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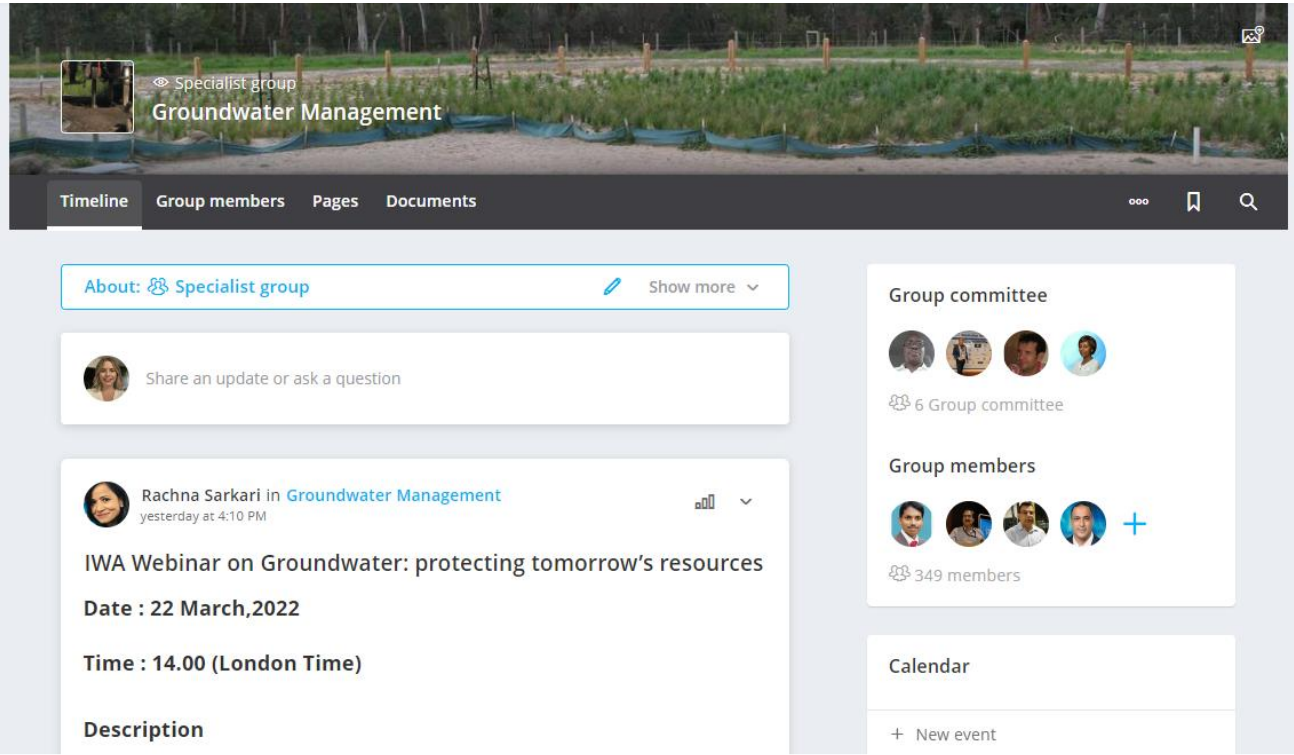
IWA GROUNDWATER MANAGEMENT SG



The **IWA Groundwater Management Specialist Group** provides a unique platform to address the technical and institutional issues related to groundwater use, management and protection on an interdisciplinary basis and at an international level.

Join the IWA Groundwater SG on IWA Connect!

https://iwa-connect.org/group/groundwater-management/timeline?searchFor=groups

WEBINAR INFORMATION

- This webinar will be **recorded and made available "on-demand"** on the IWA website.
- Following the webinar, you will be sent a **post-webinar email** with the on-demand recording, presentation slides, and other information.

- **'Chat' box**: please use this for general requests and for interactive activities.
- **'Q&A' box**: please use this to send questions to the panelists.

  (We will answer these during the discussions)

Please Note: *Attendees' microphones are muted. We cannot respond to 'Raise Hand'.*

AGENDA

- Welcome, introduction, housekeeping rules
  Tanya Gottlieb Jacobsen
- Groundwater – overview of a vital resource
  Stephen Foster
- The hidden importance of groundwater in Latin America
  Ricardo Hirata
- Importance of groundwater in India
  Faiz Alam
- The value of groundwater to Africa
  Julia Gathu
- Sustainable production of drinking water based on clean groundwater
  Troels Kærgaard Bjerre
- Q&A Panel Discussion
- Groundwater activities at WWC&E Congress
  Anders Bækgaard
- Final remarks and conclusion

MODERATORS & PANELISTS

Tanya Jacobsen
State of Green,
Denmark

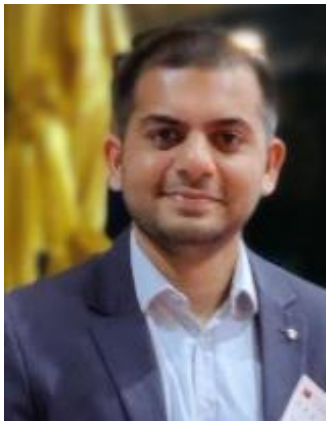
Stephen Foster,
IWA Groundwater
Managerment SG Chair

Dorte Skræm
Danva,
Denmark

Anders Bækgaard,
IWA Congress
President

Julia Gathu,
Drilling for Life,
Kenya

Ricardo Hirata,
University of Sao
Paulo, Brazil



Faiz Alam,
IWMI,
India

Troels Bjerre,
VCS Denmark,
Denmark

LEARNING OBJECTIVES

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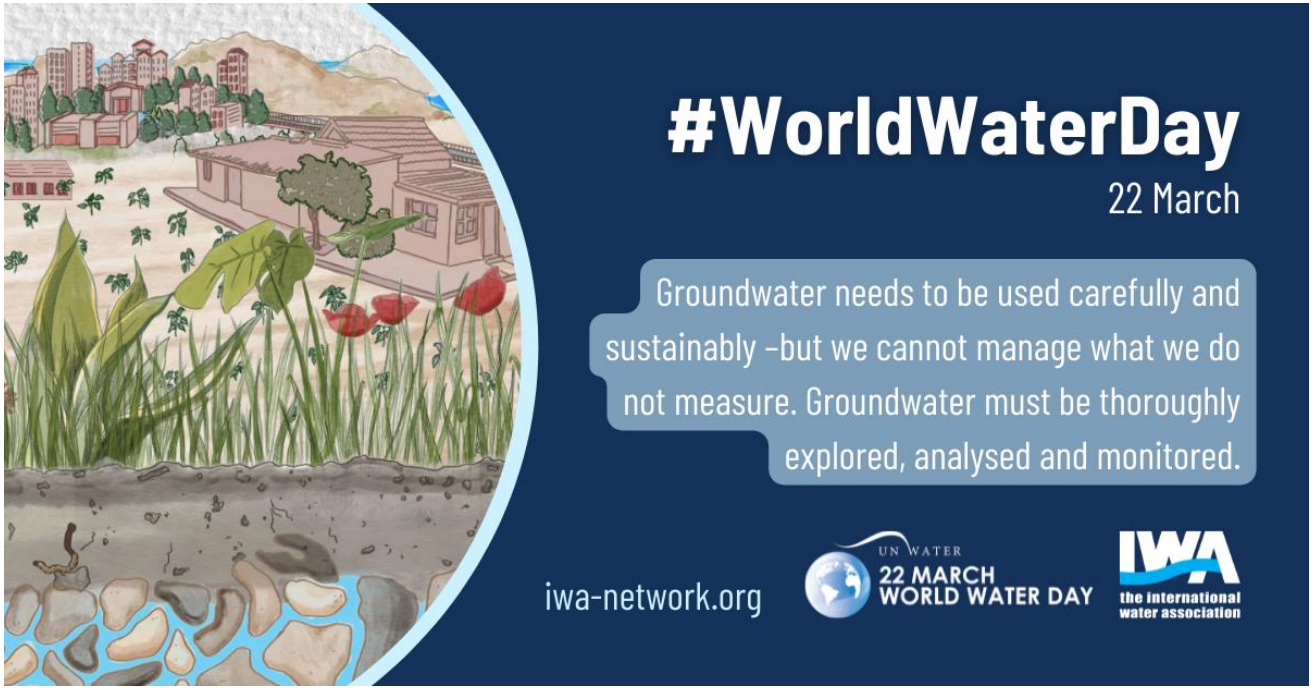
1. Emerging practices around designing water reuse treatment schemes;
2. Comprehend key issues related to sustainable groundwater use;
3. Understand the how sustainable groundwater management can help achieve SDG-6;
4. Understand the benefits for water utilities of incorporating groundwater into their water supply mix;
5. Learn the importance of “protecting tomorrow’s groundwater resource” for future generations.

SHARE YOUR THOUGHTS ON SOCIAL MEDIA

IWA is proud to support the official #WorldWaterDay campaign led by UN Water.



Share your groundwater story with us, tag @IWAHQ and @UN_Water on social media and tell us: *How does groundwater affect your life? Is there enough? Is it safe? What needs to be done to protect groundwater?*

Don't forget to include the hashtags #MyGroundwaterStory & #WorldWaterDay.

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GROUNDWATER – OVERVIEW OF A VITAL RESOURCE

STEPHEN FOSTER
IWA-GROUNDWATER MANAGEMENT SG CHAIR UNIVERSITY COLLEGE LONDON

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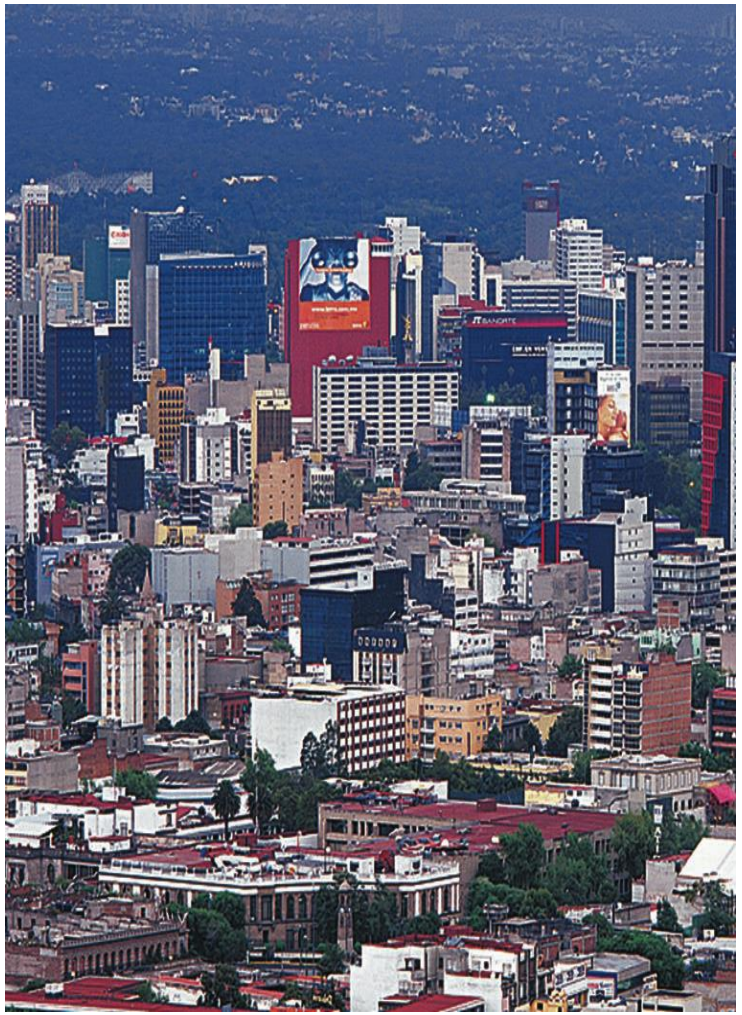
GROUNDWATER RESOURCES – THEIR RELEVANCE TO FOOD PRODUCTION, DRINKING WATER-SUPPLY & ECOSYSTEMS

- Provides a major component of irrigation water in many countries, under direct control of farmers.
- Aquifer discharge essential to the sustainability of many aquatic ecosystems.
- Critical resource for low-cost (generally high quality) drinking water-supplies for both urban and rural populations – urban water-supply is main focus here.

GROUNDWATER – IMPORTANCE FOR DRINKING WATER-SUPPLY

- Groundwater is critical for economical water-supply provision to innumerable cities and towns worldwide.
- About 50% of global population are today estimated to be supplied by waterwells and springs.
- In the EU and US water-utilities provide 310 and 105 million people with groundwater respectively.
- Large natural storage of aquifer systems means that groundwater is likely to be even more important for drinking water-supply under climate-change adaptation.



GROUNDWATER & URBANISATION – AN INTIMATE BUT INVISIBLE RELATIONSHIP

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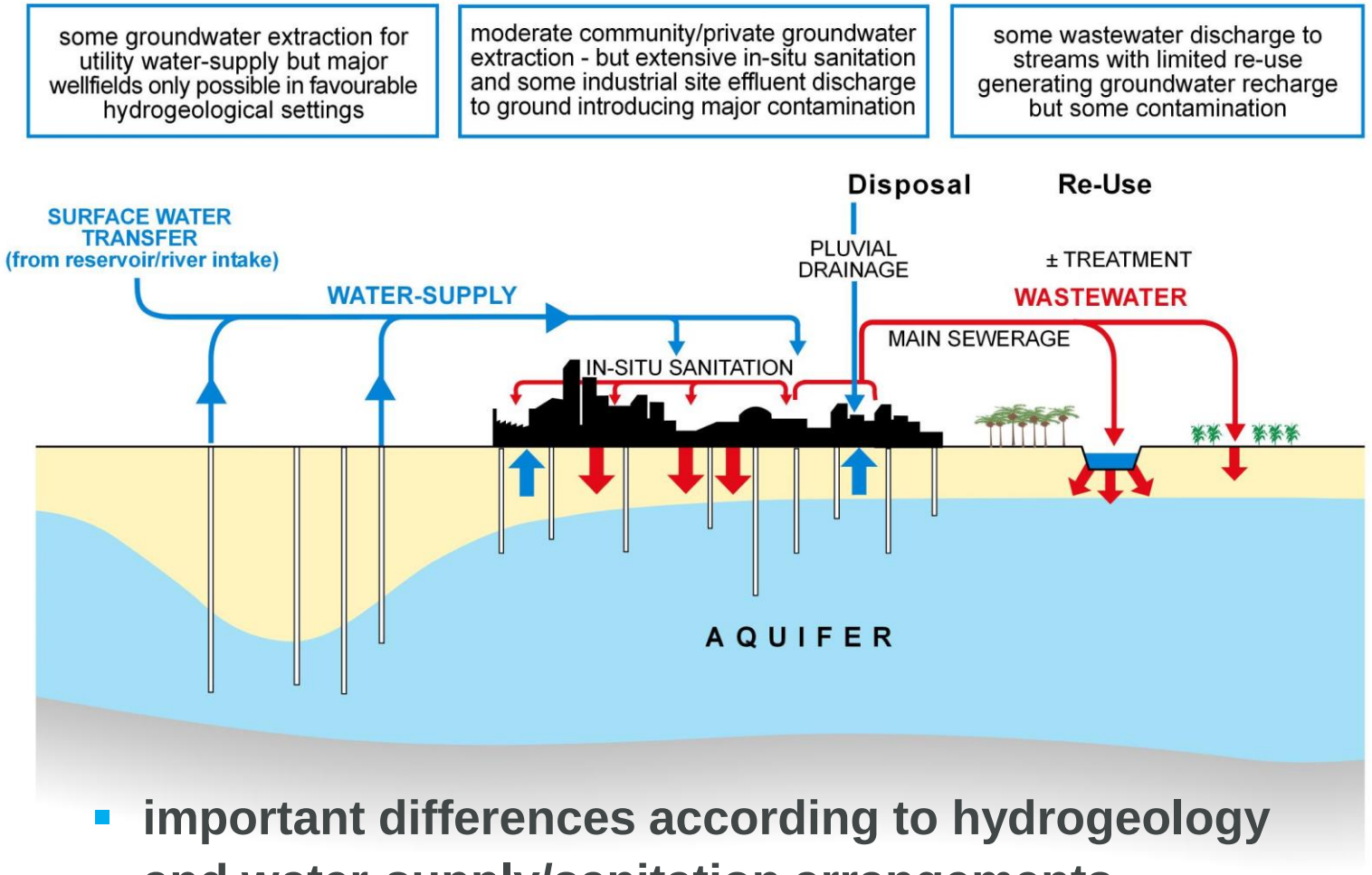

- important differences according to hydrogeology and water-supply/sanitation arrangements

URBANISATION & GROUNDWATER – POTENTIAL INTERACTIONS

- **of urbanisation on groundwater**

  -increased recharge (despite land-surface impermeabilisation)

  -significant quality degradation

- **of groundwater use on urbanisation**

  -infrastructure damage from land subsidence

  (caused by excessive abstraction)

  -infrastructure damage and uplift problems

  (caused by waterwell abandonment)

URBAN GROUNDWATER – MANAGEMENT CHALLENGES

- **rarely sufficient groundwater resources within municipal limits to support urban water-utility requirements – thus sustainability issues often arise unless 'external protected wellfields' are developed for water-utility supply.**
- **more severe challenges arise in aquifer systems simultaneously exploited for waterwell irrigation (the major consumer of groundwater resources).**
- **private self-supply from groundwater is major phenomena in fast-growing urban areas where waterwell construction costs are low and greatly improves water access (and reduces water cost) for some user-groups.**
- **rapid uncontrolled urbanisation places groundwater under increasing risk of serious pollution – resulting in growing concerns over water quality and potential impacts on human health.**

GROUNDWATER AND THE CITY – AN EVOLVING RELATIONSHIP

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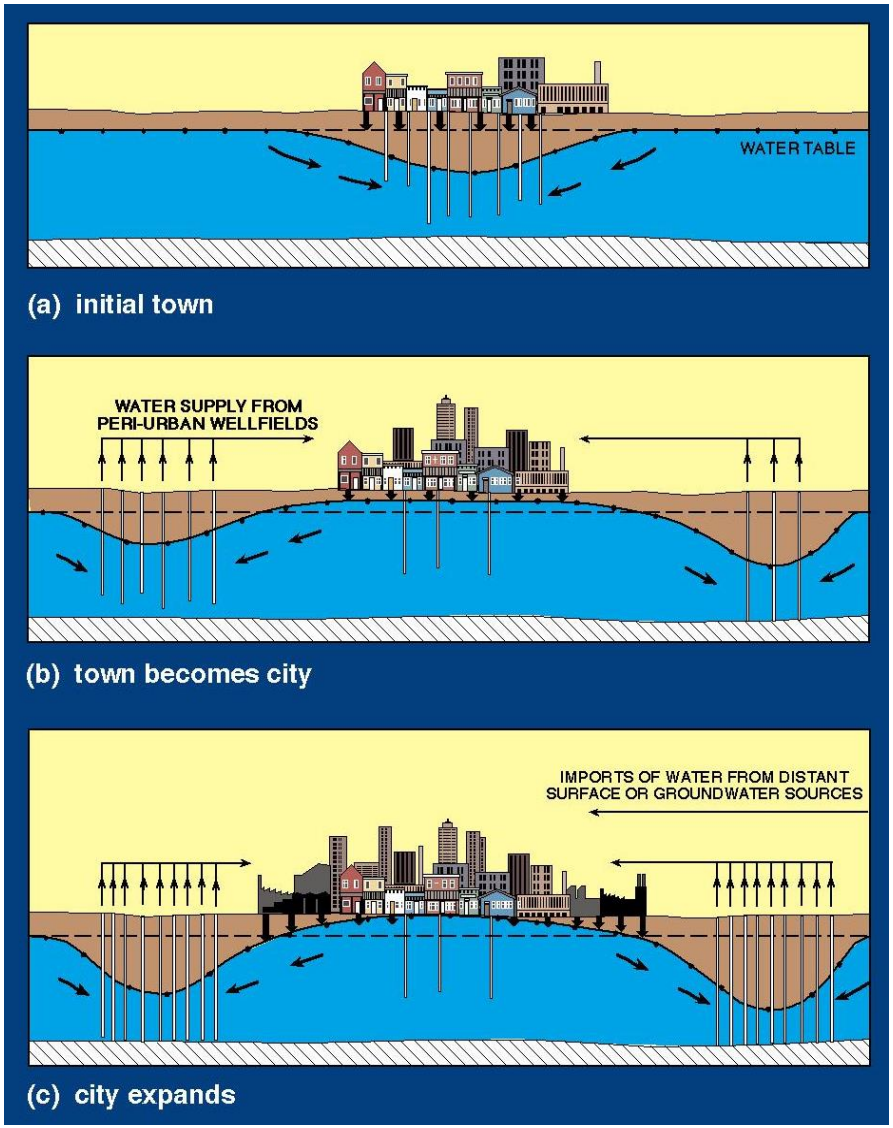
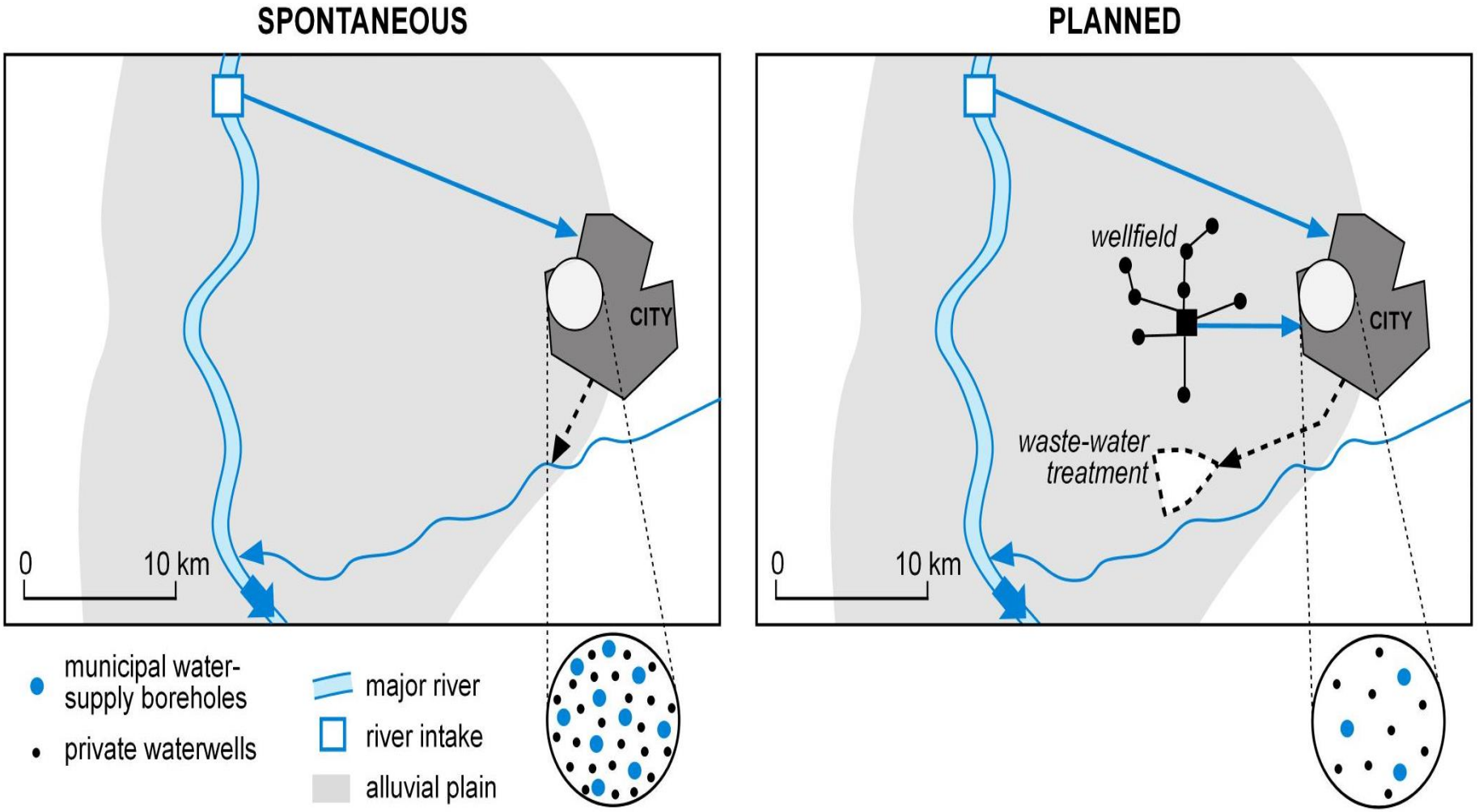


URBAN GROUNDWATER MANAGEMENT

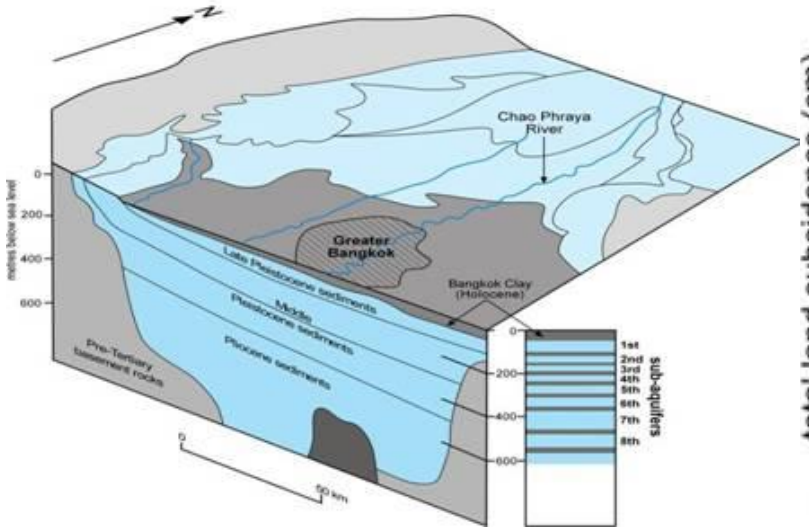
- groundwater is more significant in overall water-supply than appreciated, and often the 'invisible link' between various facets of urban infrastructure
- urban groundwater should be proactively managed, since a *lassez faire* approach will be costly and hazardous
- urban groundwater too often the responsibility of 'no body' – broad stakeholder engagement essential (led by resource regulatory agency or commissioned with water utility)
- development of conjunctive use of groundwater and surface water sources highly recommended but may face both 'internal and external impediments'

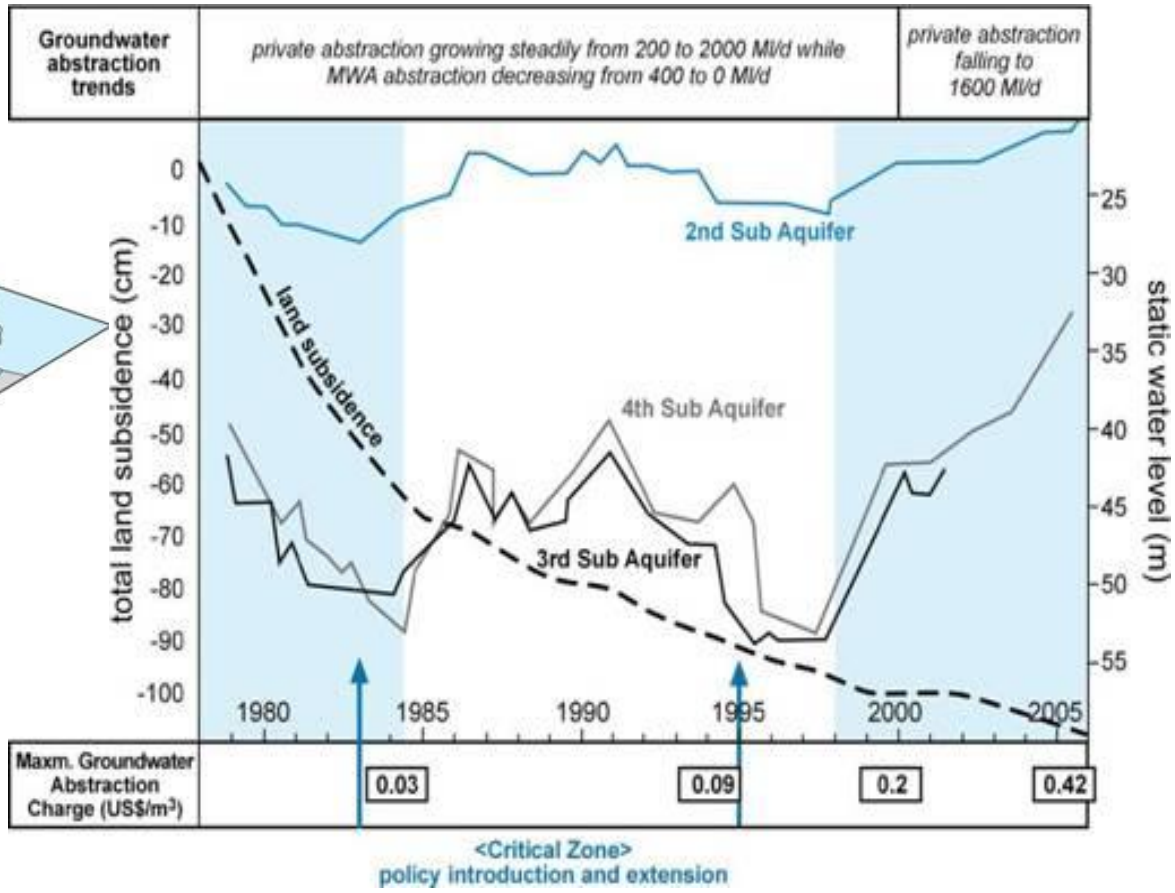
CONJUNCTIVE USE – FROM SPONTANEOUS DEVELOPMENT TO PLANNED STRATEGY



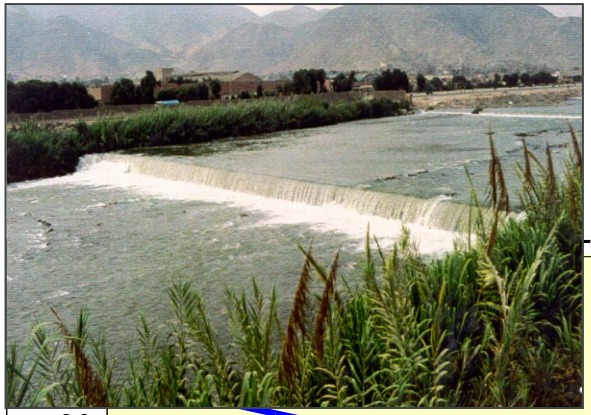
BANGKOK - THAILAND

- partial ban waterwell construction/closure of some existing sources
- alternative sources of municipal water-supply in some areas
- metering and progressive charging for groundwater use

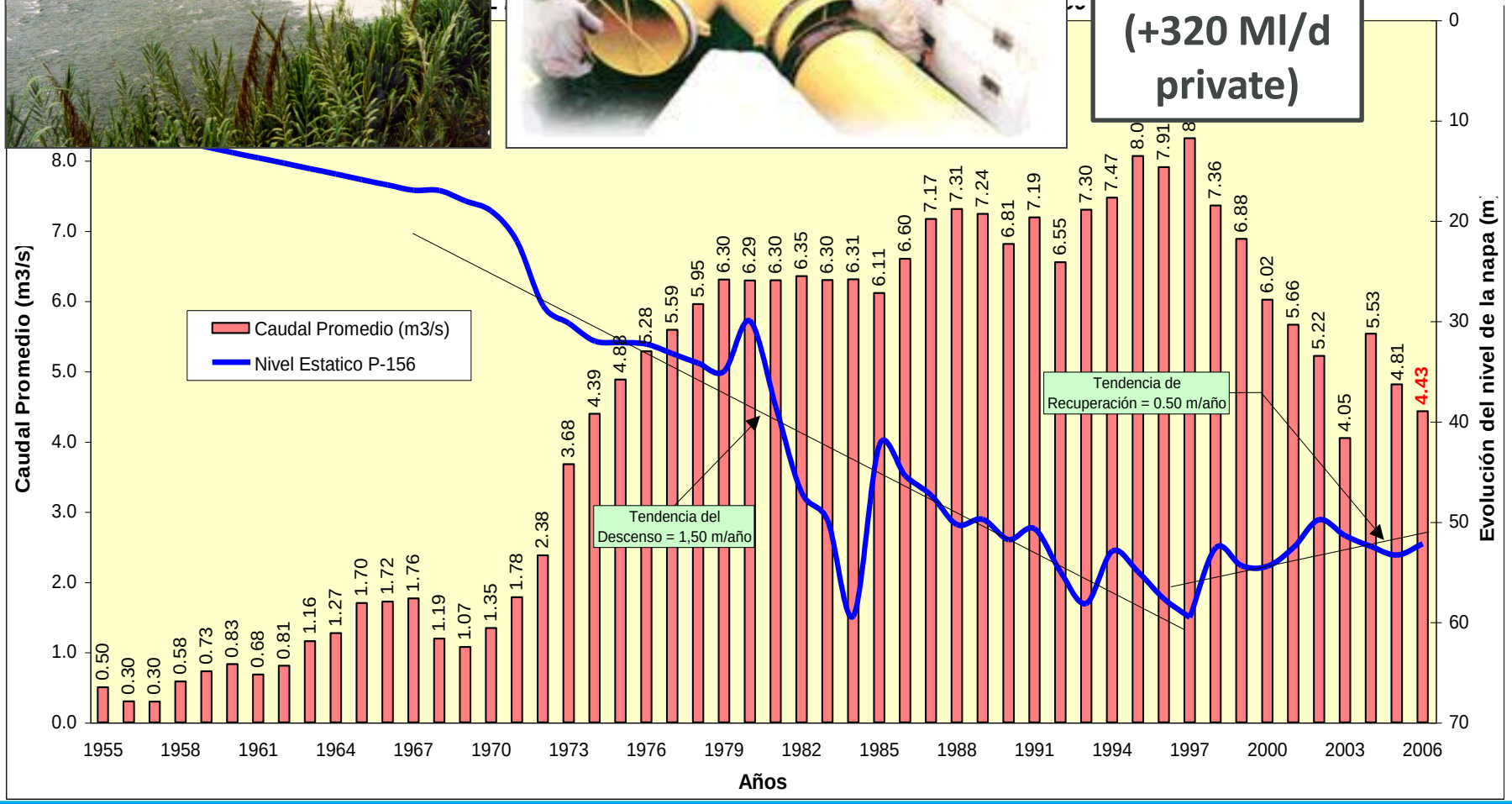




LIMA - PERU



720 Ml/d (+320 Ml/d private)



PRIVATE SELF-SUPPLY FROM GROUNDWATER– FORGOTTEN POLICY DIMENSION

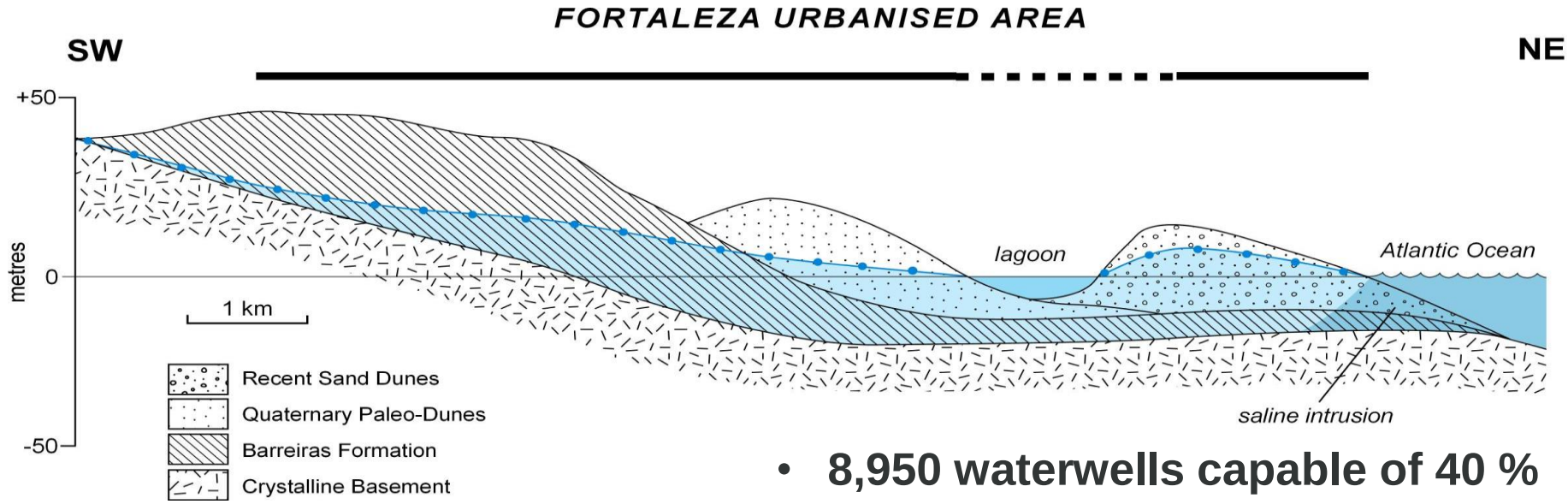
- Private urban groundwater use represents a ‘coping or cost-reduction strategy’ for some users and reduces demand on, and recovers mains leakage from, utility water-supplies.

- Large-scale private domestic self-supply can distort utility water operations with major implications for finance and investment.

- ‘Banning’ such practice too simplistic (unrealistic and impractical), except where they pose major public health or environmental hazard.

- What management measures should be taken – improve construction standards for private waterwells and in-situ sanitation, reduce subsurface pollution load, advise users on potential quality hazards and regulate/charge for groundwater.

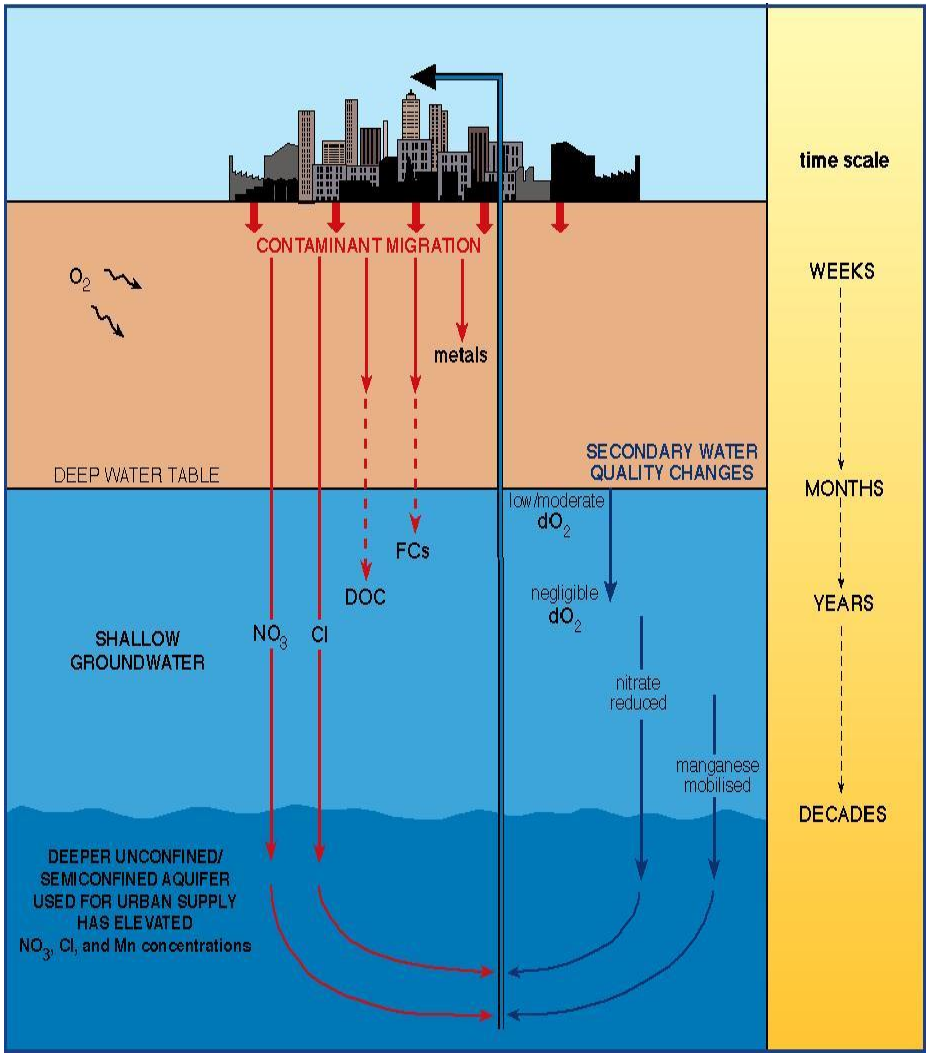
FORTALEZA – BRAZIL



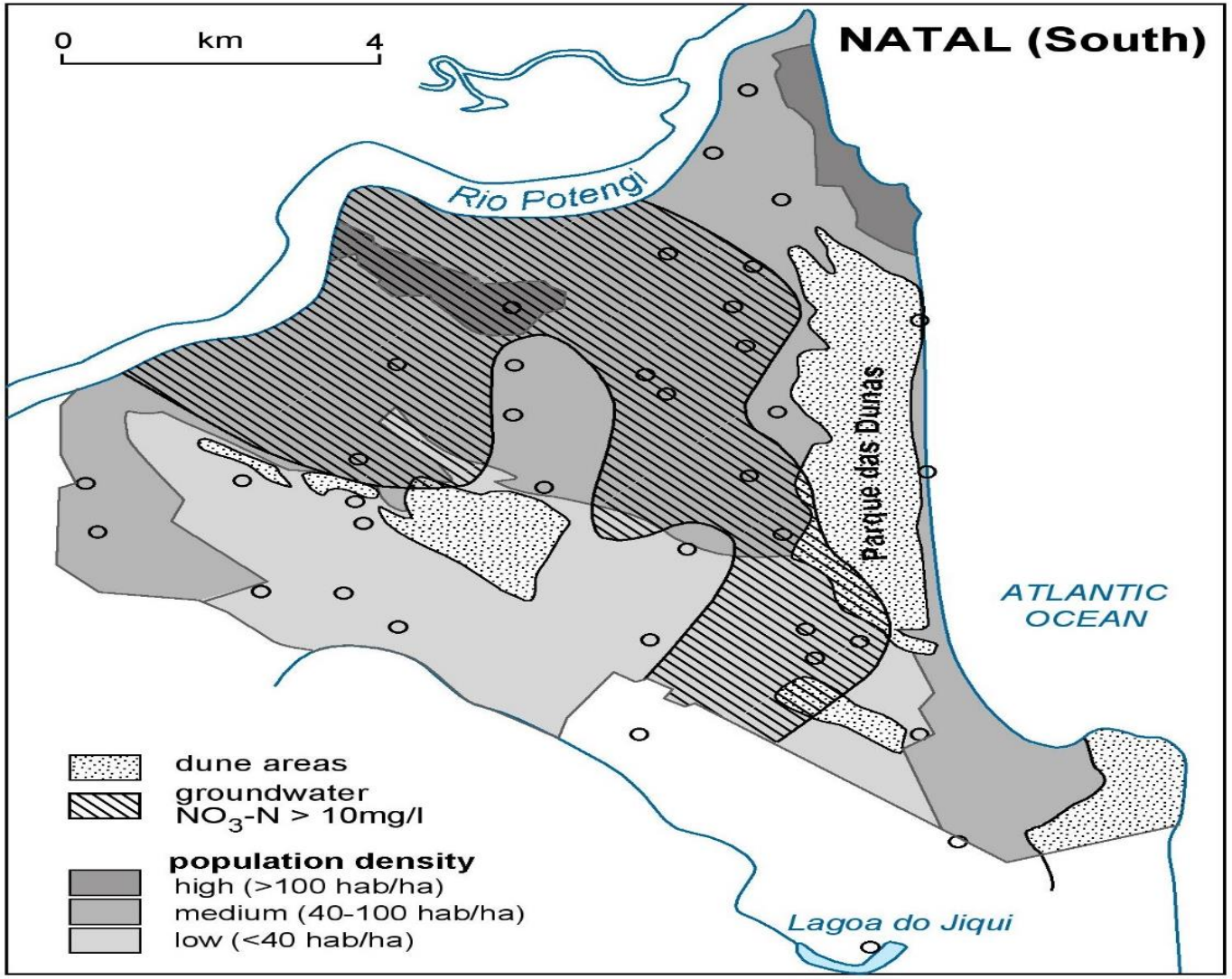
- **8,950 waterwells capable of 40 % utility water-supply production**
- **most multi-residential dwellings have high-yielding tubewells used to substitute for utility water when social tariff exceeded**
- **consequent difficulty in collecting sewerage charges until utility completed waterwell inventory**

GROUNDWATER POLLUTION THREATS IN URBAN AREAS

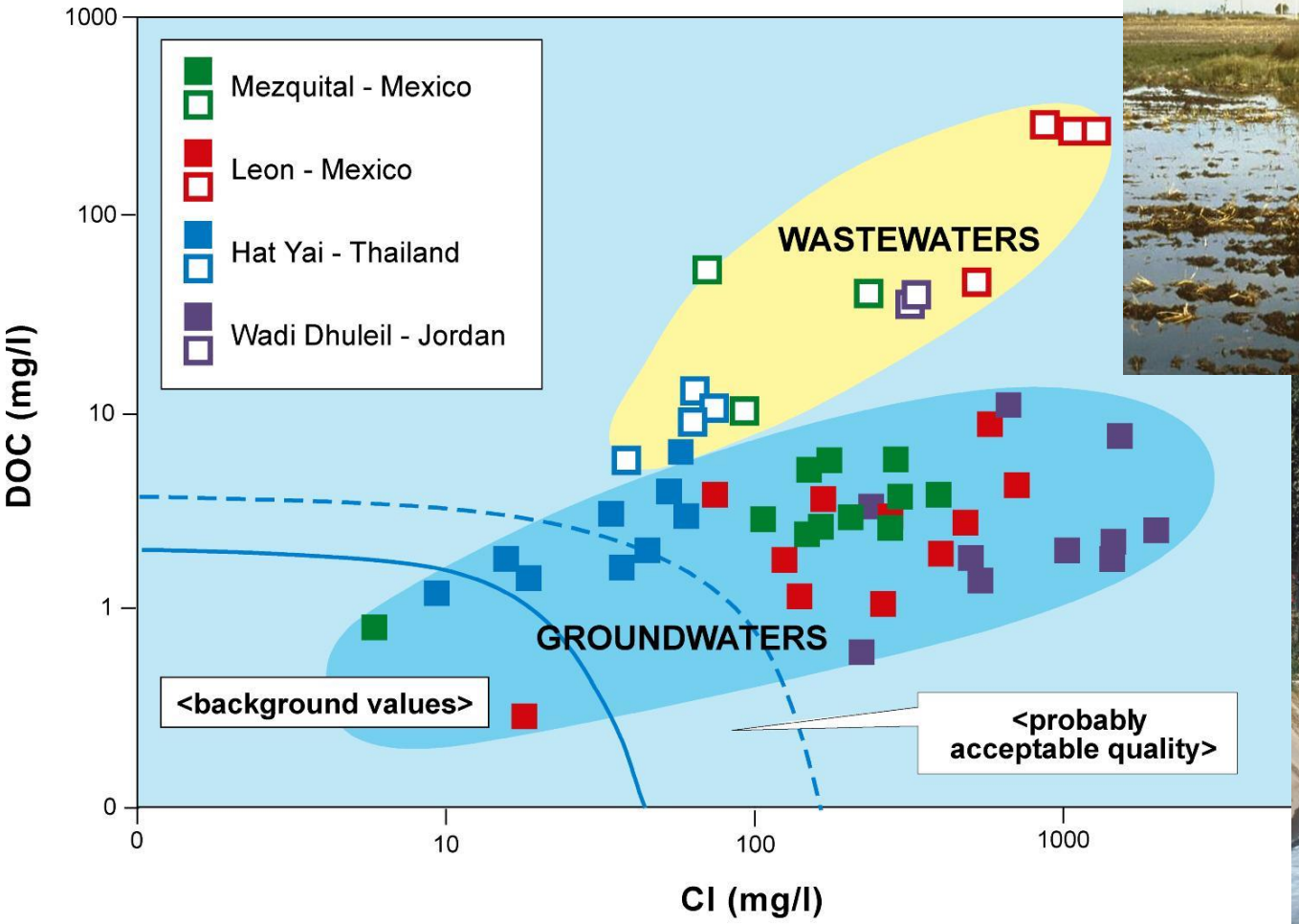
- wastewater (via in-situ sanitation, sewer leakage, wastewater reuse), industrial chemical spillage/ground disposal, and solid waste landfill
- impact varies widely with natural vulnerability of groundwater system
- in-situ sanitation at high density often results in excessive N load and FC/DOC pollution, and must be regarded as incompatible with use of shallow aquifers for drinking water-supply

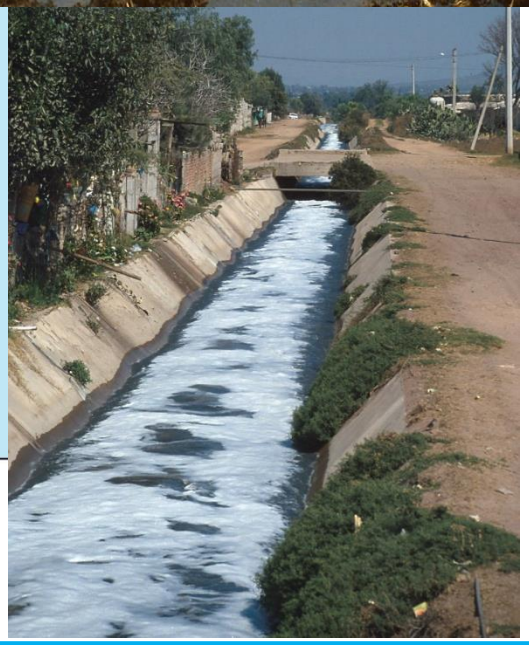


NATAL (SOUTH) – BRAZIL



GROUNDWATER POLLUTION FROM SEWAGE – 'DOWNSTREAM OF DOWNTOWN'





DEVELOPING AN INTEGRATED VISION – NEED TO SEE THE PICTURE FROM BOTH SIDES !

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THANKS FOR ATTENDING

- Stephen Foster
  IWA-GROUNDWATER MANAGEMENT SG CHAIR, University College London, UK

THE HIDDEN IMPORTANCE OF GROUNDWATER IN LATIN AMERICA

RICARDO HIRATA, UNIVERSITY OF SAO PAULO, BRAZIL

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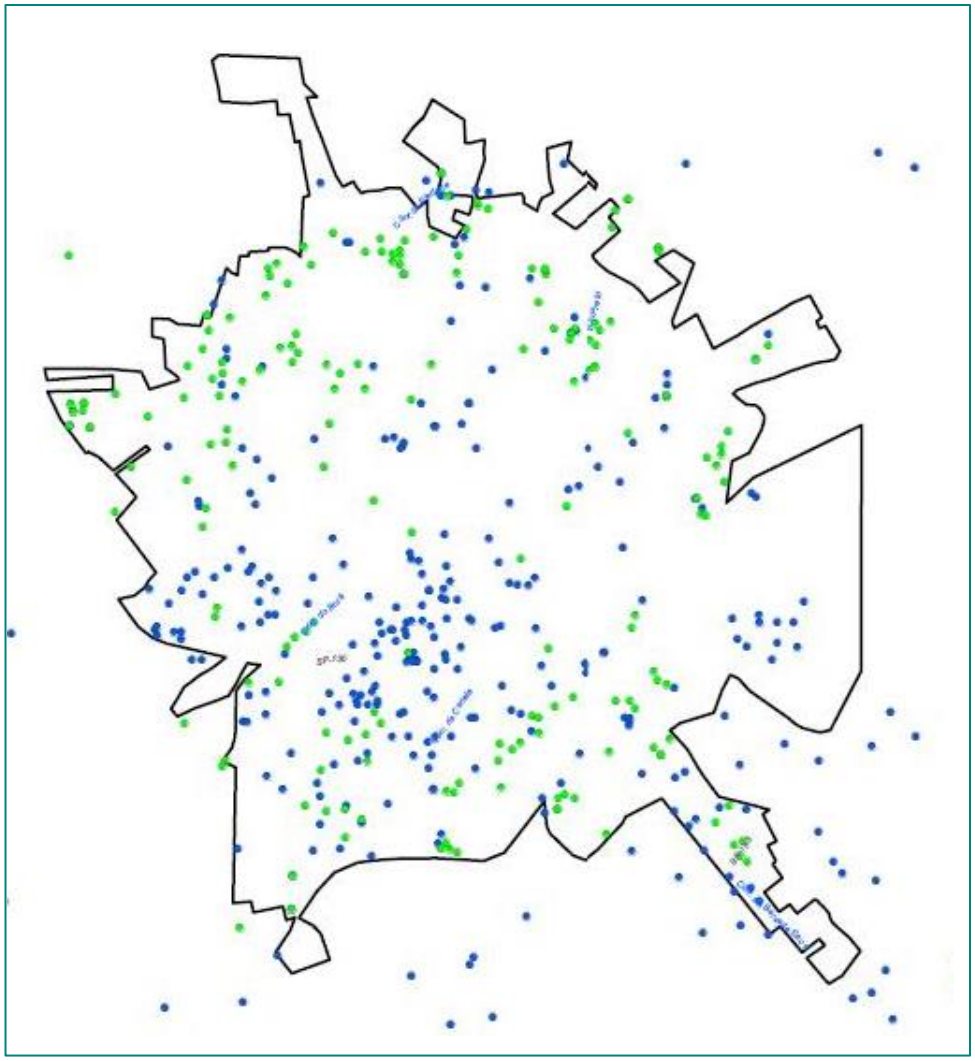
THE HIDDEN IMPORTANCE FOR LIFE

- Undoubtedly, groundwater plays a crucial role in human supply, irrigation, industry, and ecosystem services in Latin America.
- Although there are occasional problems, there is still a large groundwater availability in the Region.
- However, in Latin America, few reliable data & studies demonstrate this importance.
- With 80% of illegal or clandestine wells (countries varying between 70-90%), it is almost impossible to determine the groundwater resource's value or even propose efficient management.





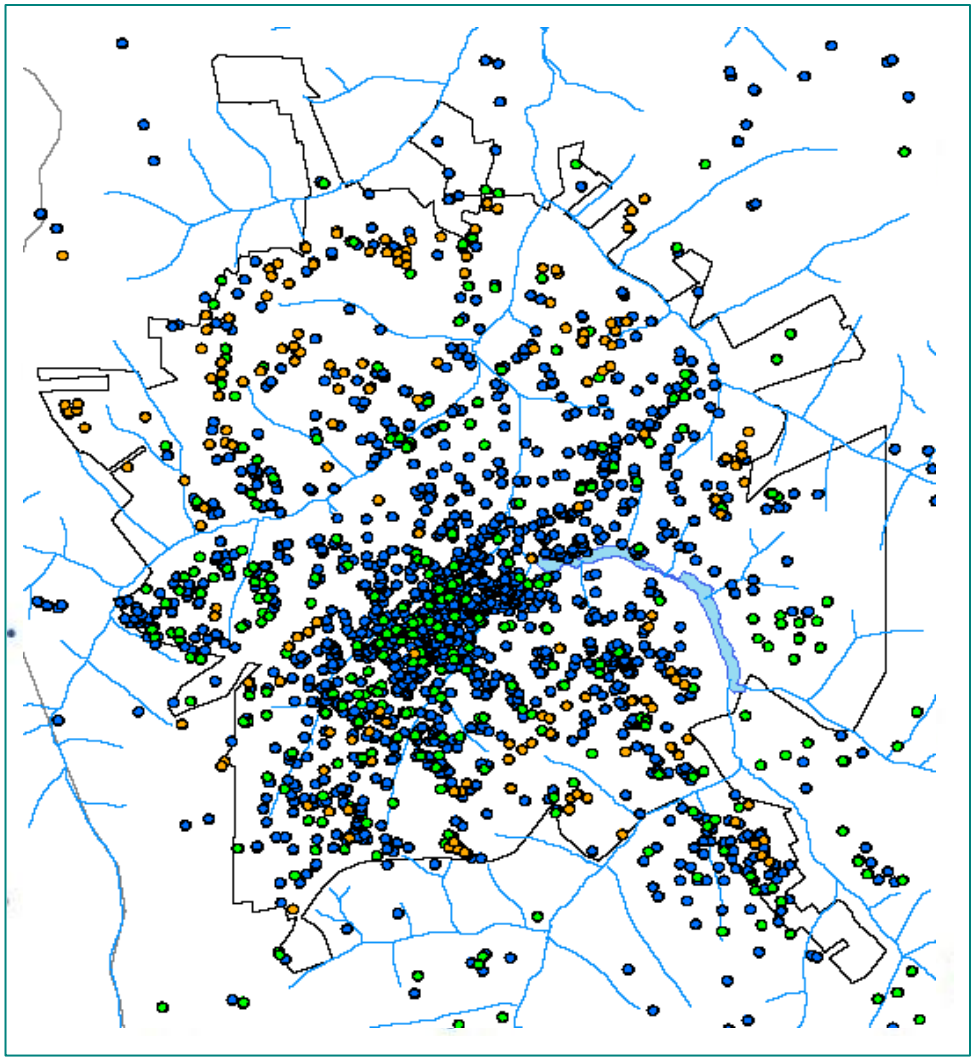


(Hirata et al 2015)

São José do Rio Preto, Brazil

Regular wells

Irregular wells



(Hirata et al 2015)

São José do Rio Preto, Brazil

Regular wells

Irregular wells

Private wells attend unofficially 30% of urban population demands

83% of the wells are irregular (no abstraction licenses)

CAUSES & CONSEQUENCES OF THIS INVISIBILITY

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- In almost all Latin America, regulations control groundwater use, but they are not effectively enforced except in a few countries (regions in Mexico, Chile, and Costa Rica).
- Local regulations are based on the concept of 'command and control', where compliance is enforced and sanctioned.
- Governments are not prepared to comply with the regulation due to poor institutional infrastructure (and political will).

METROPOLITAN REGION OF RECIFE, BRAZIL

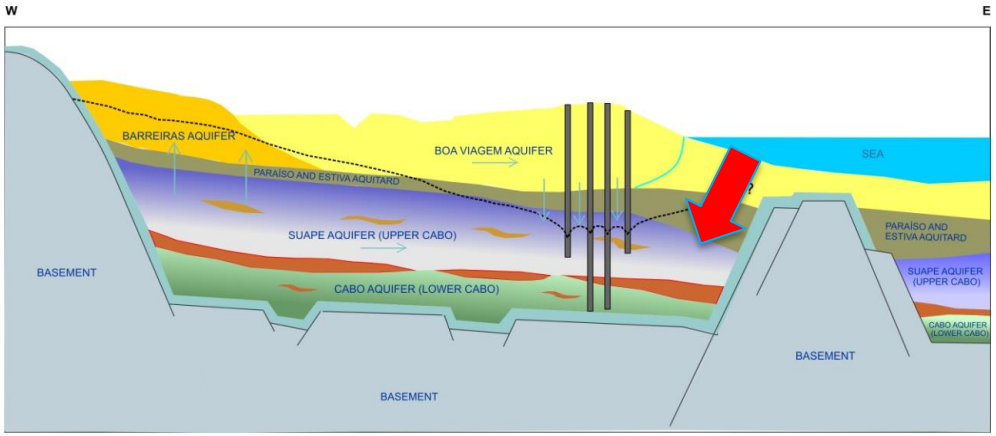
- Total population: 3.9 M inhabitants
- Public supply 10.4 m^3/s
- 87% of surface sources
- However, Recife has 13-14,000 private tubular wells and +2 m^3/s.
- So, instead of 13%, groundwater accounts for 34% of public supply.

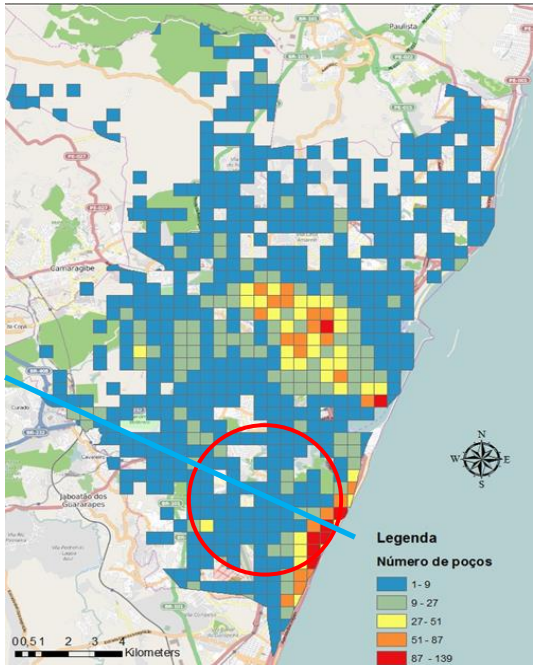
GROUNDWATER PRIVATE USE AND THEIR IMPACTS

the international water association

The Cabo (confined) Aquifer System has a modest yield (5 m^3/h/well) but **intensely explored by 13-14000 private wells**

The potentiometric level **is -90 m above sea level**, but it is not extensively affected by salinization or even contaminated





Due to intense exploitation (and hydraulic interferences), the cost has increased twice but still is 50% cheaper than the water provided by the public facility.

GROUNDWATER PRIVATE USE AND THEIR IMPACTS

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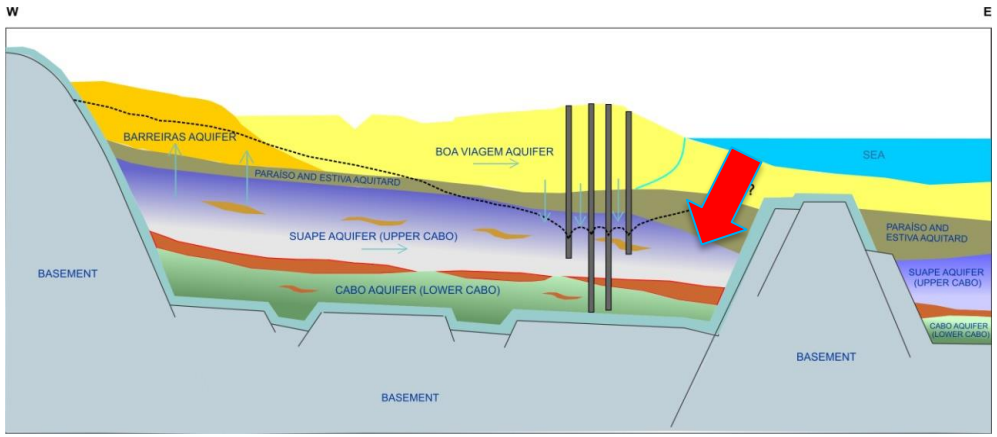

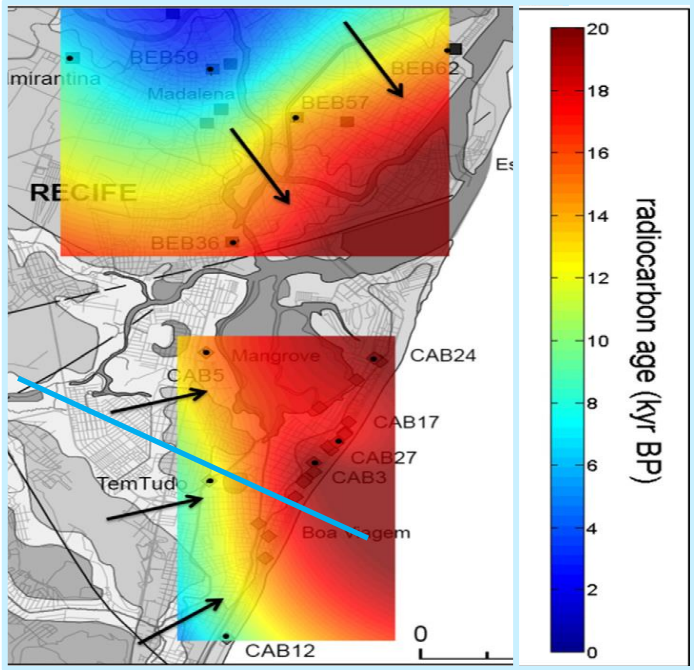

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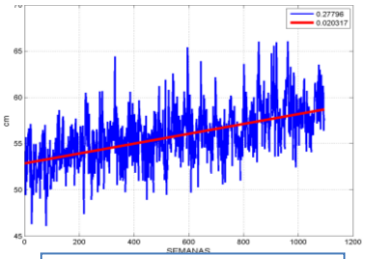
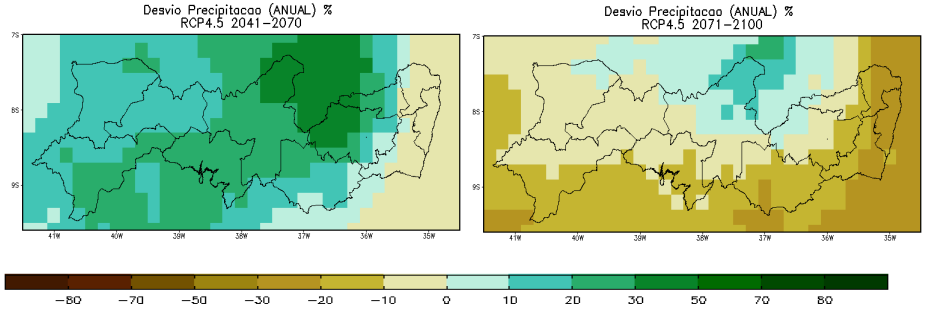
WITH A NOT VERY PROMISING FUTURE

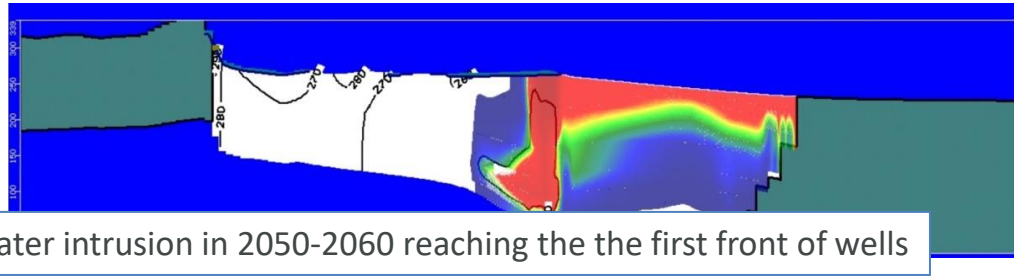
- **Global climate change** and the scenario for 2100: i) **sea-level rise + 0.8m** above the current level (Harari 2015); ii) **reduction of rainfall -20%,** impacting recharge and reducing surface water availability



Sea level up to 2100



- ModFlow + Seawat model predicts: i) **marine intrusion** of the Cabo System through the aquitard; and ii) **salinization of the Boa Viagem and Barreiras** unconfined aquifers due to the sea-level elevation and recharge reduction



Sea-water intrusion in 2050-2060 reaching the the first front of wells

COQUEIRAL PROJECT
THANKS TO:

ANR FACEPE FAPESP

WITH A NOT VERY PROMISING FUTURE

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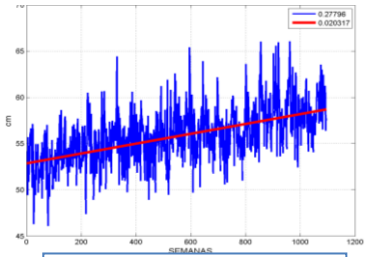

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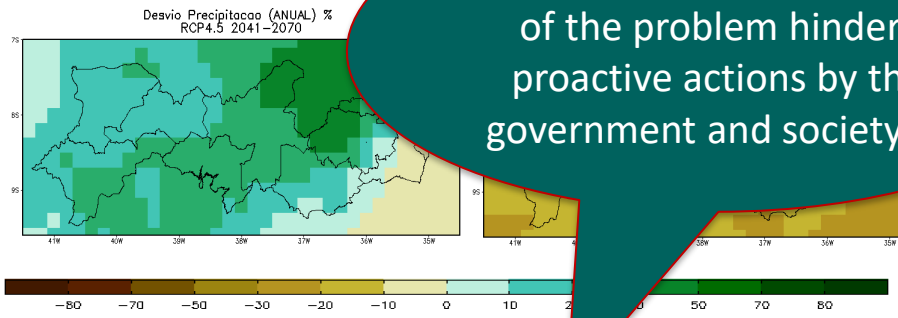
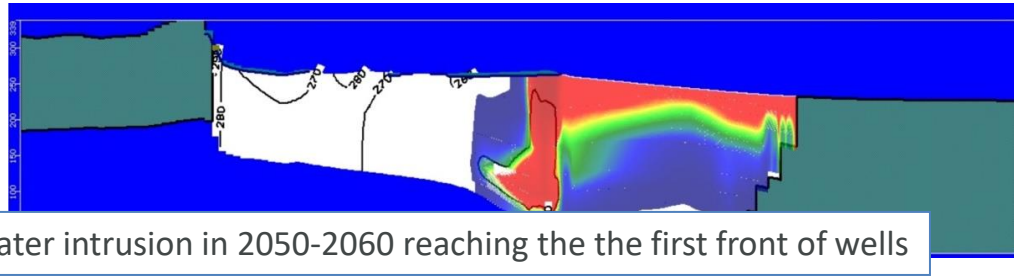


The delay in the perception of the problem hinders proactive actions by the government and society.....

- ModFlow + Seawat model predicts: i) **marine intrusion** of the Cabo System through the aquitard; and ii) **salinization of the Boa Viagem and Barreiras** unconfined aquifers due to the sea-level elevation and recharge reduction



Sea-water intrusion in 2050-2060 reaching the the first front of wells

COQUEIRAL PROJECT
THANKS TO:
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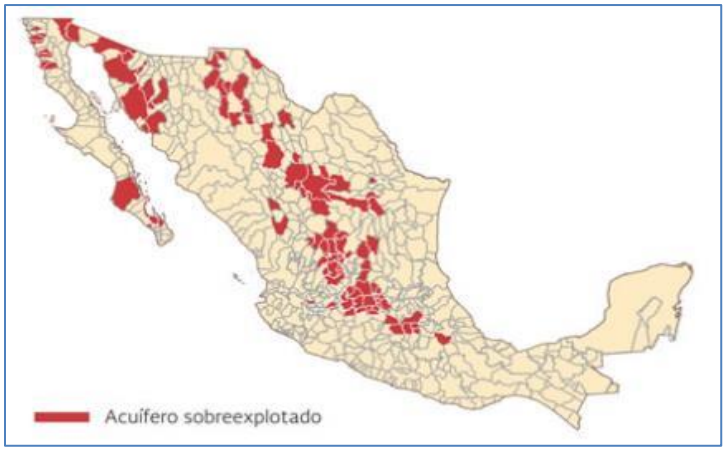
SEEKING SOLUTIONS

- Prioritize groundwater protection actions starting with the most critical areas (more groundwater use and/or dependence, conflicts), investing in more appropriate control mechanisms



- Restriction of groundwater uses in aquifers declared overexploited by Mexican federal government

SEEKING SOLUTIONS

- Low perception of groundwater relevance and dependence (hidden in private, individual and illegal well use) in Latin American cities has led to a lack of groundwater protection policies or enforcement of existing laws
- Bring visibility to groundwater through studies of its socio-economic and environmental dependence, opportunity, and value

SEEKING SOLUTIONS

- Create training programs for professionals in hydrogeology through formal courses (creating specific disciplines in the university courses) and informal courses (government and social associations)
- Create mechanisms to involve users in management, offering services or advantages to be legal



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Thanks for your attention!

RICARDO HIRATA

GROUNDWATER RESEARCH CENTER
UNIVERSITY OF SÃO PAULO, BRAZIL

rhirata@usp.br

CEPAS IGc·USP

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IMPORTANCE OF GROUNDWATER IN INDIA

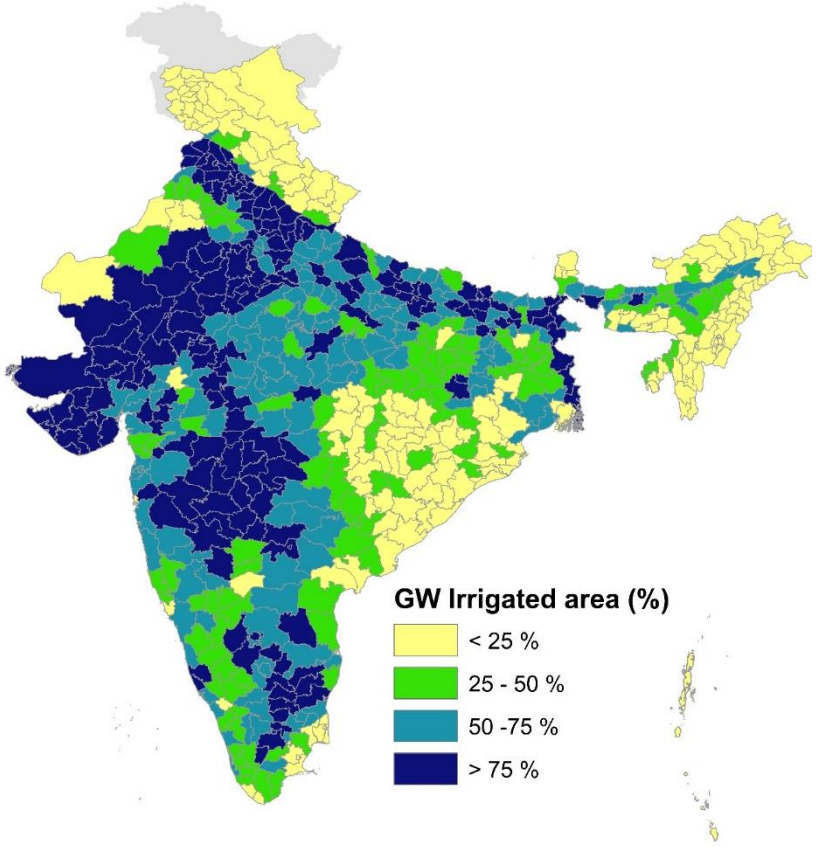
FAIZ ALAM, IWMI, INDIA

International Water Management Institute

inspiring change

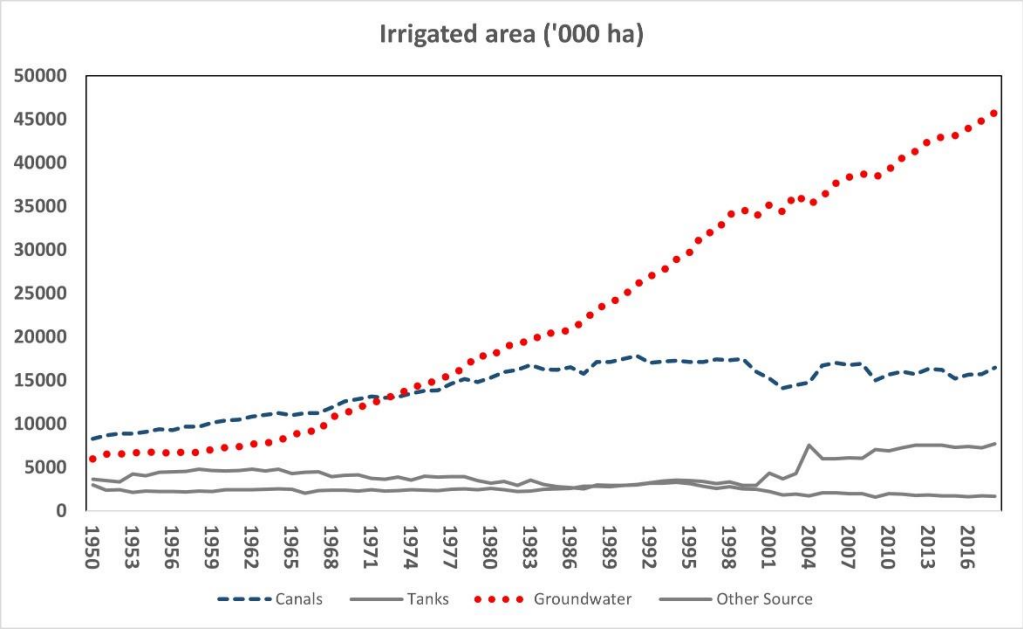
GROUNDWATER USE IN INDIA

- 250 billion cubic meters
  - Largest user in the world
- ~ 85 % for Agriculture and 15 % for domestic and industrial use
- ~ 25 million groundwater pumps
- Groundwater irrigation ~ 10 % of India's gross domestic product, 70–80 % of the farm value output



AGRICULTURE: GW CONTRIBUTION TO IRRIGATED AREA INCREASED FROM 29 % IN 1950-51 TO 63 %

- Net irrigated area increased from nearly 18% in the early 1960s to about 48% in recent times.
- Instrumental in the success of the Green Revolution in India.
- Advent of modern drilling and pumping technologies, government policies through subsidies, and rural energy supplies.
- GW structures increased from 11.4 million in 1986-87 to about 24 million.



GROUNDWATER: Critical for Drinking water security

85-90% of rural India depends on groundwater for its drinking water

At least half of urban India relies on GW for its drinking water

Inadequate coverage and depleting GW resources and quality deterioration

GROUNDWATER: THE BLIND SPOT IN URBAN WATER PLANNING

- Critical, but understanding of groundwater in urban India is extremely limited
- Reliable data on magnitude of groundwater use is limited
- Proliferation of private groundwater well
  - Remains invisible in utility planning and management

Profiles of 10 selected cities worldwide

Link to publication: https://www.mdpi.com/2073-4441/14/4/575

WHY INCREASED RELIANCE ON GW IRRIGATION?

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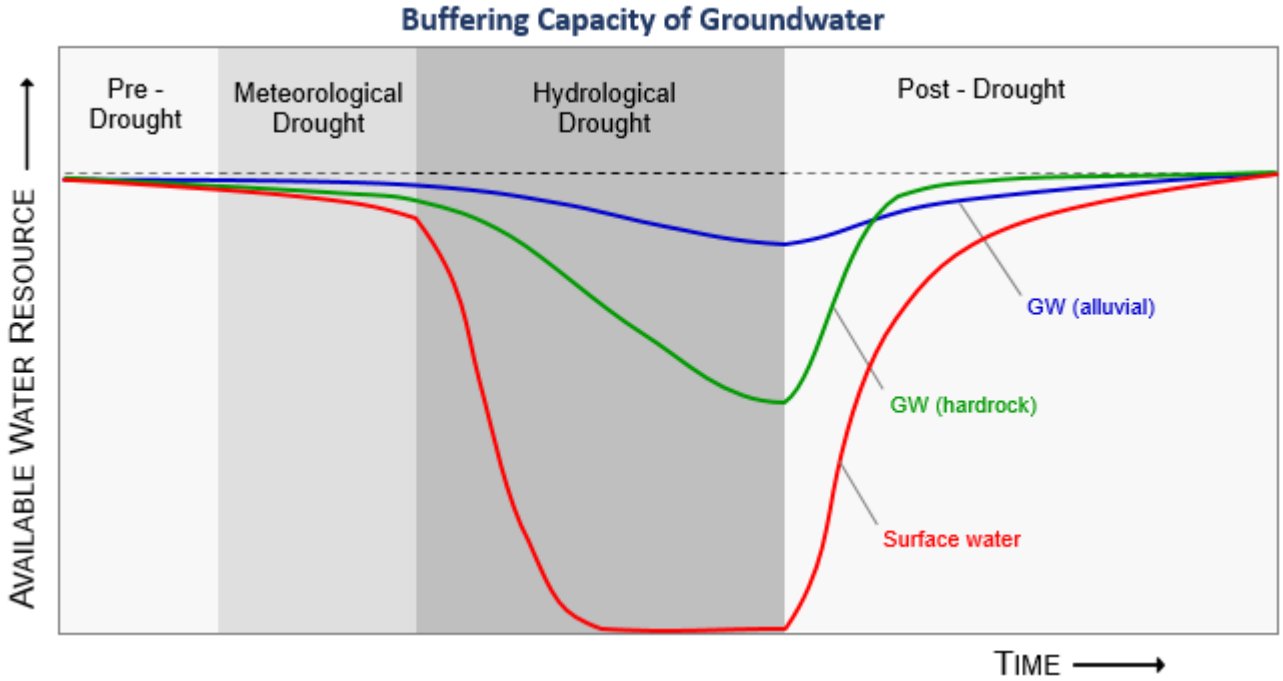
High Buffering capacity

More control and reliability

Policy incentives

Relatively large storage

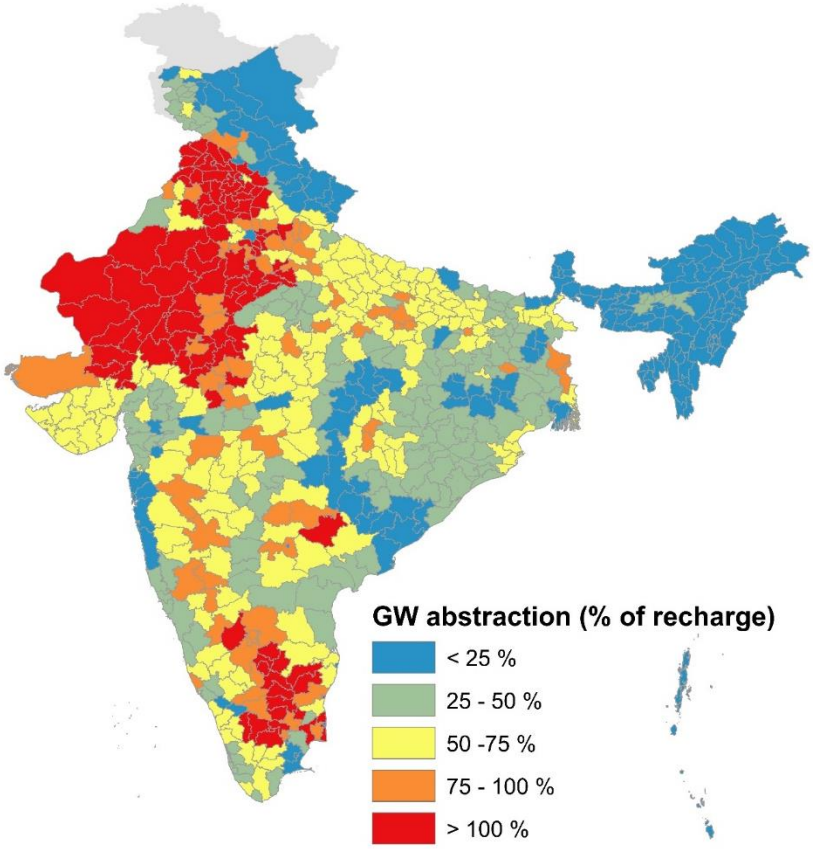
Less susceptibility to evaporation



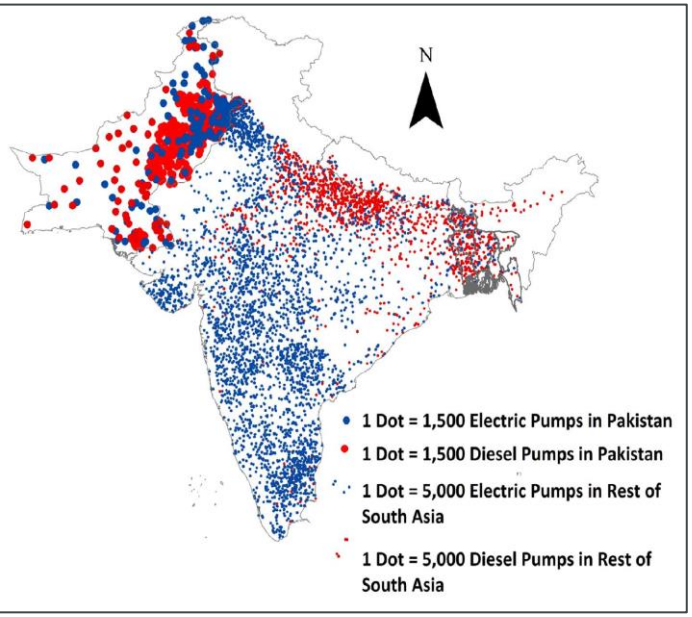
Source: Adaptzaed from Calow et al. (1997)

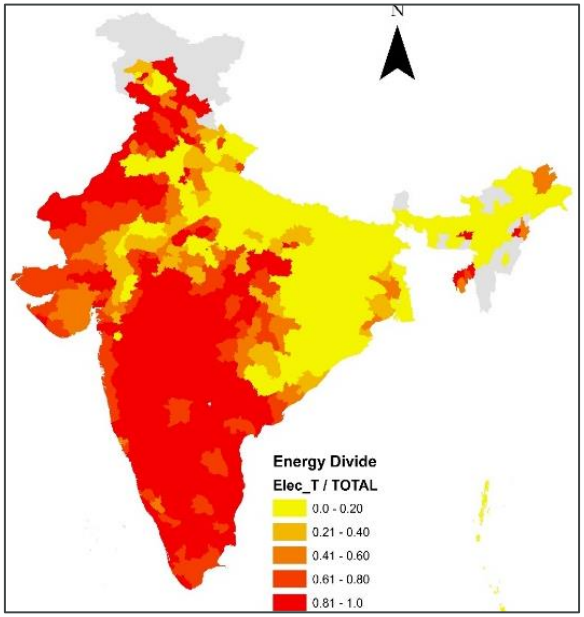
GROUNDWATER IS OVEREXPLOITED

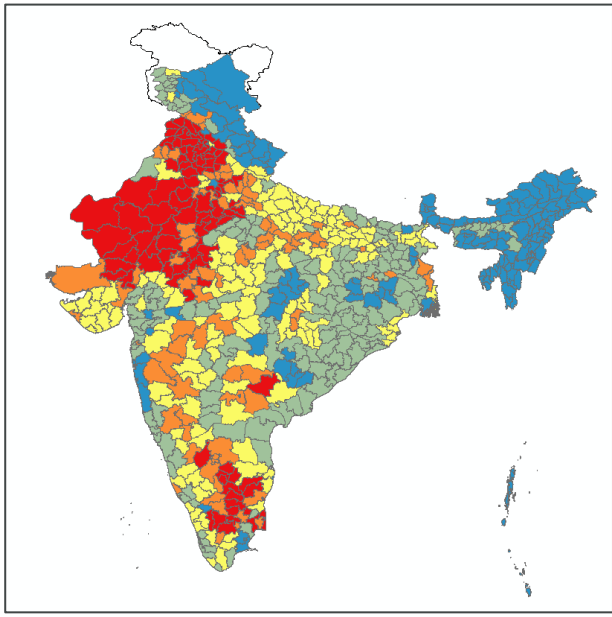
- Serious risk of aquifers being overexploited
- 17% overexploited and 5 % critical
- Unsustainable groundwater abstraction produces enough food to feed 173 million people (Zaveri *et al.*, 2016).
- Without any adaptations cropping intensity may decrease by 20% in India and by 68% in groundwater-depleted regions (Jain *et al.*, 2021)
- Increase water insecurity in cities and conflicts



MANAGING THE GW-ENERGY: NEXUS







- 24 m+ groundwater structures
- >80% electric pumps in west and south India and <20% electric pumps in east and north-east India
- Western and Peninsular India faces groundwater depletion

INNOVATIVE SOLAR IRRIGATION PROGRAM: MANAGING GW-ENERGY NEXUS

- Grid-connected solar pump pilot program - Tariff for selling energy to grid – quality energy, conserve energy and source of farm income.

Farmers would generate solar electricity, and inject generated electricity into grid and can draw electricity from grid for pumping

Revenue calculated from net evacuation is credited to farmer after EMI deduction

Rs. 3.50 / kWh, feed-in tariff by DISCOM + 3.50 /kWh, evacuation-based incentive (subsidy) by Govt. up to maximum of 1,000 kWh /hp/year

INDIA FOCUSING ON MAR

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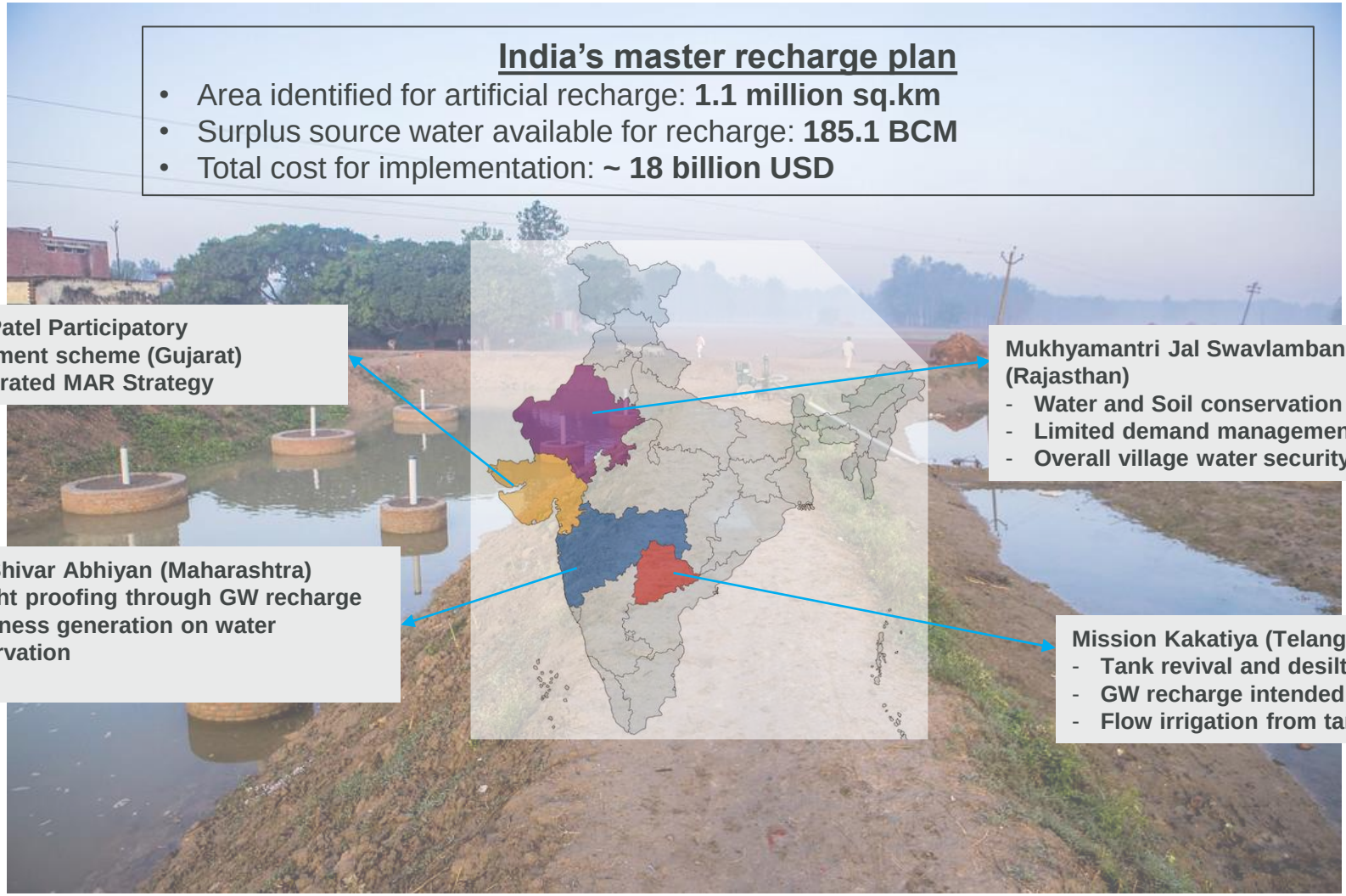

India's master recharge plan

- Area identified for artificial recharge: **1.1 million sq.km**
- Surplus source water available for recharge: **185.1 BCM**
- Total cost for implementation: **~ 18 billion USD**

Sardar Patel Participatory management scheme (Gujarat)
- **Integrated MAR Strategy**

Mukhyamantri Jal Swavlamban Abhiyan (Rajasthan)
- **Water and Soil conservation structures**
- **Limited demand management**
- **Overall village water security**

Jalyukt Shivar Abhiyan (Maharashtra)
- **Drought proofing through GW recharge**
- **Awareness generation on water conservation**

Mission Kakatiya (Telangana)
- **Tank revival and desiltation**
- **GW recharge intended**
- **Flow irrigation from tanks**

CONCLUSION

- Groundwater is critical important for India's economy and food security
- Large reliance is leading to unsustainable groundwater abstraction
- Govt programmes and policies focusing but managing this GW-Food-Energy nexus is challenging
  - Effectiveness of same remains to be seen
- GW critical but remains invisible in urban areas
  - Need for stocktaking and holistic management

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Thanks

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inspiring change

the international water association

THE VALUE OF GROUNDWATER TO AFRICA

JULIA GATHU, DRILLING FOR LIFE, KENYA

inspiring change

KEY ASPECTS

- Groundwater is a major source of drinking water in many parts of Africa.
- Groundwater is highly depended upon for domestic water supply, rural livelihoods, livestock rearing and agricultural practices in most of Africa.
- The presence of successful water wells equipped with reliable pumps allow for the functioning of settlements, clinics, schools and livestock posts.
- Private groundwater abstraction is increasingly becoming popular despite the high cost associated with drilling and equipping of boreholes.
- Water utilities have a key role to play in managing groundwater if this resource is to contribute fully to water security in the face of climate change.

GROUNDWATER FOR RURAL LIVELIHOODS

Accessible groundwater means IMPROVED LIVELIHOODS for families.

Women do not have to walk several kilometers many hours a day in search of water.

They can use the newly found extra time to earn a livelihood for their family.

GROUNDWATER FOR RURAL LIVELIHOODS

- A lot of these rural communities also greatly rely on cattle for their livelihood.
- Groundwater ensures that rural and pastoralists communities can coexist, reducing incidences of banditry attacks over cattle rustling and water conflicts.

GROUNDWATER FOR FOOD SECURITY

- Accessible groundwater means that communities can grow their own food without over reliance on seasonal rains that may or may not come
- Groundwater mitigates against effects of prolonged drought that is common in many arid and semi arid parts of Africa

GROUNDWATER FOR IMPROVED HEALTH

- Accessible groundwater means improved health for remote rural communities
- Health centers located in remote areas where utilities cannot reach rely on groundwater for the running of the hospitals

GROUNDWATER FOR EDUCATION & HYGIENE

Accessible groundwater means BETTER EDUCATION for school going children who now have the time to fully focus on their studies and growth and development.

It also means BETTER MANAGEMENT OF MENSTRUAL HYGIENE for girls and ensures reduced incidences of school girls missing school

PERIMENOUPSAL WOMEN are also protected from social stigma when they have sufficient water for hygiene

GROUNDWATER FOR IMPROVED SANITATION

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Accessible groundwater also means IMPROVED SANITATION facilities for PERIURBAN DWELLERS

It also enables peri-urban dwellers access improved sanitation facilities. With availability of water they can construct sustainable better sanitation facilities

STAKEHOLDERS PLAY A KEY ROLE

- Government subsidies on solar equipment in Kenya has made motorized boreholes more accessible
- International donor organizations have continued to play a key role in funding for community projects. Otherwise most communities would not be able to access groundwater
- Increased penetration of private contractors has helped to lower the cost of drilling therefore making groundwater more accessible
- Manufacturers and suppliers of borehole and pump equipment have also increased in recent years thus playing a role in sustainability of groundwater projects as spare parts are more readily available

COMPARISON WITH WEST AFRICA

- The cost of constructing a water well is much cheaper in West Africa as compared to East Africa mainly because water levels are much shallower in West Africa.
- In Nigeria for example, the maximum depth for a borehole is 150m in most cases while in Kenya most boreholes will range at 200 – 300m depth
- Costs of drilling a water well in Nigeria range at upwards of 1500USD while in Kenya you need at least 10,000USD to drill a 200m borehole without the pumping equipment.
- Associations play a big role in both regions in self regulating the industry and weeding out irregular unprofessional contractors.

GROUNDWATER FILLS THE GAP IN SDG6

- Many African Countries are still lagging behind in meeting the various targets of SDG 6 especially access to basic and safe drinking water
- Groundwater is the invisible resource needed in bridging this gap

IT'S TIME TO MAKE THE INVISIBLE VISIBLE!

REFERENCES – IWA GW SG PUBLICATIONS:

- Groundwater quality management for urban water supply security – Issue 19 (2020) – pg45-49 Foster et al
- Climate change : the utility groundwater role in supply security – April 2020 – pg50-54 Foster et al
- Policy priorities for the boom in urban private wells – Oct 2019 – pg54-57 Faiz & Foster
- Urban groundwater – mobilizing stakeholders to improve monitoring –March 2019- pg58-62 Foster, Gogu & Gathu
- Groundwater Development in Sub-Saharan Africa - A Strategic Overview of Key Issues and Major Needs - GW.MATE Sept 06 – Foster, Tuinhof & Garduno

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THANKS FOR ATTENDING!

JULIA GATHU

IWA GROUNDWATER MANAGEMENT SG SECRETARY

DRILLING FOR LIFE, OPERATIONS MANAGER

Drilling for life

inspiring change

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SUSTAINABLE PRODUCTION OF DRINKING WATER BASED ON CLEAN GROUNDWATER

TROELS KÆRGAARD BJERRE, VCS DENMARK, DENMARK

VCS Denmark

inspiring change

CLIMATE CHANGE IMPACT ON PRECIPITATION PATTERN IN EUROPE

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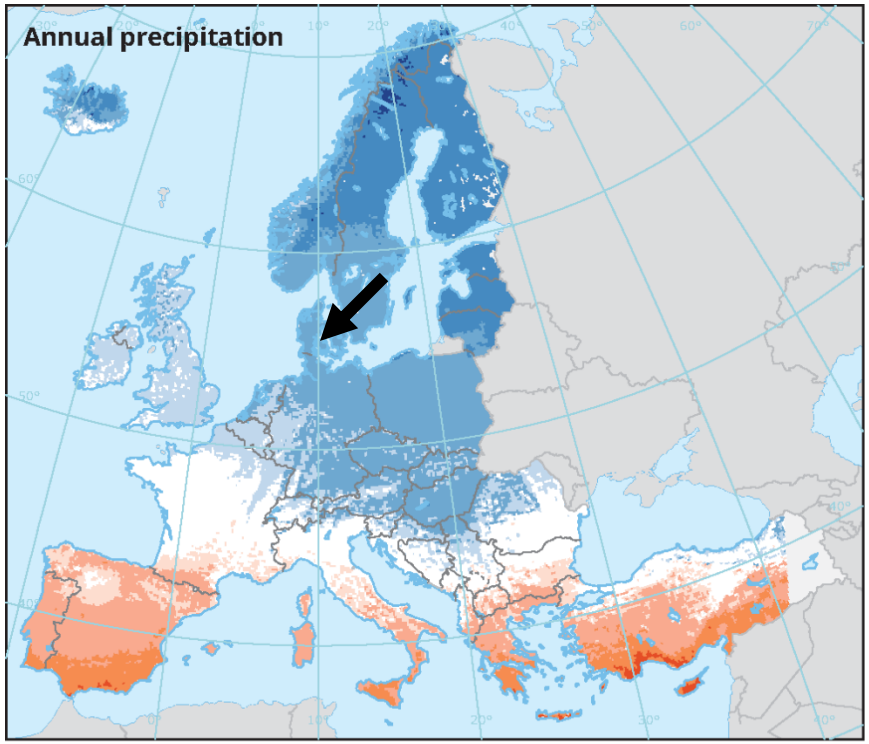
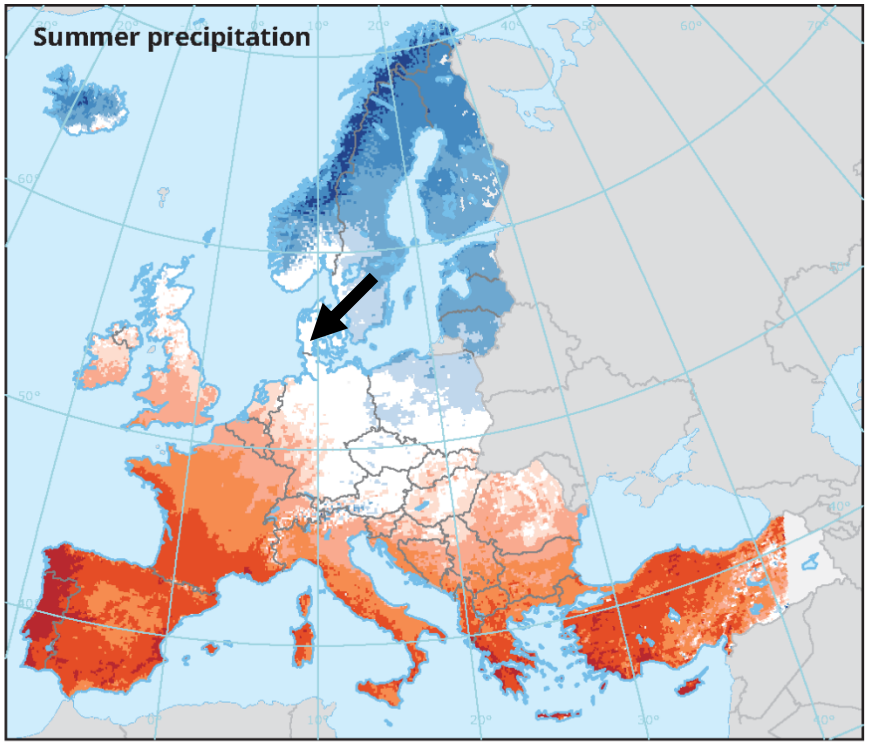




Projected change in annual and summer precipitation, 2071-2100

% < -40 -40 to -30 -30 to -20 -20 to -10 -10 to -5 -5 to 5 5 to 10 10 to 20 10 to 30 > 30

No data

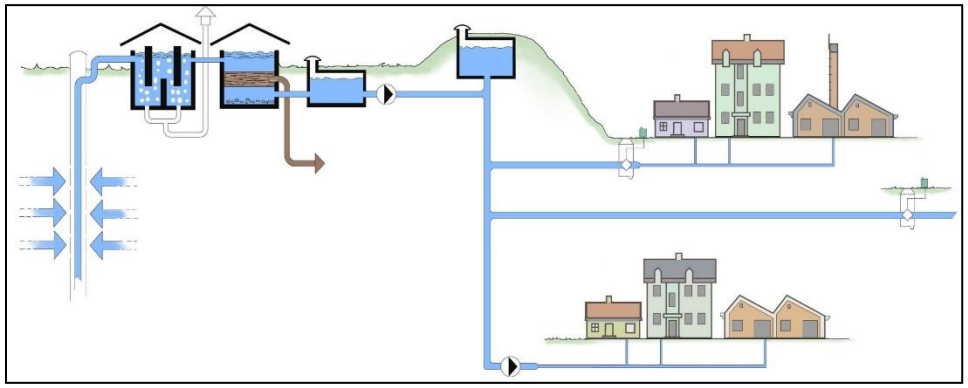
Outside scope

0 500 1000 1500 km

Reference: European Environment Agency

DRINKING WATER SUPPLY IN DENMARK

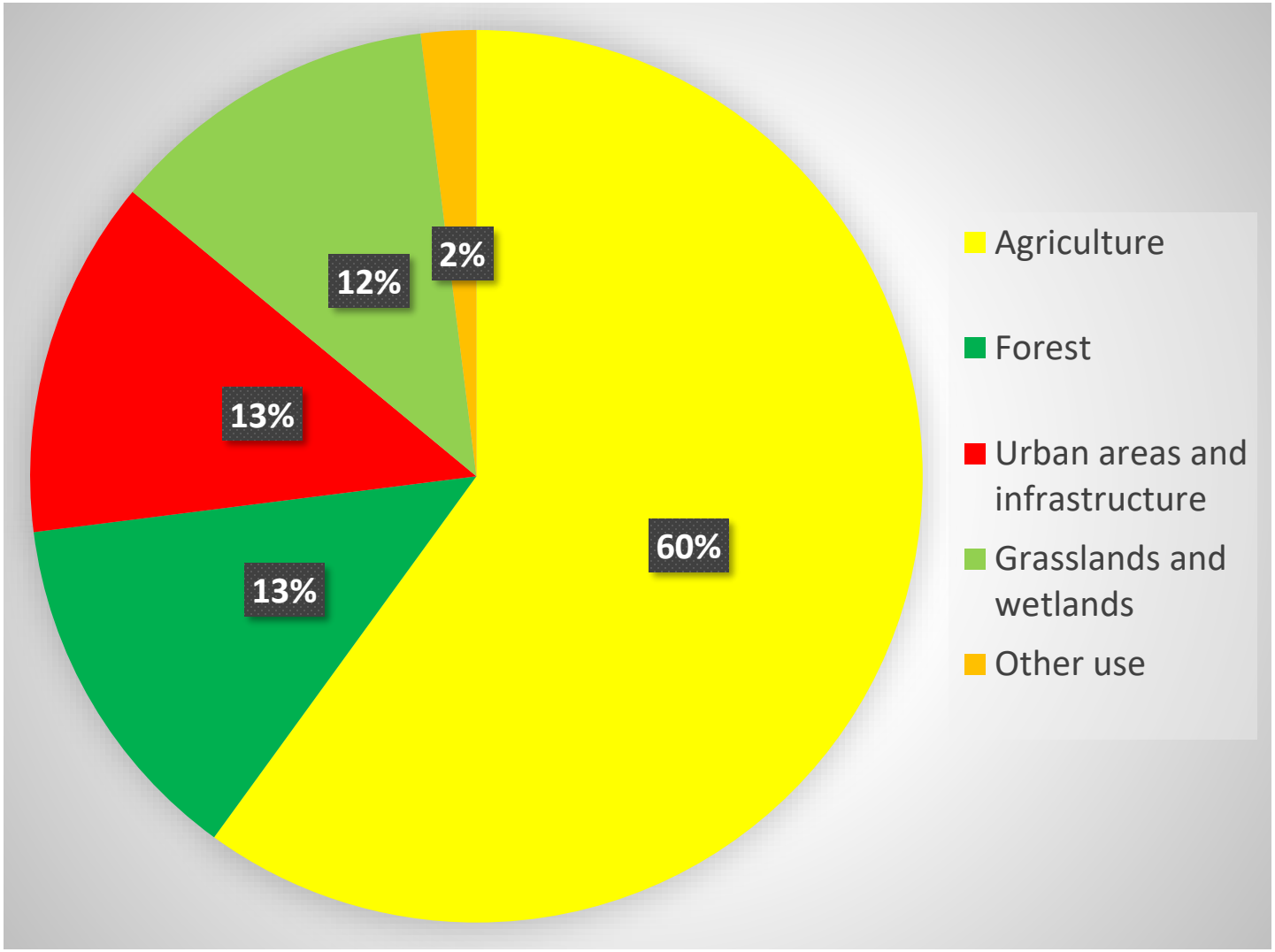
- Based on groundwater (100%)
- No abstraction without permission since 1926 (concession system)
- Decentralised (appr. 2.600 water utilities)
- Simple water treatment (aeration and sand filtration)
- Total drinking water production: 400.000.000 m^3/year
- Water consumption: 100 liters/person/day



NATIONAL DRINKING WATER POLICY

"Production of drinking water should be based on clean ground water – no advanced treatment"

LANDUSE IN DENMARK (2018)



PESTICIDES IN ABSTRACTION WELLS

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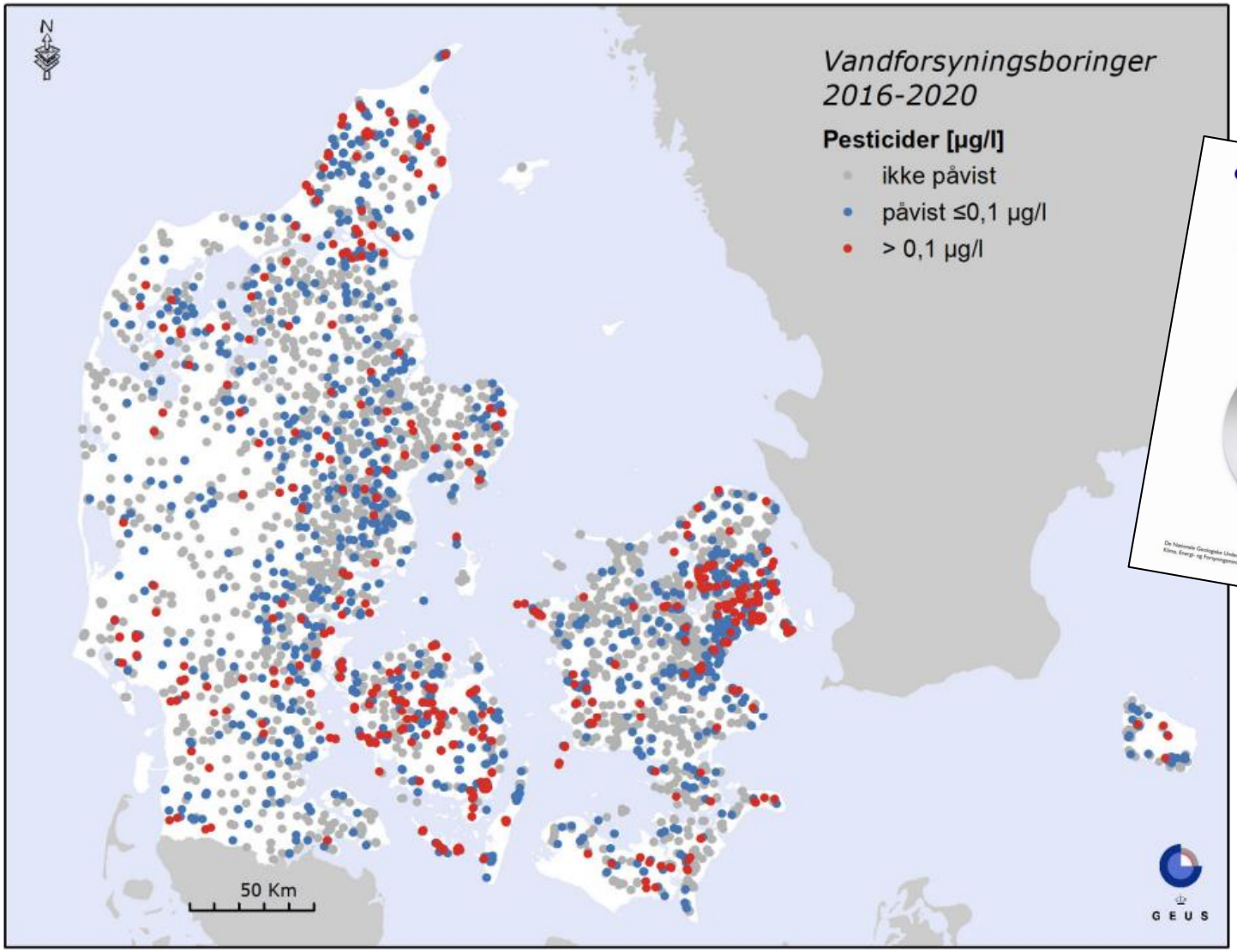

GROUNDWATER PROTECTION

Danish environmental regulation + targeted measures

ACTION PLANS FOR GROUNDWATER PROTECTION

- National hydrogeological investigation of the groundwater ressources
- Covers appr. 40 % of Denmark
- Financed by tax on drinking water
- From 1999 - 2020: 320 mill. €
- Municipal action plans for groundwater protection
- Targeted measures

VCS DENMARK

- The first public water utility in Denmark
- Located in the city of Odense
- One of the largest water utilities in Denmark
  - ✓ Production and distribution of drinking water
  - ✓ Disposal and treatment of wastewater
  - ✓ Storm water management
- A corporate utility company owned by the municipality - nonprofit and full cost recovery
- Our main challenges?

OUR MAIN CHALLENGE IN THE PAST

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PRODUCTION OF DRINKING WATER: BEFORE 1988

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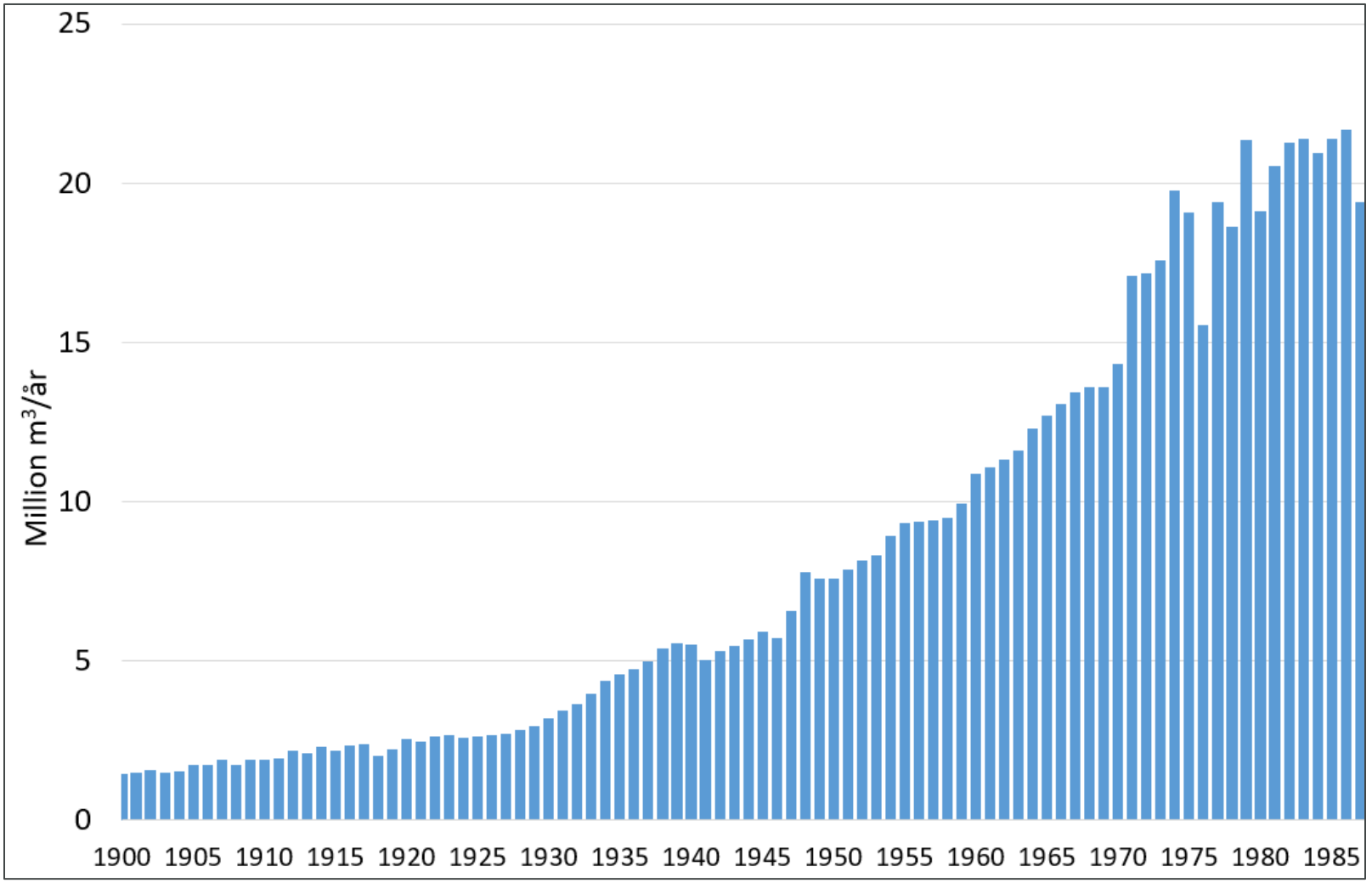
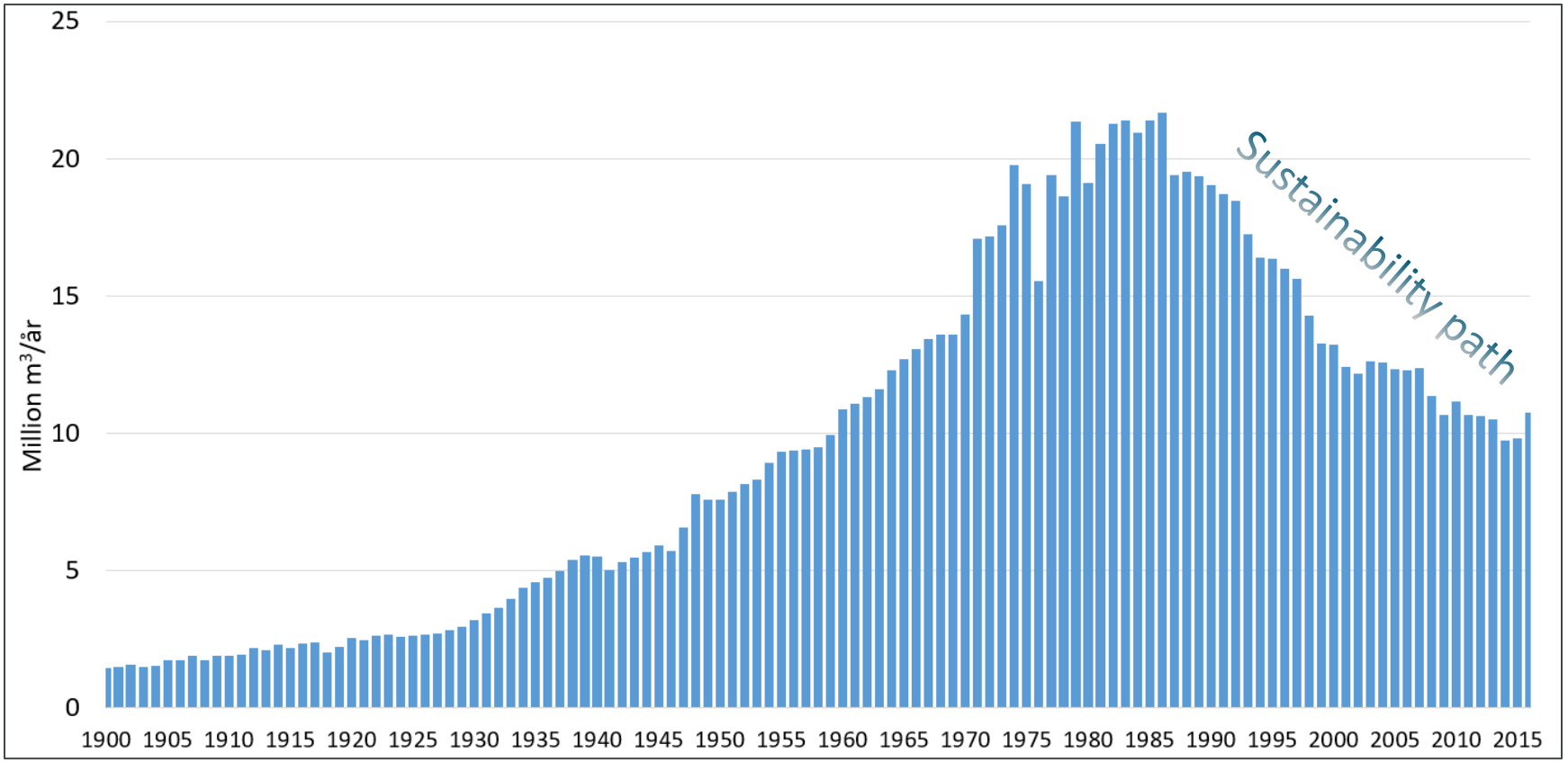


PRODUCTION OF DRINKING WATER: AFTER 1988



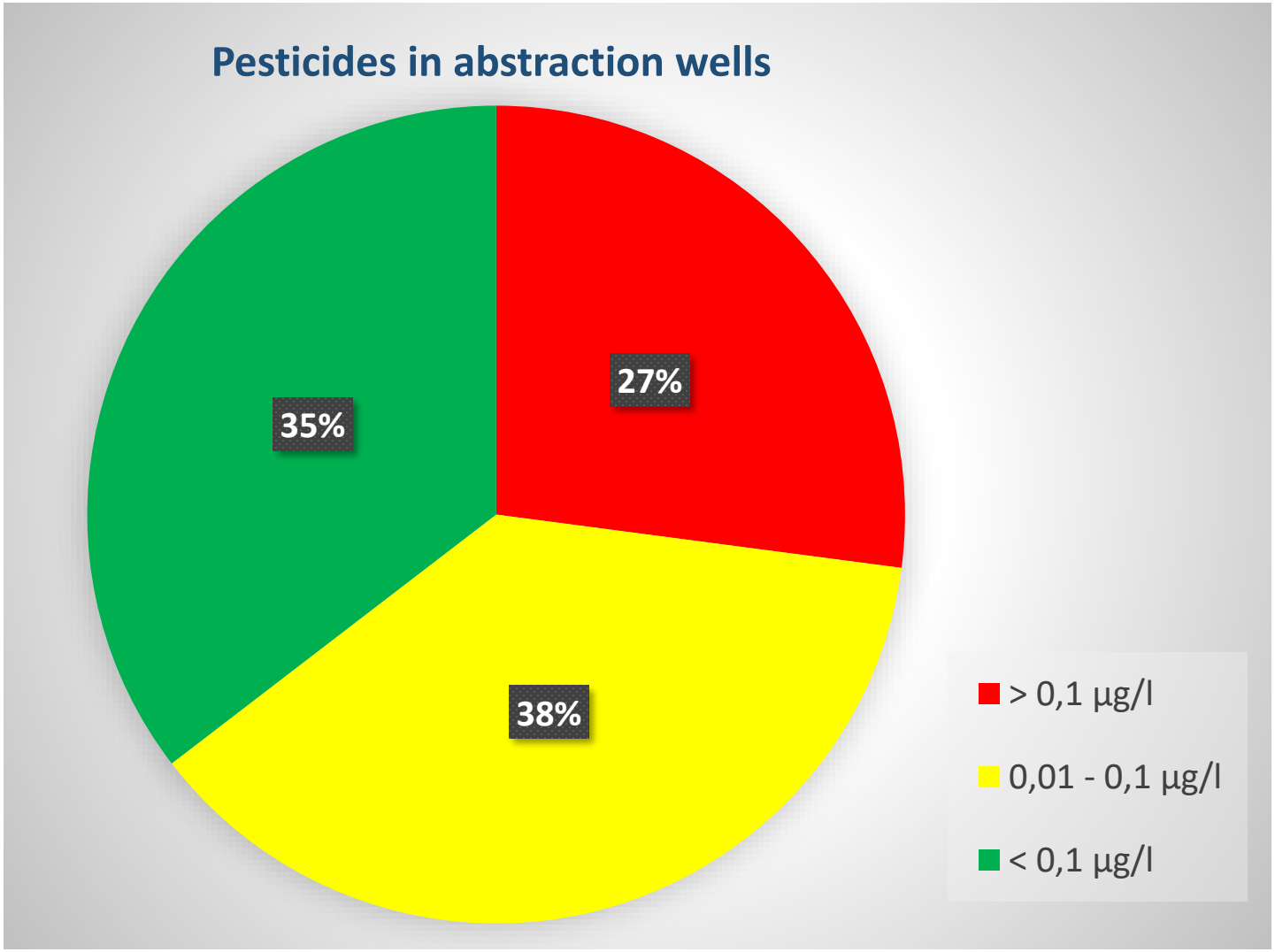
ENERGY INTENSITY OF PRODUCTION (EXCL. SCOPE 3)

	Energy consumption	Carbon footprint
Abstraction	0,09 kWh/m^3	0,013 kg CO_2e/m^3
Treatment	0,16 kWh/m^3	0,024 kg CO_2e/m^3
Destribution	0,05 kWh/m^3	0,007 kg CO_2e/m^3
Total	0,30 kWh/m^3	0,044 kg CO_2e/m^3

That is not a lot!!

”LESS IS MORE (SUSTAINABLE)”

OUR MAIN CHALLENGE TODAY



THE STRATEGY OF VCS DENMARK

”Drinking water production based on clean groundwater in 2050”

OUR ACTIONS TAKEN

- Wellfield management
- Sustainable groundwater abstraction
- Alternative ressources
- Advanced water treatment
- Groundwater protection

GROUNDWATER PROTECTION: OUR TARGETED MEASURES

- Joint financing of state, municipal and private funded afforestation
- Agricultural land use agreements
- Plugging of old and unused wells
- Public awareness campaigns
- …
- …

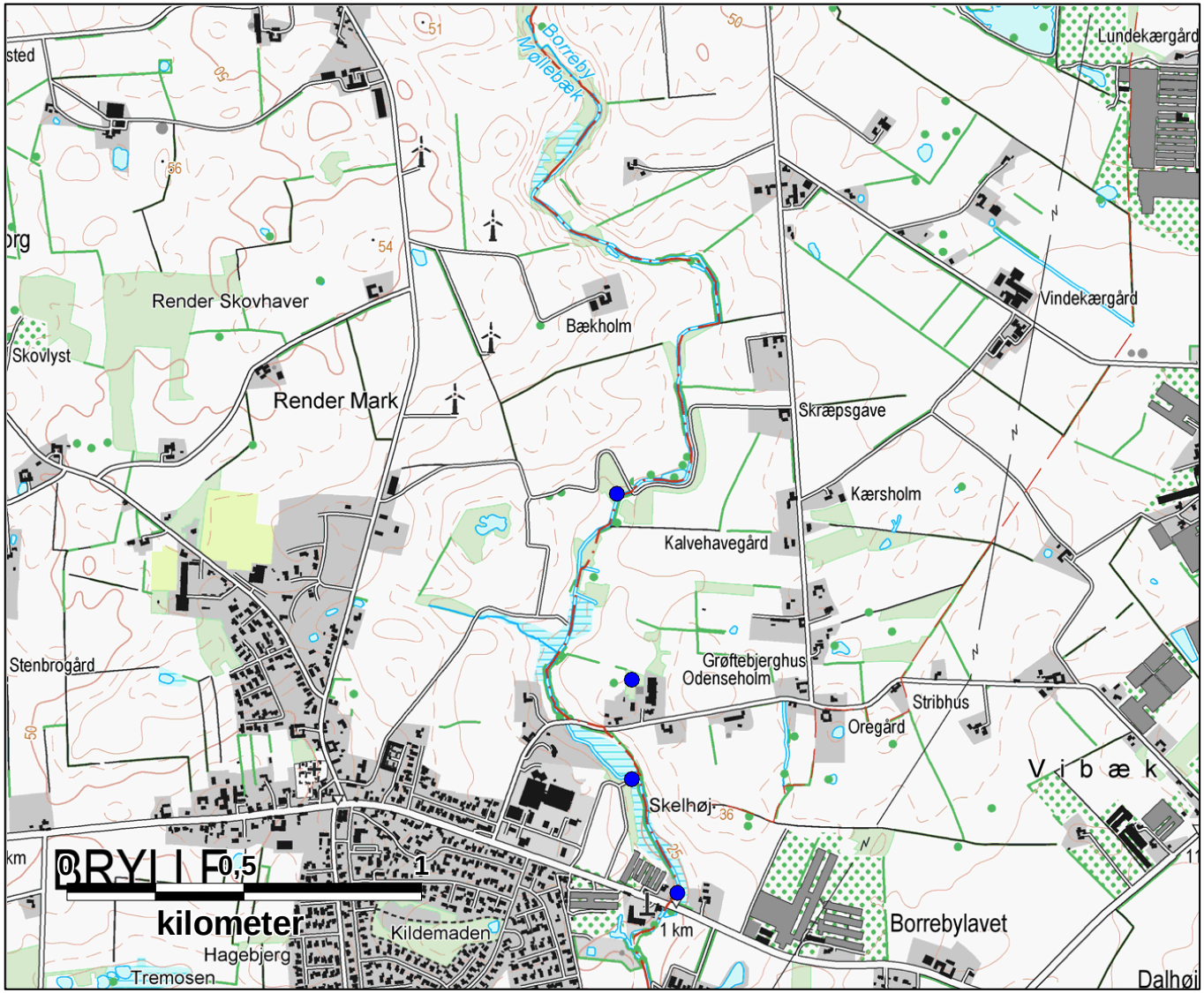
WHY AFFORESTATION?

- National Forest Programme
- National Forest Regulation from 1805
- No use of pesticides and fertilizers
- Other benefits
  - ✓ Production of wood
  - ✓ Carbon sequestration
  - ✓ Biodiversity
  - ✓ Recreation and public health
  - ✓ Energy from biomass
  - ✓ …

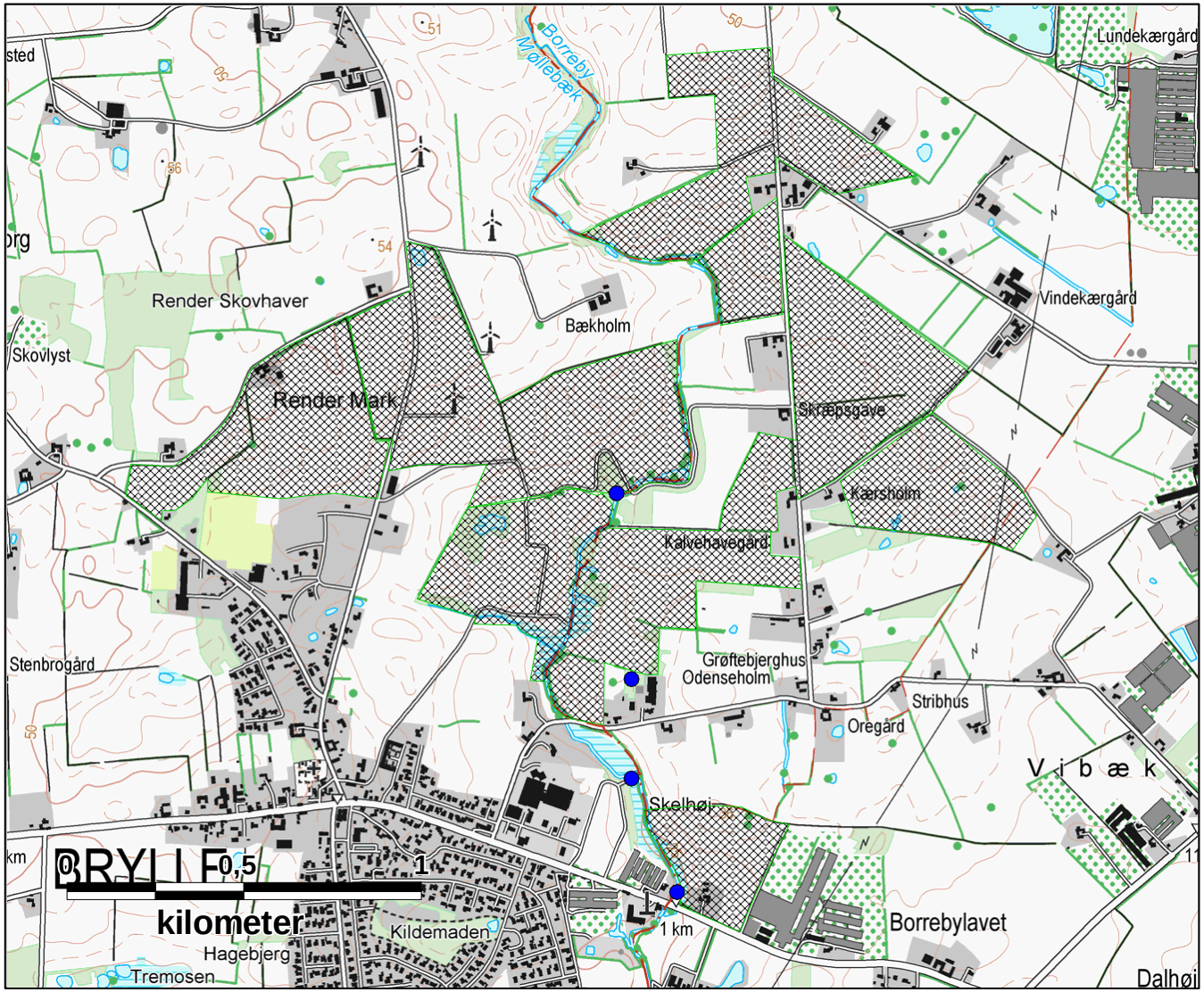
CASE: BRYLLE WATER FOREST

- Protecting groundwater in the catchment of the Borreby Wellfield
- Private partnership between VCS Denmark and the private company Hedeselskabet
- Acquisition of farmland through land consolidation
- VCS Denmark contributes with 60 % of the acquisition costs
- Hedeselskabet are responsible for afforestation, operation and maintanance

BORREBY WELLFIELD 2014



BORREBY WELLFIELD 2022



TECHNOLOGICAL FIX

SYSTEMIC FIX

THANK YOU FOR YOUR ATTENTION!

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Q&A Discussion

MODERATOR: DORTE SKRAEM

GROUNDWATER ACTIVITIES BEFORE AND DURING THE 2022 IWA WORLD WATER CONGRESS & EXHIBITION

ANDERS BÆKGAARD, CONGRESS PRESIDENT, DENMARK

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#WorldWaterCongress 2022 in Copenhagen:

- Learn and grow professionally and expand your network through privileged access to the best content and the best people worldwide
- Visionary thinkers and compelling speakers on how water can create Smart Liveable Cities of the future, supported by the IWA Principles for Water Wise Cities.
- High-level summit with utility, government and city officials and other organisations about the progress towards implementation of the SDGs.
- Groundwater and digitalization as special focus areas.
- Engagement of the industry, agriculture and energy sectors.
- Advance opportunities for IWA Young Water Professionals and #EmergingWaterLeaders.
- Highlight global innovations and offer a global business platform.

Topics for IWA WWCE 2022

THE AGENDAS


WATER FOR SMART LIVEABLE CITIES
UNLOCKING THE POTENTIAL OF WASTEWATER
NATURE BASED SOLUTIONS
Groundwater-based water supply
Digital Water
The value of meta-data for water resource recovery facilities
The IWA Principles for Water Wise Cities
2nd Edition
Action Agenda for Basin-Connected Cities
Influencing and Activating Urban Stakeholders to be Water Stewards in their Basins
DNNK State of Green
Manual of the Human Rights to Safe Drinking Water and Sanitation for Practitioners
Lead Author: Robert Bos

GROUNDWATER FORUM

IWA World Water Conference

Groundwater Forum all day on September 12, 2022

Presented by **The Capital Region of Denmark** and **The Danish Academy for Technical Sciences, Soil and Groundwater**
Co-host: Dr. Stephen Foster, IWA Groundwater Management Specialist Group

Sessions:

- **Groundwater Management**
- **Groundwater Sustainability**
- **Protection of Groundwater Quality**

LEARN MORE: WHITE PAPER ON GROUNDWATER BASED WATER SUPPLY

- **Lessons learned from Denmark**
  - A country entirely reliant on groundwater
- **Case examples from around the world**
  - South Africa, USA, Denmark, Chile, Ukraine, India, Kazakhstan and Malaysia
- **Available to download at** https://stateofgreen.com/en/publications/groundwater-based-water-supply/

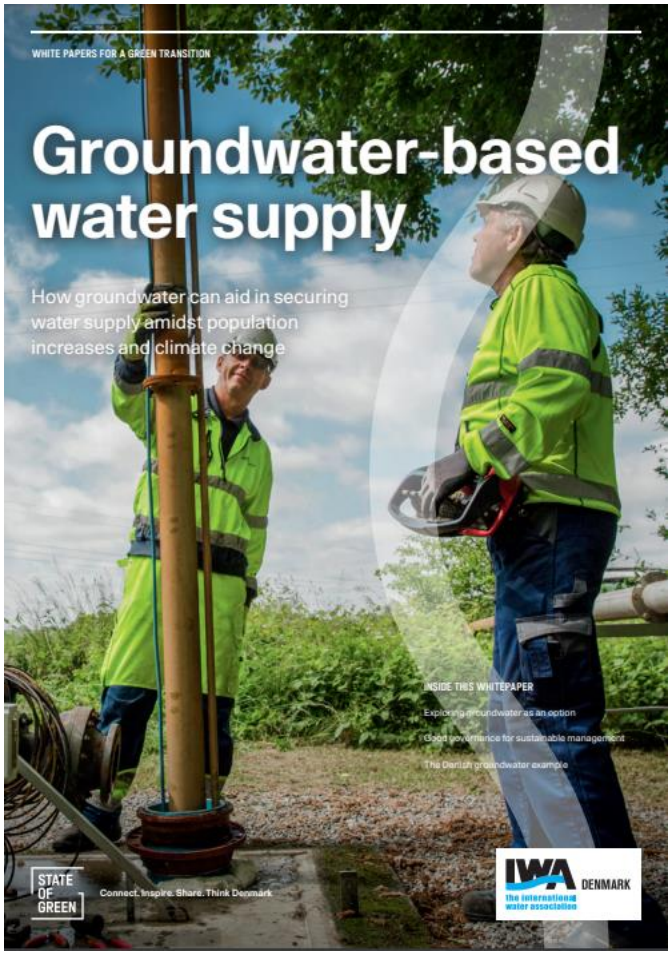
"WATER IS ESSENTIAL FOR ALL LIFE. WHETHER WATER IS USED IN THE PRODUCTION OF FOOD OR AS DRINKING WATER, THE QUALITY IS OF GREAT IMPORTANCE TO ENSURE HUMAN HEALTH."

Lea Wermelin
Minister for the Environment, Denmark

LEARN MORE: WHITE PAPER ON GROUNDWATER BASED WATER SUPPLY

Key take-aways:

- Groundwater as a reliable source of high-quality drinking water
- Exploring groundwater as an option
- Sustainable utilisation of groundwater
- Smart use of data in water utilities
- Protecting tomorrow's water resource
- Ensuring high quality
- Good governance for sustainable groundwater management
- The Danish groundwater example
- Regulation, pricing and benchmarking



JOIN THE TECHNICAL TOUR DURING WORLD WATER CONGRESS 2022

”From well to tap – Groundwater protection and visit to a Danish waterworks”

Visit a small waterworks and Birkerød Groundwater Park where groundwater protection and remediation, biodiversity, climate adaptation and recreational activities are integrated.

Learn more and sign up at: https://worldwatercongress.org/technical-tours/

GROUNDWATER BEHAVIOR

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Groundwater flow is so slow that even specialists have difficulties in fully comprehending the timespan of the entire cycle.

The slow flow has positive and negative effects. On the one hand, groundwater undergoes a very efficient purification process through natural filtration in the unsaturated zone and in the subsoil, from the time that it falls as rain, until it ends up in the aquifers. On the other hand, if groundwater is polluted, it takes years or even decades to remedy, as pollution usually originates in more or less distant "sins of the past".

Effects of the implementation of today's groundwater protection measures will not be immediately assessable – perhaps not even in our lifetime.

Nonetheless, the objective of securing clean groundwater for future generations demands action now. The recognition of this fact requires highly enthusiastic specialists and brave politicians.

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More than 700 children under five years of age die every day from diarrhoea linked to unsafe water and poor sanitation

‘Leaving no one behind’

Less than 10 years to go in 2022…

Women and girls are responsible for water collection in eight out of ten households with water off-premises.

2.1 billion people live without safe water at home

IWA World Water Congress & Exhibition

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September 2022
CREATIVE SPACE

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