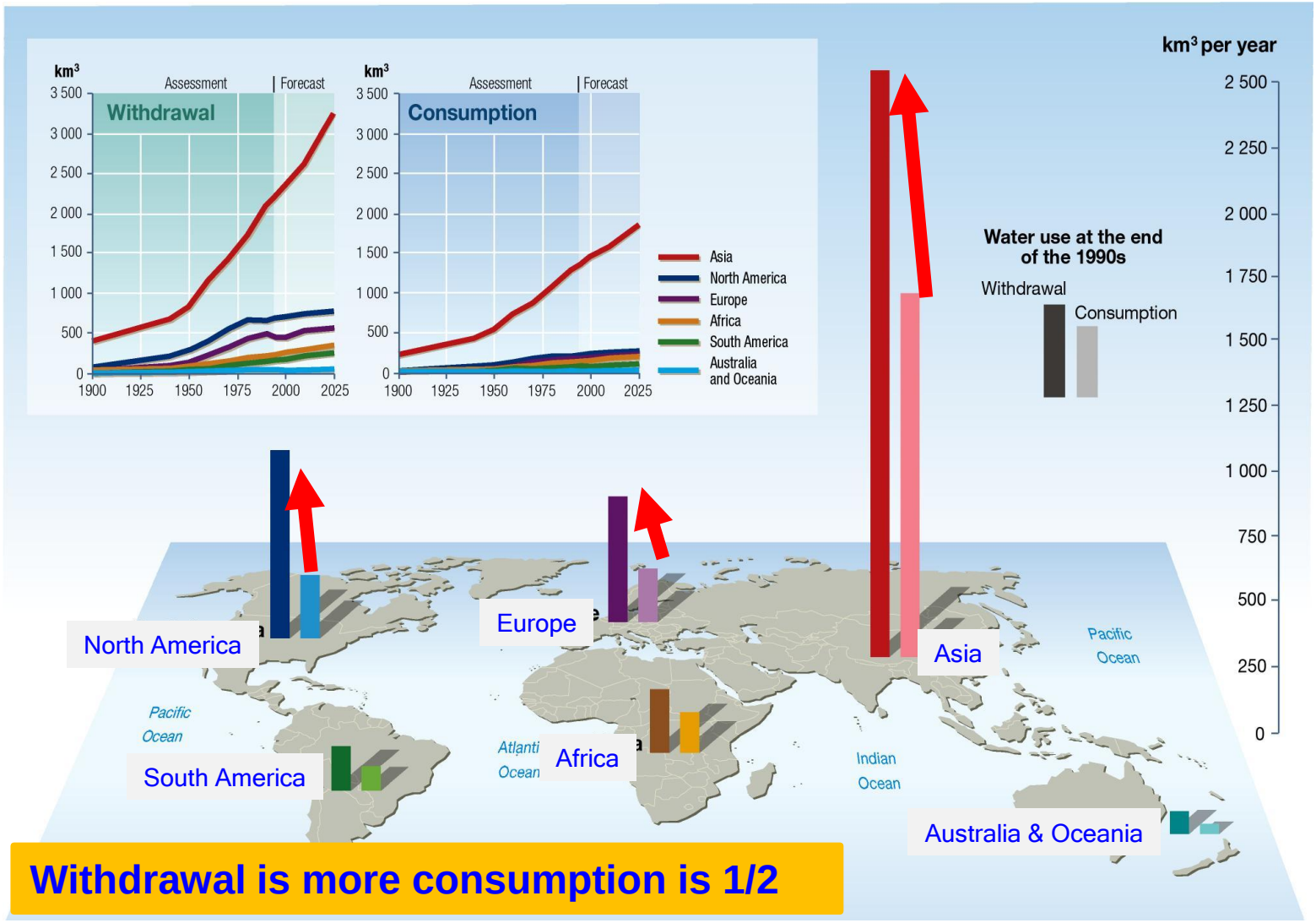
Freshwater Use by Sector



- Agricultural sector is by far the biggest user of freshwater, (70%)
- Second largest consumer sector is Industry (19%)
- Municipal withdrawals is 11%

UNEP/GRID-ARENDAL. http://www.unep.org/dewa/vitalwater/article43.html

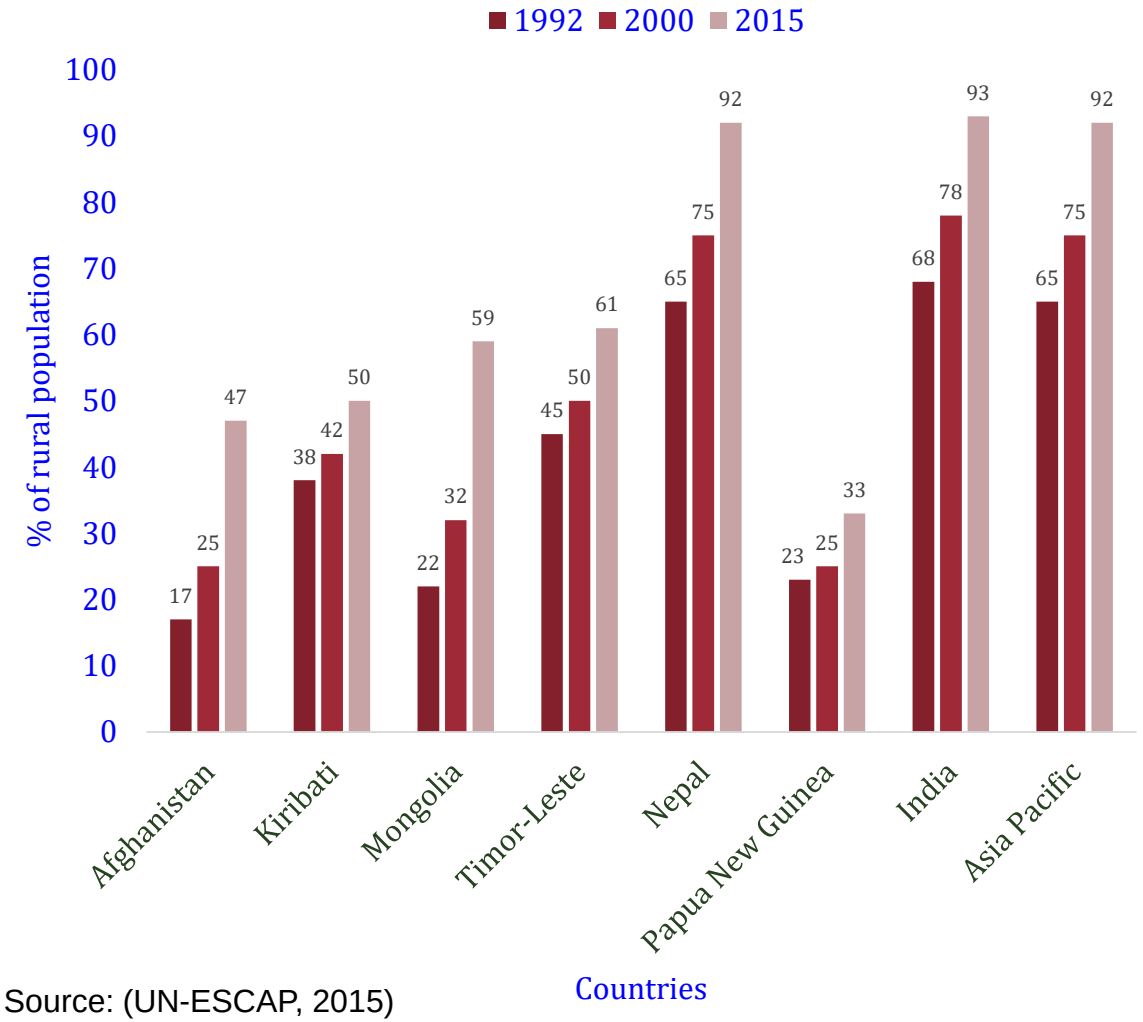
Water Withdrawal and Consumption: The Big Gap



Withdrawal is more consumption is 1/2

- Annual global freshwater withdrawal grown from 3,790 km^3 to in 1995, to 4,430 km^3 in 2000
- Of which consumption accounted for 2,304 km^3 or 52% only
- Not all quantity of water withdrawal is consumed. There is significant loss of water during distribution and application
- Annual global water withdrawal is expected to grow by about 10-12% every 10 years, reaching approximately 5,240 km^3

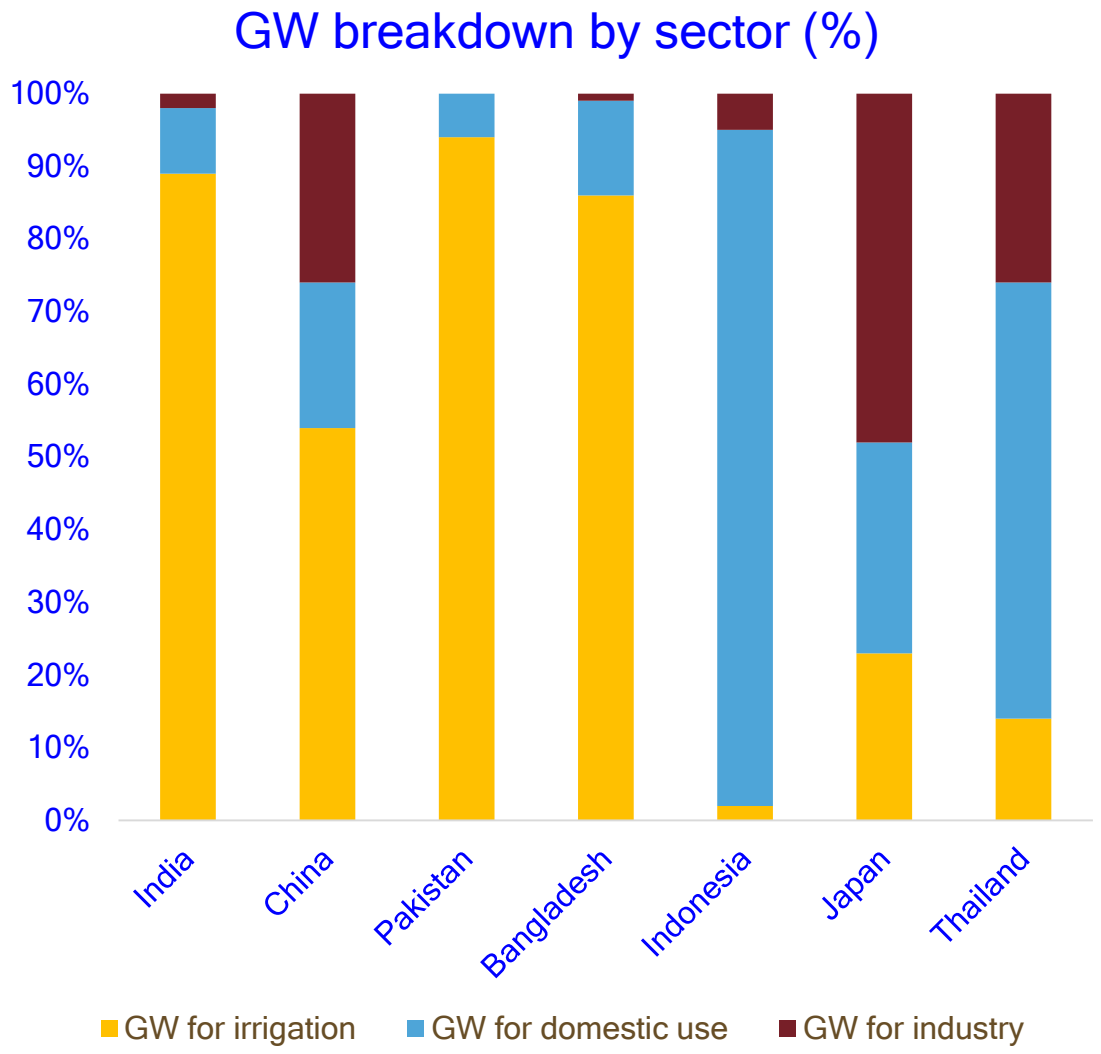
Water Accessibility and Availability in Asia



Source: (UN-ESCAP, 2015)

- Progress in access to clean drinking water in Asia and Pacific region
- Access to safe drinking water (1990-2015):
  - Urban Asia: 94% to 97%
  - Rural Asia: 63% to 91%
- 213 million rural residents of Asia still lack access to water
- Poor access in countries like Papua New Guinea, Afghanistan and Kiribati

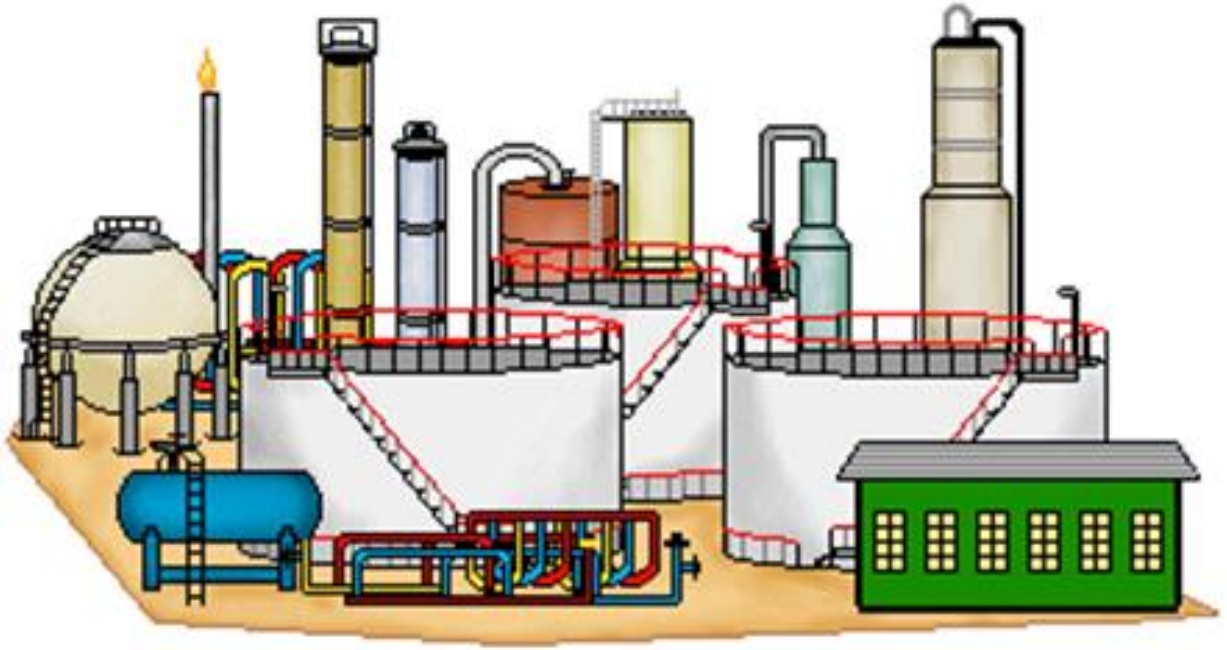
Ground Water (GW) Extraction by Sector

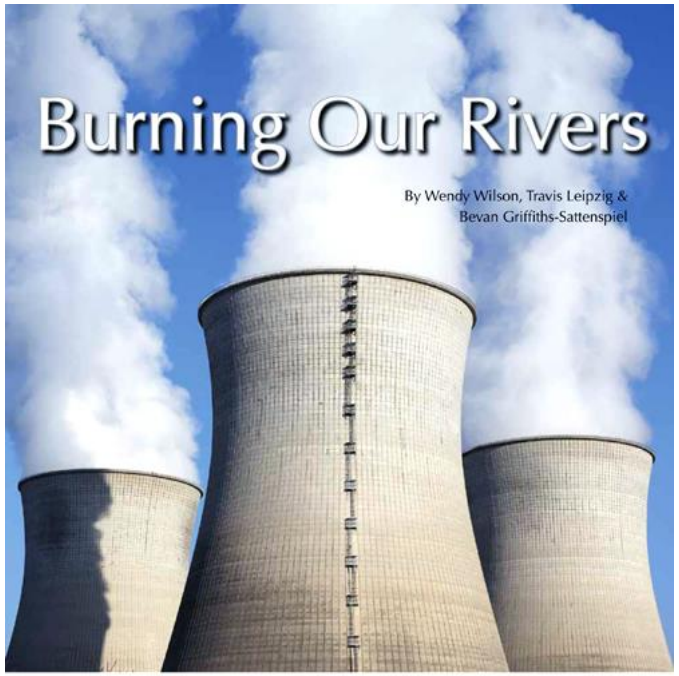


Water Use by Industries

- The industrial sector uses freshwater stored in reservoirs and dams for hydropower generation and various industrial processes

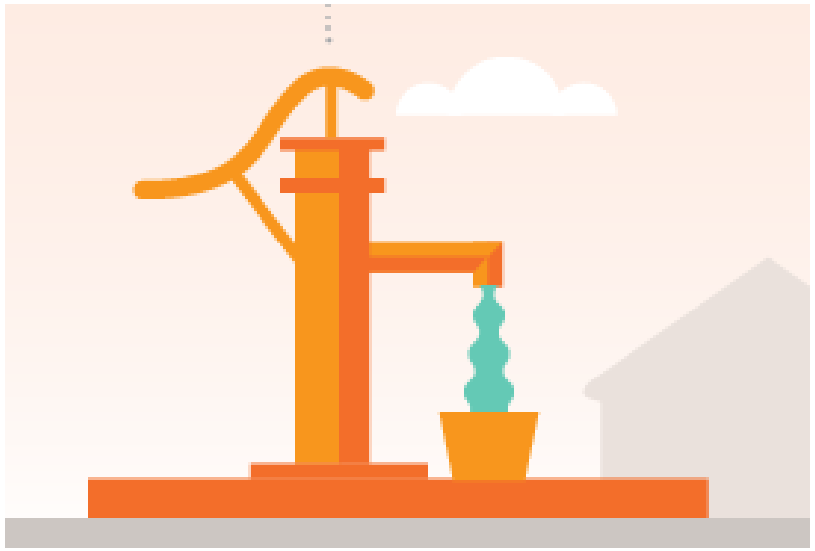
- Approximately 15-18 billion m^3 of freshwater resources are contaminated by fossil fuel production every year





Water Use by Domestic Sector

- Domestic water use is related to the quantity of water available to populations in cities and towns - for sanitation and drinking water uses



- Groundwater reportedly provides drinking water to at least 50% of the global population

Challenges of Water Security in Asia & Pacific

Threats to Water Security

- Asia & Pacific is facing the double sword of increased water demand but decreased freshwater resources due to wastewater pollution
- Prime causes of region's poor water security state are:
    - Heavy population,
    - Accelerated urbanization rate
    - Intensified industrial development
    - Extensive agricultural development
    - Prone to climate induced disasters

Threat: Urbanization and Lack of Access to Water, Sanitation, and Drainage System

- Asia and the Pacific is one of the most rapidly urbanizing (2.4% annual growth of the urban population regions) region in the world.
- Currently there are seven of the world's mega cities (cities with populations of 10 million or more) in Asia-Pacific, which by 2025 is expected to have 21 such mega cities.
- Asia and the Pacific has the highest annual water withdrawal of all the world's regions.
- Such unprecedented urban population growth is placing considerable stress on the water resource, with insufficient water supply (%), wastewater treatment (%), and drainage management in cities.

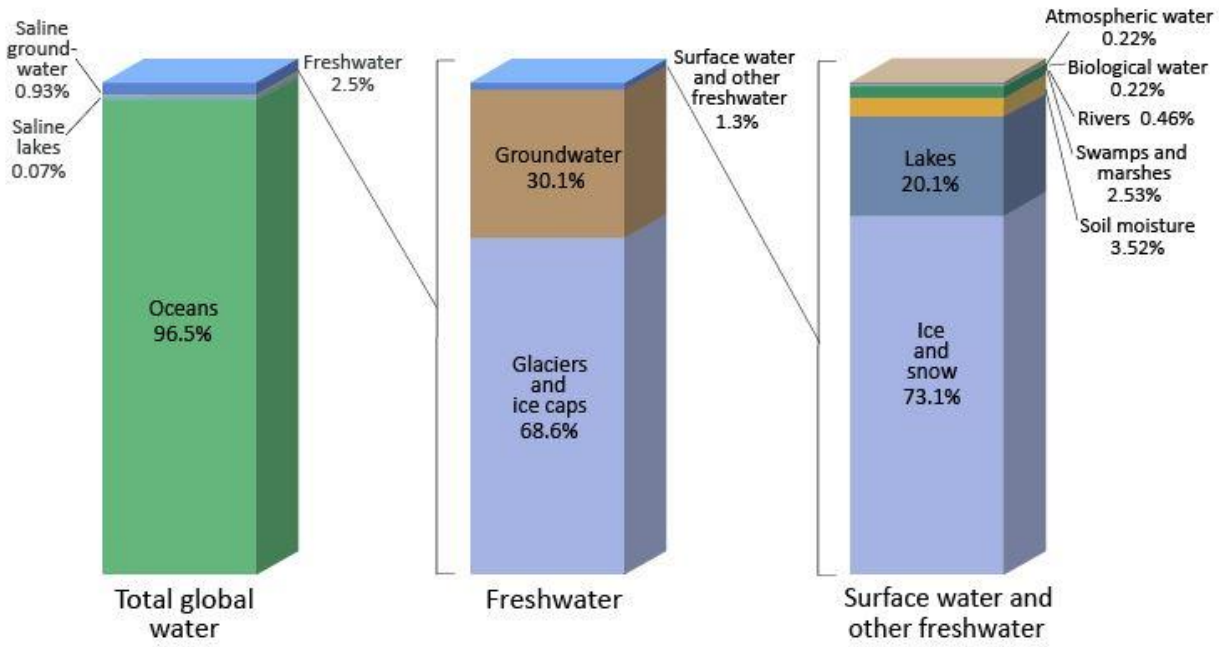
Where the Japanese Water Sector will/ should Focus on the Future

Surface Water Pollution → Pollution of Drinking Water Sources

Natural Disaster effect on water treatment systems → Asia under climate change risks

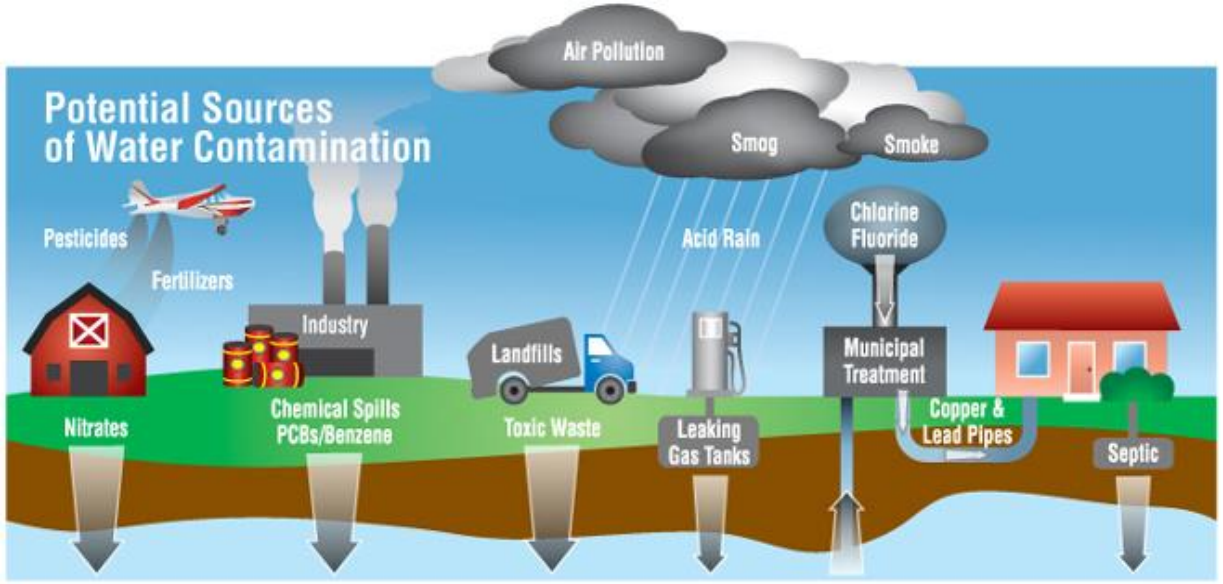
Surface Water Scarcity and Pollution

Scarcity



Only 0.007% of the water on earth is accessible for human use

Pollution



Agricultural, Industrial, Domestic sewage

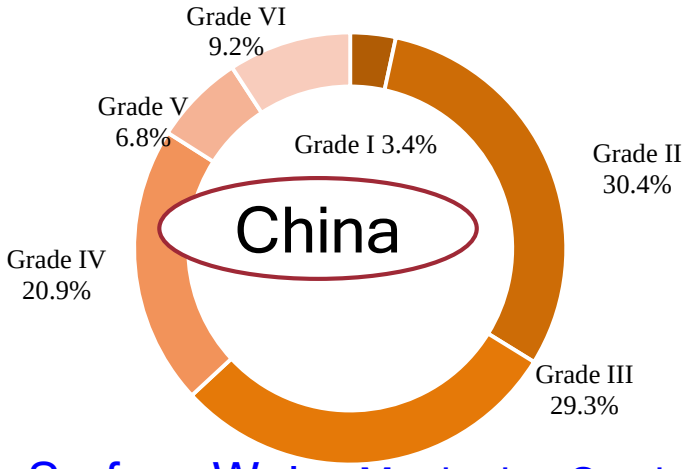
Surface Water Scarcity and Pollution

- Every day, 2 million tons of sewage and other effluents drain into the world's waters.
- Every year, more people die from unsafe water than from all forms of violence, including war.

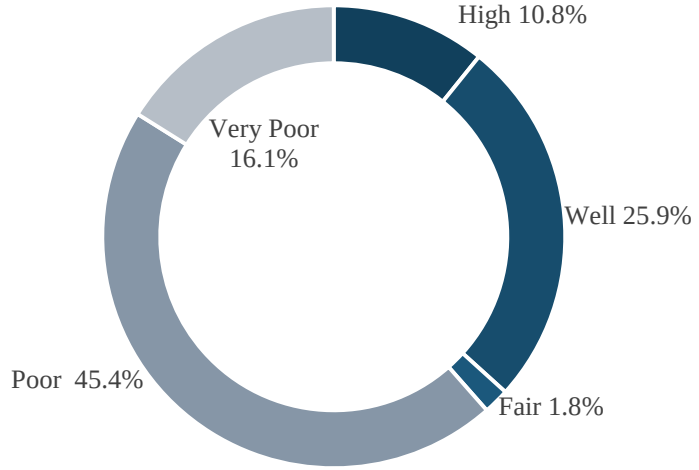
Big challenge in water treatment sector

With the existing climate change scenario, almost half the world's population will be living in areas of high water stress by 2030, including 75 - 250 million people in Africa.

Surface Water Pollution



Surface Water Monitoring Section



Ground Water Monitoring Site

Surface Water Environmental Quality Standard of China (GB3838-2002)

Parameters	Grade I	II	III	IV	V
pH			6~9		
DO ≥	7.5	6	5	3	2
COD_{Mn} ≤	2	4	6	10	15
NH_3-N ≤	0.15	0.5	1.0	1.5	2.0

Thailand

Parameters	Tha chin river	Chao phyya river	Bangpakong river	Maeklong river
Application	Agriculture 76%	Drinking water; Irrigation;	Drinking water Agriculture Aquaculture Industry	Water supply
DO	< 1,	1~7	3~6	4~7
BOD	-	1~7	1~5	~ 2
FCB (MPN/100ml)	-	1,000 ~ 1,000,000	100~100,000	< 4,000

Surface Water Issue

2025

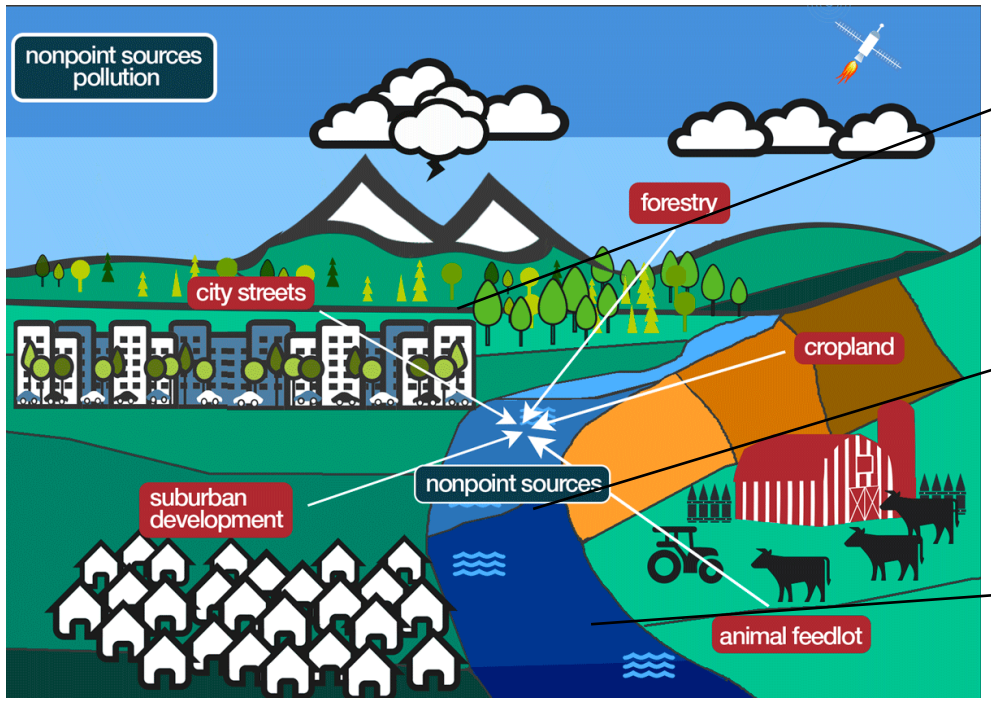
- More than 40% high to extreme stress
- 40% to 20% medium to high stress
- 20% to 10% low to medium stress
- Less than 10% low stress

With global water consumption estimated, To 2025, up to **60%** of world's population will be leave in **high water stress**.

Water Pollution

Water Scarcity

Non-point Source Pollution



Source Control

Regulations to reduce pollution

In-situ remediation

Ecological restoration

Terminal Control

Turbidity, carbon source, nitrogen source etc.

To develop a technology to treat this polluted surface water

Typical Water Treatment Process for Surface Water

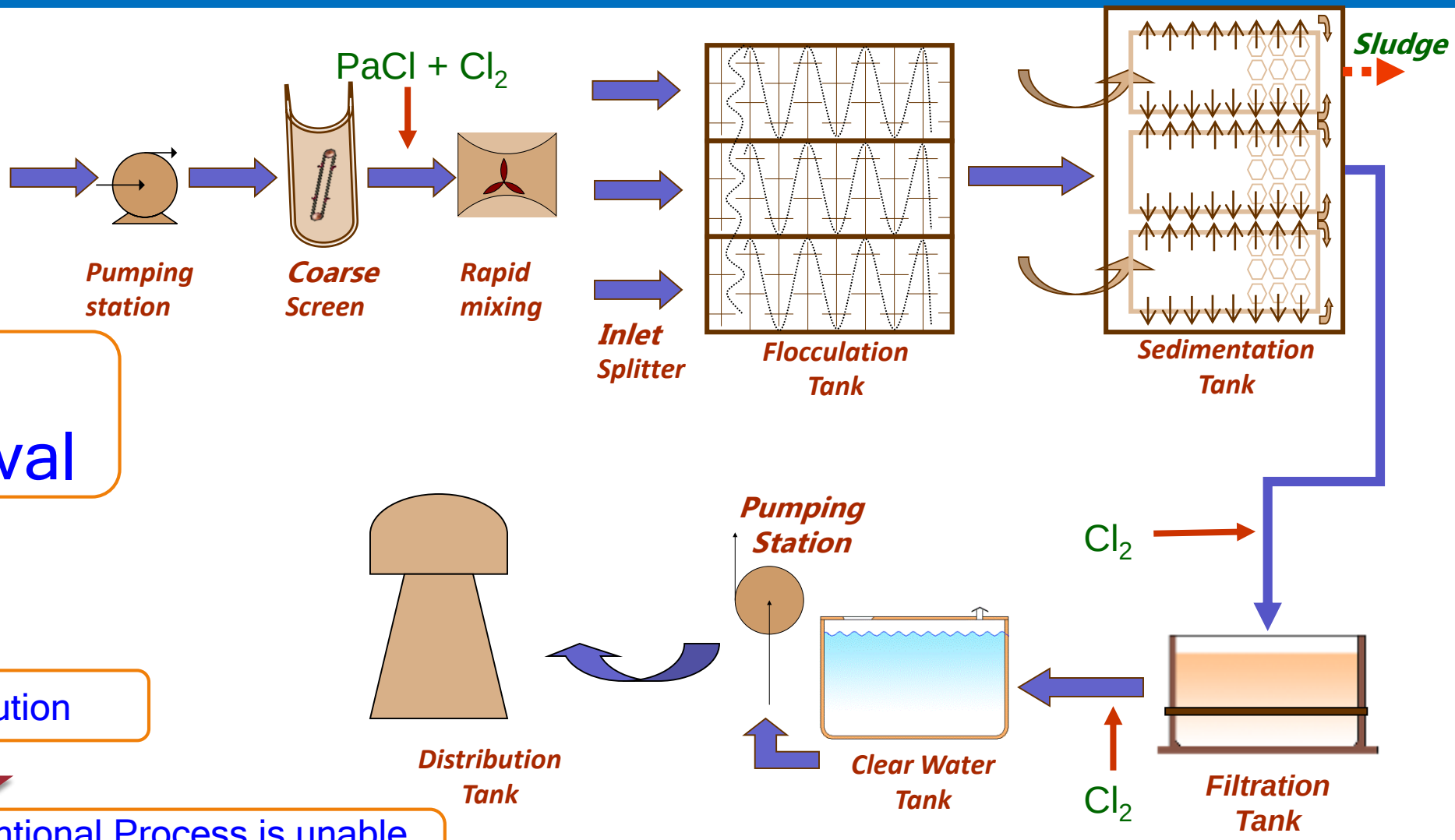
Conventional Process

Main Target : Inorganic Removal

Surface Water Pollution

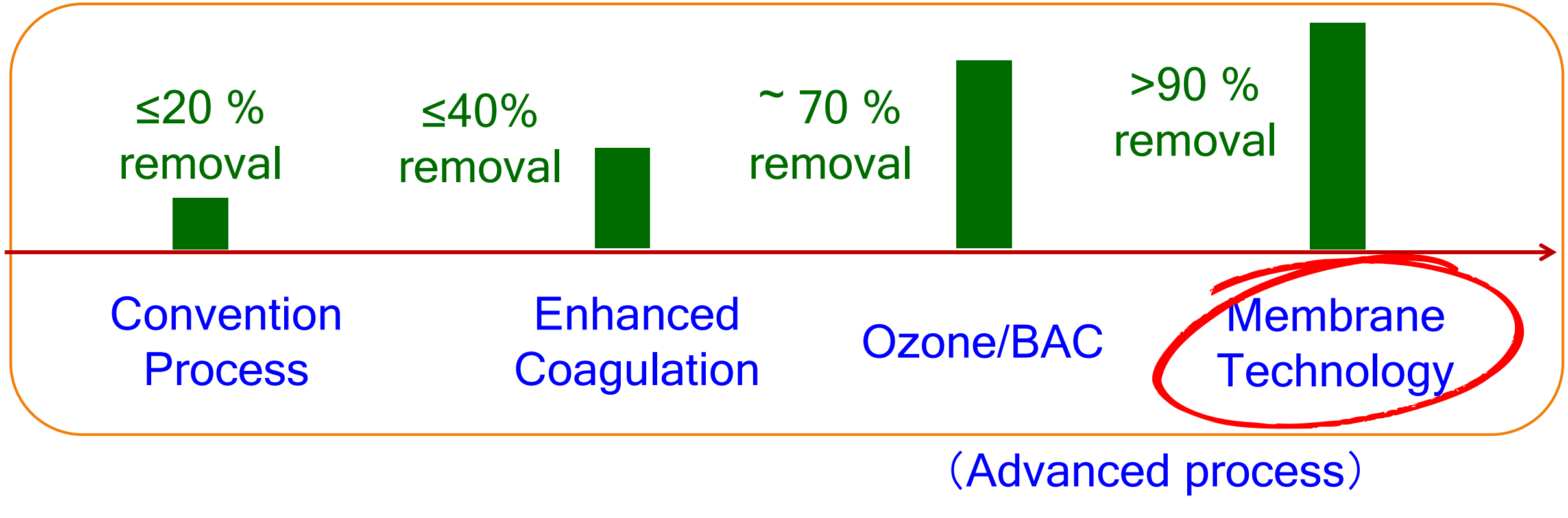
Organic Pollution

Conventional Process is unable to remove organic pollutants



Main Issue in Drinking Water Sector in the World

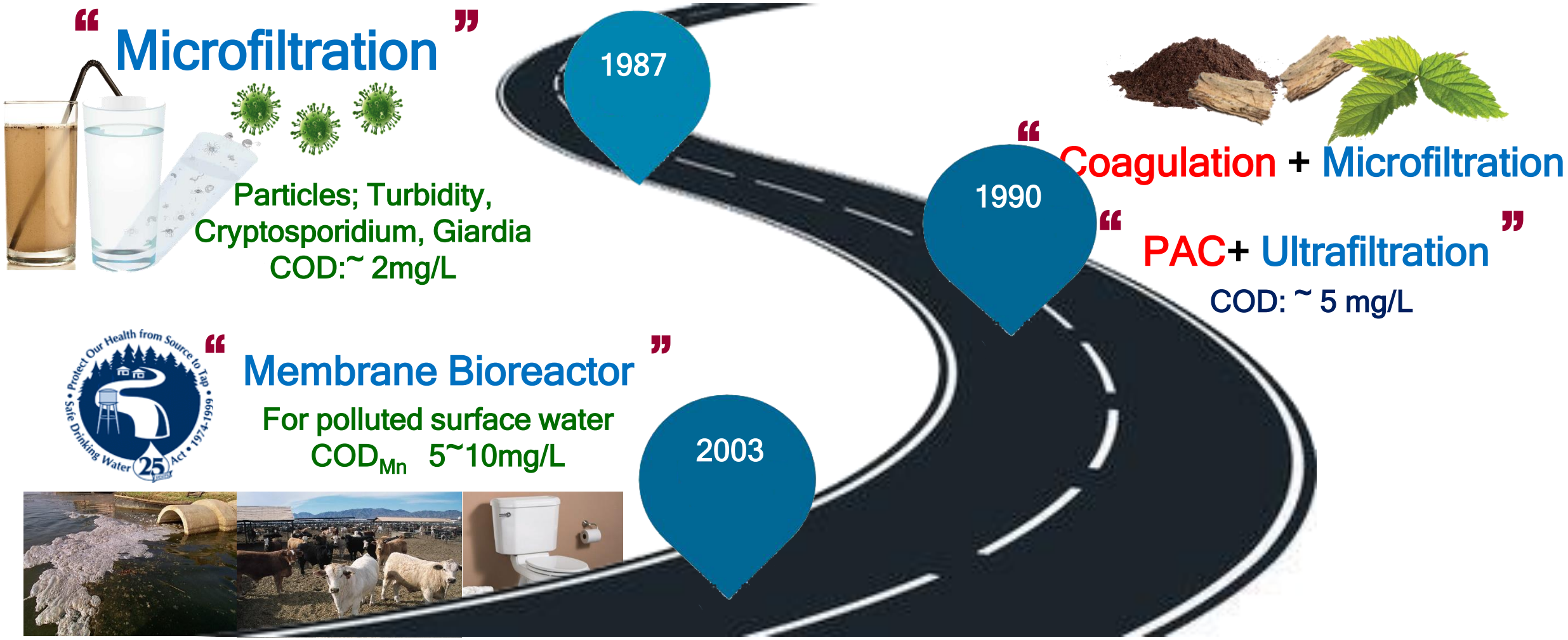
Organic Pollution



（Advanced process）

Membrane Technology for Surface Water Treatment:

From Microfiltration to Membrane Bioreactor



1987

"Microfiltration"

Particles; Turbidity,
Cryptosporidium, Giardia
COD:~ 2mg/L

1990

"Coagulation + Microfiltration"

"PAC+ Ultrafiltration"

COD: ~ 5 mg/L

2003

"Membrane Bioreactor"

For polluted surface water
COD_{Mn} 5~10mg/L

Experienced/ Expert in Membrane Technology

Japan Membrane Manufactures

Kubota

HITACHI
Inspire the Next

MITSUBISHI RAYON

SUMITOMO ELECTRIC

'TORAY'
Innovation by Chemistry

Many more leaders in membrane industry

NGK

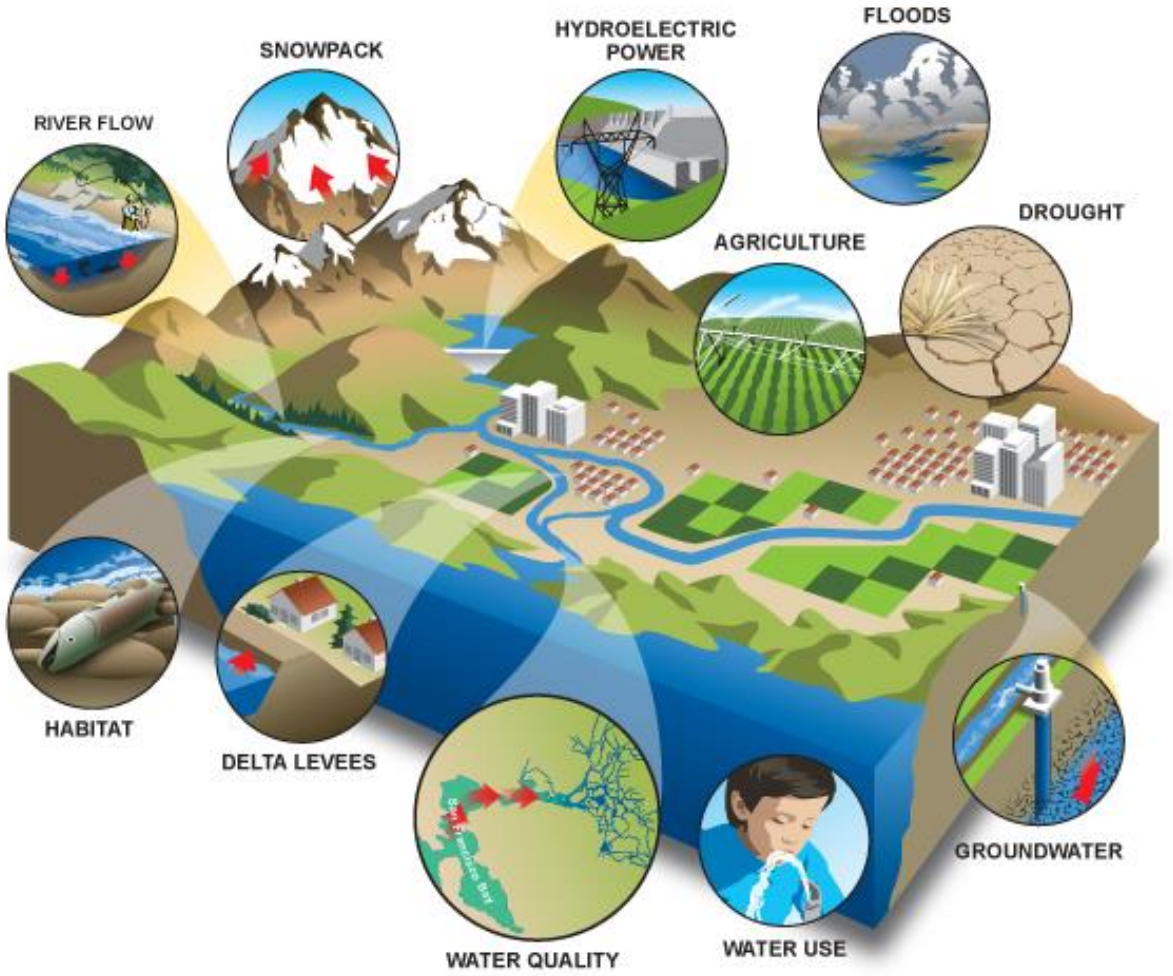
NITTO DENKO

GS YUASA

Sourse: http://www.membrane-guide.com/membrane-directory/asia/japan-membrane.htm

Water Supply in Asia Under Climate Change Risks

Climate Change and Water Security



- Key impacts:
  - Air temperature
  - Precipitation
  - Sea level rise and storm surges
  - Surface-water impacts
  - Regional-scale changes: snow melt, groundwater storage
  - Water demand
  - Water availability and accessibility
  - Water quality and health

Source: (Major, D et al., 2011)

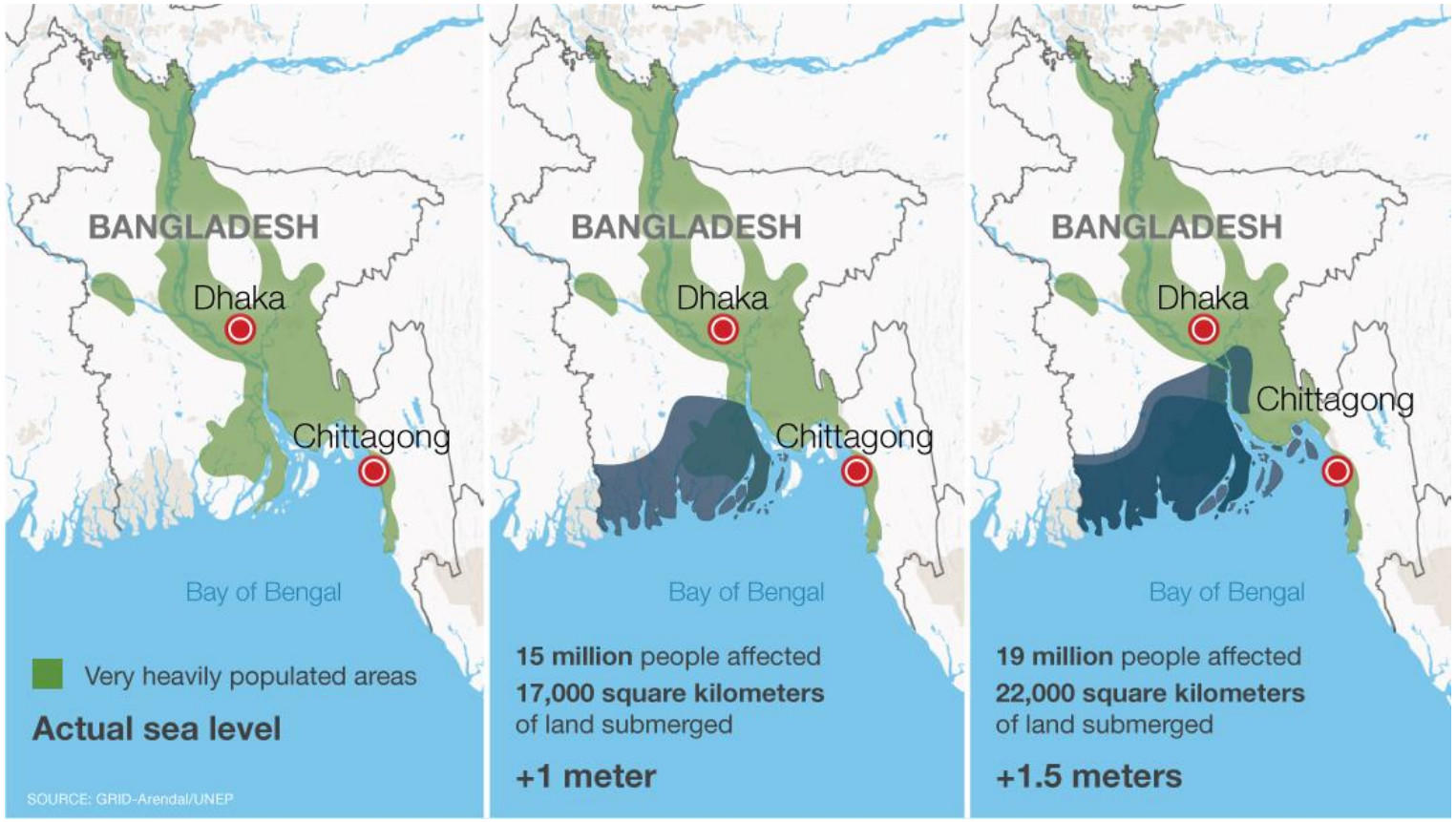
Climate Change and Water Security

- Extreme climatic events like floods, drought threatens sustainable water resources

- In coastal regions, sea level rise increases the risks of:
  - salinization of coastal aquifers,
  - reduced access to freshwater
  - food insecurity,
  - loss of livelihood security, and other instabilities

Climate Change Impacts on Water Resources of Asia Pacific

- Seasonal precipitation changes increasing in East Asia,
- Temperatures, droughts, and flooding projected to increase in Southeast Asia,
- Socio-economically and geographically vulnerable low-lying, flood-prone areas including countries like Bangladesh will be further impacted by underlying water and food insecurity

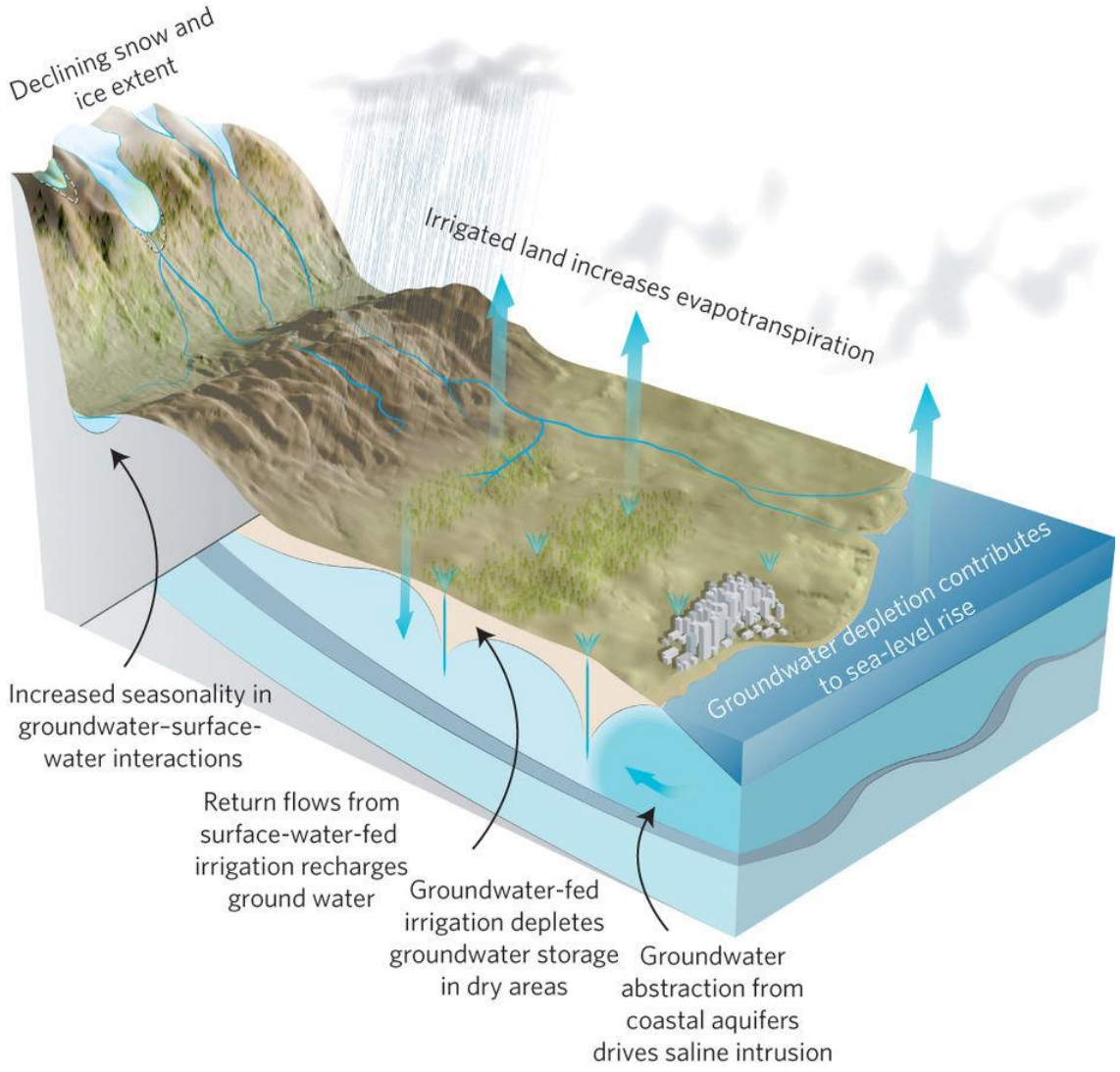


Case: Climate Change Impacts on Water Availability in Delhi

- Delhi water supply sources: Yamuna, Ganga, and the Beas
- 1.4 billion liters of water from the Western Yamuna Canal every day
- Amounting to 48 % of Delhi's total water supply
- Impacts of climate change:
  - Increase in water availability until 2041
  - Post 2041, projected water deficit of 1 billion litres of water per day
  - Deficit is projected to increase to 2.3 billion litres of water per day by 2100

Observed Climate Change Impacts on Water Systems

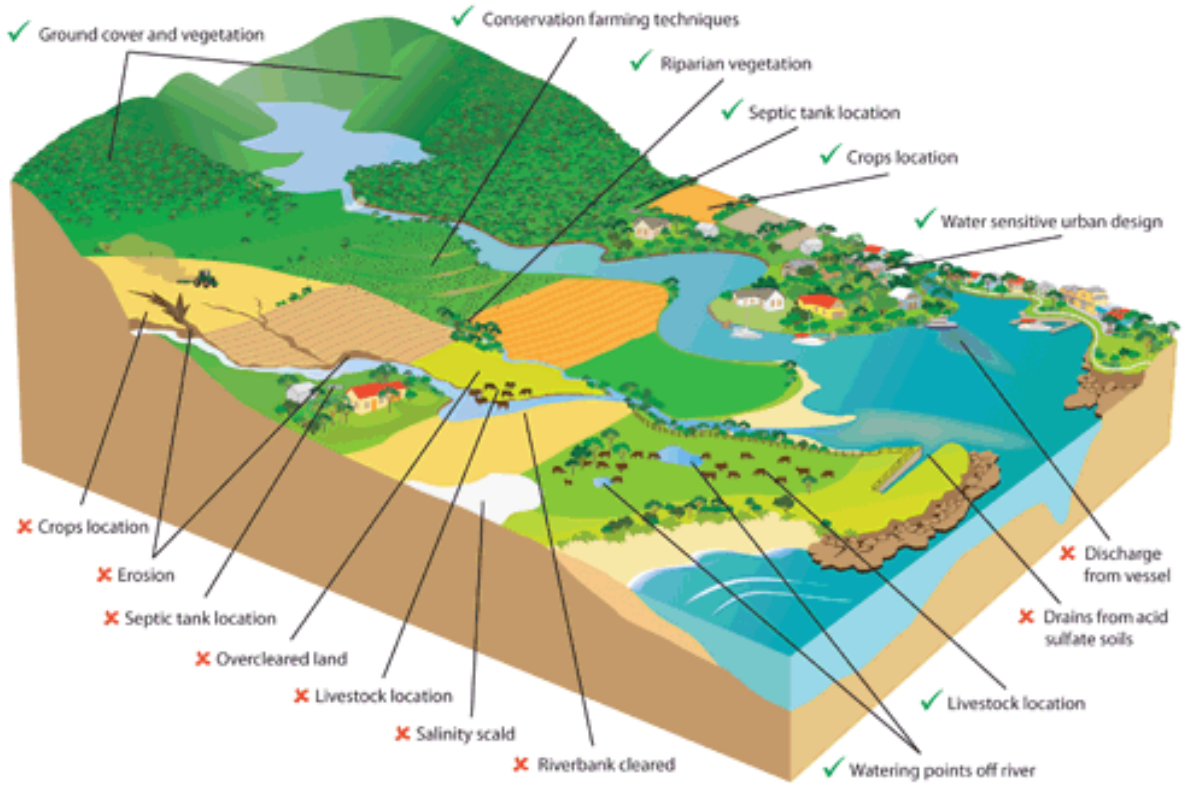
- Restrictions on water supply due to low rainfall
- Reductions in the amount of water in dams
- Water quality: blue-green algae
- Increase in water-related disasters
- Effects in aquatic ecosystem
- Increase in groundwater consumption



Water Oriented Climate Change Adaptation

- Effective utilization of infrastructures
- Synergy with urban area development schemes
- Emphasis on crisis management
- Water saving society through demand side management
- Integrated water resources management
- Promoting integration and efficiency

Not only the treatment process



Public Private Partnership (PPP) in Water Management Sector

Where/ How the Japanese private companies that can involve

PPP in Water Management Sector

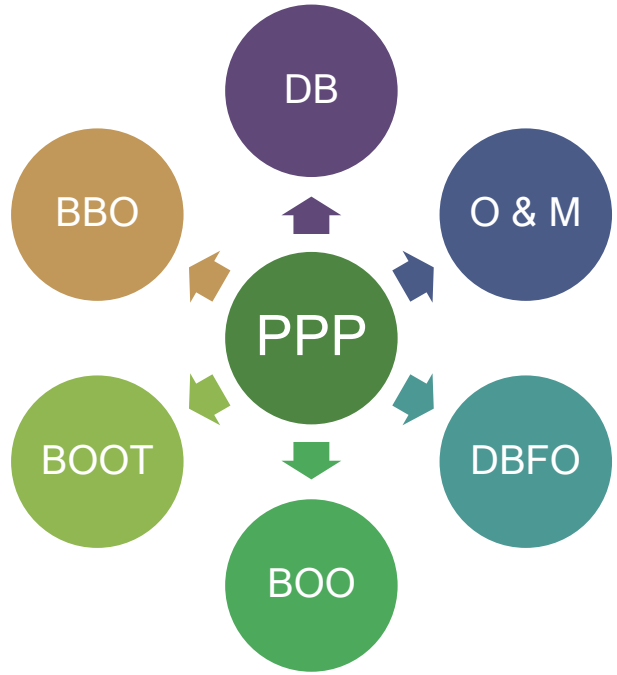
- Application of advanced technologies for water treatment
- Design, operation and maintenance of water treatment systems
- Improved water distribution
- Emergency response in disaster stricken areas
- Infrastructure development of water treatment systems

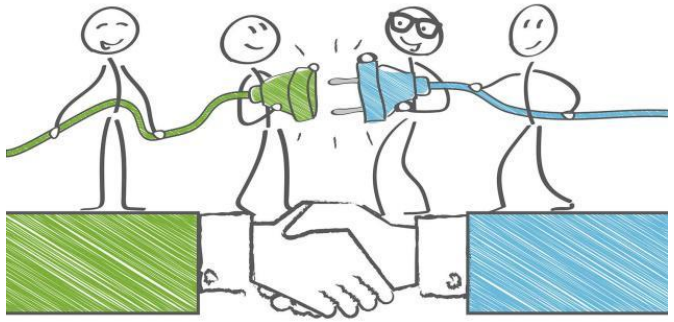
Area that need to be looked at in Asia Pacific region countries

Different Models of PPP in Practice

- Design Build (DB): Private Operator (PO) designs and builds the asset for a fixed price
- Operation & Maintenance (O & M) Contract: PO operates asset for a specified term under contract
- Design-Build-Finance-Operate (DBFO): PO designs, builds and operates, and transfers the asset under a long term contract
- Build-Own-Operate (BOO): PO is in fully ownership and control, subject to regulatory oversight
- Build-Own-Operate-Transfer (BOOT): PO builds and charges for use and then transfers ownership after agreed period
- Buy-Build-Operate (BBO): Asset is transferred to PO, improved and operated for an agreed term
- Operation license: PO is licensed to operate a public service for an agreed term

Different PPP models

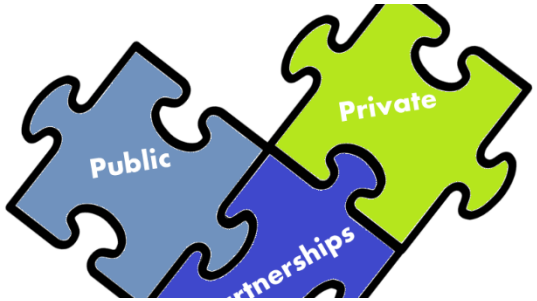




Advantages of PPP (1/2)

It's a Win Win Situation

- Potential to increase and provide greater infrastructure solutions
- Faster project completion and reduced delays on infrastructure projects
- Opportunities for innovation in design, service delivery and financing approaches



Advantages of PPP (2/2)

It's a Win Win Situation

- Integrated whole life management
- Asset utilization
- Predictability, accountability and transparency of costs and funding
- Potentially greater return of investment (ROI)
- Reduces government budget and budget deficits

Case of PPP: Water Supply Improvement Plan in Ho Chi Minh City, Vietnam

- Plan to propose the development of new water sources and an efficient water distribution system
- Application of advanced technologies
- Utilization of experience of Japanese private companies and water operators under local government
- Mobilization of local private-sector funds in addition to partnerships with Japanese private companies

Japan has experience in steadily developing water supply and sewerage systems to build a highly sanitary society, while overcoming floods and droughts during postwar economic growth.

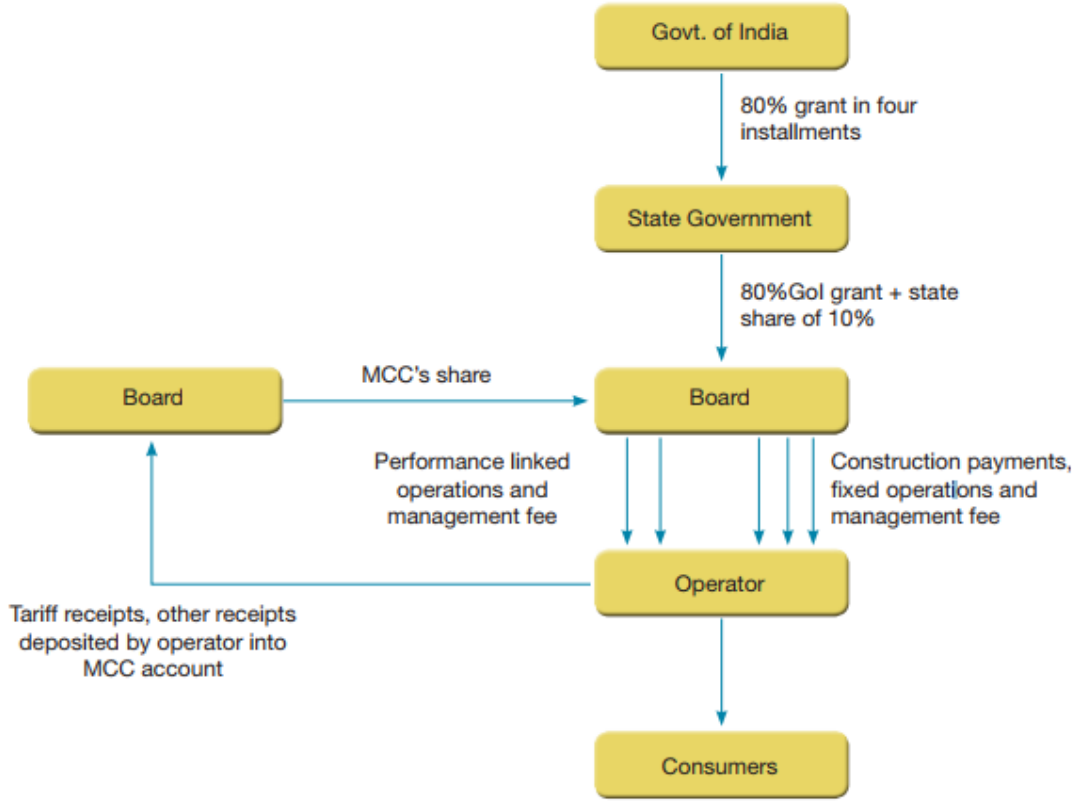
Japan has pioneered the building of water cycle models based on combined satellite and terrestrial observation data

Source:
http://gwweb.jica.go.jp/km/FSubject0301.nsf/ff4eb182720efa0f49256bc20018fd25/3958a0a725aba98549257a7900124f29/$FILE/Water_&_Sanitation_Assistance_Strategy.pdf

Case of PPP: Mysore, India

- PPP between the City of Mysore and JUSCO, a private operator
- Plan: rehabilitate the distribution assets and improve operational performance to achieve continuous 24/7 water supply
- The contract is a combination of fixed construction payments for rehabilitation and a management fee for operations.

KUWSDB
KARNATAKA URBAN
WATER SUPPLY AND DRAINAGE BOARD



- Source: https://www.wsp.org/sites/wsp.org/files/publications/Running-Water-in-India-Public-Private-Partnership-Initiatives.pdf

Disaster Risk Resilient Water Supply Systems

Where the Japanese are Expert in….

Lessons from Japanese Water Systems

- Providing adequate post-disaster water supply in the service area
- Reducing disaster damage to facilities
- Ensuring minimum level system functionality and rapid system recovery
- Rapid emergency response
- Public safety
- Continuous development and improvement in prevention capabilities

Providing Adequate Post-disaster Water Supply In The Service Area

- Normal source
  - System redundancy
  - Emergency equipment
  - Extra storage
  - Household treatment
- Local alternate source
- Neighbouring utility (including bulk water)

Reducing Disaster Damage to Facilities

- Existing facilities upgradation and strengthening (retrofitting) to provide the resistance necessary to meet the disaster **resilience** program goals
- Disaster **resilient** designs for new buildings
- Installation of corrosion protection systems

Rapid System Recovery

- Provide disaster resistant power supply (normal and backup).
- Implement block distribution system
- Provide system redundancy to expected damage areas.
  - Water storage (as much as possible)
  - Supply and distribution pipelines
  - Utilize multiple water supply sources/points
- Provide isolation capabilities within the system, consider installing remote valve operations.
- Ensure continued and uninterrupted system operation in lightly damaged and undamaged regions.

Rapid Emergency Response

- Coordinate emergency support with other cities and water utilities
- Incorporate community emergency planning
- Establish a mutual aid scheme (formal and informal relations with other organizations)
- Coordinate post-disaster response with municipal department and emergency service agencies (e.g., fire, police, city, county, state agencies)
- Develop damage assessment teams (with pre-assigned reporting location)
- Prepare plans for communicating damage assessment and dispatching crews to damaged facilities
- Prepare plans for communicating water system problems to the community in a disaster

Continuous Development and Improvement in Prevention Capabilities

- Learning from past earthquake experiences,
- Learning from other water organization experiences,
- Networking with others who are working on water system seismic aspects,
- Training managers, engineers, operators, and field personnel on seismic issues,
- Providing staff development.

Thank You!