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Governance and institutional framework session

Groundwater – rational use to enhance urban water security under global change

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UPGro
Unlocking the Potential of Groundwater for the poor
upgro.org

skat_ Swiss Resource Centre and Consultancies for Development

GWOPA
Global Water Operators' Partnerships Alliance
UN-HABITAT
FOR A BETTER URBAN FUTURE

OUTLINE OF THE PRESENTATION

1) **Introducing UPGro**

2) **Water security and ground water resources**
   - Concept of water security
   - Role of groundwater in water security

3) **Self-supply boom – current trends in use of ground water**
   - Urban growth unprecedented and growth of water demand
   - Typical “supply” response
   - Africa regional evolution of type of supply
   - Causes and consequences of the self-supply boom (Rich and Poor people)
   - Advantages of using groundwater resources for the utilities/ water security

4) **How to enhance water security through ground water use**
   - Example of conjunctive use of ground and surface with loop of reuse
   - What should be done to optimize use of ground water in the utilities’ perspective (to enhance source security)
   - Mapping the sources of pollution of the aquifers (Risks and hazards assessment)
   - What should be done to regulate and optimize; policy implications, role of the utilities

1) INTRODUCING UPGro

Unlocking the Potential of Groundwater for the Poor (UPGro), 7 year international research programme (2013-2020)

Focus on improving the **evidence base** around **groundwater** availability and management in **sub-Saharan Africa** (SSA) to enable developing countries and partners to use groundwater in a sustainable way in order to **benefit the poor**.

UPGro is funded by:

NERC SCIENCE OF THE ENVIRONMENT

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

UKaid from the British people

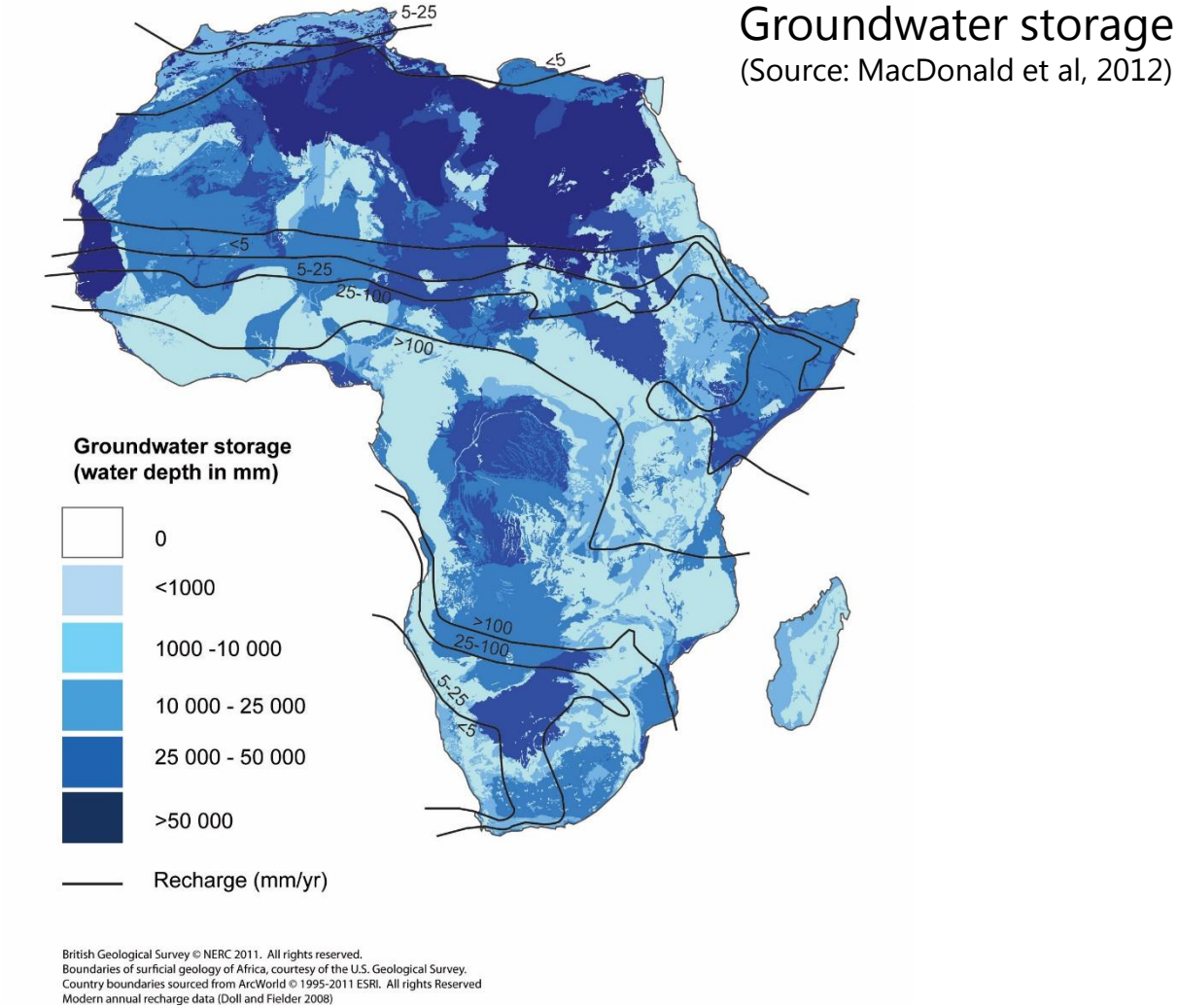
skat_ Swiss Resource Centre and Consultancies for Development

UPGro Knowledge Broker charged with facilitating the uptake the research findings into policy and practice.

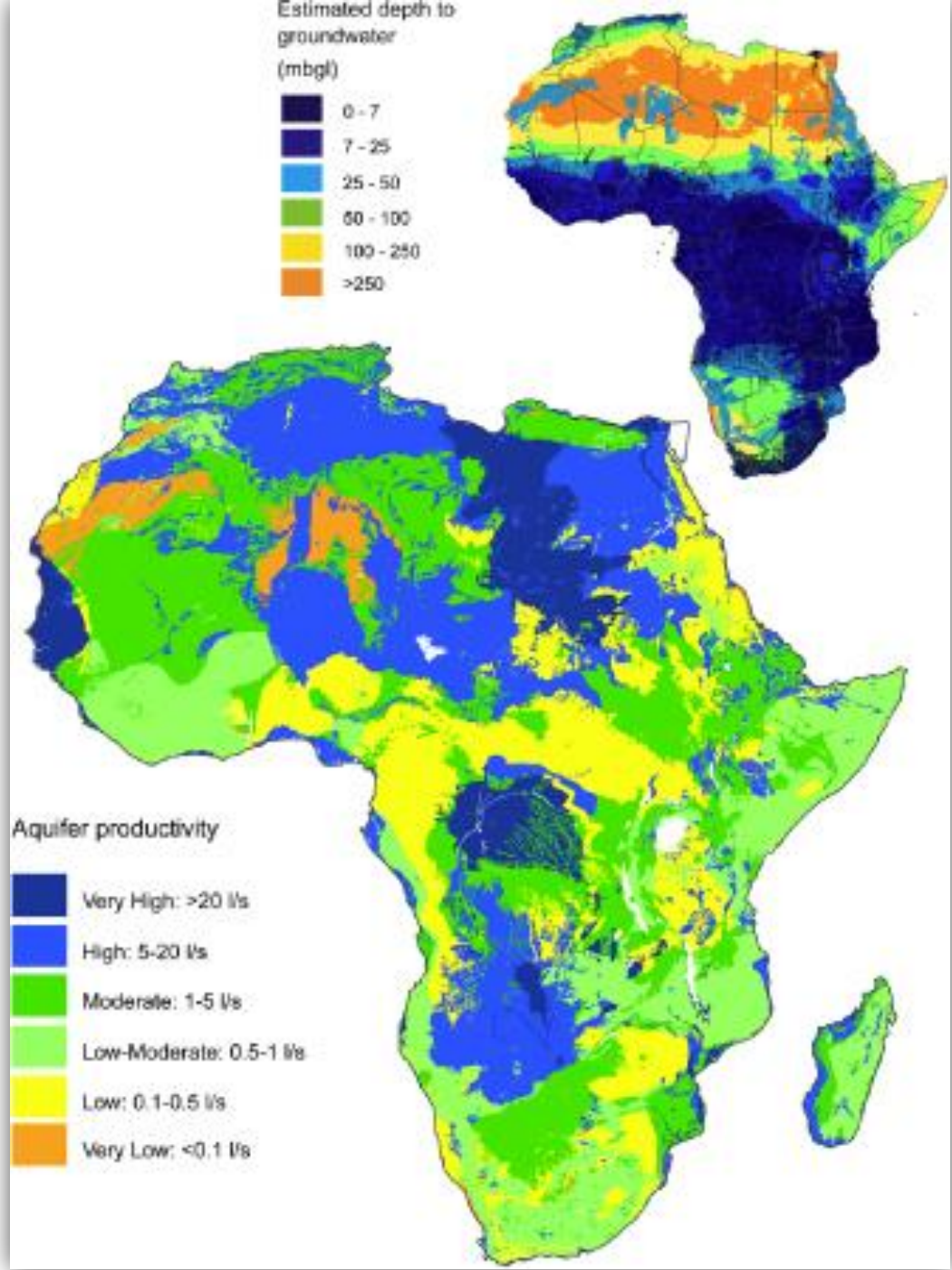
Diverse groundwater

2012: first quantitative continent-wide maps of aquifer storage and potential published

- 0.66 million km^3 of storage (not all available for abstraction)



Groundwater storage
(Source: MacDonald et al, 2012)


Estimated depth to groundwater (mbgl)
0 - 7
7 - 25
25 - 50
50 - 100
100 - 250
>250
Aquifer productivity
Very High: >20 l/s
High: 5-20 l/s
Moderate: 1-5 l/s
Low-Moderate: 0.5-1 l/s
Low: 0.1-0.5 l/s
Very Low: <0.1 l/s

The Consortium Projects (2015-19)

BRAVE

Hidden Crisis

T-GroUP

Working in **Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Niger, Nigeria, South Africa, Tanzania, Uganda**

Gro for GooD

Grofutures

+ research commissioned on ground water use and urban utilities =>Stephen Foster

Upgro.org

2) WATER SECURITY AND GROUND WATER RESOURCES

DEFINITION

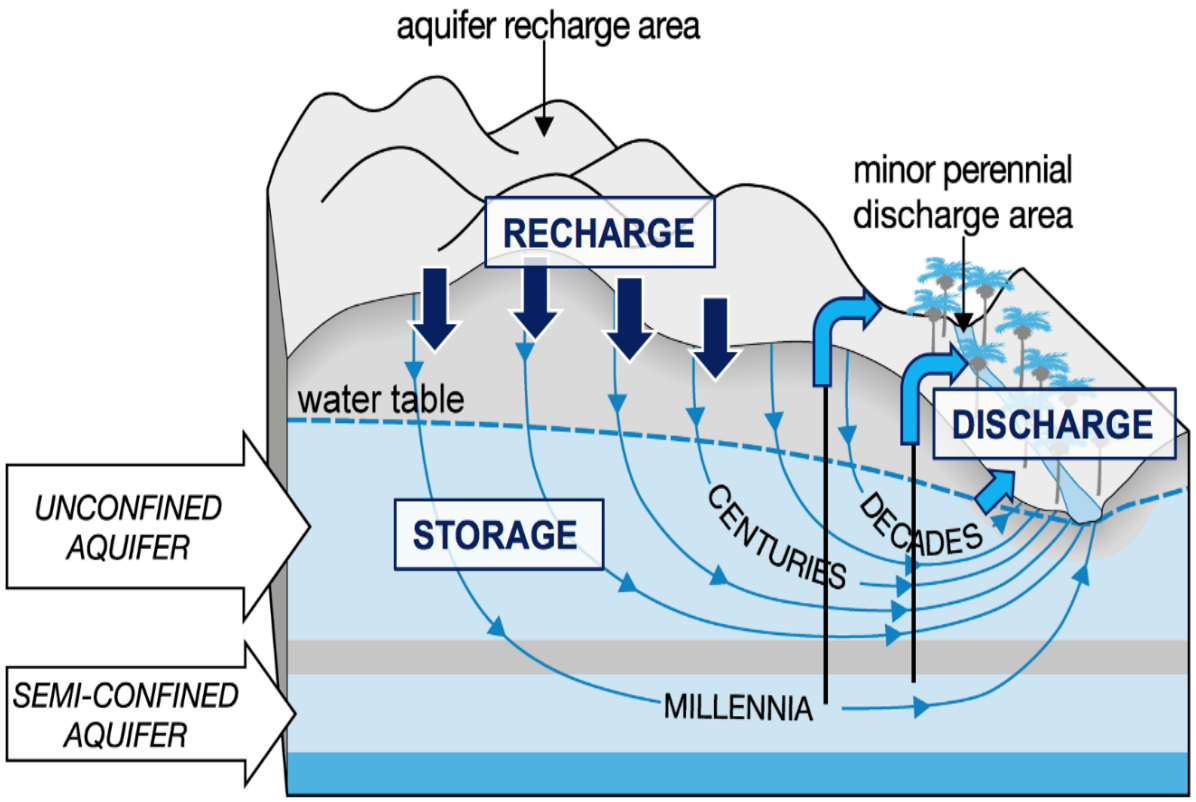
- 'Availability of an acceptable **quantity and quality** of **water** for **health, livelihoods, ecosystems and production**, coupled with and **acceptable level of water-related risks** to people, environments and economies'*.
- The 'scale' issue – use at national level too nebulous better when referred to **specific city (or basin)** and to a **specific function (like water-supply**)**

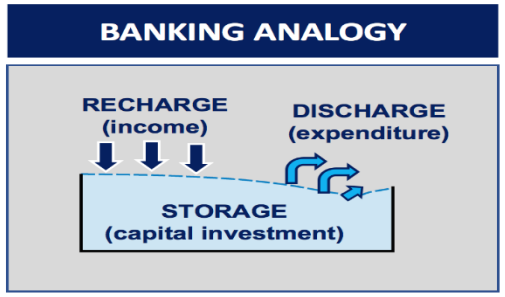
- Urban water-supply security assessed in terms of:
  - accessibility – in effect availability and continuity
  - affordability – cost especially for lowest income quintile
  - acceptability – safety as regards quality
  - sustainability – susceptibility to decline/vulnerability to pollution

*Grey & Sadoff, 2007 ** Foster & MacDonald, 2014

ROLE OF GROUNDWATER IN WATER-SUPPLY SECURITY

vast stocks (storage) but modest fluxes (flows)





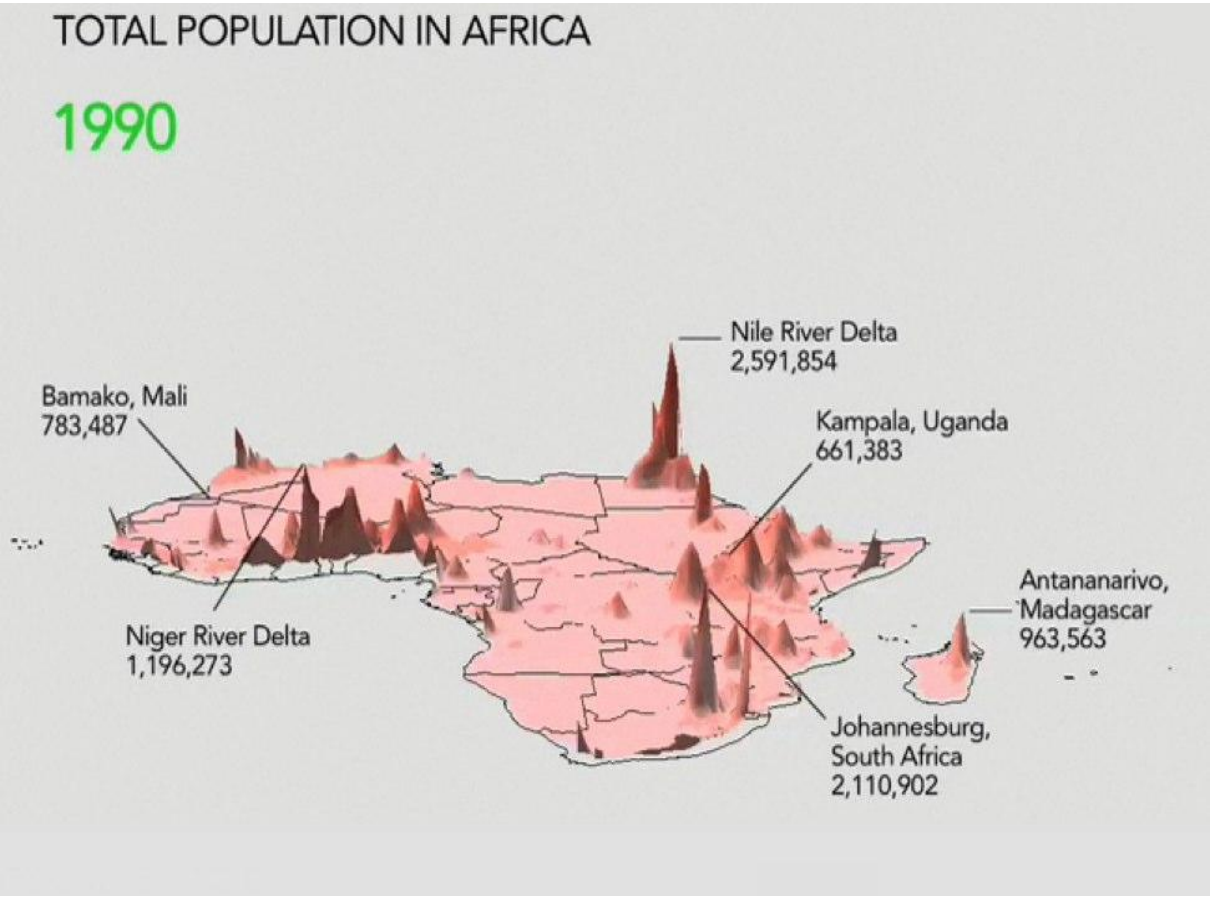
Predominant form of global freshwater storage

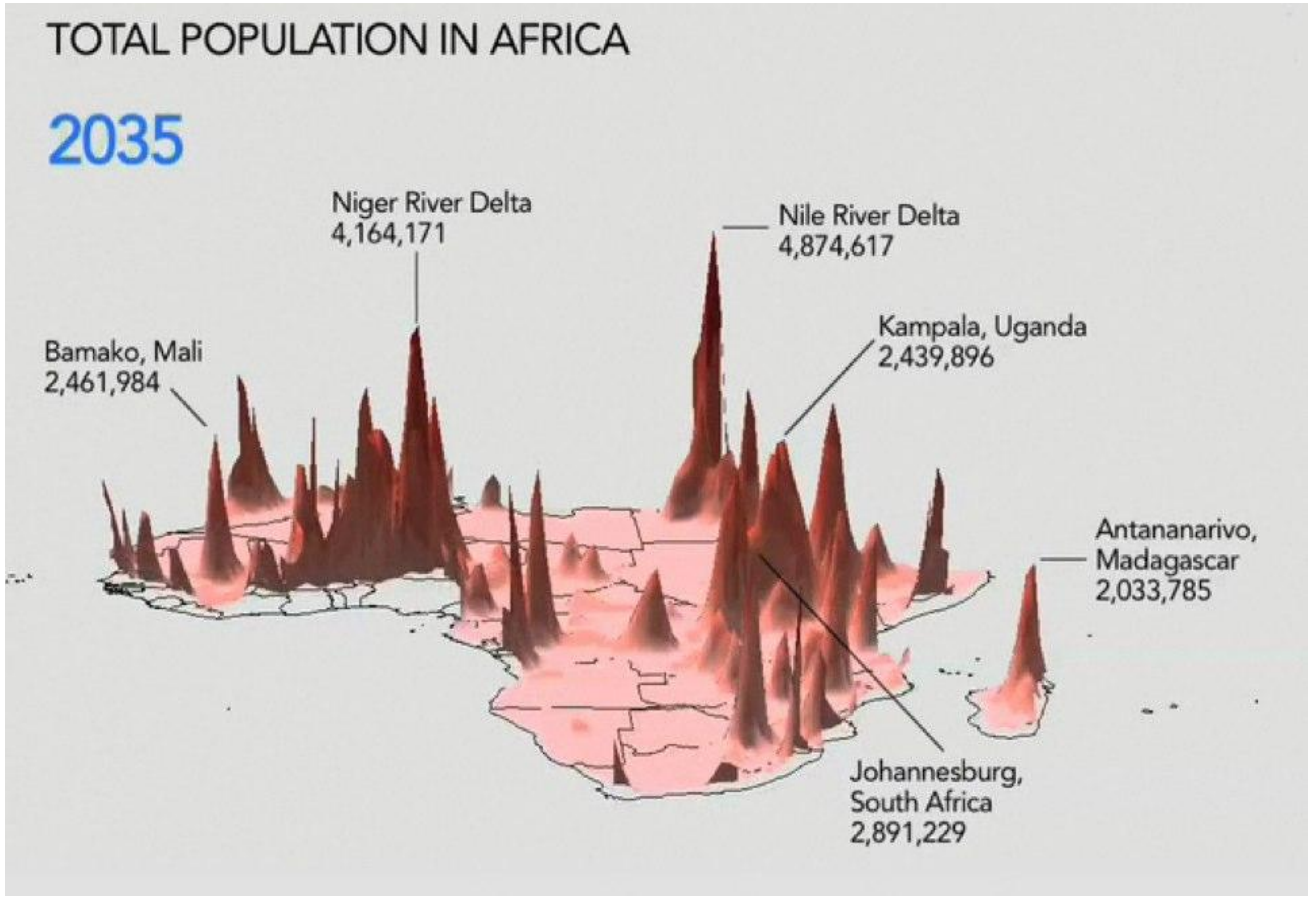
95-97% of ‘circulating freshwater’ = groundwater – but only 0.03 % of ‘groundwater stock’ replenished annually

Very large storage means= subsurface ‘residence times’ large and ‘aquifer memories’ long (decades to millennia) high microbiological and chemical quality

But any pollution can be very persistent and remediation problematic

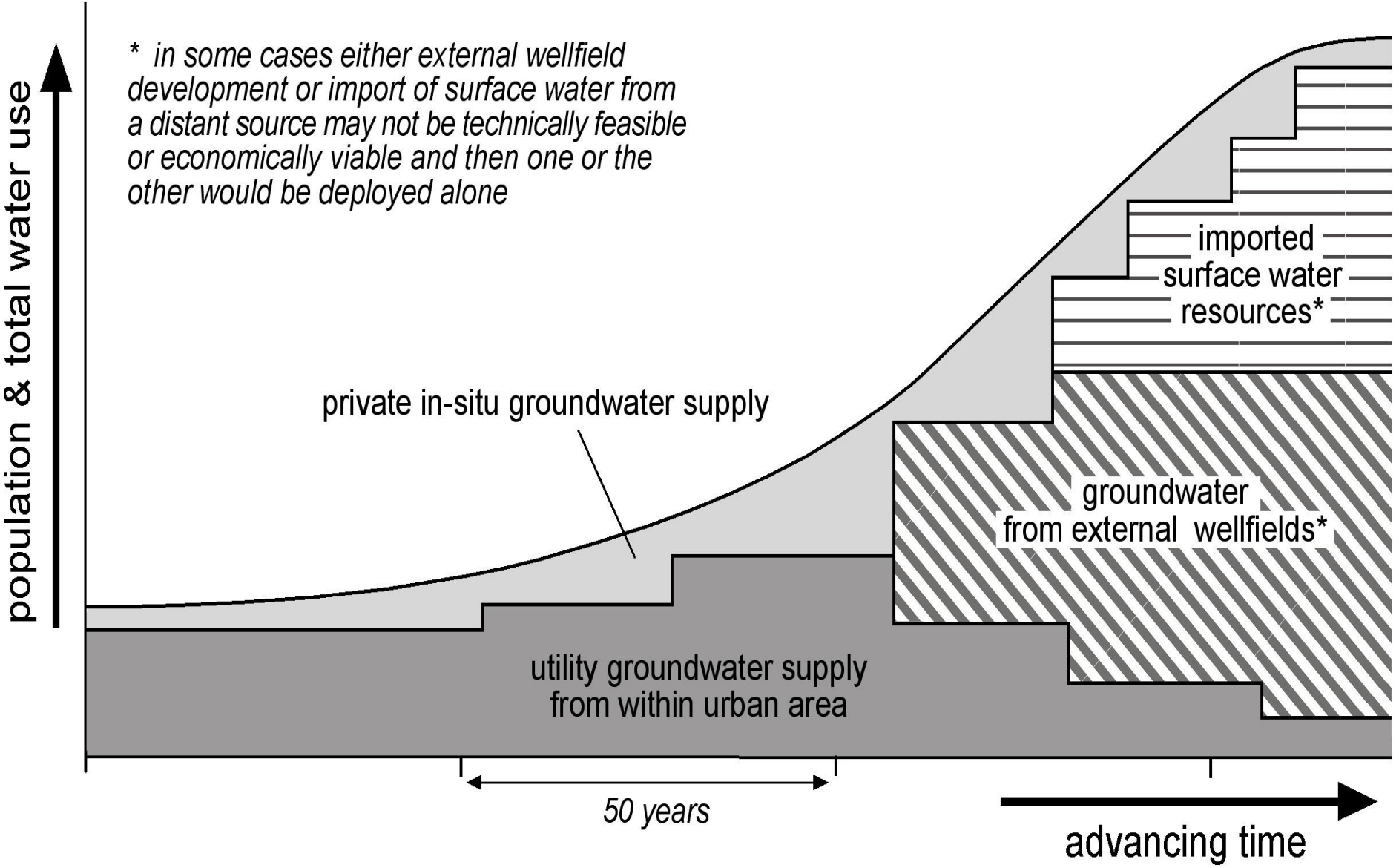
3) SELF-SUPPLY BOOM AND CURRENT TRENDS





Unprecedented growth in urban population and water demand, **especially West Africa**

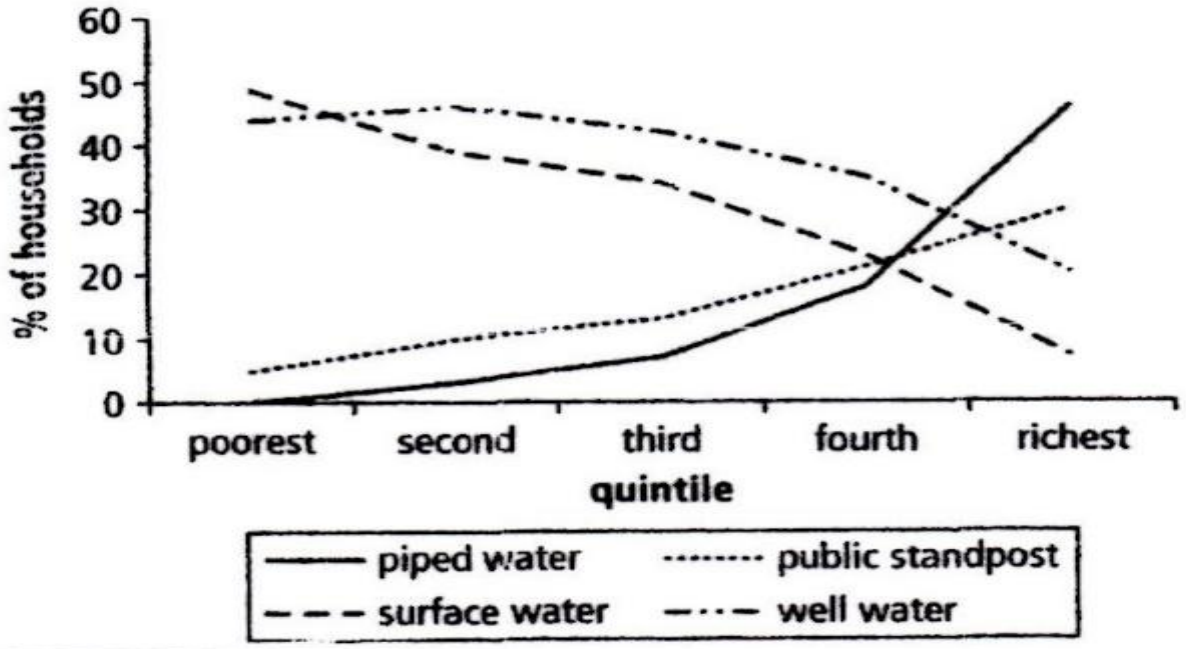
TEMPORAL GROWTH IN URBAN WATER DEMAND
with typical supply-side response



EVOLUTION OF WATER-SUPPLY SOURCES IN AFRICAN CITIES: ACCESSIBILITY AND AFFORDABILITY *

Regional average urban water-supply accessibility

PERIOD	PIPED-SUPPLY	WATERWELLS (boreholes/dugwells)	STAND-POSTS	SURFACE WATER
1990-1995	50%	**20%**	29%	6%
1995-2000	43%	**21%**	25%	5%
2000-2005	39%	**24%**	24%	7%



Regional average urban water-supply affordability

* Sources: World Bank AICD + Foster & Briceño-Garmendia, 2010, and Banerjee et al, 2017

GROUNDWATER USE IN SELECTED AFRICAN CITIES

data for sometime in period 2011-2015

CATEGORY OF CITY	CITY	UTILITY GW USE (Ml/d) (propn)	UTILITY SERVICE LEVEL	PRIVATE GW USE (Ml/d)
Water Utility with Major Groundwater Dependency	Abidjan **	285 (100%)	moderate	some #
	Dakar **	210 (70%)	excellent	minor #
	Arusha	50 (80%)	excellent	minor
	Dodoma **	45 (100%)	good	minor
	Kabwe	40 (100%)	good	minor
	N'Djamena **	35 (100%)	poor	some #
Water Utility with Conjunctive Resource Use	Addis Ababa	120 (40%)*	moderate	minor #
	Dar-es-Salaam	30 (10%)*	poor	major
	Benin City	45 (50%)	poor	major
Water Utility with Poor Service Levels & Major Private Groundwater Use	Nairobi	30 (5%)	moderate	80-240 #
	Lusaka	135 (45%)	moderate	100-300
	Mombasa	80 (100%)	poor	major

* major new groundwater source under exploration/development

** modern supply system deploying external wellfield(s)

cost constructing/equipping private water borehole > US$ 10k

CAUSES AND CONSEQUENCES OF THE SELF-SUPPLY BOOM (RICH AND POOR PEOPLE)

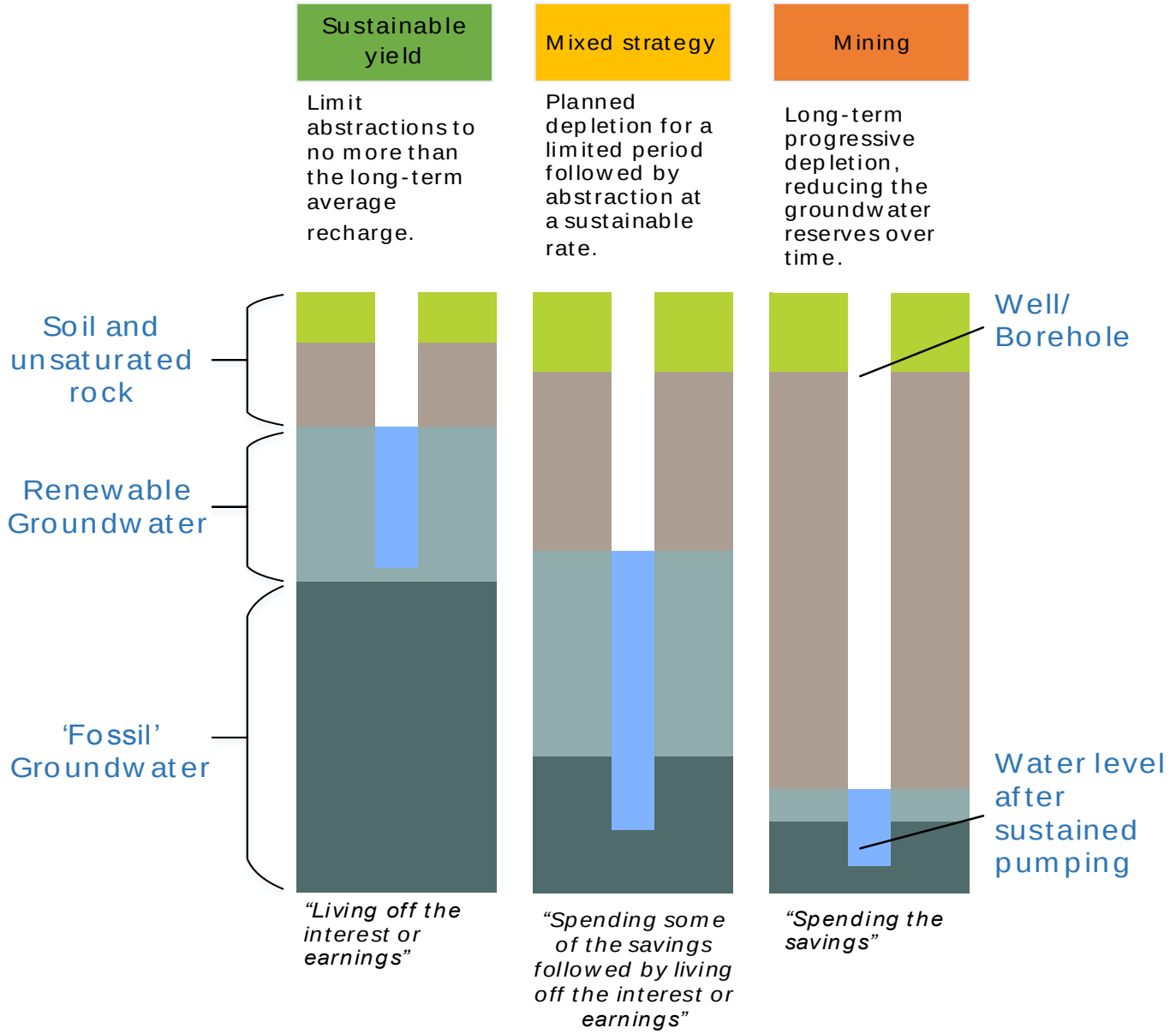
- Coping strategy' for confronting poor water-utility service coverage and/or reliability
- High cost of constructing/equipping water-supply boreholes means only affordable by high-income quintile
- Poorer households have to resort (where feasible) to shallow handpump dugwells with poor sanitary completion which are more vulnerable to pollution
- Private borehole use likely to be perpetuated long-term as cost-reduction strategy
- Massive private domestic self-supply reality – can distort utility water operations with major implications for finance/investment
- Open-access to groundwater cannot be regarded as 'pro-poor' since reduces revenue of water utilities
- Could be regarded as reducing demand on (and recovering leakage from) utility water-supply and very good practice for 'secondary uses'
- 'Banning' such practice too simplistic (unrealistic and impractical), except where it poses major public health or environmental hazard
- Need for systematic study of hydrogeologic dynamics, engineering economics and sociologic impact (only limited work in districts of Accra, Lusaka & Lagos)

WHY TAPPING INTO THE POTENTIAL OF GROUND WATER RESOURCES

- allow phased investment in supply expansion at much lower capital cost (avoiding advanced treatment)
- suitability located and constructed groundwater sources provide supply security against drought and pollution
- basis for providing a high level of water-supply reliability and continuity
- but requires proactive involvement in resource management and quality protection

4) HOW TO ENHANCE WATER SECURITY THROUGH GROUND WATER USE

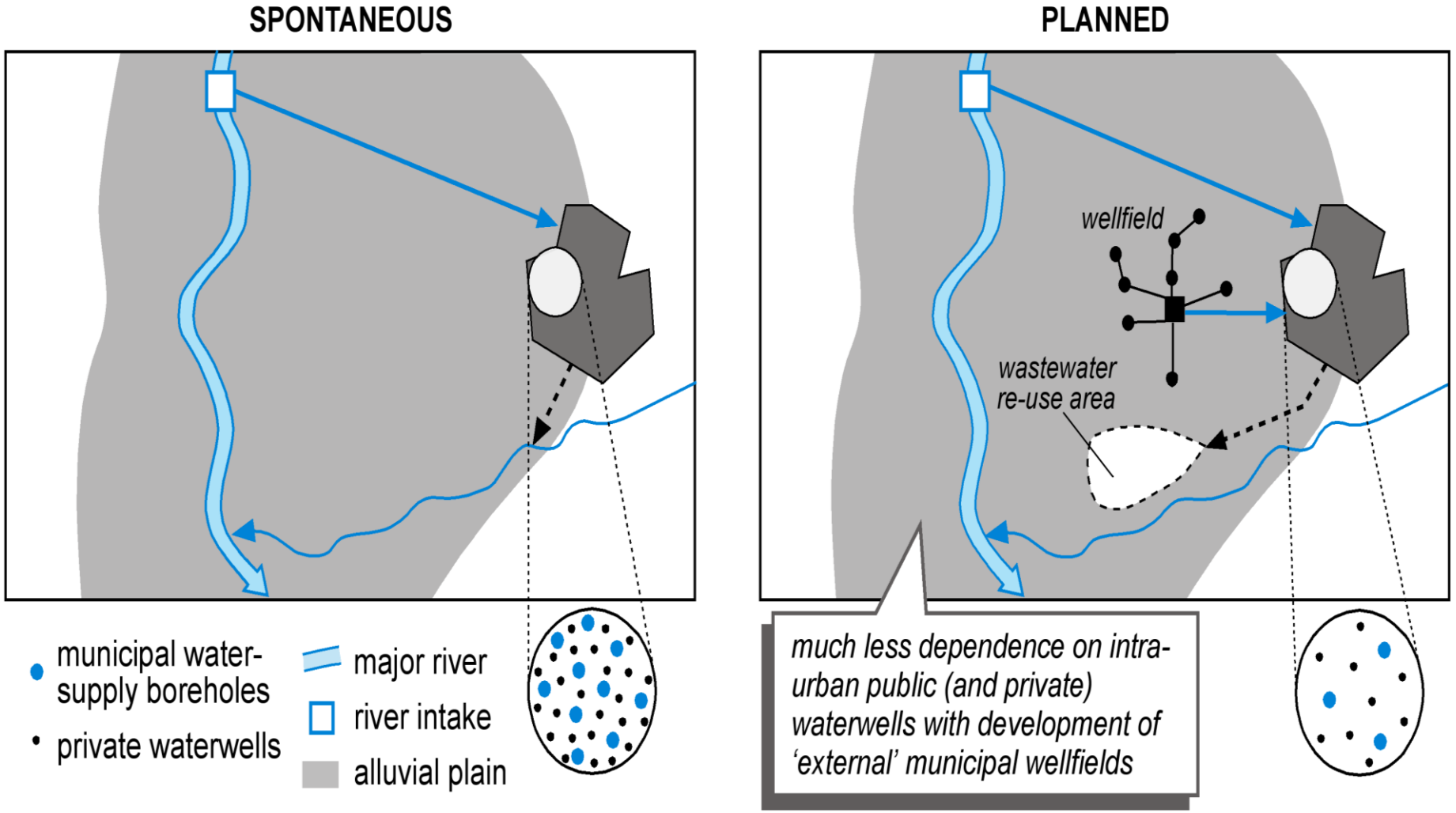
Recommendations on management of the aquifers:
Enhance recharge, reduce pollution load, improve construction standards for private wells and in-situ sanitation, advise users on potential hazards, charge or regulate groundwater use(?)



UTILITIES' INVOLVEMENT, RECOMMENDATIONS:

- Proactively integrate utility and private investment
- Coordinate piped and non-piped service provision
- Develop utility involvement and capacity for groundwater resource management and protection
- Establish utility low-income user support units for :
  - construction/operation of community stand-post boreholes
  - advisory/registration services for private waterwell users (with appropriate charging especially if generating sewer discharge)

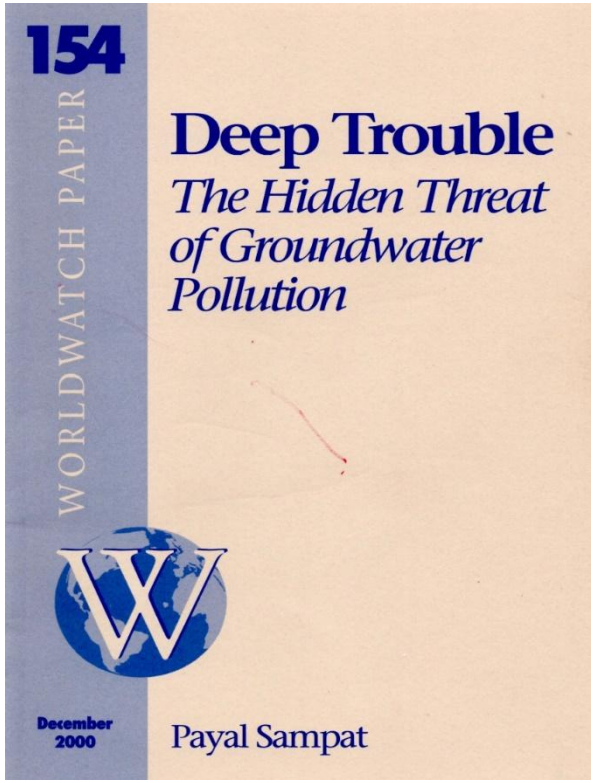
CONJUNCTIVE USE & MANAGEMENT OF RESOURCES
key to urban water-supply security



RECOMMENDATIONS (ctd)

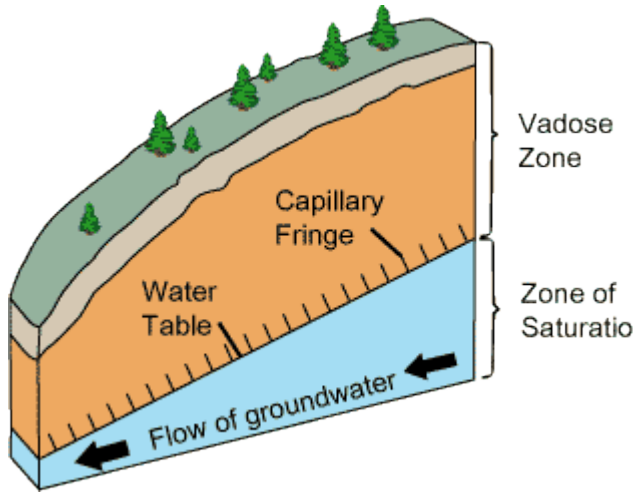
Measures to enhance the source security

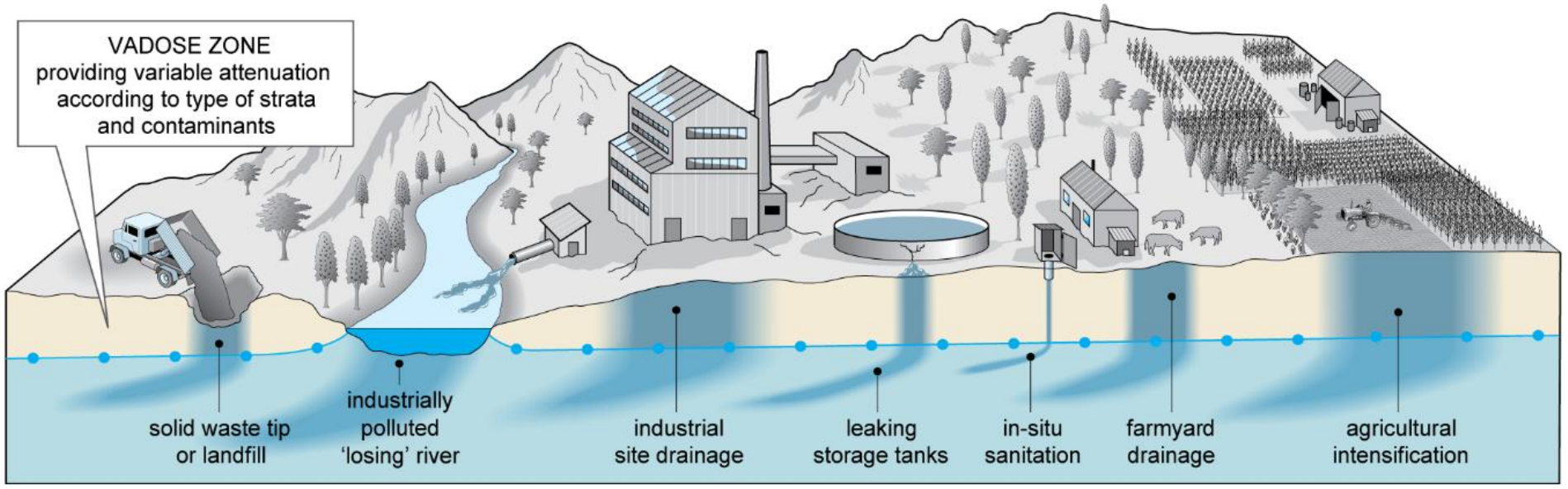
- develop protected external municipal wellfields (with agreement between urban and rural municipalities involved on land-use controls)
- establish municipal waterwell protection zones (to take advantage of parkland and prevent generation of polluting discharges)
- prioritise main sewerage in densely-populated zones and limit population density of new unsewered zones
- undertake groundwater pollution hazard assessments and reduce dependence on vulnerable municipal waterwells



GROUNDWATER POLLUTION PROTECTION
'avoiding unexpected hazards from above'

- understand vadose-zone attenuation
- map aquifer pollution vulnerability
- assess pollution risk and
  manage by prevent/limit measures





THANK YOU!
MERCI!

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