Water and Wastewater Treatment:

Developing Markets for Environmental Goods and Services: Overview of Key Environmental Categories

Presented at the
WTO Workshop on Environmental Goods and Services
23 -25 September 2009

Chizuru Aoki, Ph.D
Senior Programme Officer
United Nations Environment Programme
International Environmental Technology Centre

UNEP

Background: Need for Water & Wastewater Treatment

Unmet demand for clean drinking water

1. 884 million people without access to improved drinking water[1]
2. Water use increasing in virtually all countries, except for some OECD countries: 10% increase projected in 10 years[2]
3. Safe access to drinking water depends more on the level of supply infrastructure[3]

Unmet need for wastewater treatment

1. 2.5 billion people without access to sanitation[1]
2. 90% of sewage and 70% of industrial wastes in developing countries discharged without treatment into surface water[2]

Increasing need for augmenting water and new solutions

1. Water quality and availability likely impacted strongly by climate change
2. ~1.6 billion people live in water-stressed areas in 1995: 2.8-6.9 billion people projected to live in water stressed areas by 2050[3]
3. Changing precipitation patterns and volume may necessitate changes in water supply infrastructure, and replacement of freshwater supply with desalination[3]

References:

1. The Millennium Development Goals Report 2009, United Nations (2009)
2. Millennium Ecosystem Assessment (2005)
3. Climate Change and Water, IPCC Technical Paper VI (2008)

UNEP

Market Drivers at Country and/or International Level

1. Population growth, especially urban areas
2. Industrial development and treatment needs
   - Industrial water use increases from 10% in low-middle income countries to 60% in high income countries[1]
3. Increasing emphasis of wastewater treatment
   - 2000: >70% of market for water treatment equipment, <30% for wastewater
   - 2020: 60% of market for water treatment, 40% for wastewater[2]
4. International commitments and targets
   - Millennium Development Goal (MDG) 7, Target 10: halve, by 2015, the proportion of people without access to safe drinking water & sanitation
   - Johannesburg Plan of Implementation (JPOI)
5. Government policy
   - Push towards environmental sustainability, water security

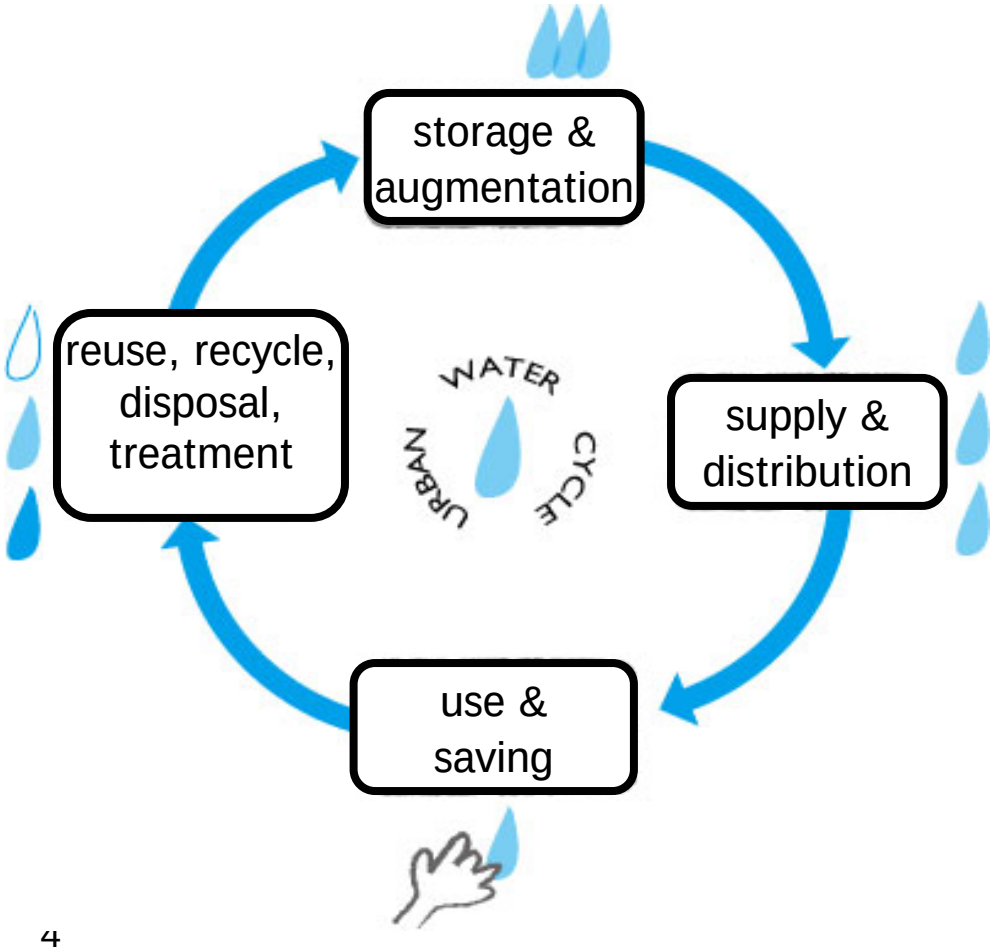
References:

1. Water for People, Water for Life, UNESCO (2003)
2. Middle East & Africa Water & Wastewater Treatment Equipment, Frost and Sullivan (2009)

UNEP

What are the goods and technologies of particular relevance to this category?

- ✓ Different ways of categorizing technologies and practices
- ✓ Different methodologies for selecting appropriate options



One way to think about them:

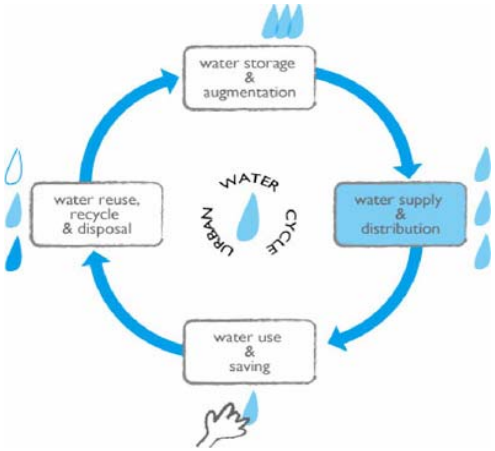
- Technologies for water storage and augmentation
- Technologies for water supply and distribution
- Technologies for water use and saving
- Technologies for water reuse, recycling, and safe disposal/treatment

References:

Every Drop Counts: Sourcebook, UNEP (2008)

UNEP

Supply and Distribution Technologies



Environmental benefit: to facilitate supply and delivery of water of appropriate quality and quantity

1. Surface water abstraction
2. Groundwater abstraction
3. Water supply reservoirs (tanks)
4. Transfer of water
5. Single and dual pipeline systems
6. Water containers (bottles, tanks)
7. Monitoring, metering, and distribution equipment
8. Centralised treatment systems

   Sedimentation =>filtration => disinfection => reservoir => customers
9. Point of use treatment systems

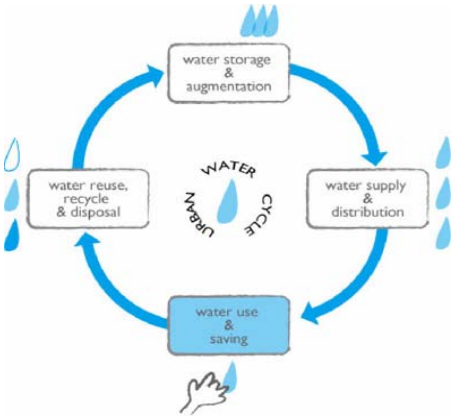
   Filters, membranes, tablets, UV, etc.

References:

Every Drop Counts: Sourcebook, UNEP (2008)

UNEP

Water Use and Saving Technologies



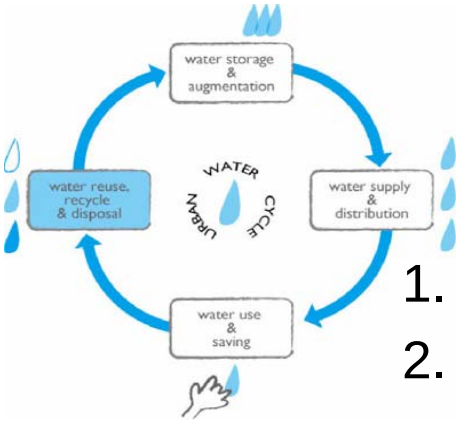
Environmental benefits: to provide and conserve water used for personal bathing, toilets, washing, watering, cleaning, and drinking

- Water saving toilets and urinals
- Waterless toilets and urinals
- Water saving taps
- Water saving showerheads
- Pressure reducers
- Water saving household appliances
- Meters, monitors, gauges, etc.

References:
Every Drop Counts: Sourcebook, UNEP (2008)

UNEP

Reuse, Recycle, Disposal & Treatment Technologies



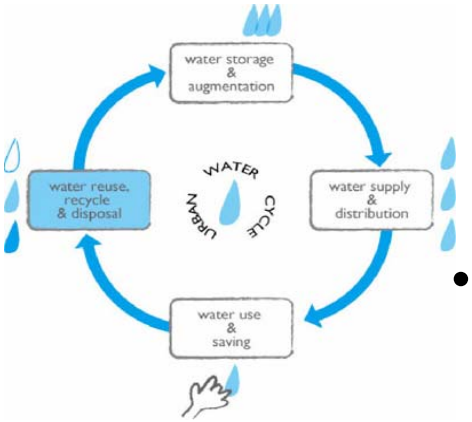
Environmental benefits: to remove pollutants and to enable reuse, recycle, and safe discharge

1. On-site treatment and reuse of grey water
2. On-site sanitation systems: pit latrine, composting toilet, pour flush toilet, sceptic tank, improved on-site treatment unit
3. Conventional wastewater treatment
   - Primary treatment (mechanical removal of suspended solids)
   - Secondary treatment (biological removal of organic matter)
   - Advanced treatment (chemical removal of nutrients and other contaminants)
4. On- or near-site treatment of black water and mixed sewage

References:
Every Drop Counts: Sourcebook, UNEP (2008)

UNEP

Treatment Technologies (cont)



Environmental benefits: to remove pollutants and to enable reuse, recycle, and safe discharge

- Biodegradable organics removal: activated sludge treatment, trickling filtration, lagoons, land-based treatments, constructed wetlands,
- Pathogen removal: chlorination, ozonation, land treatment
- Heavy metal removal: chemical precipitation, ion exchange, etc.
- Solvents and oil removal: distillation, evaporation, filtration, incineration, separation, etc.
- Acids and alkali removal: membrane separation, reuse, neutralization
- Salts and inorganic ions: adsorption, fixation, membrane separation, landfill, precipitation, etc.

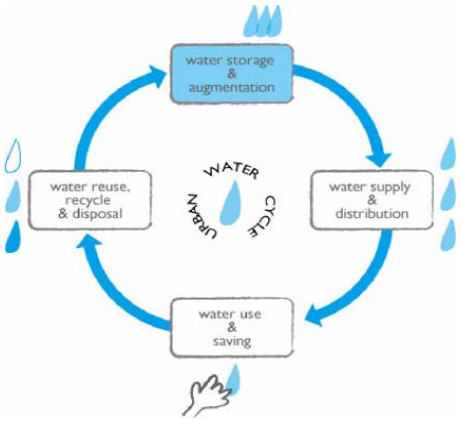
References:

ESTs in wastewater treatment, UNEP (2001)

Water Quality: Tchobanoglous and Schroeder (1987)

UNEP

Storage and Augmentation Technologies



Environmental benefits: to maintain and replenish sources of water supply

1. Ponds and reservoirs
2. Artificial recharge of groundwater
3. Water tanks
4. Rainwater harvesting
   - Collected in tanks for domestic/industrial use
   - Recharge of groundwater
   - Ponds and reservoirs to augment municipal supply
5. Augmentation with treated sewage

References:

Every Drop Counts: Sourcebook, UNEP (2008)

UNEP

Example: Reverse Osmosis (RO) Treatment and Distribution

- RO technology: used to remove salts and pollutants to produce safe water
  - Large scale: sea water (middle east), wastewater (Singapore…)
  - Small scale: rural communities near brackish water (Iraq)
- Our example: modular RO plants, distribution network with common taps in Iraq, serving ~25,000 persons with 7 plants

UNEP

Example RO System (Simplified Summary)

1. Access water from source & transport to plant

2 Treat water to potable quality by filters & membranes, and store before distribution

3 Distribute water for access by residents

UNEP

Actual RO System: Combination of Many Goods

1. Access water from source & transport to plant

2 Treat water to potable quality by filters & membranes, and store before distribution

3 Distribute water for access by residents

Submersible pump (HS8413xx), accessories, pipe (6810xx? 6906? 7303??), valves

1. Dual media filter with valves and fittings , pressure gauge, pressure transmitter, backwash blower, electrovalves
2. Chemical dosage mixer & pumps
3. Pre-filtration cartridge filter
4. RO system with membrane (842121?), centrifugal pump, pressure switch, vessels, flow meter, valves and fittings
5. Cleaning system with tank, level regulator, pump, cartridge filter, flow meter
6. Control panel & electrical kit
7. Container with air conditioner, basket filter, flow meter

1. PRFV cylindrical tanks
2. Level transmitters
3. Valves and fittings
4. Centrifugal pump
5. Control panel with pressure switch
6. Pressure gauge
7. Autoclaves
8. Electrical connections
9. Container
10. Diesel tank
11. Electrical generator
12. Control panel
13. Container

Standpipes
Taps (8481xx?)

UNEP

Example: Community Water System Upgrade (Simplified Summary)

1. Improve water intake conditions and treat with chlorine tablets

→

2 Extend distribution to another unserved area with standpipes

&

3 Augment existing rainwater harvesting with extended supply

•Our example: community water supply upgrade, with intake protection and pipeline extension to augment rainwater in rural Jamaica

Actual Community Water System Upgrade: Combination of Goods

1. Improve water intake conditions and treat with chlorine tablets

2 Extend distribution to another community with standpipes

&

3 Augment existing rainwater harvesting with extended piped supply

1. Concrete
2. Screen
3. Pipe (6810xx? 6906? 7303??)
4. Chlorine tablets (280110??)

1. G I pipes
2. G I tee
3. G I adaptor
4. Nipple
5. Stop cock
6. Elbow
7. Reducer
8. Gate valve
9. Stand pipes
10. Taps (8481xx?)

1. Rainwater harvesting tanks
2. Cisterns and reservoirs for rainwater (681091? 730900?)
3. Gutters
4. Pipes

UNEP

What is the Potential for Growth in This Sector?

OECD countries: significant potential for growth[1,2]

1. ~US$200 billion in investments required to rehabilitate existing infrastructure, comply with environmental and health regulations, and to maintain service quality and supply
2. US Example: US$23 billion required annually over next 20 years to maintain water infrastructure, estimated by EPA
3. Japan and Korea: may need to increase water expenditure by 40%

Increasing trend in ODA allocations[3]

- ODA for water and sanitation increased since 2001
- US$4.7 billion in bilateral aid commitments in 2006-07
- US$1.5 billion in multilateral aid commitments in 2006-07
- Key recipient regions: Asia (54%), Africa (33%)
- Limited but catalytic source of funding

References:

1. Managing Water for All: An OECD Perspective on Pricing and Financing, OECD (2009)
2. The Cost of Meeting the Johannesburg Targets for Drinking Water, Smets (2004)
3. Measuring Aid to Water Supply and Sanitation, OECD (2009)

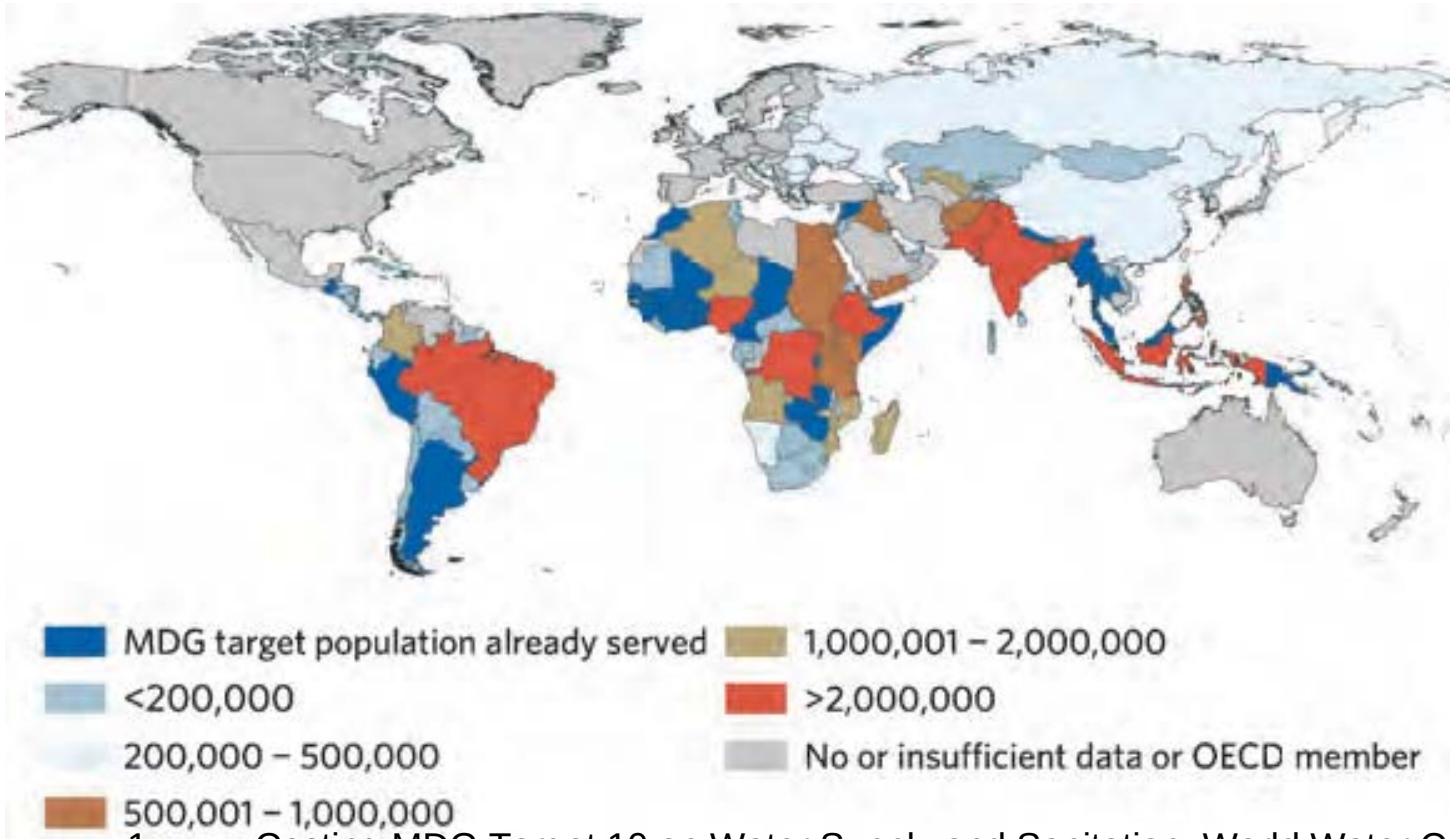
UNEP

What is the Potential for Growth in This Sector?

Developing countries: significant need and potential

1. Progress made, but investments in water-sanitation still low

- US$14 to 20 billion invested annually, excluding wastewater treatment[1]
- Number of people per year that require access to an improved drinking water source to meet the MDG target, 2006-2015 shown in map[2]



References:
1. Costing MDG Target 10 on Water Supply and Sanitation, World Water Council (2006)
2. The Millennium Development Goals Report, UN (2009)

UNEP

What is the Potential for Growth in This Sector? (cont)

2. More Investments required for attaining MDG Target 10[1]

- Additional US$10 billion/year: to supply low cost water and sanitation services to people without access now
- Additional US$15 billion–US$20 billion/year: to supply higher level of service and maintain level of service to people already supplied
- US$80 billion/year: to collect and treat household wastewater and to preserve global environment through Integrated water resource management (IWRM)

3. Investment required for better service for all[2]

- US$136.5 billion/year: to obtain access for all with regulated in-house piped water supply with water quality monitoring and in-house sewerage connection with partial sewage treatment

4. Key Technologies may see significant market growth

- Desalination technology: expected to increase to US$30 billion by 2015, compared to 2005 level of US$3.8 billion[3]

References:

1. Costing MDG Target 10 on Water Supply and Sanitation, World Water Council (2006)
2. Cost and Benefits of Waster and Sanitation Improvements at Global Level, WHO (2004)
3. Environmental Technologies Action Plan: Water Desalination Market Acceleration, EC (2006)

UNEP

Main Non-Tariff Barriers (NTBs) Faced

Our direct experiences are limited, but include:

1. Import prohibitions
   - Certain monitoring equipment prohibited by some countries, hampering on-the-ground water quality and related environmental monitoring efforts

2. Custom procedure complications
   - Typical cause of delay, creating cost and equipment performance concerns
   - Evolving procedural requirements
   - Central directorate and border office giving different instructions

Additional factors identified by others:[1]

- Standards and certification, food safety and health requirements, import quotas, intellectual property protection inadequacies, subsidies and tax benefits for domestic firms

References:

1 Non-tariff Barriers that Block Trade, New Zealand Ministry of Foreign Affairs and Trade (2009)

UNEP

Economic and Developmental Benefits of Water and Wastewater

- Economic benefits
  - US$3 to US$34 benefits per US$1 invested[1:] most stemming from health benefits, including health care costs avoided due to less illness, avoided days lost for employment, other productive activities in the households or school attendance, and increased production, more leisure time
- Developmental benefits
  - Improved water management and sanitation can contribute to poverty alleviation, food security, gender equality, industrial development with employment generation
  - Post-conflict stability building: In Iraq, UNEP's drinking water provision generated "tremendous impacts in confidence building within the communities and has increased their desire on reviving life within the…ecosystem, encouraging many households to return to their village."[2]

References:

Costs and Benefits of Water and Sanitation Improvements at the Global Level, WHO (2006)

Monitoring and Evaluation Report of the Pilot Drinking Water EST Project for the UNEP Iraqi Marshlands project (2007)

UNEP

Thank you

For more information, please access:

www.unep.or.jp

Or contact

chizuru.aoki@unep.or.jp

UNEP