# **Unconventional Water Resources**

#### **Manzoor Qadir**

United Nations University Institute for Water, Environment and Health (UNU-INWEH), Hamilton, Ontario, Canada



#### FogNet Alliance – Learning Sessions 2021

Digital Edition 7 October 2021

www.fognetalliance.org





FogNet Alliance

Munich Re Foundation

From Knowledge to Action

## The water world we have!

- Water resources and population densities are unevenly distributed across the world.
- More than two-third of the global population is expected to face water scarcity by 2030.
- The conventional water resources rainwater, snowmelt, and river runoff – are not sufficient to meet water demand in water-scarce areas.



• Climate change is leading to rainfall uncertainty and extended droughts periods, mostly in dry areas.

UNITED NATIONS UNIVERSITY UNU-INVEH Institute for Water, Environment and Health

1 m<sup>3</sup> = 1,000 L ARWR: Annual Renewable Water Resources

## The water world we need amid growing water scarcity

- Water-scarce countries and communities need to consider alternative – unconventional water resources – to narrow the water demand-supply gap.
- Unconventional water resources (UWR):
  - are generated as a product of specialized processes; or
  - need suitable pre-use treatment; or
  - require pertinent on-farm management when used for irrigation; or
  - result from a special technology to collect/access water.







## **Unconventional water resources (UWR)**



Wastewater (Municipal, agricultural)



**Desalinated water** 



Groundwater (Undeveloped, deep, off-shore)

Atmospheric water capture (Fog harvesting, cloud seeding)





Transported water (Iceberg towing)



## **Knowns about unconventional waters**

- Major types
- Key technologies and interventions
- Relevance in specific situations
- Limited data
- Limited awareness at the public policy arena
- Critical shortage of skilled human resources



Peter H. Gleick





## **Unknowns about unconventional waters**

- Global and regional status and potential of certain UWRs
- Future scenarios and projections
- Quantification on how far UWRs can narrow water demandsupply gap at different scales
- Fate of certain UWRs such as long-distance iceberg towing





## **Recent updates on some unconventional waters**



- Desalinated water
- Municipal wastewater
- Fog harvested water



#### Where the Water Is

#### May 17, 2018 | MANZOOR QADIR , VLADIMIR SMAKHTIN

Sustainable Development Goal 6 calls for universal access to clean water and sanitation. But if governments do not embrace unconventional water resources, achieving that goal will be as difficult as getting water from a stone – and the consequences for water-scarce regions will be dire.



Institute for Water, Environment and Health

#### **Desalinated water**

- There are over 16,000 desalination facilities in more than 100 countries.
- 35 billion m<sup>3</sup> desalinated water per year; almost half of the annual volume of water that passes through Niagara Falls.
- Desalination facilities are expected to increase in number and capacity in future.





### **Desalination assessment**

Almost half of the global desalination capacity is in the MENA region (48%)

- Saudi Arabia, UAE, Kuwait, and Qatar
- USA: 11.5%
- China: 7.5%
- Spain: 5.7%

National economies in waterscarce countries drive desalination facilities

- High Income Countries: 70.5%
- Upper Middle Income: 20.1%
- Lower Middle Income: 9.3%
- Low Income: 0.1%





## **Desalination challenge: Hypersaline brine**

- Global brine production stands at 52 billion
   m<sup>3</sup> per year.
  - 50% greater than previous estimates of 1:1 ratio
  - Desalination plants produce more brine than they produce desalinated water.
- Feedwater quality and desalination technology drive brine production volumes.



UNITED NATIONS UNIVERSITY UNU-INVEH Institute for Water, Environment and Health

#### **Municipal wastewater**

- 380 billion m<sup>3</sup>; almost 5 times the annual volume of water that passes through Niagara Falls.
- Wastewater volume to reach 470 billion m<sup>3</sup> by 2030 and 574 billion m<sup>3</sup> by 2050.
- With 42% of the wastewater volume, Asia is the largest producer of wastewater.





#### Wastewater as a source of water

- Use in 4 major sectors (AAAA)
  - Agriculture
  - Aquaculture
  - Agroforestry
  - Aquifer recharge
  - Other uses in industrial processing, heating and cooling systems.
- Potential to irrigate 42 million ha (without dilution)





### Wastewater as a source of major nutrients

- Collectively, 26 tera-gram (Tg) of nitrogen, phosphorus, and potassium are embedded in wastewater produced annually.
  - (1 Tg = million metric ton)
- Comparable to 70 times the mass of the Empire State Building.





### Wastewater as a source of major nutrients

- Collectively, 13% of the global fertilizer nutrient demand can be supplemented by full nutrient recovery from wastewater.
- Nutrient recovery could result in a revenue generation of **\$14 billion**.
- Removing these nutrients would be environmentally beneficial resulting in minimized eutrophication.





#### Wastewater as a source of energy

- Municipal wastewater contains different forms of energy, such as chemical and thermal energy.
- The organic compounds in wastewater can be converted into **methane-rich biogas** via anaerobic digestion.
- Many wastewater treatment plants utilize biogas for heating the wastewater treatment reactors.





### Wastewater as a source of energy



158 million households





Energy neutral treatment plants



Year



Institute for Water, Environment and Health Qadir et al. 2020. Natural Resources Forum 44 (1): 40-51

## **Fog water collection**

- Fog water collection is an emerging opportunity to address local water shortages in areas where sustainable access to water is unreliable and rainfall is limited, but:
  - fog events are frequent;
  - fog concentration is high;
  - winds are persistent such as trade winds from one direction; and
  - space and altitude are enough to intercept fog (Dry mountainous and coastal regions).
- Minimal operation and maintenance. Environmentally feasible as it does not rely on energy consumption.





## **Fog water collection**

- Fog water yield largely depends on the fog intensity, duration, and frequency of fog events.
- Fog days range from 60 to 360 days on fog collection sites.
- Daily fog water yields range from 2 to 20 L/m<sup>2</sup> of fog water collection mesh.
- Functional 'Bright Spots' exist to promote fog water collection systems in dry areas around the world.



Water yield: litres per square metre per year

21,900
11,500
12,600
21,800
21,800
21,800
37,800
33,300
31,800
4444
48,000



## **Community involvement and gender mainstreaming**

- Community involvement and gender mainstreaming in fog collection systems bring positive outcomes for women and girls, which include:
  - Freeing of time for domestic, commercial, and educational pursuits;
  - Improved health outcomes; and
  - Improved perception of self and others' perception of women.



Water access through fog water collection



## Key barriers and tradeoffs of unconventional waters

#### Environmental and health

- Production of desalinated water also produces brine; currently 142 million m<sup>3</sup> per day, 50% greater than previous estimates – *environmental challenge*.
- Almost 50% of wastewater is released to the environment untreated *environmental and health challenges*.

#### • Economic

- Perceived high costs without undertaking comprehensive economic analyses and innovative financing mechanisms; also, the cost of alternate water options.
- Lack of mechanisms for low-income communities for initial subsidies or soft loans (fog water collection).



## Key barriers and tradeoffs of unconventional waters

#### Policies and institutions

- Lack of emphasis on UWR in water policies and limited political support even in countries with high potential for one/more UWRs.
- Fragmented institutions with lack of clarity on roles and responsibilities, although private sector is becoming increasingly active in case of some UWRs.

#### • Capacity

• Critical shortage of skilled human resources to harness the potential of a range of UWRs in waterscarce developing countries.



### **UN-Water Task Force on Unconventional Water Resources**

- By involving water institutions, policy makers, and experts, the Task Force has triggered international and regional cooperation among UN Member States to address:
  - Regional and global assessments of UWRs
  - Barriers and trade-offs to harness the potential of a range of UWRs





UN-Water Analytical Brief Unconventional Water Resources

05 JUNE 2020





## Thank you

Manzoor.Qadir@unu.edu

UNITED NATIONS UNIVERSITY UNU-INWEH Institute for Water, Environment and Health