

3Rs and Water Security in Asia & the Pacific

Achieving Water Security through Wastewater Reuse

The Sixth Regional 3R Forum in Asia and the Pacific

16-19 August 2015

Male, Maldives

Outline of the Presentation

1. World of Thirst

1.1 Global Water Status

1.2 Freshwater Use by Sector

2. Understanding Water Security

2.1 Water : A scarce and competitive resource

2.2 Key dimensions of water security

2.3 Waste security and sustainable development

3. Status and Challenges of Water Security in Asia & Pacific

4. Responding Region's Water Security Issues with 3Rs

3.1 Reducing Water Footprint- Water Demand Management

3.2 Reusing Wastewater

3.3 Recycling (Technologies) wastewater

5. Conclusions and Recommendations



A World of Thirst

1. State of world's water resource
2. Freshwater use by sectors

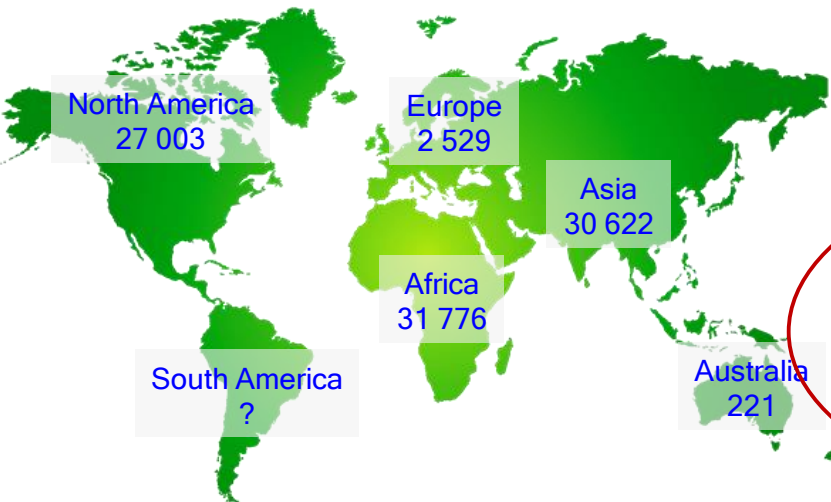
Water ! Water ! Everywhere “ Only Few Drops to Drink! ”



- Earth's total water vol. ~ 1.4 billion km^3 .
- Freshwater resources ~ 35 million km^3 , or about 2.5% of the total volume
- The total usable freshwater supply for ecosystems and humans $\sim 200,000 \text{ km}^3$ of water
- Less than 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

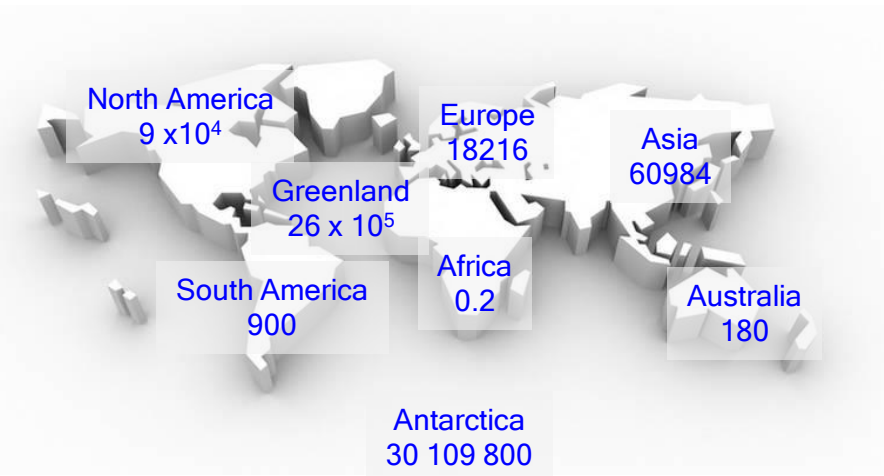
Wetlands, Large lakes, reservoirs and rivers (Km²)



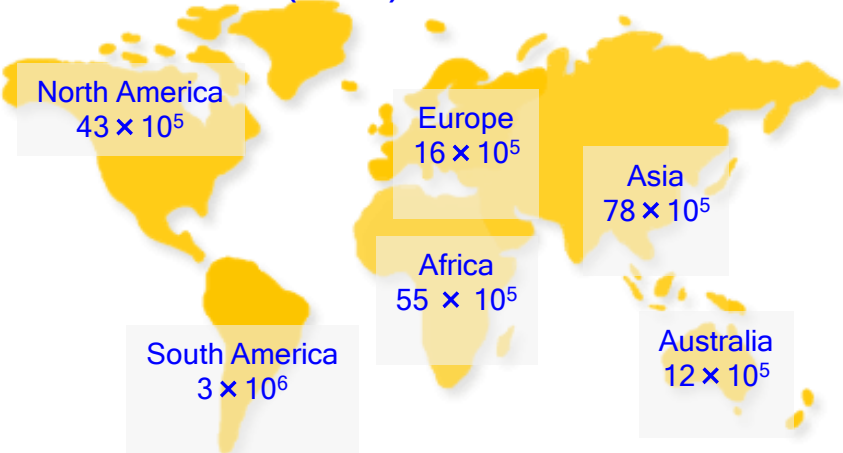
Is it enough ?

Asia
Water reserve : 30 622 Km²
Hosting 60% of world's current human population

Glaciers and permanent ice caps (km³)



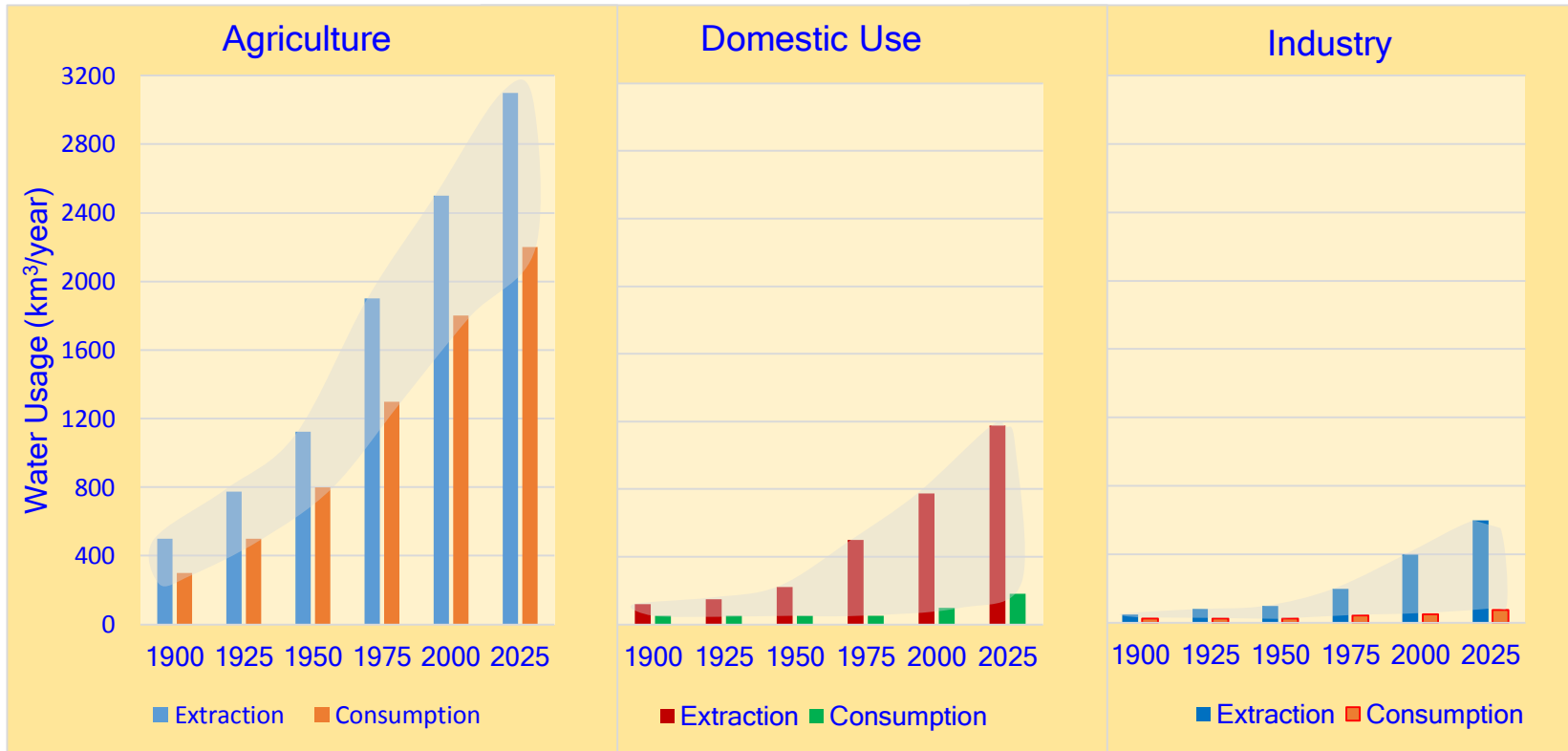
Ground Water (Km³)



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

70% Freshwater

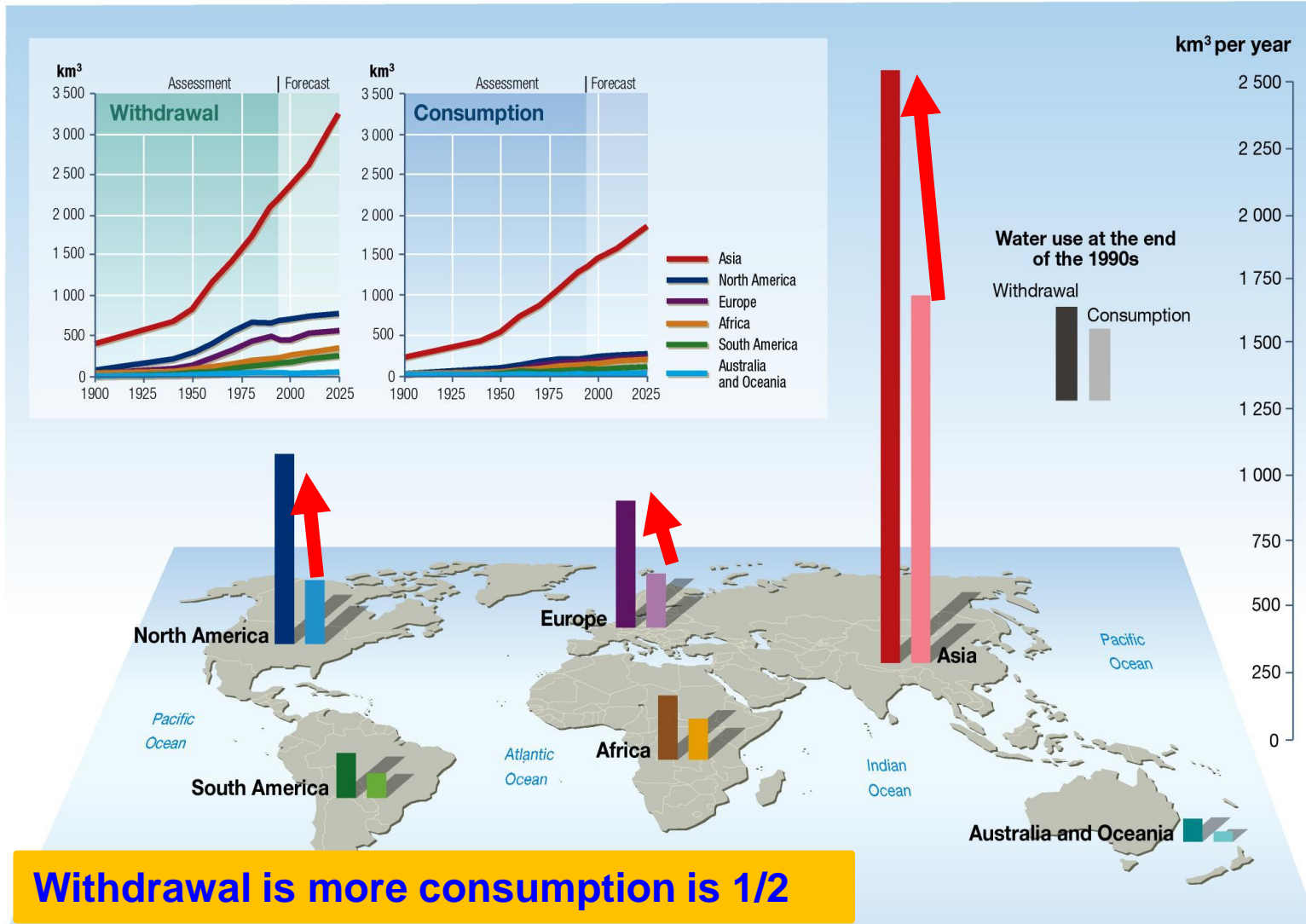
Freshwater Use by Sector



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

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

Water Withdrawal and Consumption: The Big Gap



- Annual global freshwater withdrawal grown from 3,790 km³ to in 1995, to 4,430 km³ in 2000
- Of which consumption accounted for 2,304 km³ 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 km³

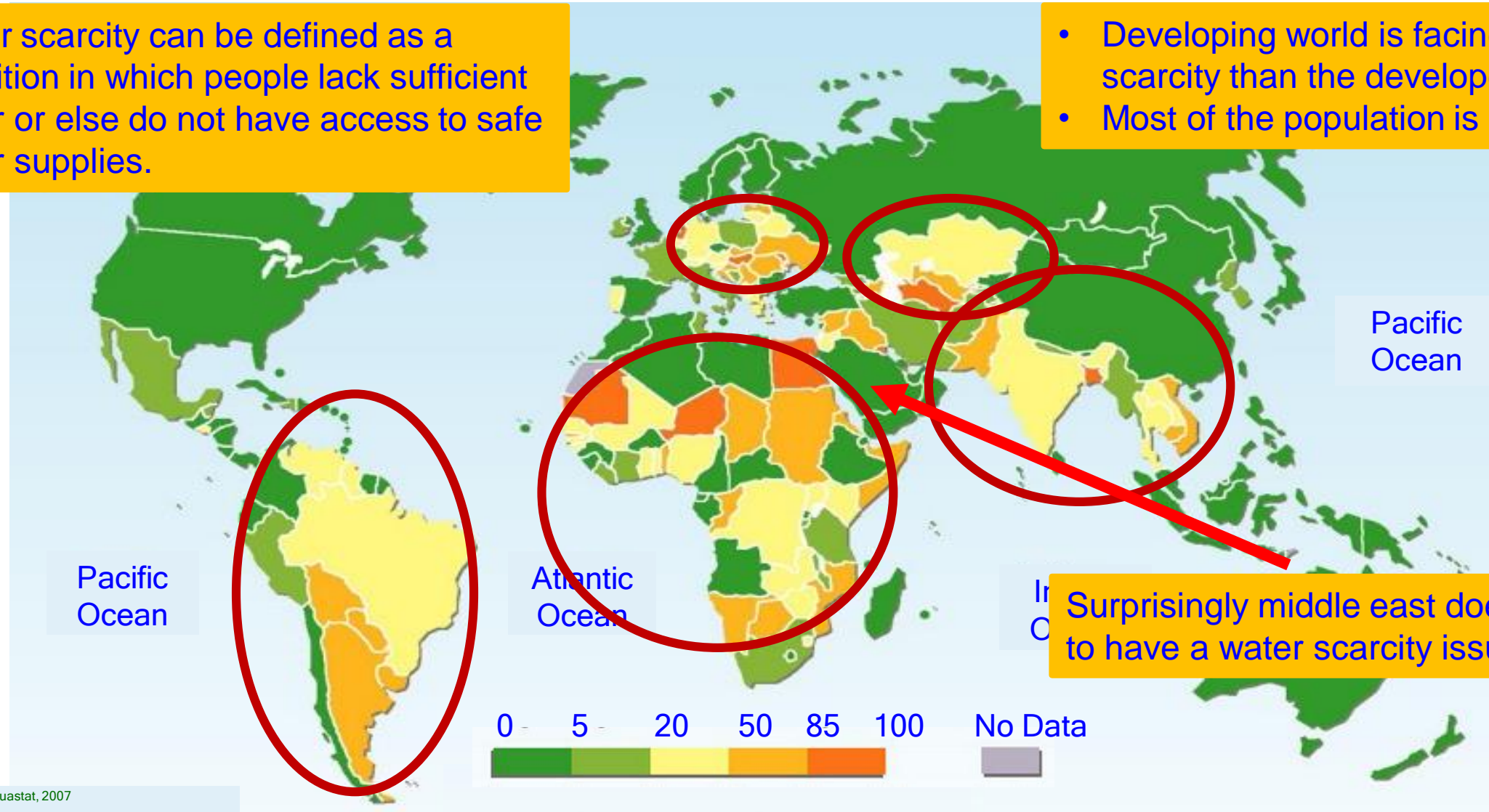
Understanding Water Security

1. Water : A scarce and competitive resource
2. Key dimensions of water security
3. Water security and sustainable development

Water : A Scarce and Competitive Resource

Water scarcity can be defined as a condition in which people lack sufficient water or else do not have access to safe water supplies.

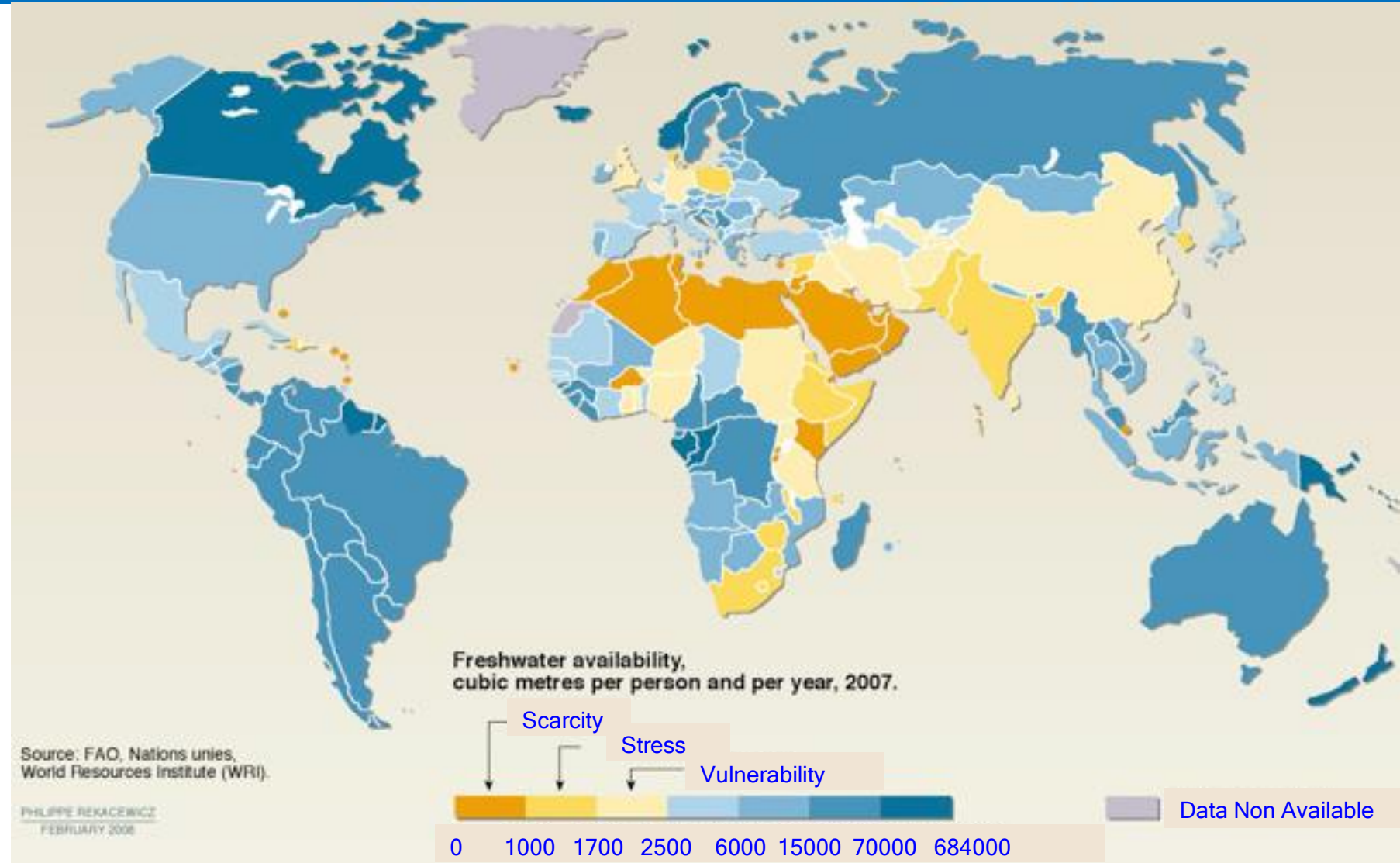
- Developing world is facing more scarcity than the developed world.
- Most of the population is living here



Source: FAO, Aquastat, 2007

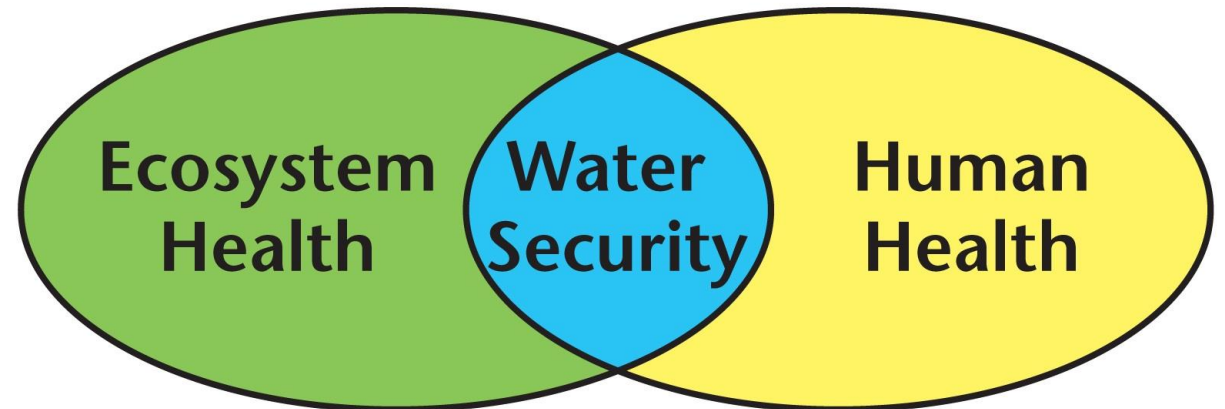
A Thirsty Planet

- By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity (<500 m³/capita/year), and two-thirds of the world's population could be living under water stressed (<1700 m³/capita/year) conditions



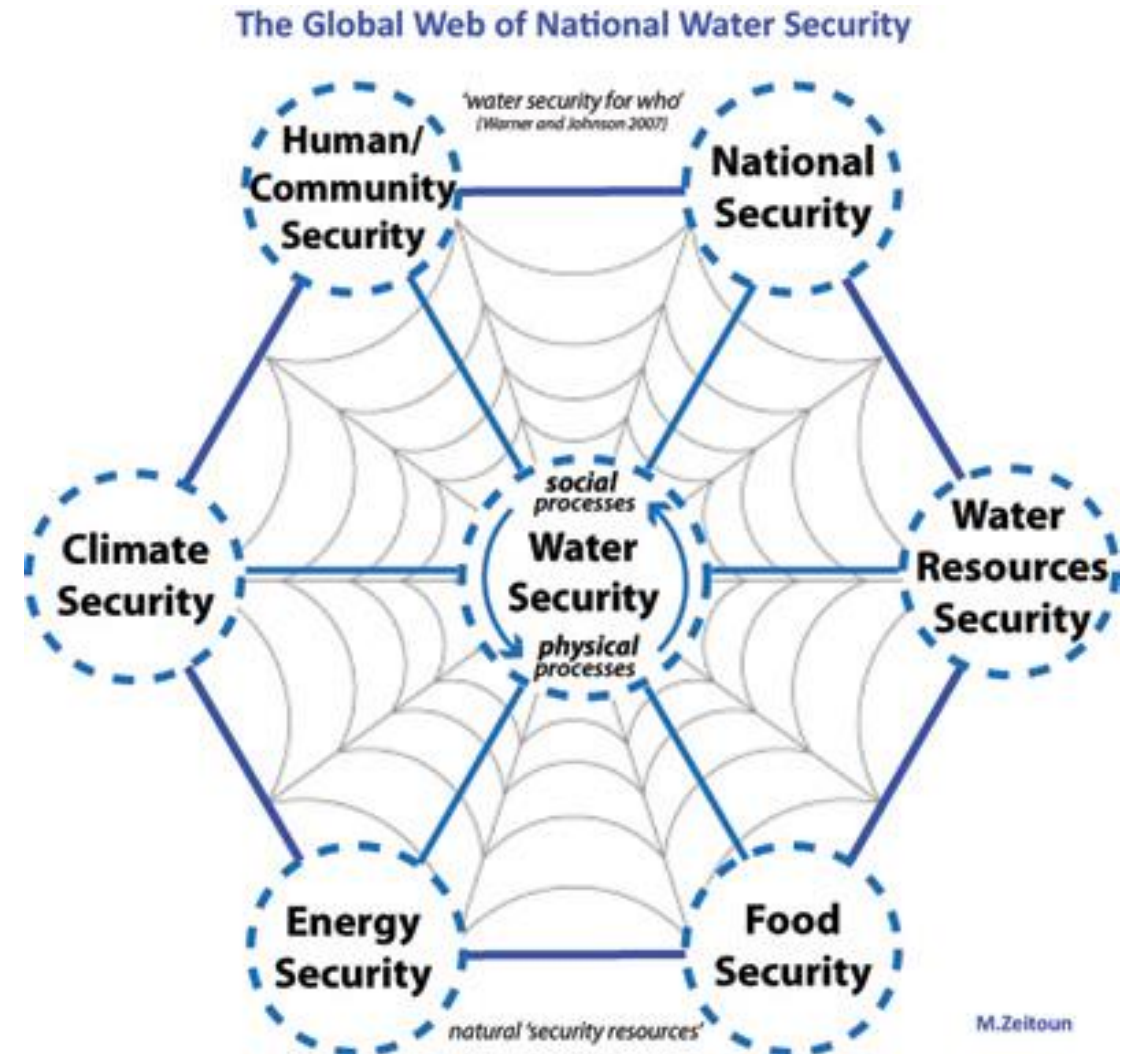
Defining Water Security

- The UN defines water security as “the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.”
- Water is central to the three dimensions of sustainable development, namely social, economic and environmental.



Water Security and Sustainable Development Nexus

- Good management of water resources is key to development
- The outcome document of the 2012 UN Conference on Sustainable Development (Rio+20), 'The Future We Want', has recognized water as the core of sustainable development



Water Security and Sustainable Development Goal

- Efforts have been made to address the issues of water security as one of the proposed Sustainable Development Goals
- The proposed Sustainable Development Goal No. 6 deals with “Ensuring availability and sustainable management of water and sanitation for all”
- Goal 6.3 specifically address the target to increase wastewater recycling and safe reuse



Status and Challenges of Water Security in Asia & Pacific

1. Status of water security
2. Threats to water security
3. Case examples

Threat: Wastewater and Pollution

- Freshwater resources in Asia and Pacific countries are threatened by pollution
- 80% of rivers in the region are in poor health
- It is estimated that up to 90% of all wastewater in developing countries is discharged untreated directly into local waterbodies, causing major environmental and health risks
- In South Asia, as little as 22% of wastewater discharges are treated
- Agricultural pollution is joined by domestic wastewater and industrial waste is of a grave concern to water security in developing countries
- Wastewater-related emissions of methane and nitrous oxide could rise by 50% and 25%, respectively, between 1990 and 2020
- Sewage is the largest source of municipal (domestic) sector wastewater.

Threat: Climate Risks to Water Security

Asia and the Pacific is one of the most disaster-prone regions in the world.

In 2013, over 17,000 people died from water related disasters in the region, accounting for 90% of all water-related disaster deaths globally. Economic losses totaled more than US\$ 51.5 billion

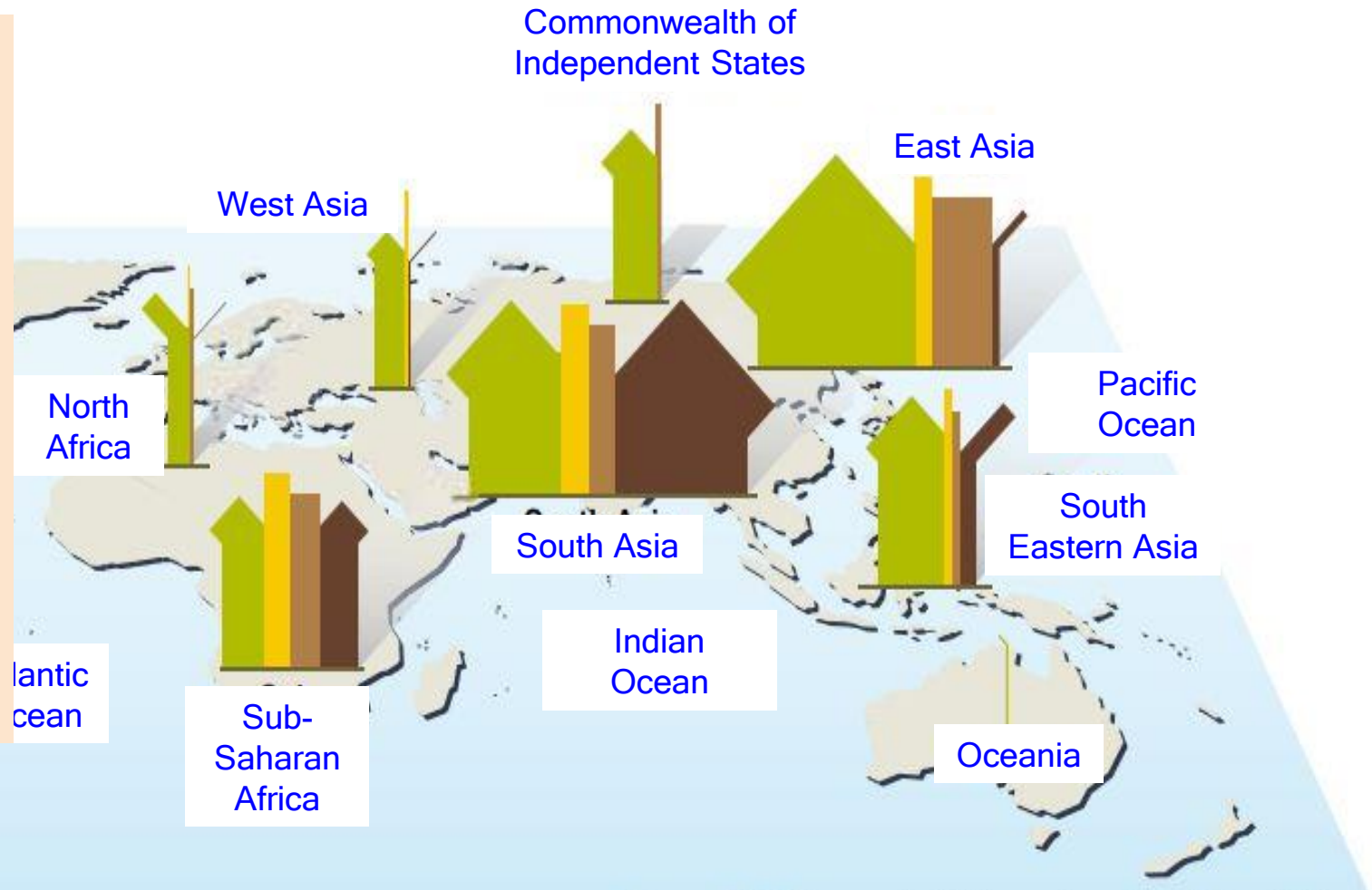
Extreme climatic events like floods, drought threatens sustainable water resources

In coastal regions, sea level rise threatens salinization of coastal aquifers, causing reduced access to freshwater leading to food insecurity, loss of livelihood security, and other instabilities



Access to Sanitation Facilities

- Almost 900 million people lack access to safe drinking water
- Estimated 2.6 billion people lack access to basic sanitation
- Over the next 25 years the annual growth rate in urban areas is predicted to be twice as high as that projected
- In 2030, 4.9 billion people, roughly 60 per cent of the world's population, will be urban dwellers



Source: JMP, Progress in drinking water and sanitation, 2008

India's Sanitation Story

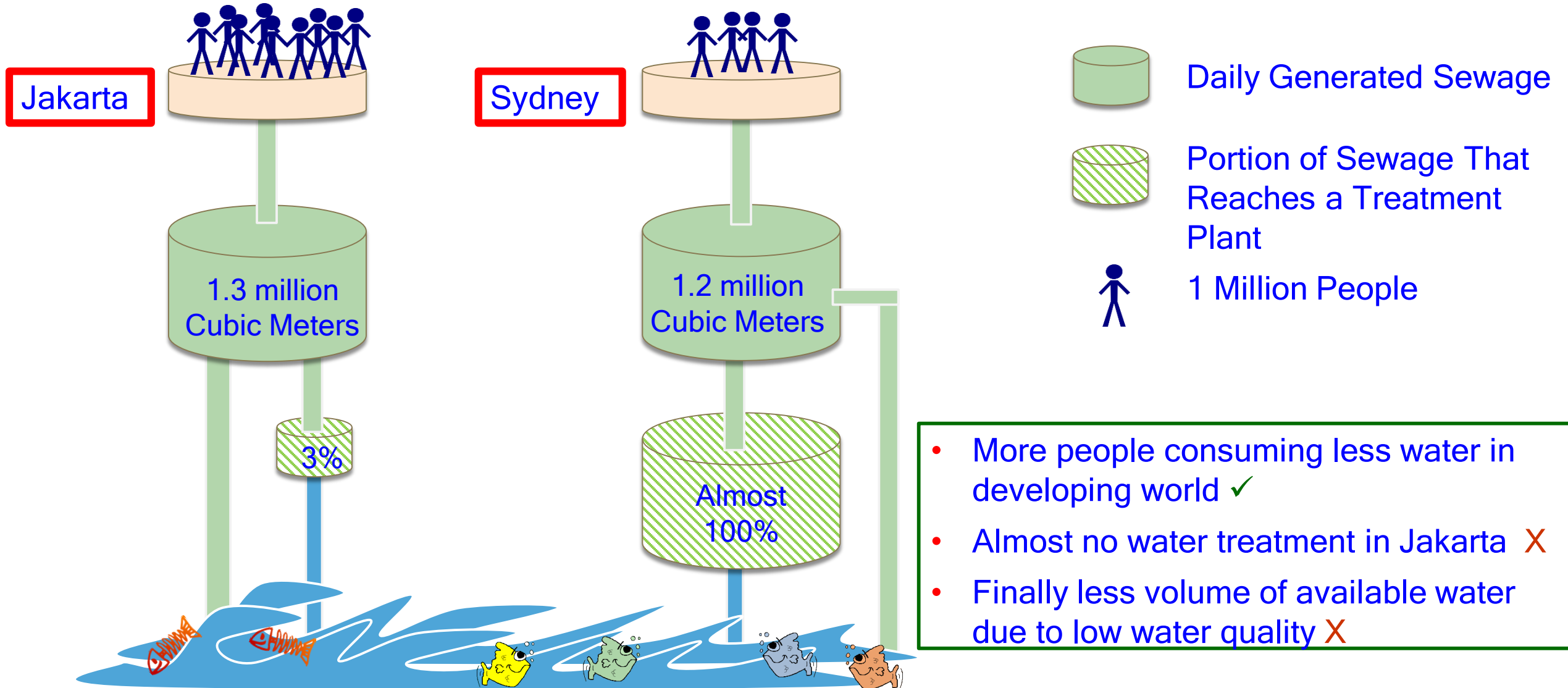


- Nearly half of India's 1.2 billion people have no toilet at home, but more people own a mobile phone.
- Only 46.9% of the 246.6 million households have lavatories while 49.8% defecate in the open.
- The remaining 3.2% use public toilets.



Source:
<http://mief.in/status-toilets-india/>

Putting it in a Perspective : Sanitation in Big Cities



Responding Region's Water Security Issues with 3Rs

1. Reducing Water Footprint- Water Demand Management
2. Reusing Wastewater
3. Recycling (Technologies) wastewater

3Rs (Reduce Reuse Recycle) for Water Security

- A broad mix of the reduce, reuse, recycle (the 3R) strategies and principles provide a holistic solutions to ensure water security
 - **First R-Reduce:** efficiency of water usage/reducing water footprint,
 - **Second R-Reuse:** reuse of treated wastewater in municipal, industry, and agricultural sector
 - **Third R- Recycling:** Implementing recycling technologies for handling and treatment of wastewater for reuse and/or safe discharge to the environment
- 3Rs as effective tools for both demand and supply side management of water.
- The first R- Reduce can lower the water demand by applying appropriate regulatory, economic and technological strategies.
- While Water reuse and recycling on the other hand address the supply side of water management, which increases the supply of water through wastewater reclamation.

Water Demand Management

Demand-side management

- Cost increasing
- Water saving technology
- Efficient use of electricity
- Policy & regulation
- Reuse



Water Demand Management: Regulatory & Economic Instruments

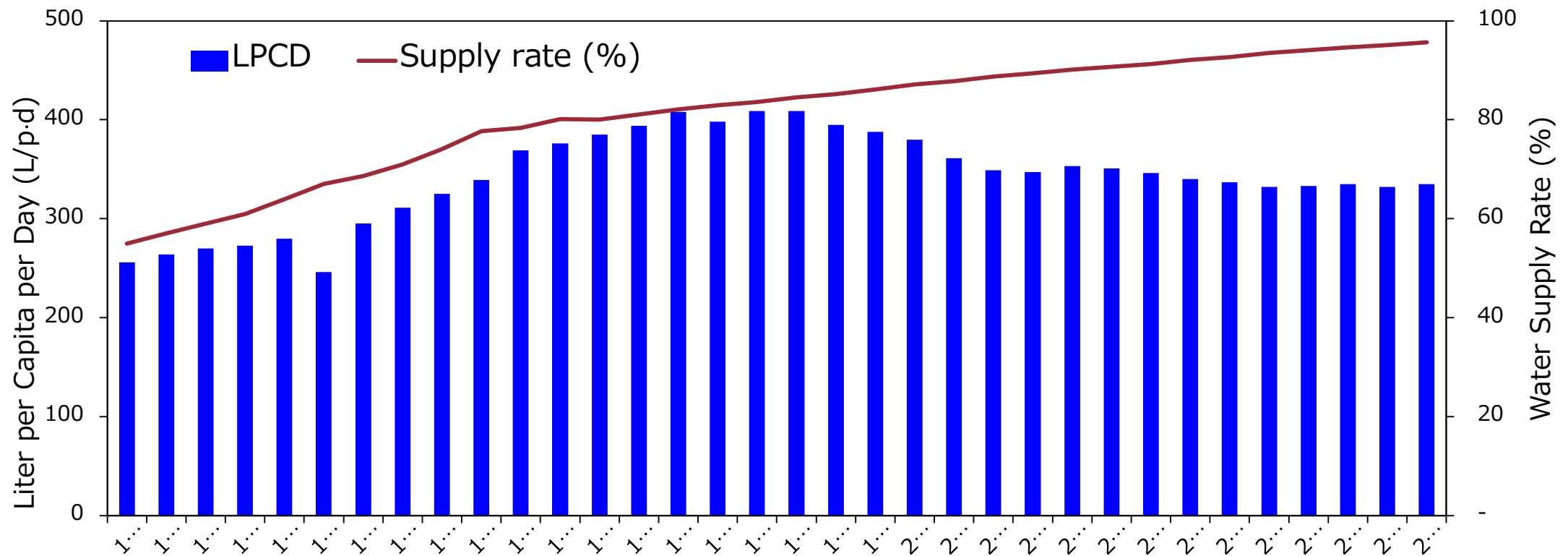
- Regulatory instruments involve setting allocation and water-use limits, as well as use economic incentives for efficient water and use and water conservation
- Example: Groundwater abstraction and use regulations in selected Asian cities

City (Country)	Regulations and Laws	Purpose
Bandung (Indonesia)	Government Regulation 43/2008 on Groundwater Management	Regulation for the well licensing system, registration of wells and water pricing
Bangkok (Thailand)	Groundwater Act (1977, 1992, 2003)	Regulations on groundwater abstraction to mitigate decline of groundwater levels associated with land subsidence; namely, permission for drilling, designation of no-pumping areas and set-up of the Groundwater Development Fund
Ho Chi Minh City, Viet Nam	National Technical Regulation on Underground Water Quality (QCVN 09:2008/ BTNMT) and several decisions issued by the Ministry of Natural Resources and the Environment (such as 05/2003/QD-BTNMT, 02/2004/CTBTNMT, 17/2006/QD-BTNMT, 13/2007/QD-BTNMT, 15/2008/QD-BTNMT)	Regulations on drilling and licensing of exploration and exploitation of groundwater
Hyderabad (India) Andhra Pradesh	Water, Land and Trees Act (2002)	Registration and licensing of groundwater extraction wells used for industrial purposes, registration of rigs, classification of groundwater basins, etc.
Tokyo (Japan)	Industrial Water Law; Law Concerning the Regulation of Groundwater Abstraction for Use in Buildings	Regulation of industrial uses of groundwater; regulation of groundwater use in both residential and commercial buildings

Water Saving Device Installation in Republic of Korea

□ Trend of Litres per Capita per Day (LPCD) in Republic of Korea

- LPCD has gradually decreased since the late-1990s
- Korea's people averagely **consume 45%** out of real water consumption **to use toilet bowl**



Case study of Water Saving Device in Republic of Korea

Existing toilet bowl



13 L per washing

Existing urinals



2 - 6L per washing



Water saving toilet bowl



4 - 6 L per washing

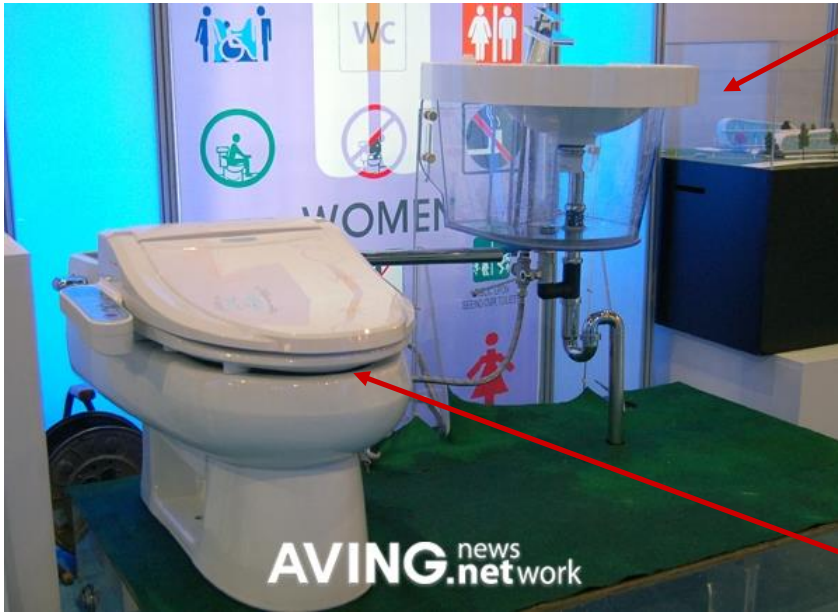
Water saving urinals



1 - 2 L per washing

Innovative Water Saving Appliances

❑ Eco Toilet



Washstand

Toilet bowl



❑ Tandem



Urinals



WASUP- washing machine integrated with toilet flush

Can save around 85 % of water consumption by combining washstand and toilet bowl

Water Efficiency Labelling Scheme in Singapore

Since 1 October 2011, washing machines sold in Singapore have to carry a mandatory WELS label.

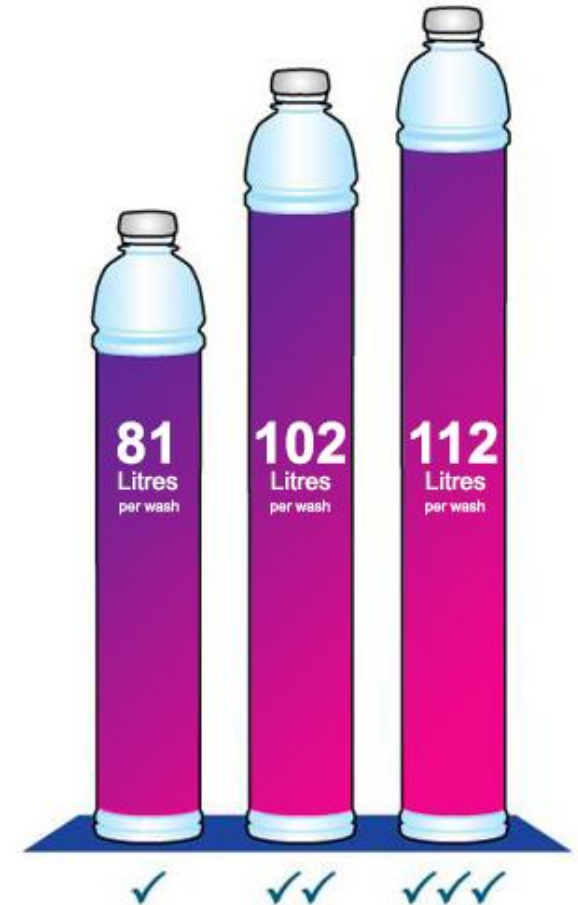


In a typical 7 kg washing machine,

One-tick products help consumers save 81 L of water per wash,

Two-tick products can save them 102 L,

Three-tick products can save as much as 112 L of water.



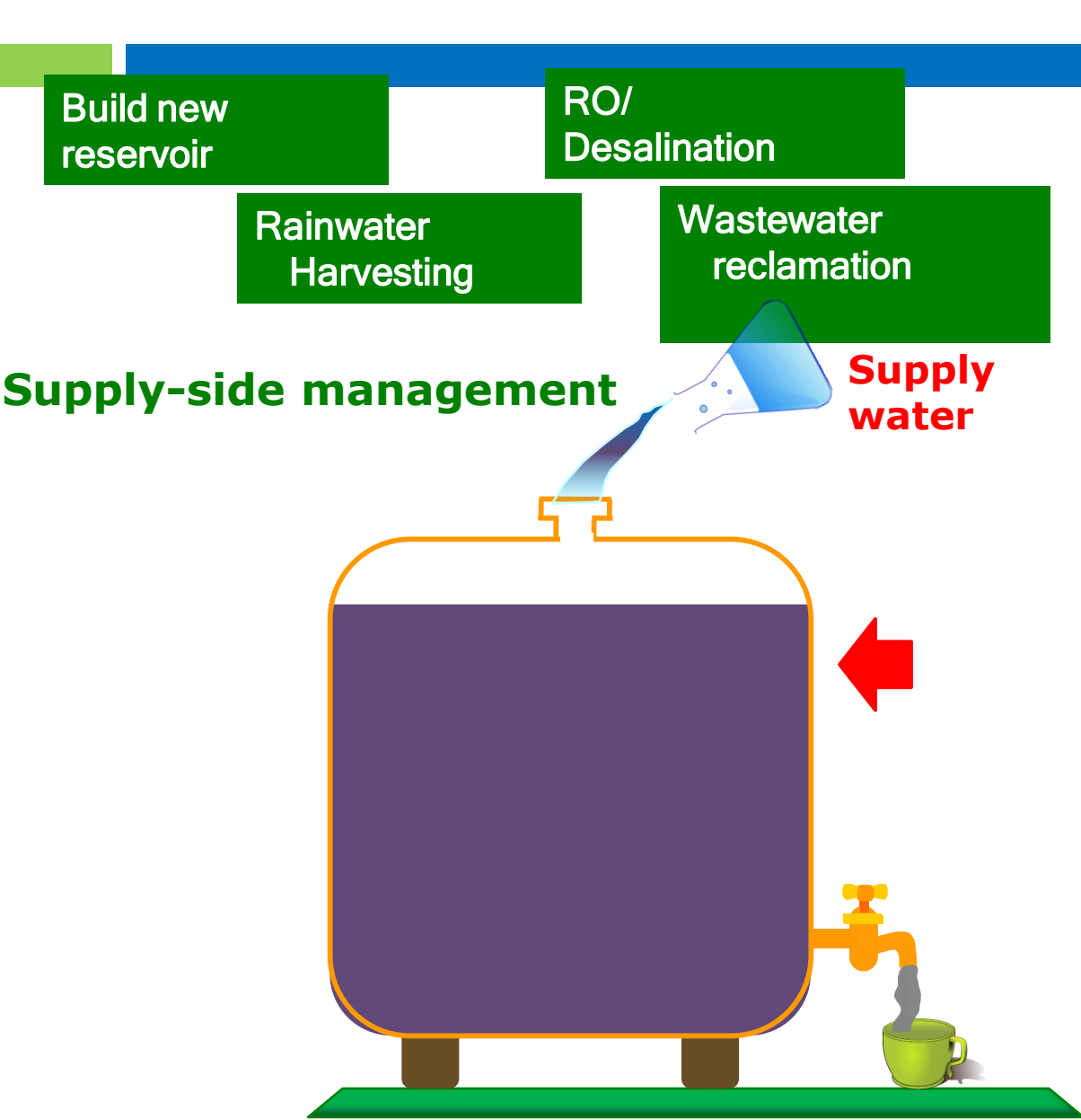
WDM: Efficient Use of Water in Agriculture Sector

Efficient irrigation thus means reducing the agricultural water footprint to a large extent, via

- Choosing right **irrigation technology** (such as sprinkler and drip irrigation),
- Application of **irrigation scheduling** (is the decision of when and how much water to apply to a field by taking into consideration of local climate and soil information to determine crop water requirements),
- **Regulated deficit irrigation** (i.e., imposing water stress on certain crops that have drought-tolerant life stages by taking care of the plant growth pattern) are some of the irrigation water management strategies



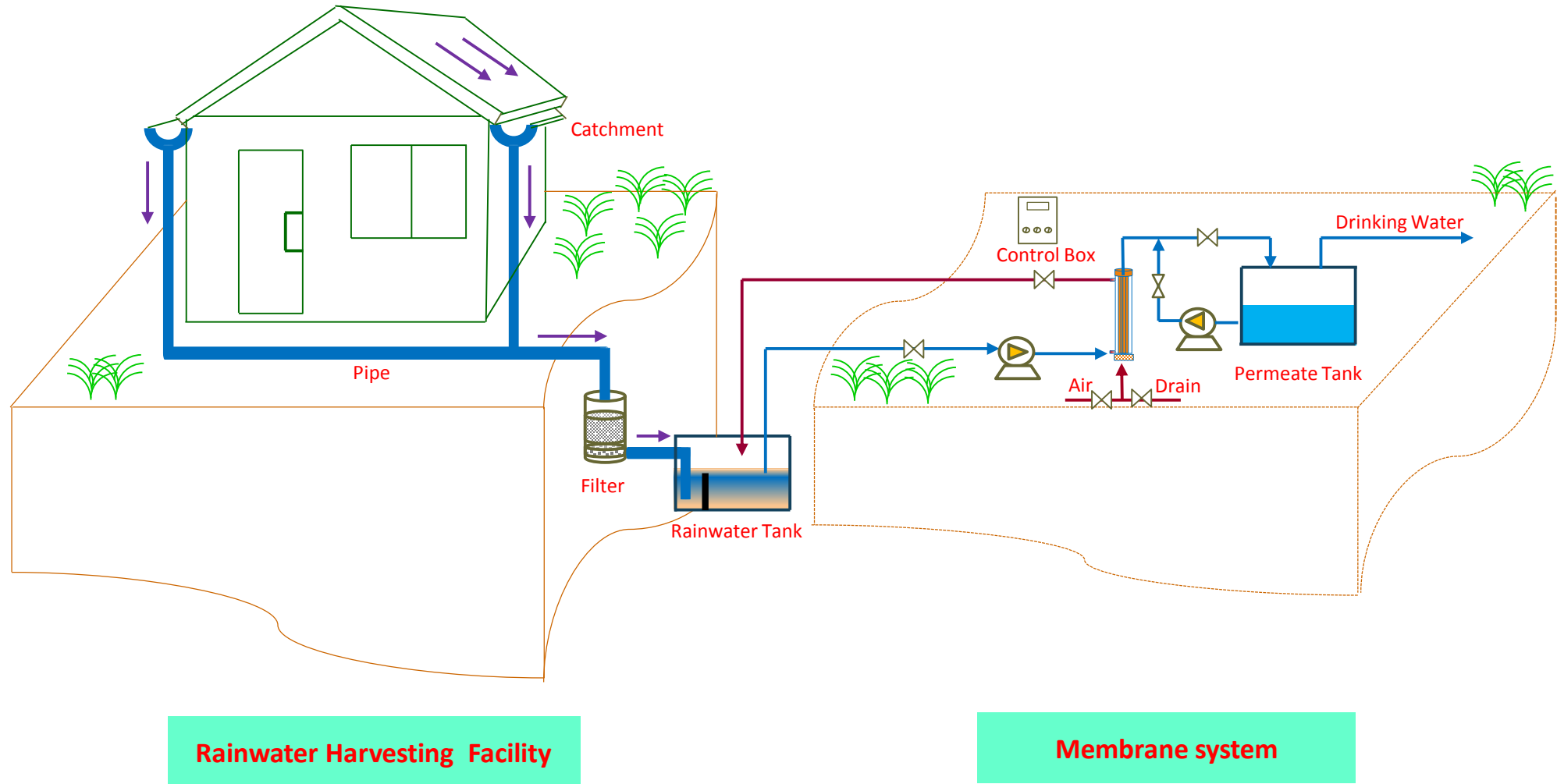
Supply-Side Management – Reclamation and Reuse of Wastewater



Supply-side Management: Wastewater as a Resource

- Wastewater is an opportunity not to be wasted
- Reclaiming and reusing the treated water can become a solution to water scarcity
- Wastewater reclamation is the treatment or processing of wastewater to make it reusable, and water reuse is the use of treated wastewater for beneficial purposes
- Wastewater reuse off benefits, such as;
 - Reduction in freshwater withdrawal and consumption
 - Minimization of wastewater discharge by reclaiming wastewater, thereby reducing cleanup costs and discharge liabilities
 - Recovery of valuable by-products (water, energy, nutrients)
 - Closing the water cycle requires
 - Wastewater management becomes investments with returns with social and economical

Rain Water Harvesting for Potable Use



National Wastewater Reuse Policy in Korea

- With the growing awareness of water reuse “Promotion of and Support for Water Reuse Act” was established in 2010
- The act enabled to manage rainwater-using facilities, greywater systems, and the reuse facilities of treated effluents from wastewater treatment plants (WWTPs) under a single umbrella while they were previously regulated by individual laws.
- For the enforcement of this Act, the “Water Reuse Master Plan (2011-2020)” was formulated in September 2011.
- It is expected to secure 25.4 tons of alternative water resources by 2020 and to replace 1.1 billion tons of tap water annually.

Wastewater Reuse for Urban Applications

In some developed countries, such reclaimed water for non-potable use is distributed through a dual distribution systems/dual reticulation (one for drinking water and another **purple pipe** for reclaimed wastewater)



Conclusions

1. Key Messages
2. The Way Forward: Use of 3Rs for Making Wastewater as a Favorable Solution to Water Security

Key Messages

Message 1: Freshwater resource is depleting both in terms of quantity and quality

Message 2: Challenges to water security are; heavy population, accelerated urbanization rate, intensified industrial development, extensive agricultural development, and climate induced disasters

Message 3: Water security is key to human and ecosystem well being and overall development

Message 4: Wastewater can be both “a resource and a problem” to water security

Message 5: Wastewater is grossly undervalued as an alternative water resource

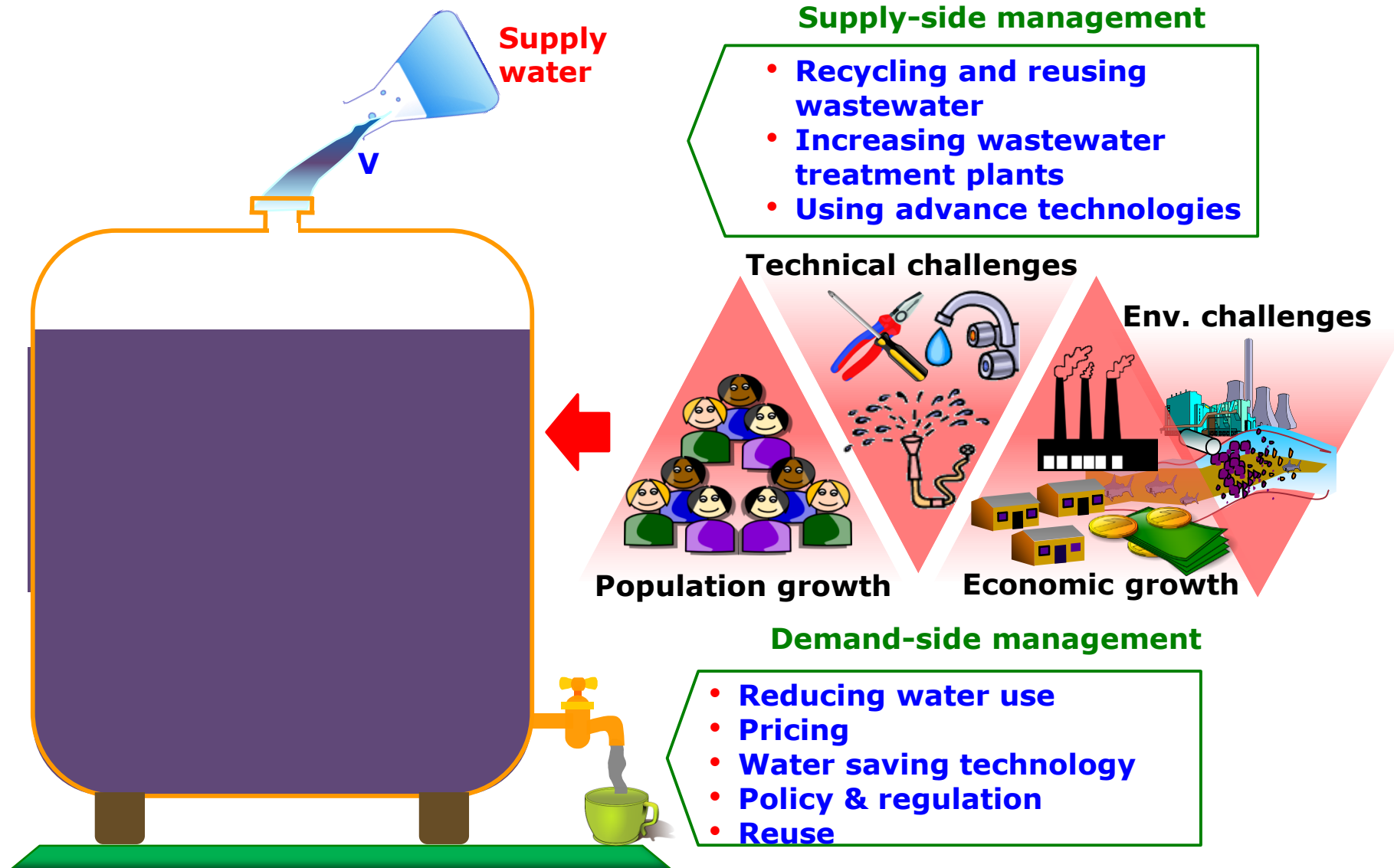
Message 6: 3Rs can be precursor to achieving water security through close loop water cycle management

Message 7: Water Demand Management strategies can reduce water use footprint

Message 8: Wastewater reclaim and reuse and augment supply side management

Message 9: Successful implementations of 3Rs for water security require adequate infrastructure, technology, policy, finance, capacity, as well as social and cultural acceptance

3Rs Answers both Water-Demand-and-Supply Side Issues



Way Forward: Ingredients for Achieving Water Security

Circular Water Economy:

- Water drives the economy (food-energy-transport-manufacturing/production-as well as service sector like tourism) is dependent on water
- Water is the resource used across all supply chains, but wastewater is the largest untapped waste category in industries.
- Industries should treat water as a 'product', and apply reduce, reuse, recycle to start the circular or closed loop
- The shift to a circular water economy transforms the linear economy (take-make-use-dispose) model into 'take-make-reuse-repair-refurbish-and-recycle' model by encouraging industries to include water component into a value chain and life cycle of a design/production/product distribution and use/service/recycle and a reuse cycle.



Way Forward: Ingredients for Achieving Water Security

Policy Levers:

- Appropriate legal and institutional frameworks are required in order to achieve sustainable use and management of freshwater resources
- Water security policies should promote investing and incentivizing the “reduce, reuse, recycle” systems, and has to cover the holistic urban water cycle inclusive of water supply, treatment, reuse application
- These policy should address technology, financial, infrastructure needs that enable wastewater reuse application opportunities. Some of the necessary regulations for wastewater reuse may include; technical specifications on wastewater treatment, reclaimed water quality standards for various applications, and regulations on disposal of waste (sludge, brine, etc.) from treatment.
- Incentives, such as grants and low-interest loans, flexible permits and priority access to the infrastructure, may also be effective in increasing interest in wastewater reuse

Way Forward: Ingredients for Achieving Water Security

Technological answers:

- Requires closed-loop system technological innovations for water saving and reclaiming and reuse of wastewater
- Identifying the appropriate technology, making favorable investment for technology acquirement, and the transferring the technology with knowledge/skills act as technology levers for wastewater reuse possibilities.

Institutional responses to water security:

- Is necessary to examine relevant existing institutions and strengthen them, or to create new ones and assign adequate mandates and responsibilities in order to undertake wastewater reclamation and reuse projects.
- Installation of a recycling and reuse infrastructure (for example, construction of new wastewater treatment plant, dual pipe system for distributing recycled wastewater in houses, retrofitting of water saving appliances etc.) may also be promoted via these institutions.

Way Forward: Ingredients for Achieving Water Security

Financing wastewater management

- Expanding a range of financial services opportunities -both public funding and private financing
- Innovative financing through public private partnership, expanding reclaimed wastewater market, community financing/microcredit schemes for decentralized water supply and wastewater treatment systems
- Polluters pay principles, economic incentivization/disincentivization

Raising public awareness and participation

- Solutions for smart wastewater management must be socially and culturally appropriate.
- Information sharing and communication programmes are therefore necessary in overcoming the public reluctance to consume safe reclaimed wastewater.

Recommendations

1. What Role Should the 3R Forum in Asia and Pacific Play in Promoting 3Rs in Water Sector?

Discussions at the 6th 3R Forum for Asia & Pacific

- Needs Assessment- Detailed status with quantification of wastewater production in each country (from municipal, industrial and agricultural sectors), and the existing wastewater reclaim and reuse practices (wastewater treatment facility)- and- forecasting future water and wastewater needs
- Study of existing laws, policies, and programs in Asian countries related water environment and conservation
- Scope for water recycling technology transfers across Asia and Pacific
- Exploring the potential market for reclaimed wastewater uses
- How to invert the end-of-pipe system to wastewater treatment practices to 'reduction and efficient use of water beforehand?
- How to create public awareness and acceptance to use reclaimed water for various potable and non-potable use
- Development of water reuse regulations, standard and guidelines for reclaimed water quality for various reuse applications, and the continuous monitoring (expanding lesson learnings from countries like Japan, Korea, Singapore and Australia)
- Extending Partnership with existing water institutions, such as Water Environment Partnership in Asia (WEPA)
- Promoting design innovation research for water efficiency products

Three Policy Questions

- Do existing legal and institutional frameworks allow wastewater reclaim and potential reuse application in Asia and the Pacific countries?
- What are the 'Push-and-Pull' factors to promote circular water economy in Asia and Pacific Region in the following respective areas; a) Technology, b) Socio-cultural and public perception, c) Policy and Institutional Framework, and d) Financial mechanisms
- Private sector's involvement can play an important role to perform 3R in water sector, especially for technology innovation and financing of the 3R projects. However, bringing private sector into water sector is a delicate issue, as it meets the public opposition because water is considered a basic human rights. In such case, how to attract private sector into 3R in water sector?



Thank You!