

GEOG 3038
Water and Development in Africa

water, health & urbanisation



outline:

- **origin of the faecal-oral paradigm:** cholera in 19th century England, John Snow & the Broad St. pump
- interrupting faecal-oral transmission of pathogenic microorganisms (safe water, sanitation, hygiene)
- urban water supply and sanitation in African cities
- *reconsidering the Victorian London analog*

cholera in 19th century England... *(Davey Smith, 2002)*

- recurring cholera outbreaks in England in 19th century (1831-1832, 1848-1849, 1853-1854)
- cholera “re-appears” in London in 1853; particularly severe outbreak in Soho begins on August 30th, 1854
- *700 people would die in 2 weeks*

water & sanitation conditions in Soho (1854)

- main connections supplied by two private companies (The New River Company, The Grand Junction Water Company) but operated just 2 hours/day
- shallow wells, open all day, drawing groundwater from a shallow sand & gravel aquifer - *good tasting water*
- household sanitation: privies draining to septic (cesspools) & flung into street

conditions remarkably similar to many African cities today

- Snow mapped water sources and registered addresses of cholera deaths (to Sept. 2nd, 1854)

- spatial relation confirmed his theory that drinking water (fouled with excreta) caused cholera

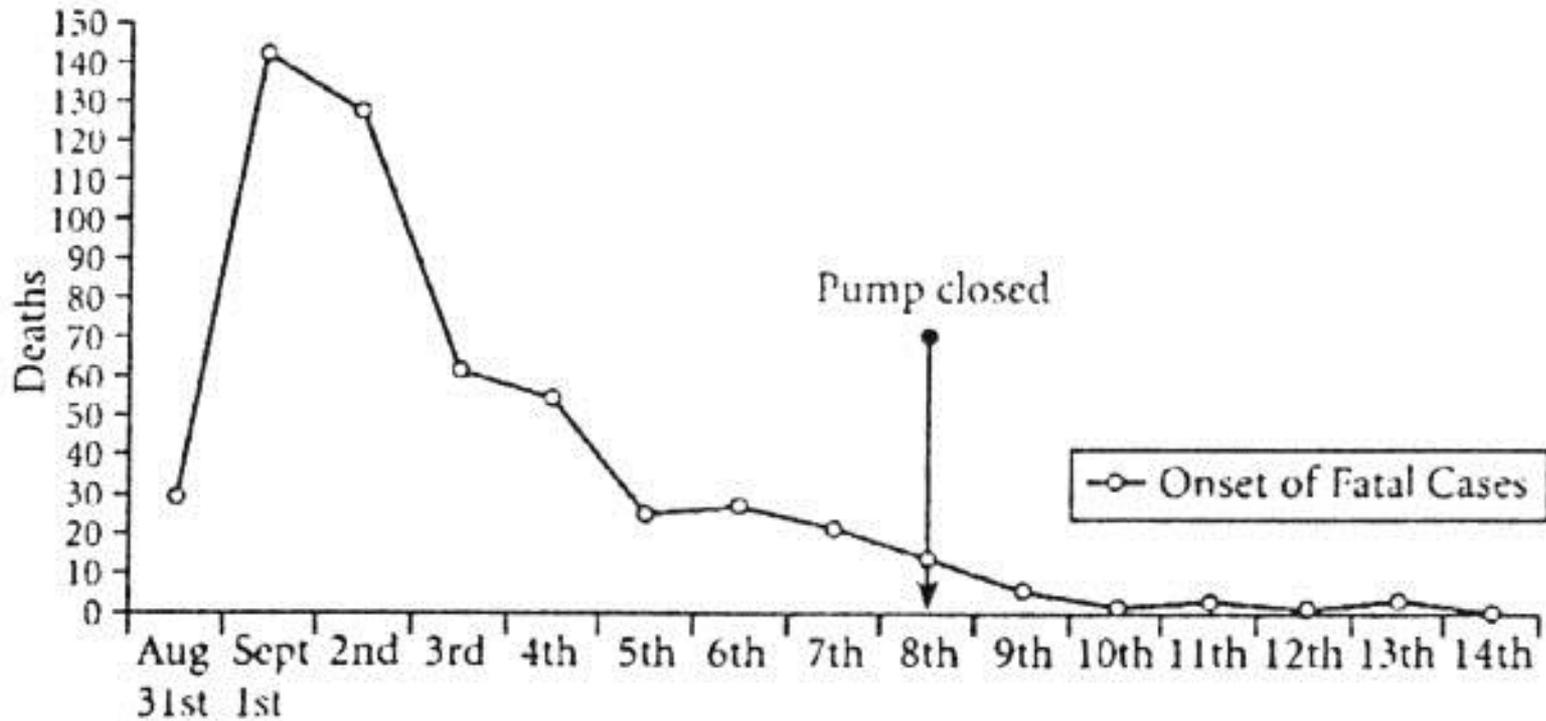


(Snow, 2002)

- 80/137 pump users developed cholera
- 20/299 non pump users developed cholera
- *well contaminated by leaky septic tank <1m away*



- Snow's removal of Broad St. pump handle was the first intervention to prevent waterborne disease
 - preceded "germ theory" (1880s)
- many doubted the merit of this intervention (outbreak had already abated) but...
did it prevent resurgence?



- water - health link for 1854 cholera epidemic in London convincingly demonstrated by a larger-scale review (*Snow, 2002*)

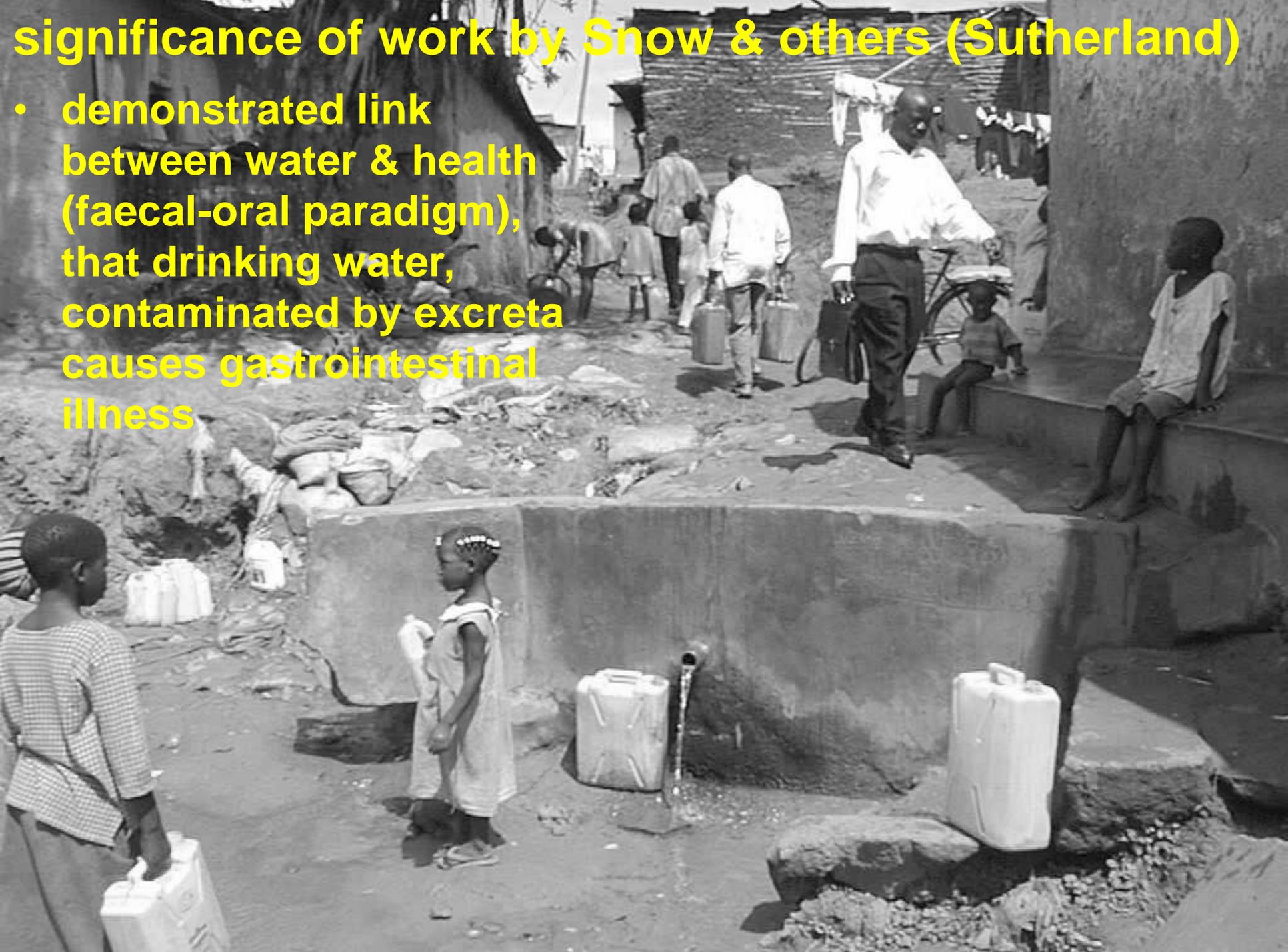
note: “above” = “upstream”

TABLE 1. Data of John Snow on Cholera In London, 1854

Water service and source (1)	Number of houses served (2)	Deaths from cholera (3)	Deaths per 10,000 households (4)
Southwark and Vauxhall Co.: from Thames River at London	40,046	1,263	315
Lambeth Co.: from Thames River above London	26,106	98	37
Rest of London: wells and surface sources	256,423	1,422	59

significance of work by Snow & others (Sutherland)

- demonstrated link between water & health (faecal-oral paradigm), that drinking water, contaminated by excreta causes gastrointestinal illness



strategies for reducing diarrhoeal disease

- interrupting faecal-oral transmission involves breaking “source-receptor” pathways:

source: sewage

receptor: point of collection or consumption

1) improved sanitation

2) improved source location and protection of water supplies

3) treatment of water (at source & in home)

4) improved community and domestic hygiene

for specific examples, see WaterAid Technology Notes

centralised sanitation (sewerage)

- sewage treatment and disposal

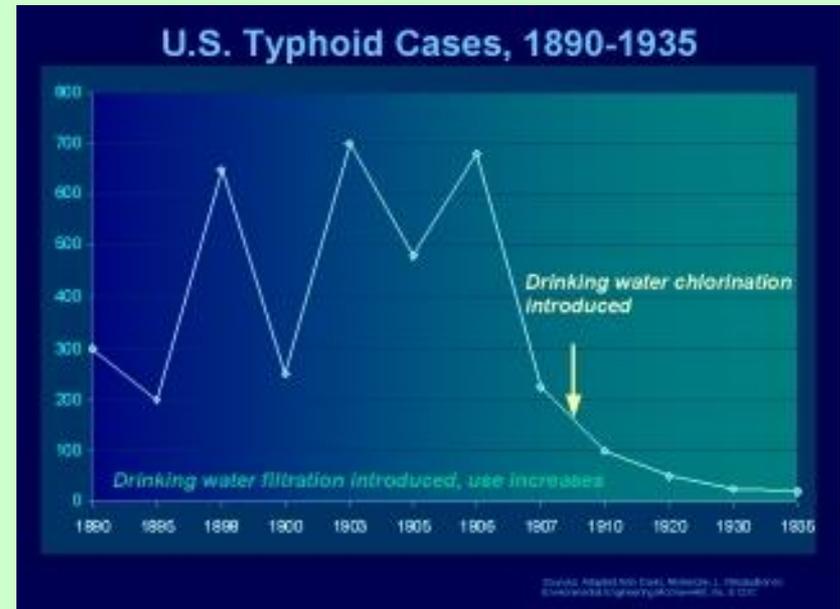


- low coverage in many low-income cities:
5% in Khartoum, 15% in Dar es Salaam
- high capital costs and energy requirements

reticulated, treated water supplies

treated surface water (river, lake)

- sources remote from human influence (sewage)



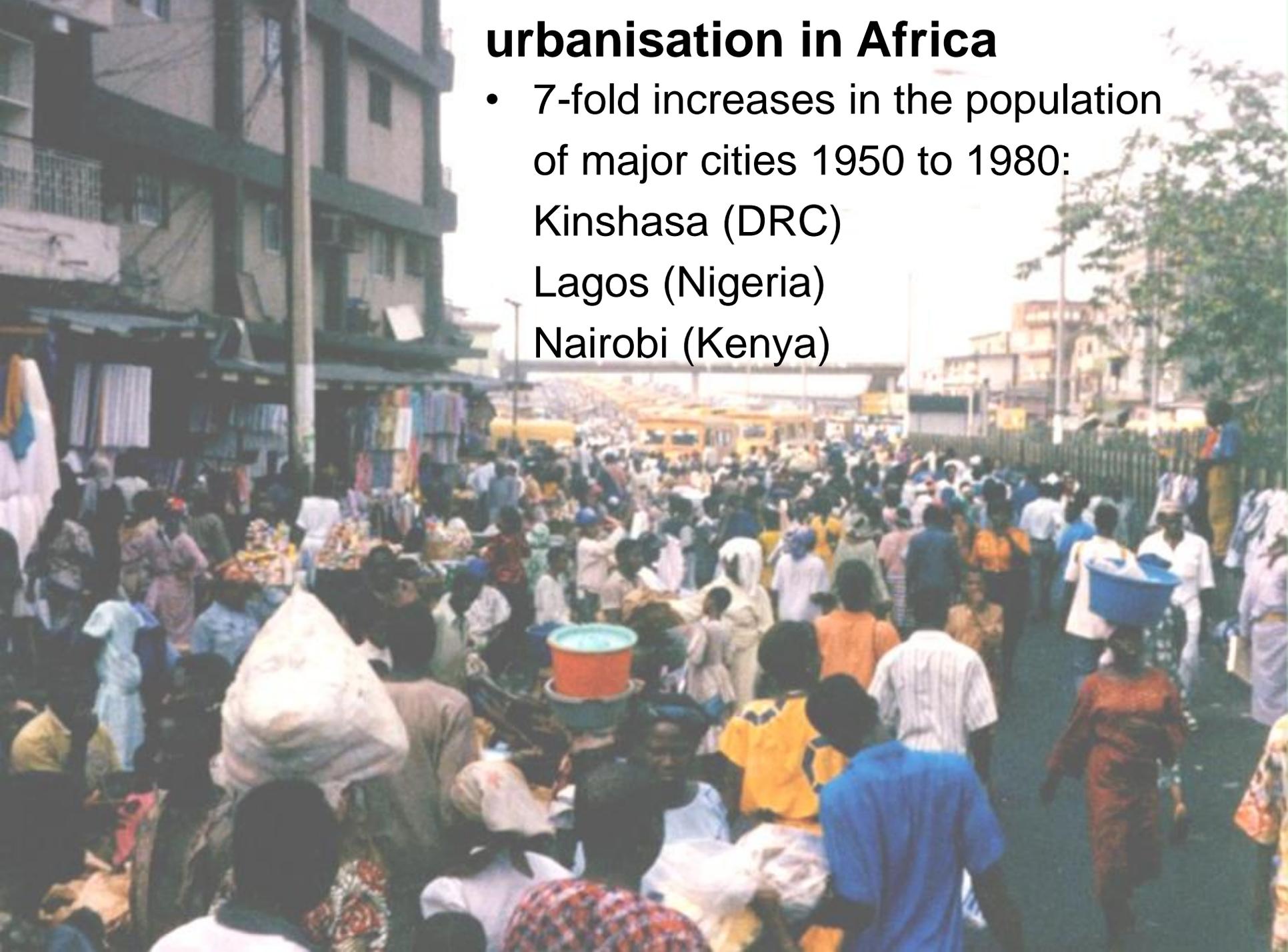
Lac Guiers – *manmade lake supplies 53% of the water supply to Dakar, Senegal*

Is sewerage and piped water (Victorian London) the solution for contemporary urban Africa?

- *historical urbanisation in Europe - 7 fold increase in population over a century:*
 - 1800: London (0.86 million)
 - 1900: London (6.5 million)

urbanisation in Africa

- 7-fold increases in the population of major cities 1950 to 1980:
Kinshasa (DRC)
Lagos (Nigeria)
Nairobi (Kenya)



- proliferation of large, unplanned settlements

Kibera, Nairobi



- overwhelmed,
conventional infrastructure:

- *piped water*
- *sewerage*
- *waste disposal*

- unable to adapt and plan
for such rapid growth

- *limited (~70%) or intermittent
access to safe water*
- *limited access (~60%) to
sanitation*
- *reduced per capita usage*



- continued use of unsafe water sources



Hoima, Uganda

global statistics...

- *1 billion cases of water-related, diarrhoeal diseases each year* involving 3 to 4 million deaths (mostly children) each year*

** WHO (2000) Global Water and Sanitation Assessment Report*

- 2.4 billion people lack adequate sanitation
- 1.1 billion people lack access to 'safe' water*
** recall "safe drinking water": water drawn from an improved source (piped water, protected well, spring, rainwater harvesting)*

Health consequences...

epidemic of diarrhoeal disease:

outbreak (cholera, E.Coli, cryptosporidium) occurs at more than one location involving anomalous increase in incidence

triggered by an extreme event (heavy rainfall-flooding, earthquake, tsunami) mobilising waterborne pathogens or the introduction (mutation) of a new toxin/pathogen

communities without access to safe water and adequate sanitation, and unable to practice good hygiene, are vulnerable to contracting diarrhoeal diseases from extreme events and/or new pathogens

endemic disease: constant, relatively low incidence rate

unsafe water and inadequate sanitation & hygiene practice lead to chronic, recurrent incidence of diarrhoeal diseases

in addition to mortality and ill-health affecting livelihoods, endemic diarrhoeal diseases lead to malnutrition and stunting (through malabsorption of consumed food)

(Checkley et al., 2008)

UN Sustainable Development Goals:

<https://sustainabledevelopment.un.org/>

6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

Are localised systems a transitional or long-term solution? *(Drangert et al., 2002)*



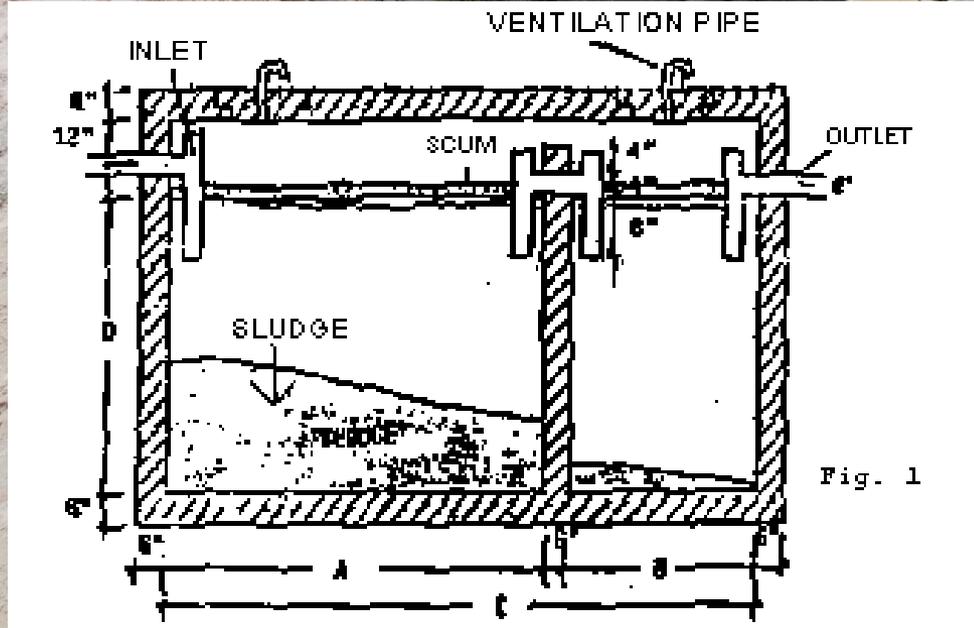
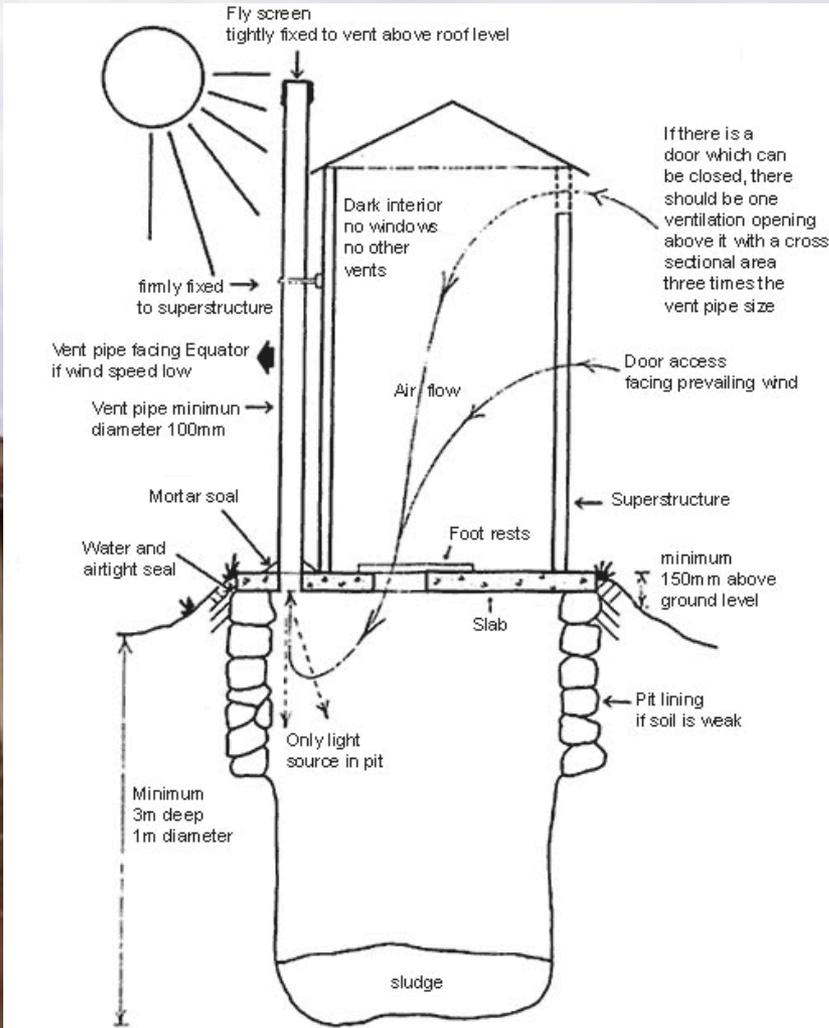


Fig. 1

Kampala

Dakar



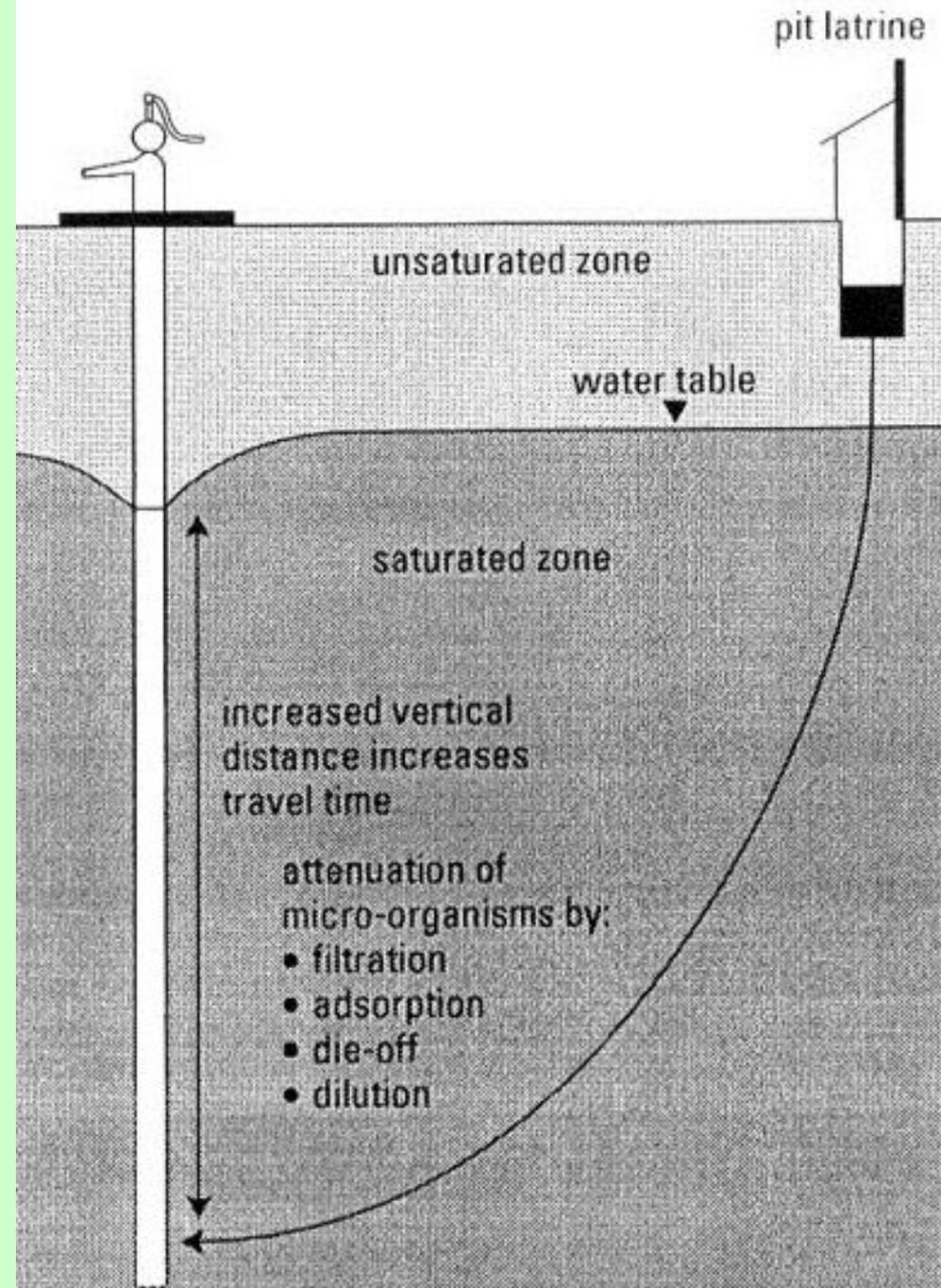
Thiaroye (Dakar), Sénégal



Bwaise (Kampala), Uganda

Low-cost, onsite water and sanitation systems: *conjunctive use of the subsurface*

- requires careful management to prevent *faecal-oral transmission*
- pathogens *attenuated* by filtration, adsorption, die-off and dilution



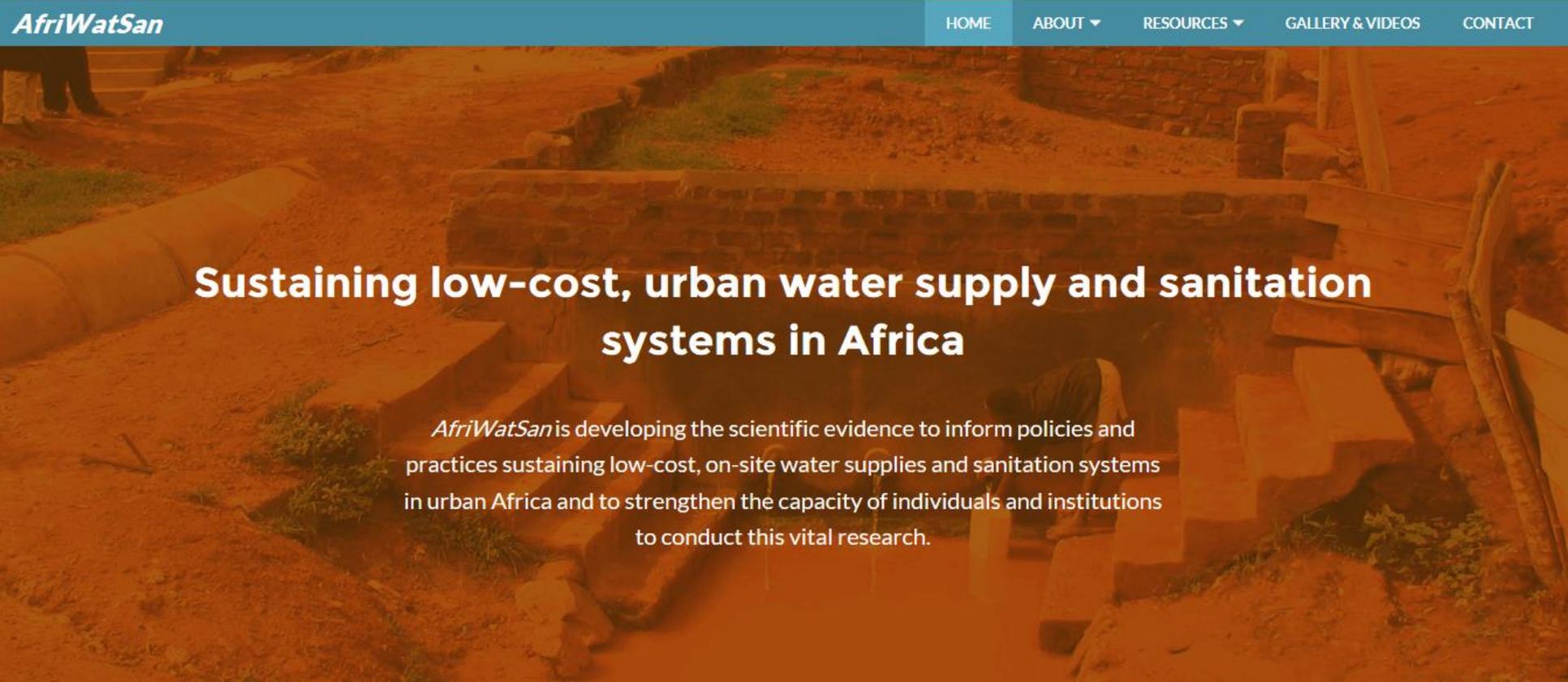
***Also relies upon
domestic &
community
hygiene***



***Tumwine et al. (2002)
Esrey et al. (1991)
Kaltenthaler & Drasar (1996)
Cairncross (2003)***

***AfriWatSan* (www.afriwatsan.org):**

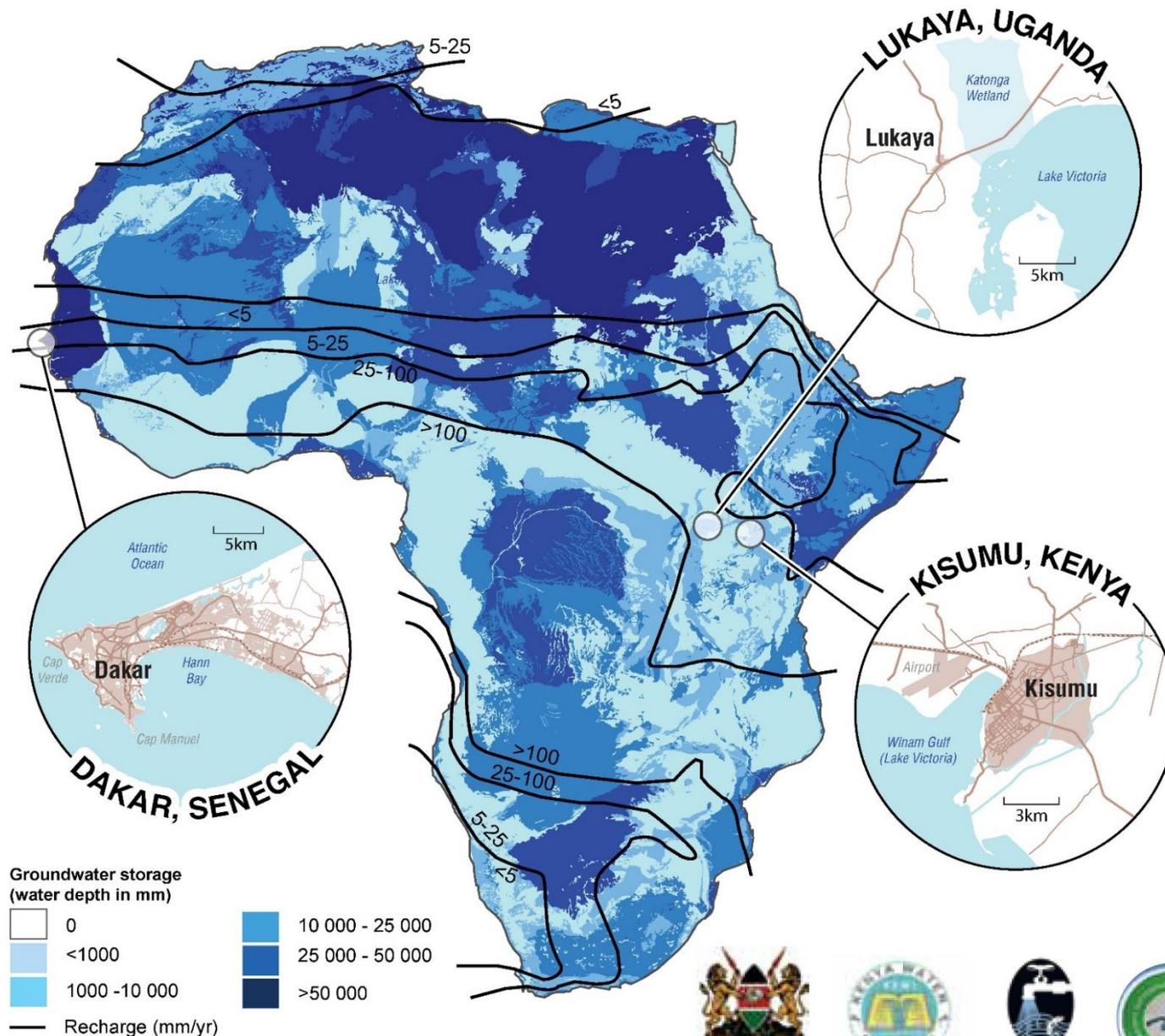
- developing the scientific evidence to inform policies and practices that sustain low-cost, on-site water supplies and sanitation systems in urban Africa and to strengthen the capacity of individuals and institutions to conduct this vital research

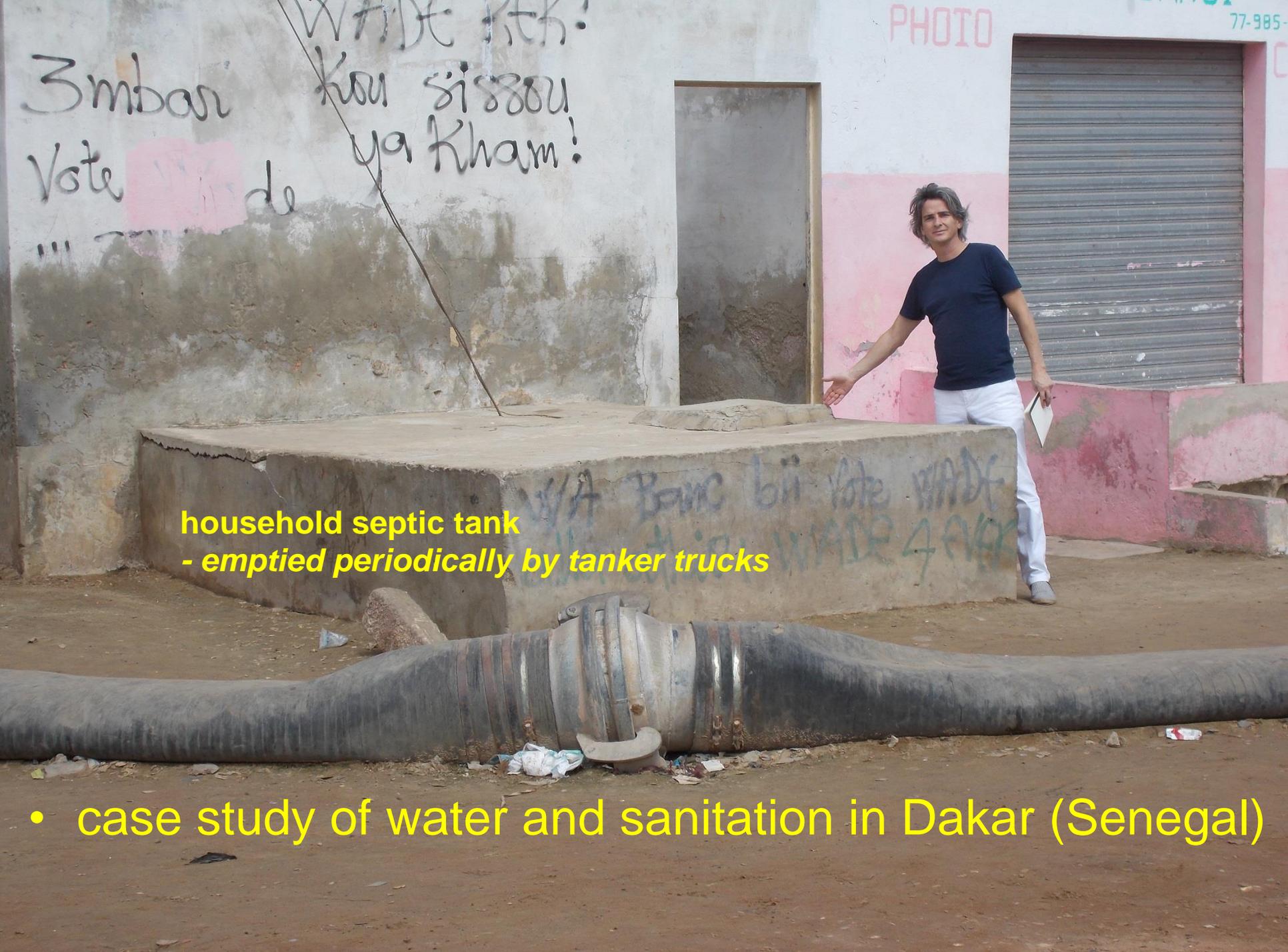


Sustaining low-cost, urban water supply and sanitation systems in Africa

AfriWatSan is developing the scientific evidence to inform policies and practices sustaining low-cost, on-site water supplies and sanitation systems in urban Africa and to strengthen the capacity of individuals and institutions to conduct this vital research.

Figure 1: Network of urban groundwater observatories in Africa





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Vote

PHOTO

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household septic tank
- emptied periodically by tanker trucks

WA Banc bii vote WADÉ
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- case study of water and sanitation in Dakar (Senegal)



**groundwater-fed public water supply
- supplemented by imported surface water and groundwater**

septic tanks
- poorly sealed (spill over) and drain to shallow subsurface (urban aquifer)



Dakar, Senegal

high urban flood risk

- *shallow groundwater lens (on seawater)*
- *imported water and urban wastewater leak to shallow subsurface*





urban flood water management
pump flood water to retention ponds
- eutrophication (nitrate > 500 mg/l)
- pump collected water to sea

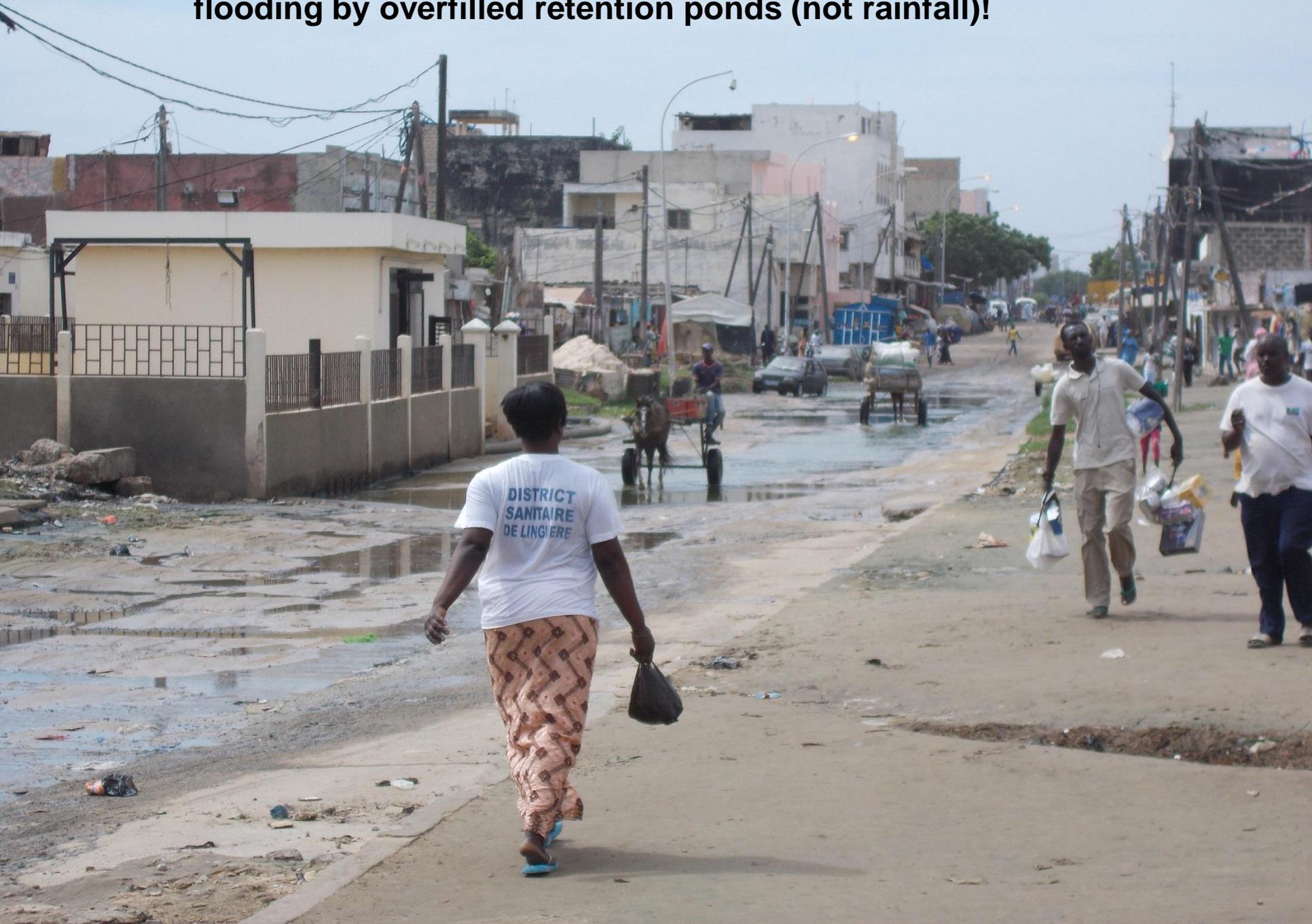


What if pumps fail?



Drain from overflowed retention pond!

flooding by overfilled retention ponds (not rainfall)!

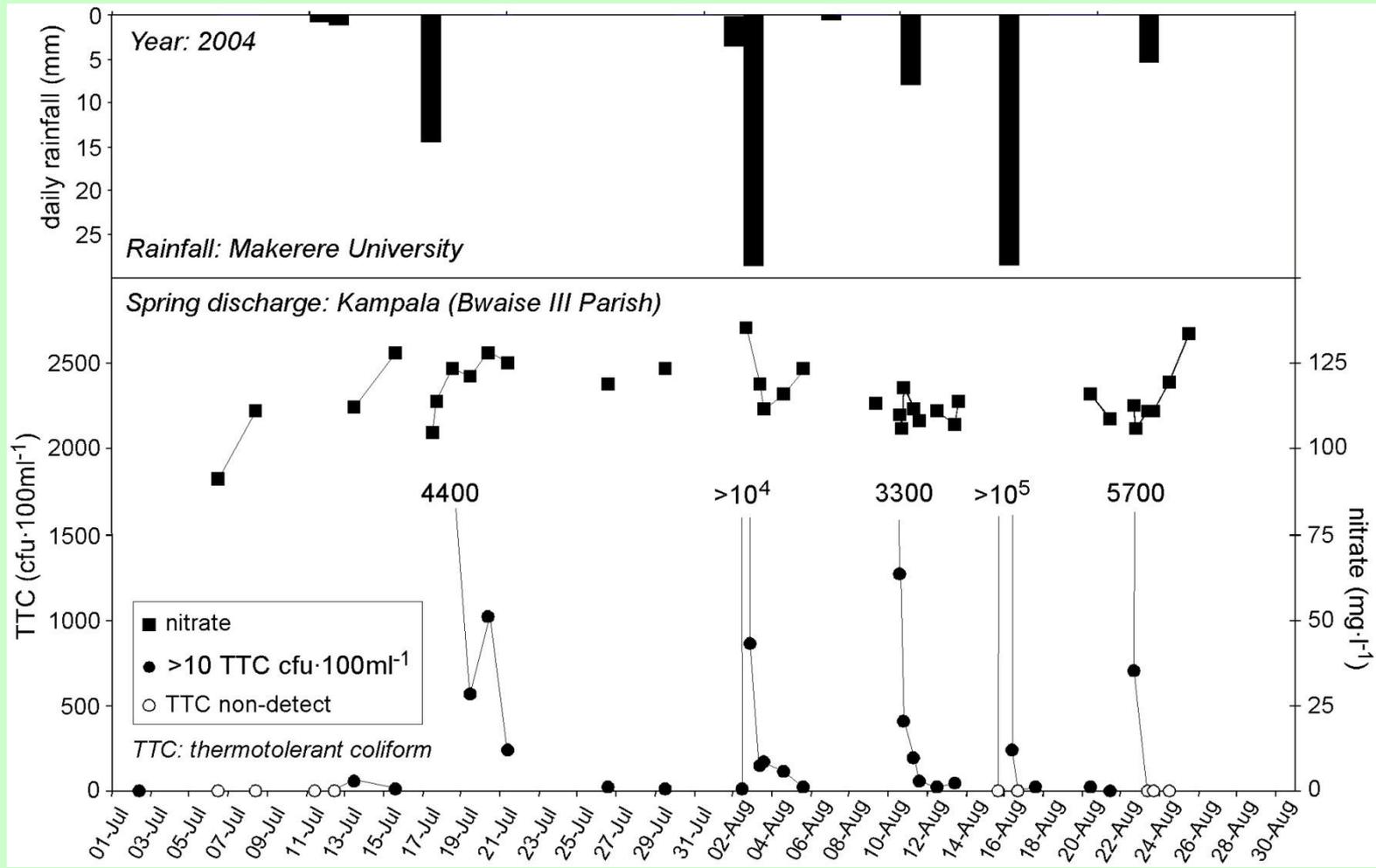


- in Kampala, dependence upon on-site sanitation and water sources such as protected springs



Vulnerability of low-cost, on-site systems to contamination

- spring discharges shows a rapid deterioration in bacteriological quality following heavy rainfall: inadequate community hygiene



Taylor et al. (2009); Flynn et al. (2012).

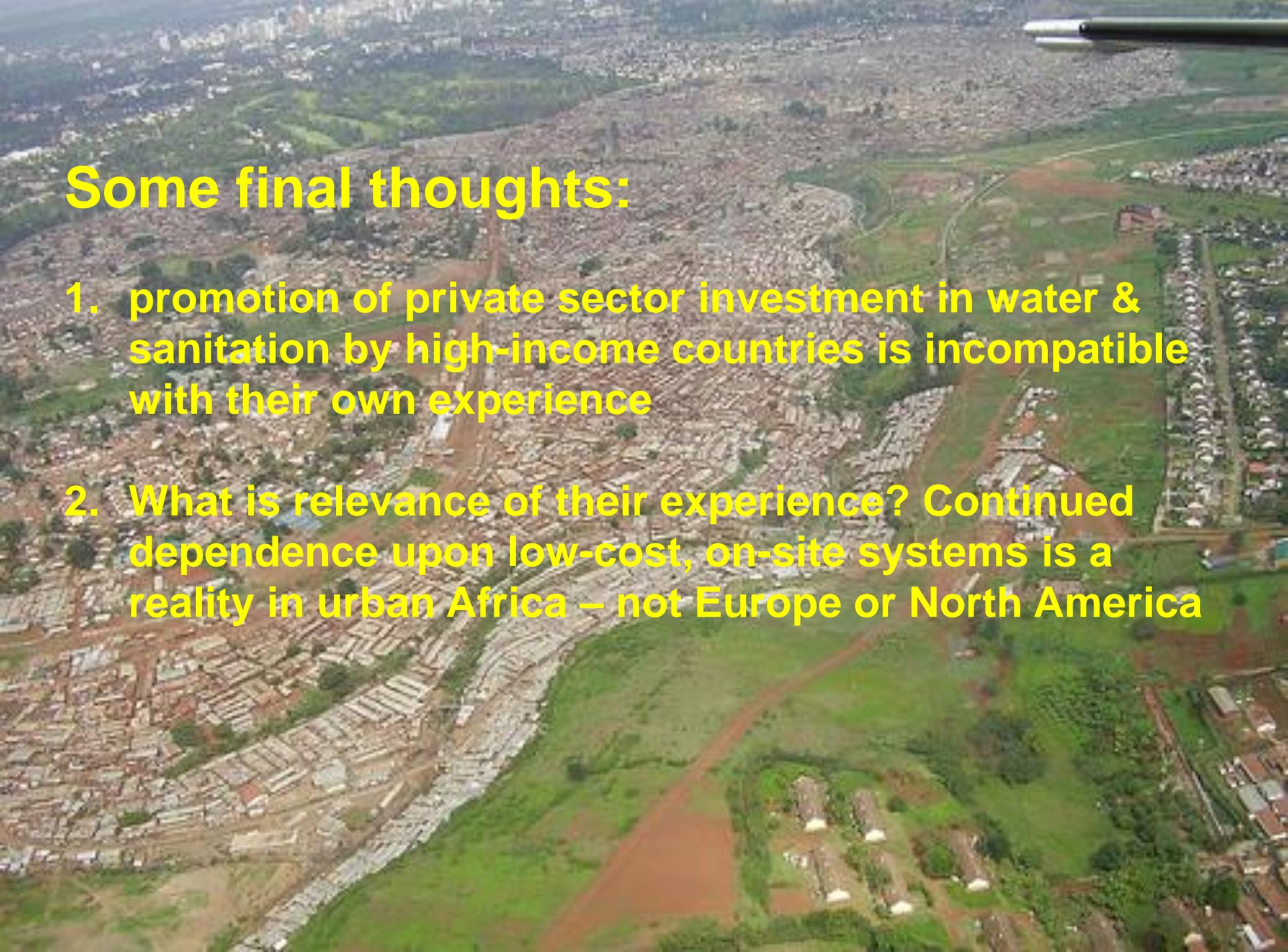
Urban water access

- reliance upon a range of sources:
 - piped (municipal)
 - piped (vendors)
 - unpiped (improved)
 - unpiped (unimproved)
- promotion of private sector investment in water & sanitation sector in Africa by high-income countries (UK, USA, France) incompatible with their own experience

Drangert et al. (2002)

Cairncross (2003)



An aerial photograph of a densely populated urban area, likely in Africa, showing a river winding through the city. The buildings are closely packed, and there are patches of green space and open fields. The text is overlaid on the image in a bright yellow color.

Some final thoughts:

- 1. promotion of private sector investment in water & sanitation by high-income countries is incompatible with their own experience**
- 2. What is relevance of their experience? Continued dependence upon low-cost, on-site systems is a reality in urban Africa – not Europe or North America**