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Water@2047: A glimpse into the challenges and opportunities

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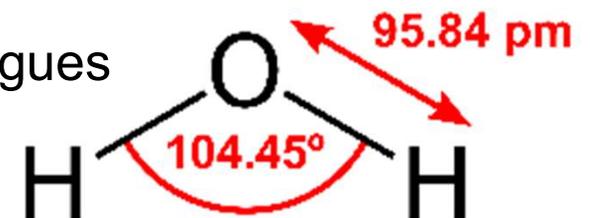
<https://pradeepresearch.org>

Professor-in-charge

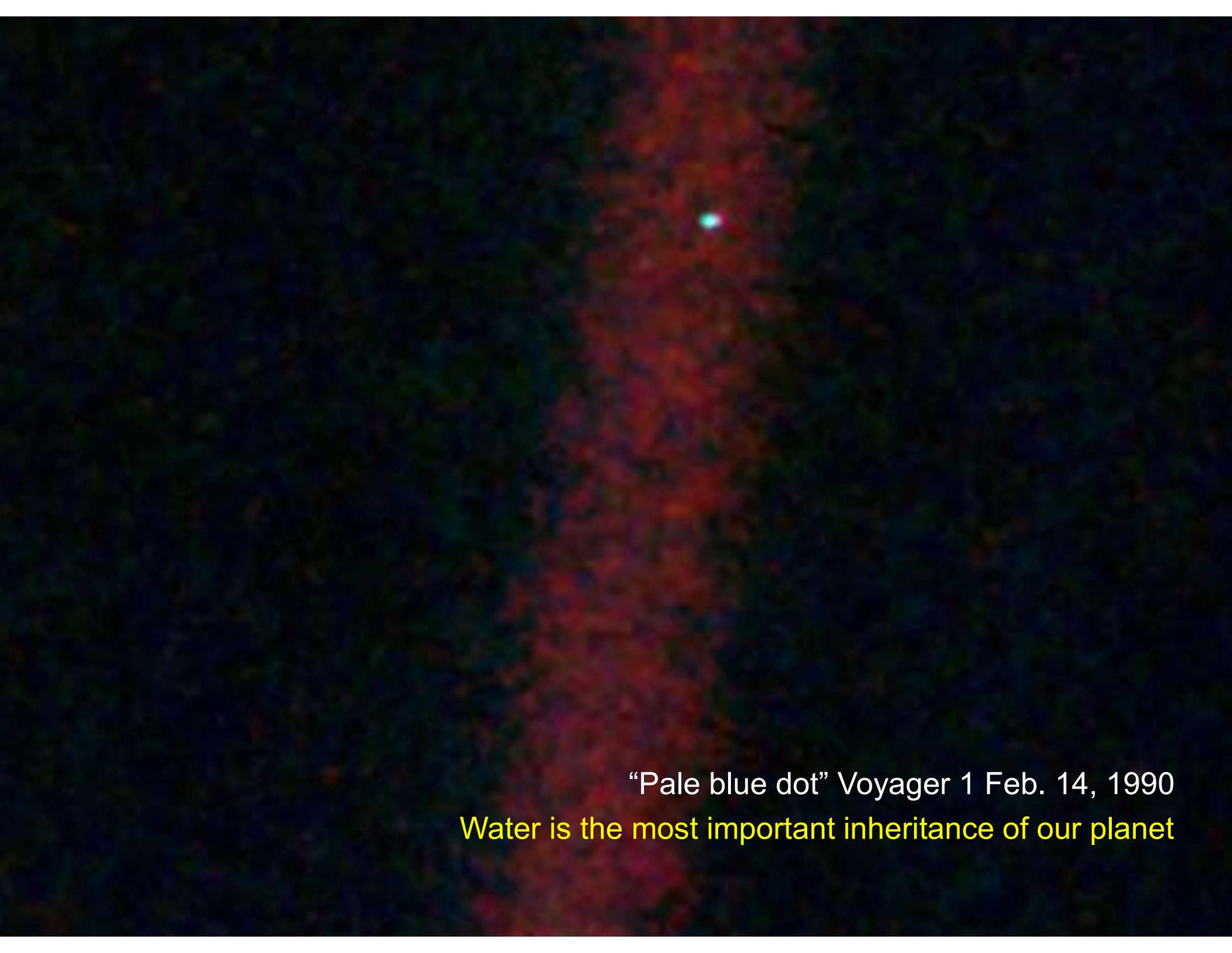


International Centre for Clean Water

Prof. Ashok Jhunjhunwala and colleagues



Imagining India@2047 through innovation, IIT Madras, March 7-9, 2022



“Pale blue dot” Voyager 1 Feb. 14, 1990

Water is the most important inheritance of our planet

Water is at the centre of action

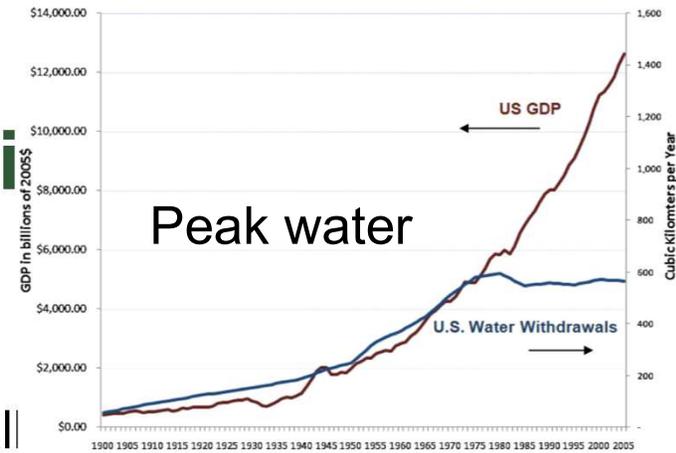


Variety and diversity are part of water, in problems and opportunities

Water is big and India is

Per capita water availability – 1500 CM

That water and its benefits need to reach all



Peter H. Gleick and Meena Palaniappan, PNAS, 2010, 107, 11155–11162

3Ss for water **Store – Sensitive – Smart**

Average rainfall 1085 mm, 85th in a list of 186 countries

Traditions of storage and conservation – we store just about 8%

Water is for all – for every living form

83% of freshwater species have declined globally in the last 50 years!

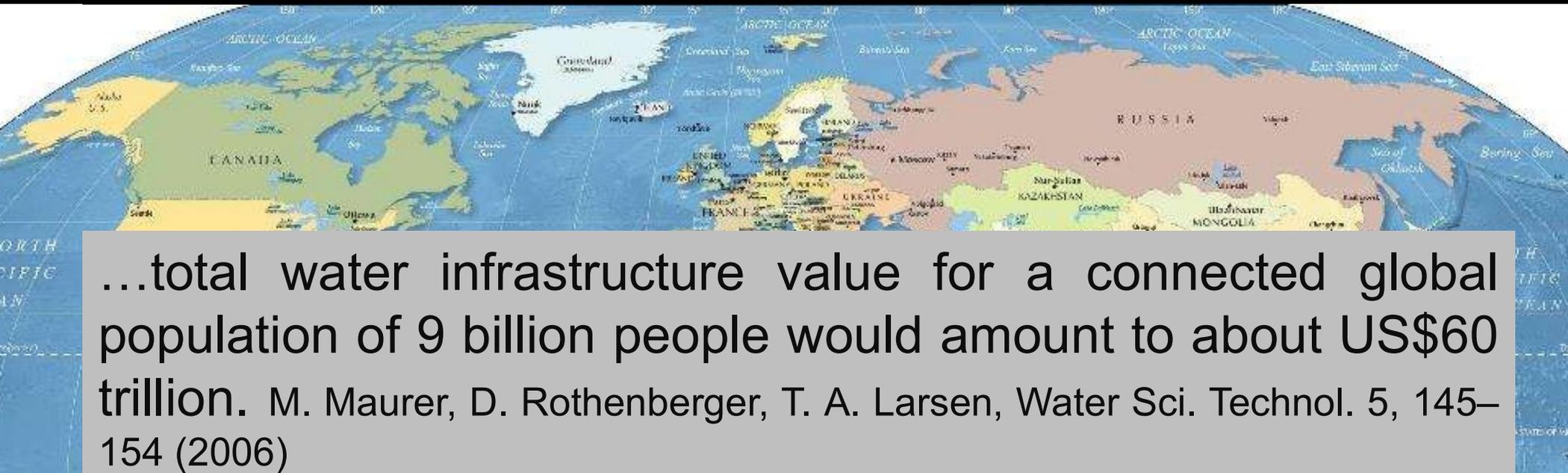
GDP can grow even by capping freshwater withdrawals

We must find technologies of relevance

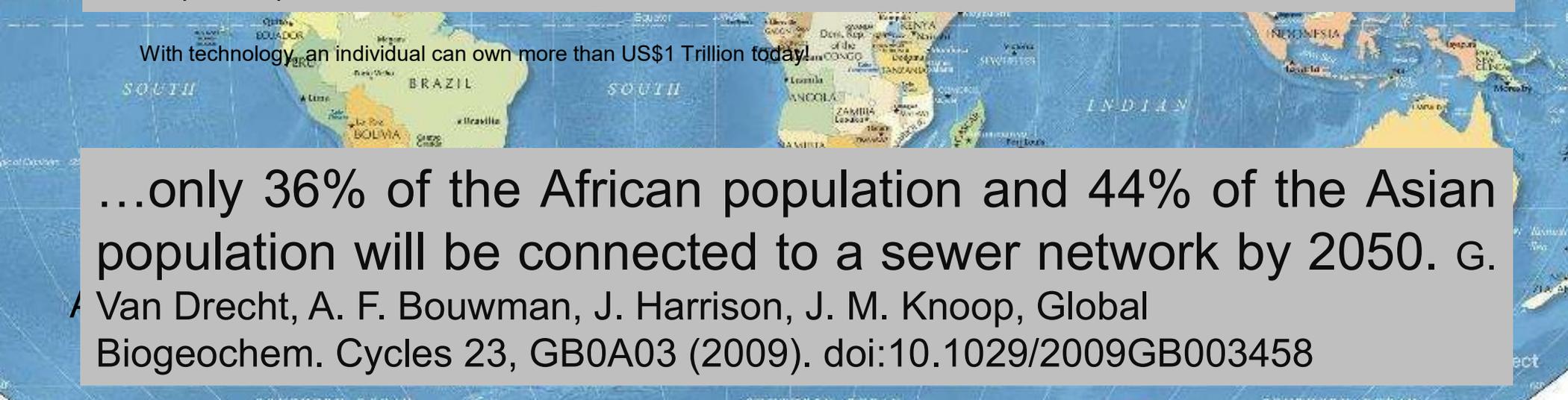
Energy - food – clothing – construction – manufacturing -

Water is big in every scale – Gaps, opportunities, wealth, satisfaction

Water, sanitation and inequality

A world map showing global water infrastructure value. The map is color-coded by region, with North America and Europe in shades of green and yellow, and Russia and parts of Asia in shades of brown and red. The text is overlaid on a semi-transparent grey box.

...total water infrastructure value for a connected global population of 9 billion people would amount to about US\$60 trillion. M. Maurer, D. Rothenberger, T. A. Larsen, *Water Sci. Technol.* 5, 145–154 (2006)

A world map showing sewer network connectivity by 2050. The map is color-coded by region, with Africa and parts of Asia in shades of yellow and orange, and South America and parts of Europe in shades of green. The text is overlaid on a semi-transparent grey box.

With technology, an individual can own more than US\$1 Trillion today!

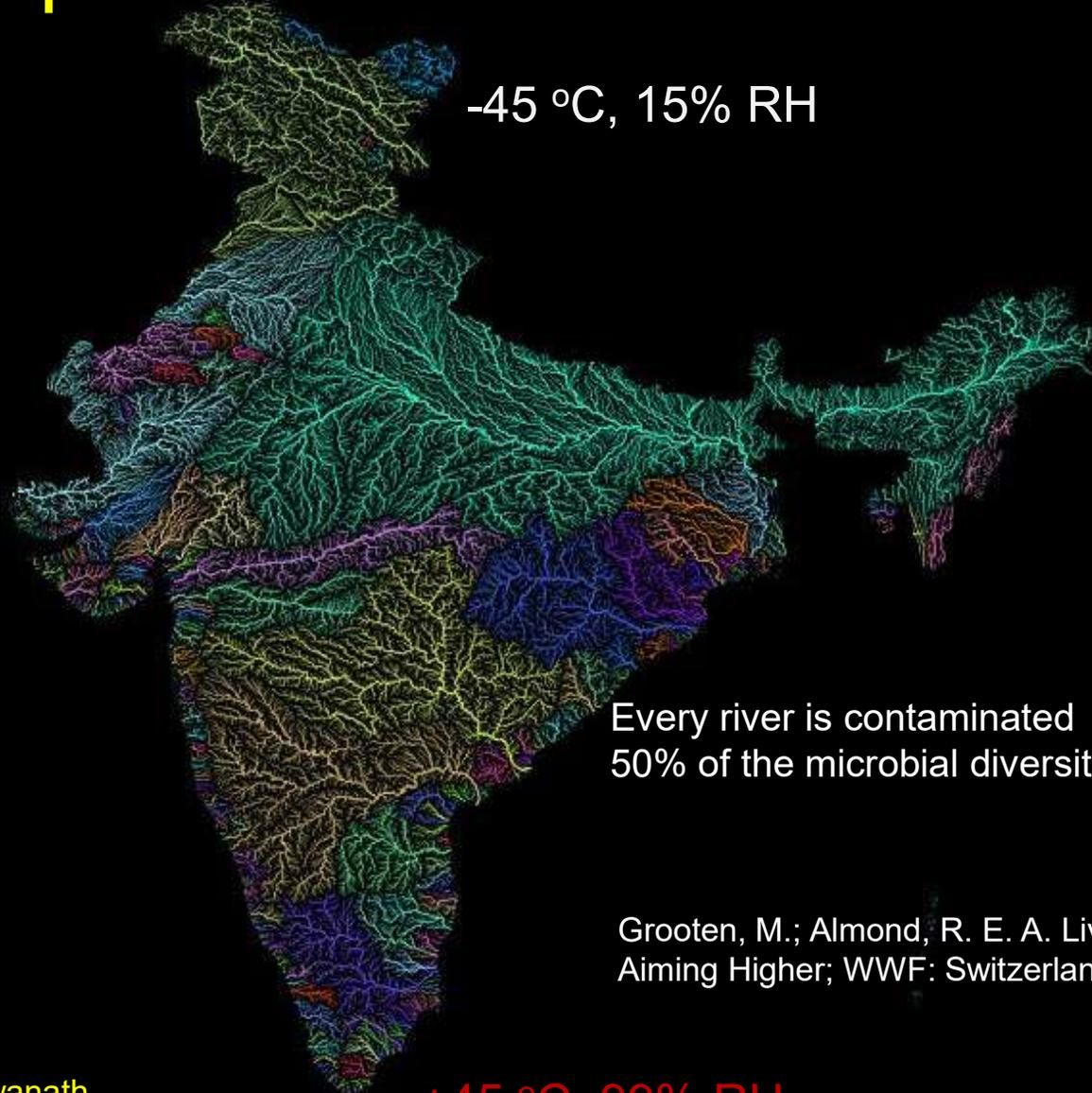
...only 36% of the African population and 44% of the Asian population will be connected to a sewer network by 2050. G. Van Drecht, A. F. Bouwman, J. Harrison, J. M. Knoop, *Global Biogeochem. Cycles* 23, GB0A03 (2009). doi:10.1029/2009GB003458

Total wealth of India – US\$12.8 Trillion
Total wealth of USA – US\$126 Trillion

Challenges

Every possible need

Arsenic
Fluoride
Uranium
Mercury
Chromium
Perchlorate
Nitrate
Pesticides
Antibiotics
Plastics
Detergents
.....



-45 °C, 15% RH

Every river is contaminated
50% of the microbial diversity is lost for ever

Grooten, M.; Almond, R. E. A. Living Planet Report - 2018:
Aiming Higher; WWF: Switzerland, 2018.

+45 °C, 99% RH

From S. Vishwanath

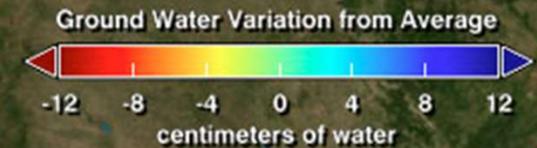
Indian agriculture

67% of agriculture run on GW

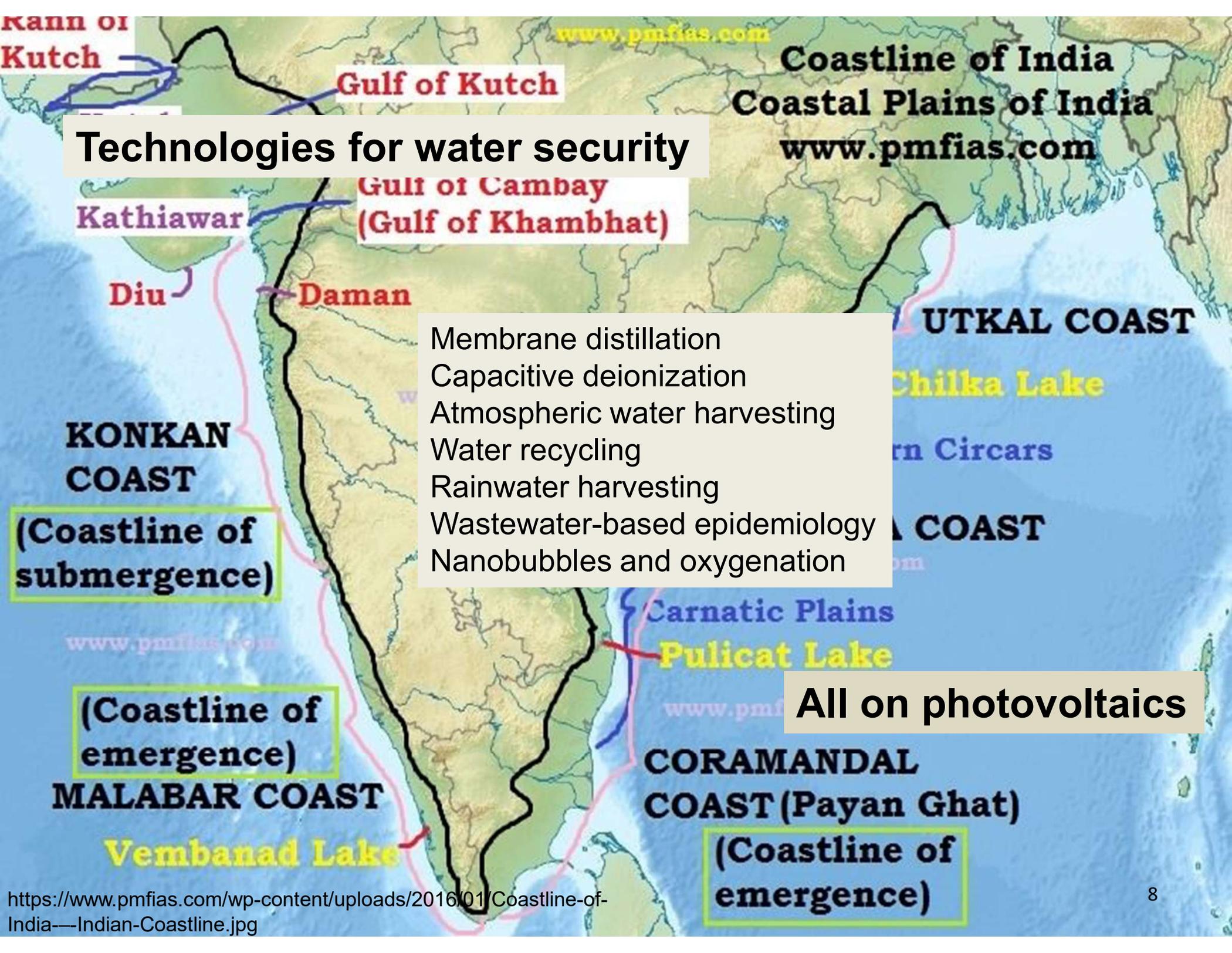
Total districts 742
Water stressed >300
256 with critical or overexploited ground water levels
'India is suffering from its worst water crisis in its history.'

November 2002

November 2008



Data from NASA

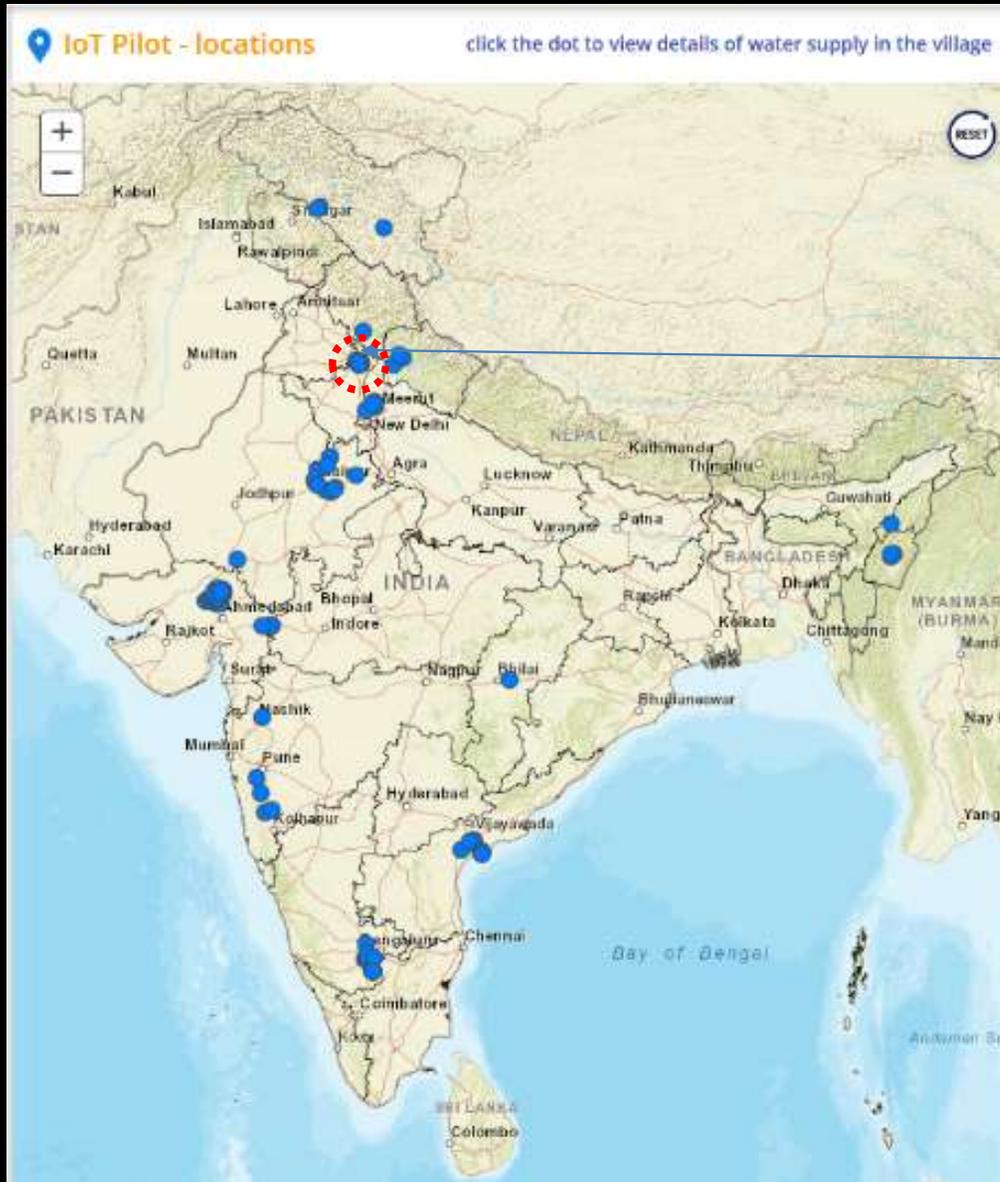


Technologies for water security

- Membrane distillation
- Capacitive deionization
- Atmospheric water harvesting
- Water recycling
- Rainwater harvesting
- Wastewater-based epidemiology
- Nanobubbles and oxygenation

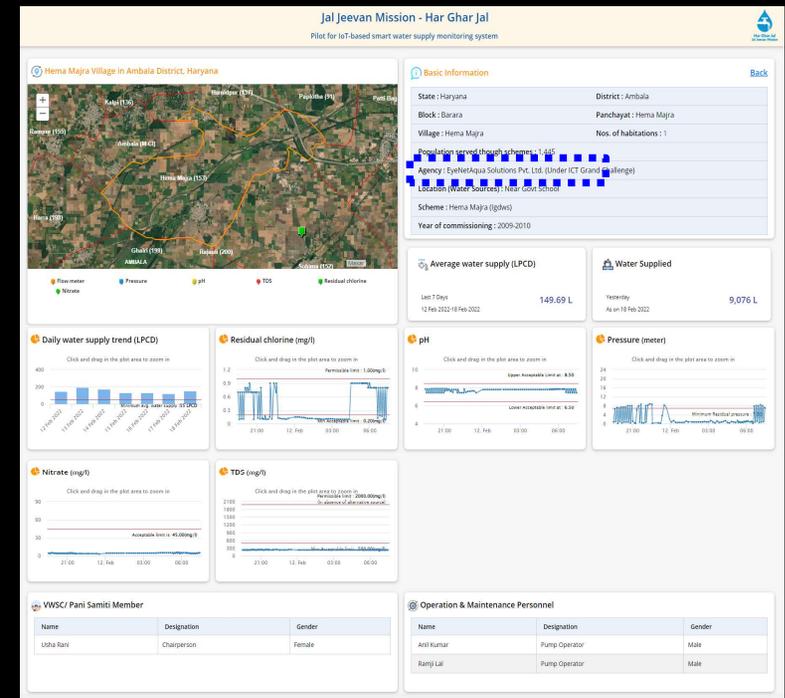
All on photovoltaics

India's water is being monitored



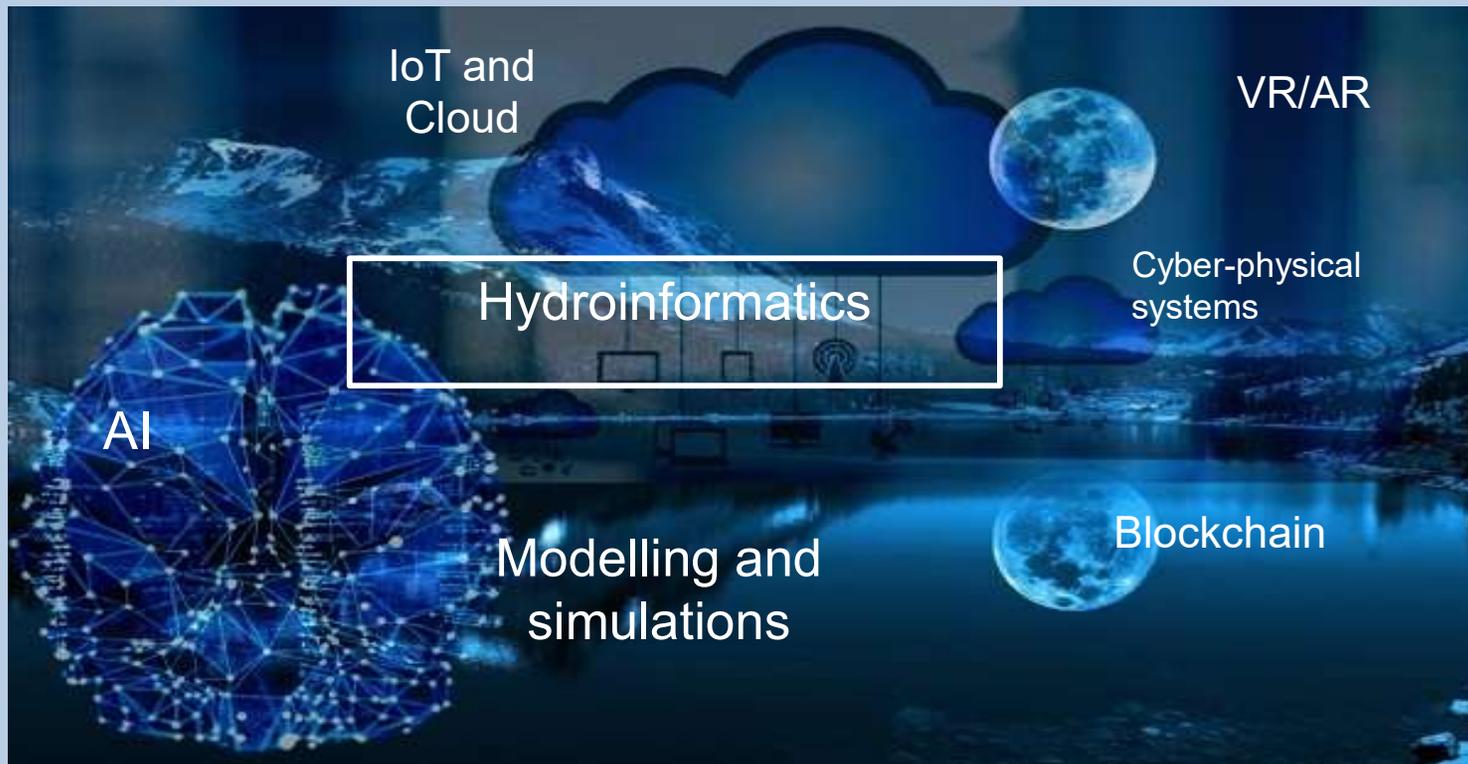
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Installations made by four companies



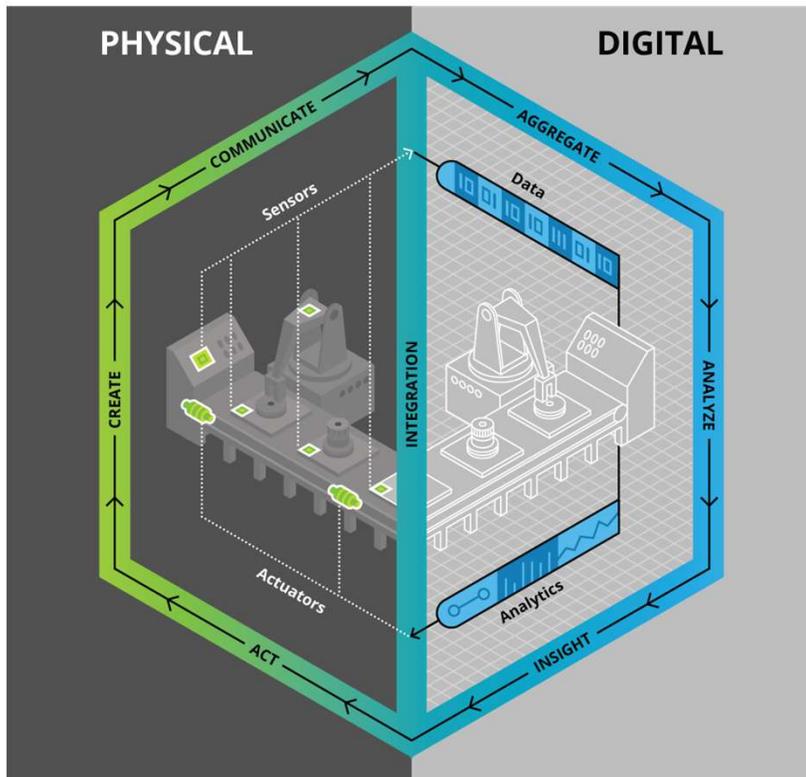
Hydroinformatics

Application of computing technologies for efficient, sustainable and equitable water management.



Water 4.0

Digital twin of water resources



Digital twin is the digital visualization and representation of a physical or natural system, which may gather data continuously from its physical counterpart and interact with it via a control system.

Create a digital twin of different elements of hydrologic environment – surface water bodies, ground water, rivers, and urban water utilities.

Data-driven modelling of events such as flood inundation of rural and urban areas with 3D visualization using the digital twin representation of the landscape.

Integration of real-time modelling of groundwater and surface water, water supply networks and utilities combined with analytics platform more accurate decision making.

Traditional knowledge



<https://www.unnatisilks.com/blog/naturally-colored-cottons-a-regain-in-popularity/>

Arsenic free rice



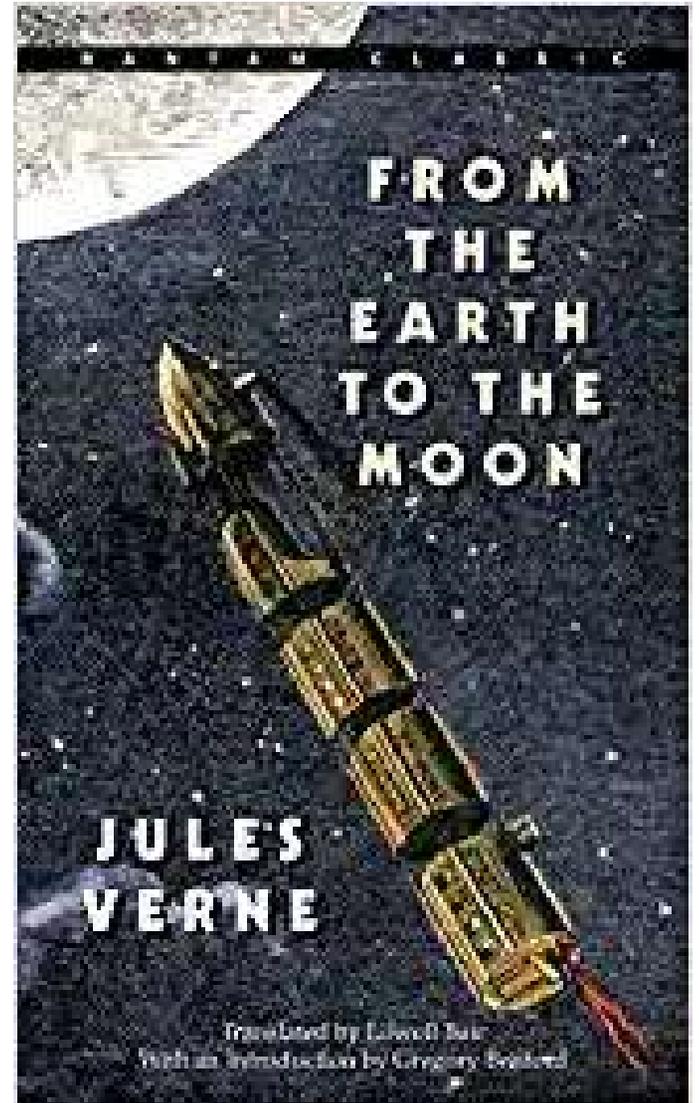
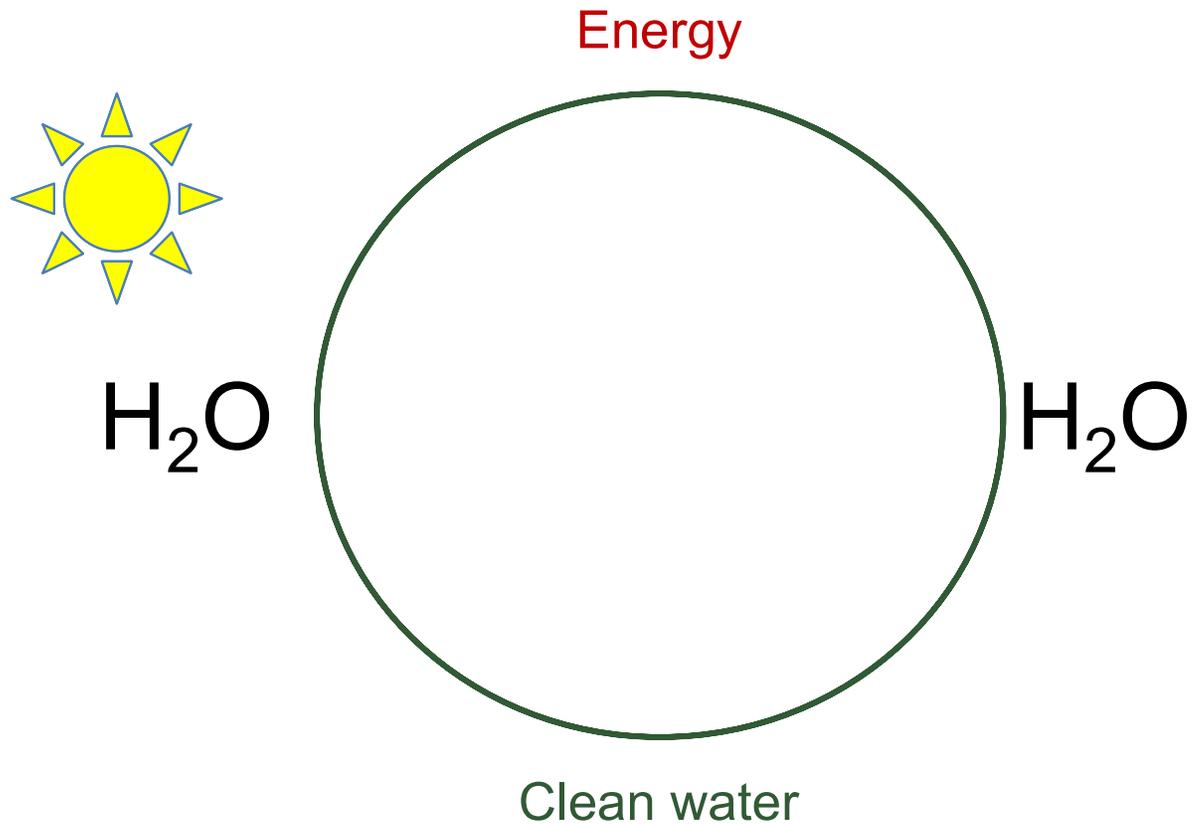
Iron rich, silver rich, etc. rice

So much is happening on the ground



Policy

Our dreams become reality with materials



Affordable, inclusive, sustainable and contextual excellence

Some simple calculations

Hydrogen + Oxygen → Water + 286,000 joules of energy per mole

1 kg of solar hydrogen is now at Rs. XX and could be Rs. 150 soon.

It can make 143 million J of energy.

Desalination needs 2.4 kWh or 8.84 million joules for 1 CM of water.

1 kg of hydrogen can therefore make 16.56 CM of water.

Or Rs. 9.06 per cubic meter, 0.9 paise per litre!

Well, add efficiency, other costs of plant, transportation, etc.

That world will need water literacy



Indian Institute of Technology Madras



Directors - past and present

Thank you all



Associate Editor

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