FAO Program
ONE WATER ONE HEALTH

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GLOBAL WATER FOOD SAFETY SUMMIT
College Park, MD, November 19-21, 2019

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One Water One Health

→Integrated human and animal environmental sanitation

→Urban and Peri-urban agriculture

→Water related human and animal health

→All open defecation issues: Cysticercosis, Schistosomiasis,

→Linking integrated approaches between Water and Health

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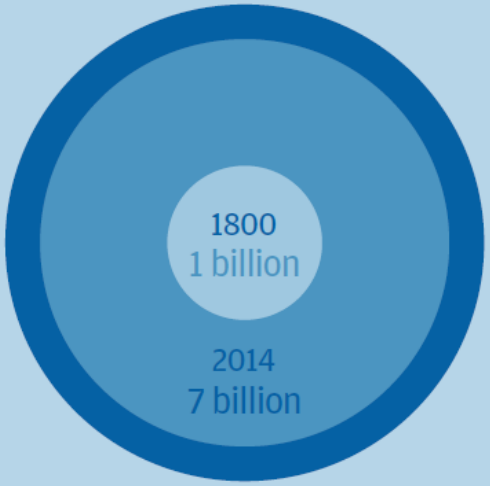
ON OUR CURRENT TRAJECTORY WE WILL PUT EVEN MORE PRESSURE ON THE PLANET

POPULATION

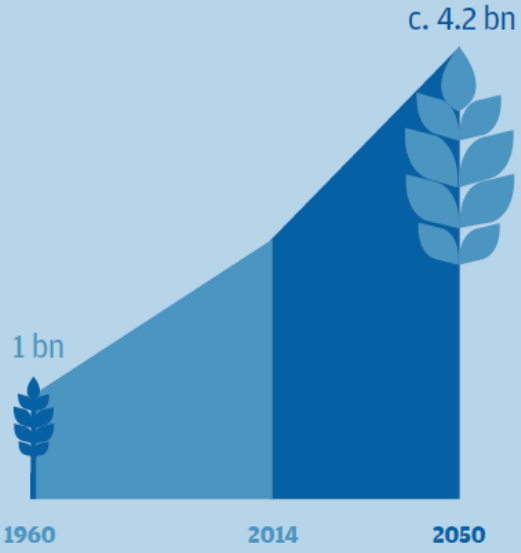
World population (billions)



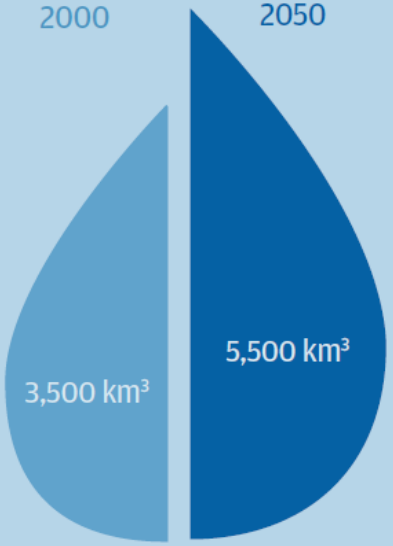
2050
9.6 billion

GRAIN PRODUCTION REQUIREMENTS

Total global cereal production
(billions of tonnes)



WATER DEMAND[2]



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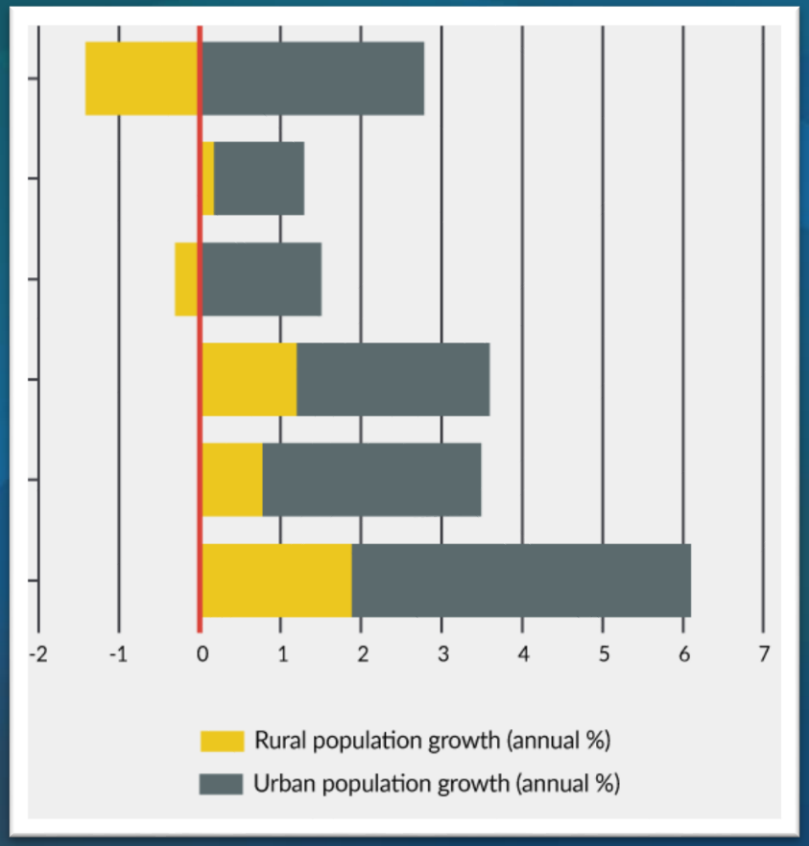
ACCELERATING URBANIZATION

Additional 2.3 billion people living in cities by 2050



Source: Based on data from the World Bank (n. d.)

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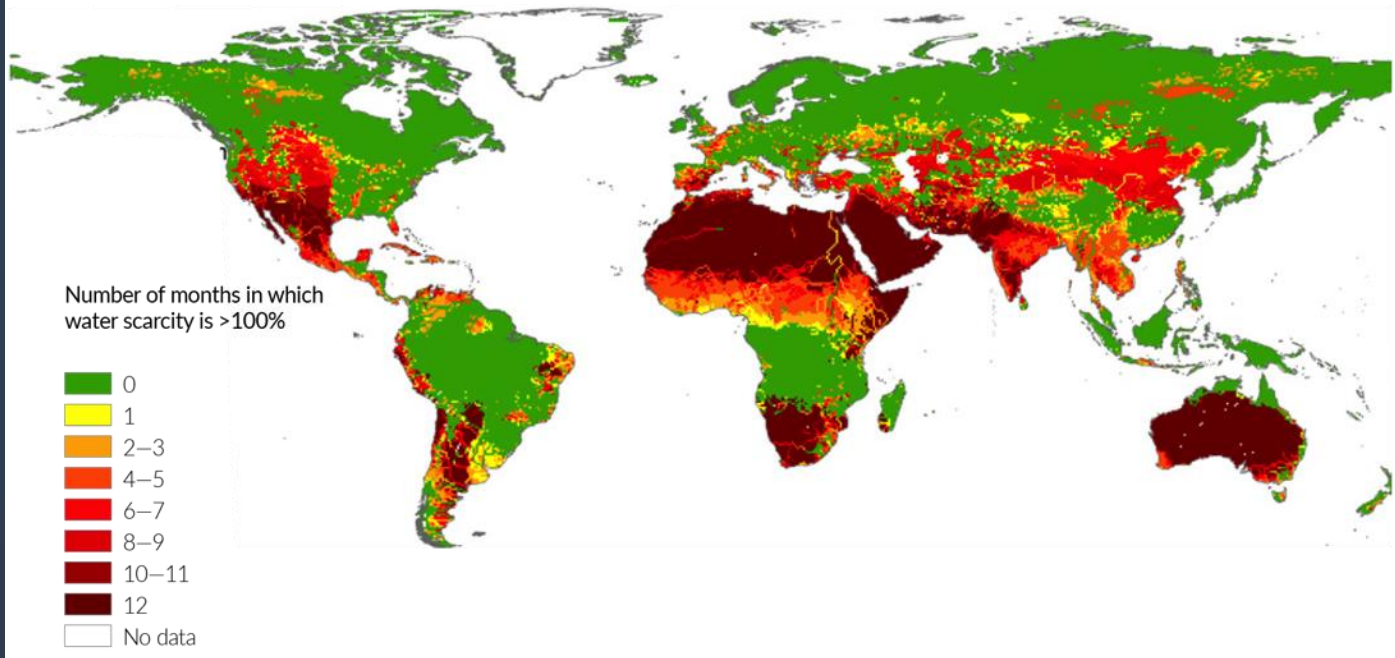
INCREASING WATER SCARCITY

Two thirds of the world's population currently live in areas that experience water scarcity for at least one month a year



Source: Mekonnen and Hoekstra (2016)

INCREASING WATER SCARCITY

Climate change will exacerbate the frequency and severity of floods and droughts

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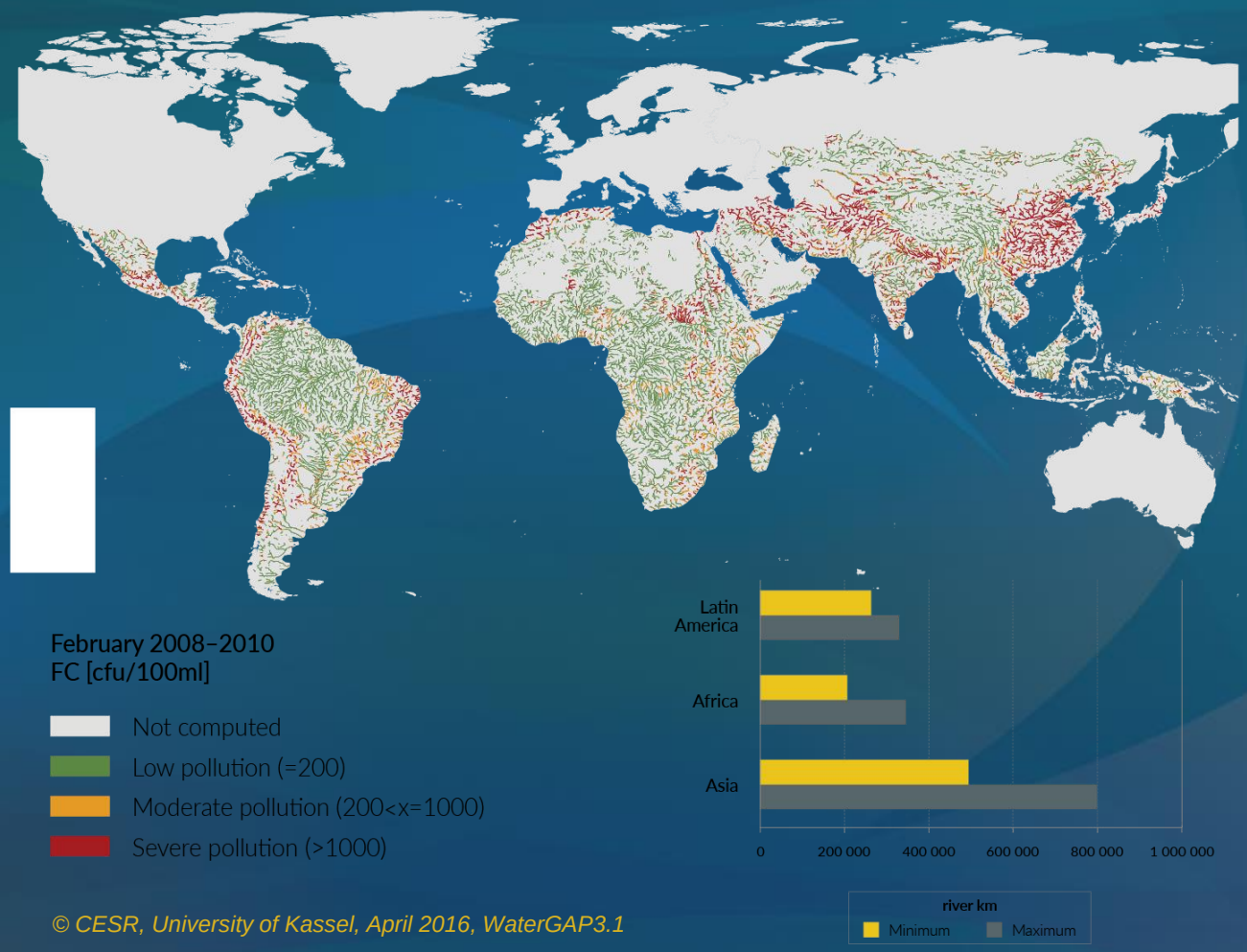
DEGRADATION OF WATER QUALITY

Severe pathogen pollution affects around one-third of all river stretches in Latin America, Africa and Asia, putting the health of millions of people at risk



© CESR, University of Kassel, April 2016, WaterGAP3.1

Source: UNEP (2016)

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MORE WASTEWATER THAN EVER

The quantity of wastewater produced and its overall pollution load are increasing worldwide

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Fit-for-purpose principles

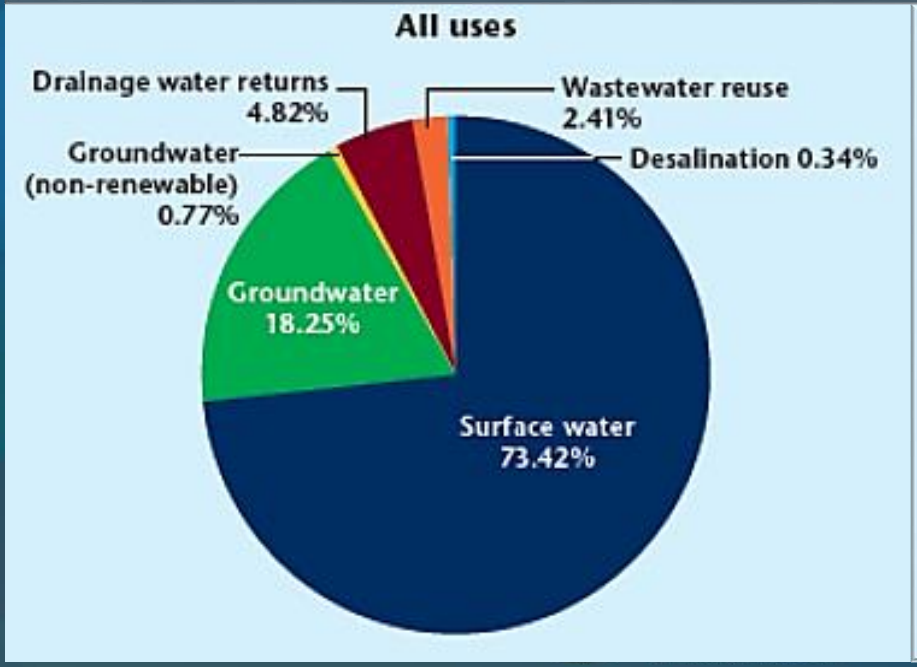
- Water of the best available quality should be selected as the source of drinking-water supplies (WHO 2011)

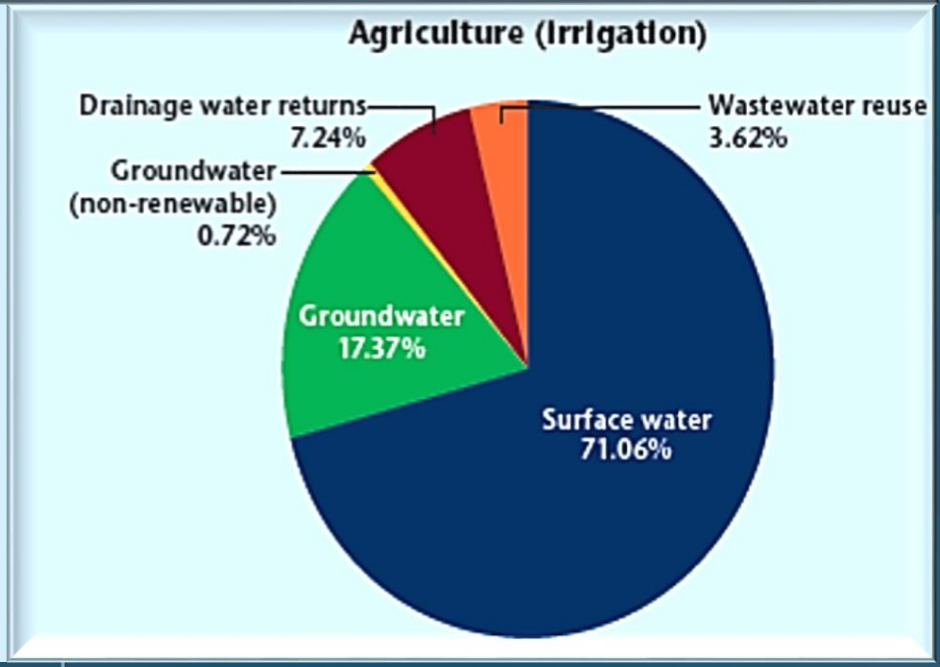
- "No higher quality water, unless there is a surplus of it, should be used for a purpose that can tolerate a lower grade" (UN 1958)

- Subject to appropriate management and treatment, wastewater represents a suitable, (relatively) climate independent source of water for irrigation of food crops

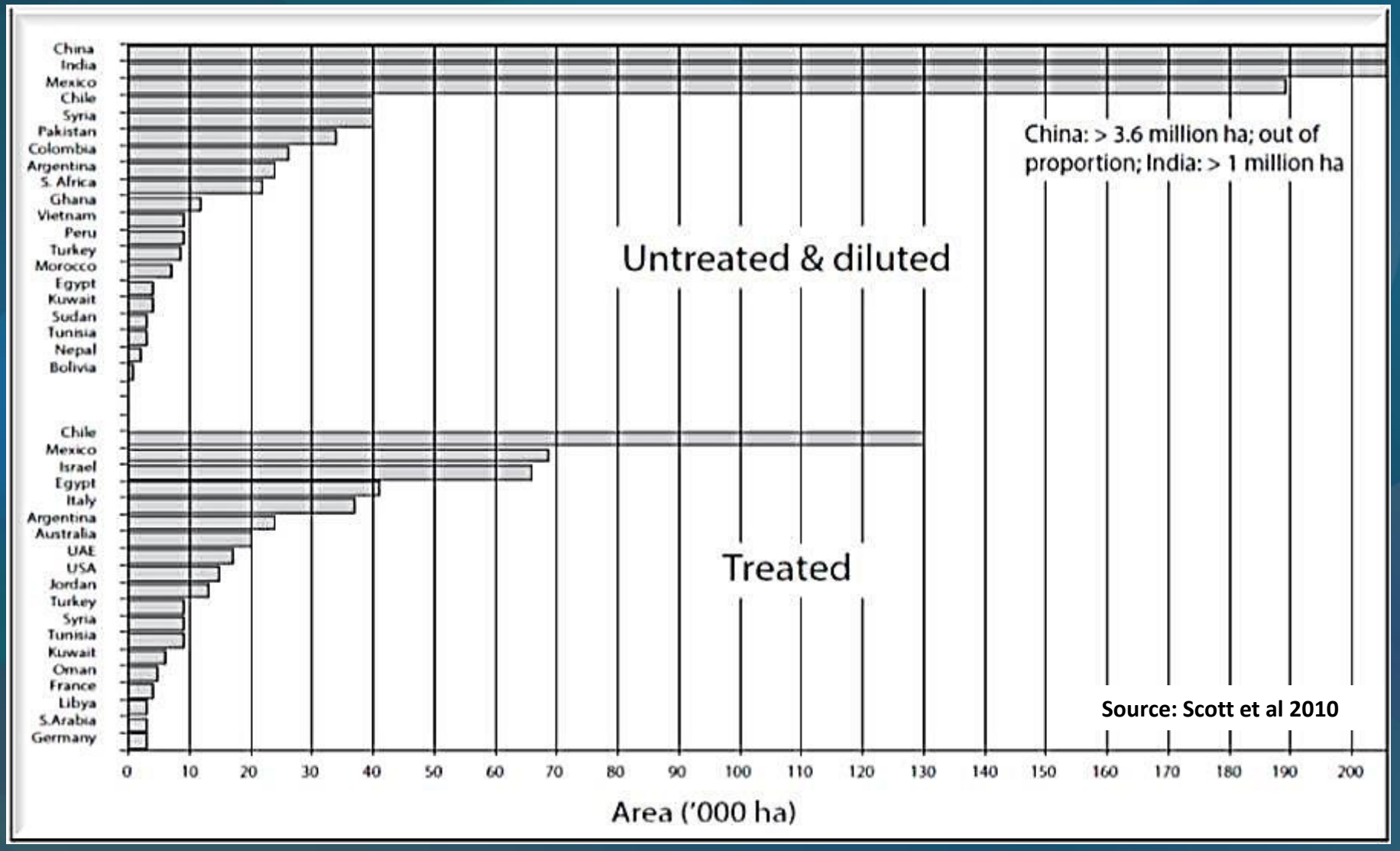
Wastewater Statistics

- Estimated that 20 million ha in 50 countries are irrigated with raw or partially treated wastewater representing around 10% of total irrigated land.
- 0.53 million ha are irrigated with treated wastewater in 44 countries. Total use 5,500GL per year





Use of Wastewater



Safety - the major caveat

- Wastewater use needs to be safe. The majority of current use is with untreated wastewater or partially diluted untreated wastewater

- FAO WHO guidelines (2006) include a volume on "Wastewater use in Agriculture". Aims include:

  - ensuring safety based on combinations of treatment and use of on-site measures such as crop selection (salad vegetables versus fruit trees) and irrigation methods (drip versus spray)

  - promoting a harmonised approach to support international trade of wastewater irrigated produce

ONE WATER

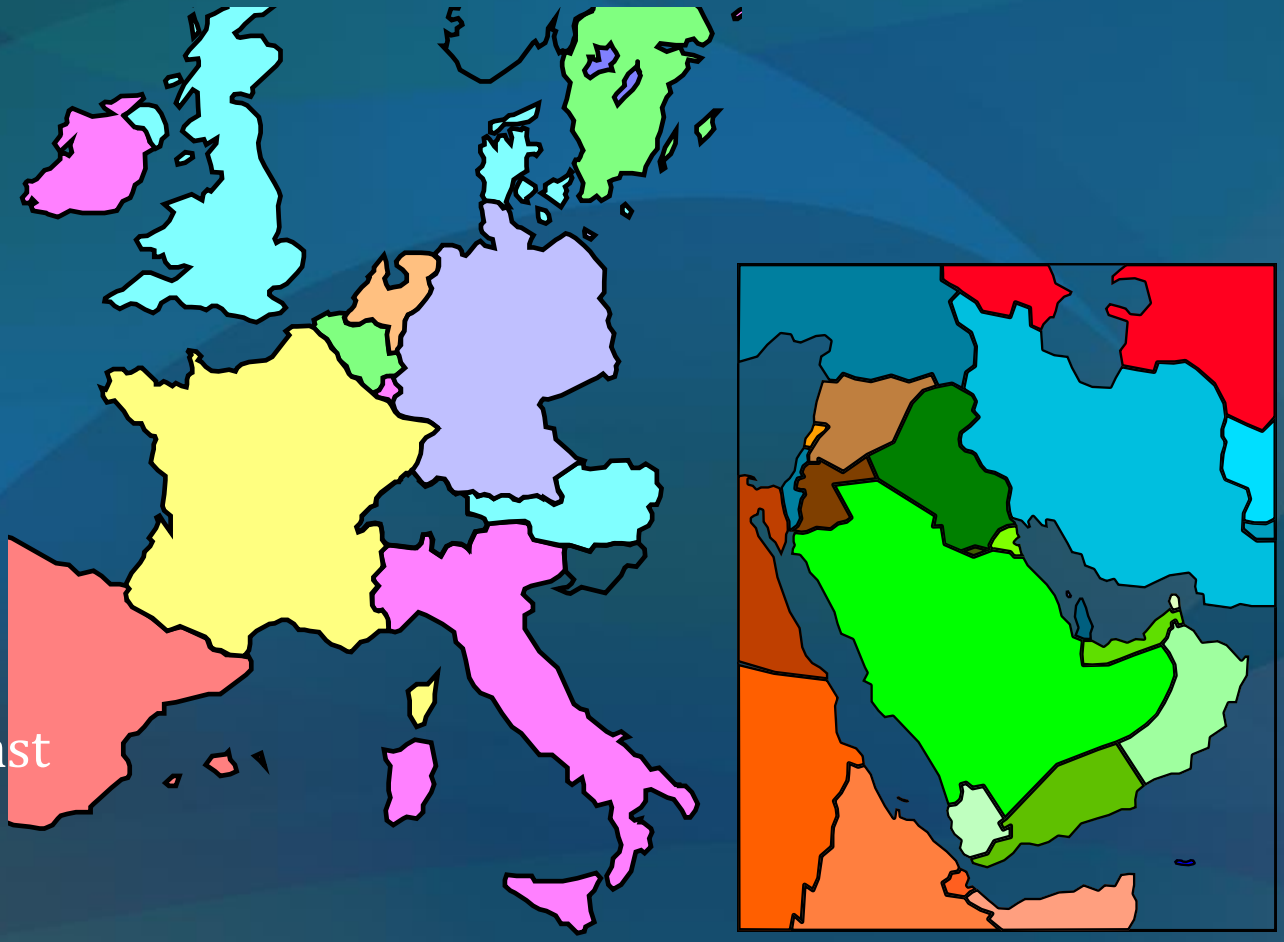
- There is clear evidence of increasing stress and over use of existing surface water and groundwater resources. Alternatives are needed.

- Over 90% of wastewater is currently discharged, mostly without treatment, causing environmental damage and human health impacts

- Wastewater can provide a valuable resource for agricultural irrigation (Win). Reuse reduces environmental impacts (Win). Basic treatment ensures safety reducing human health impacts(Win).

International Uses of Recycled Water

- Europe
- Japan
- United States
- Latin America
- Namibia
- Singapore
- South Africa
- Australia
- The Middle East



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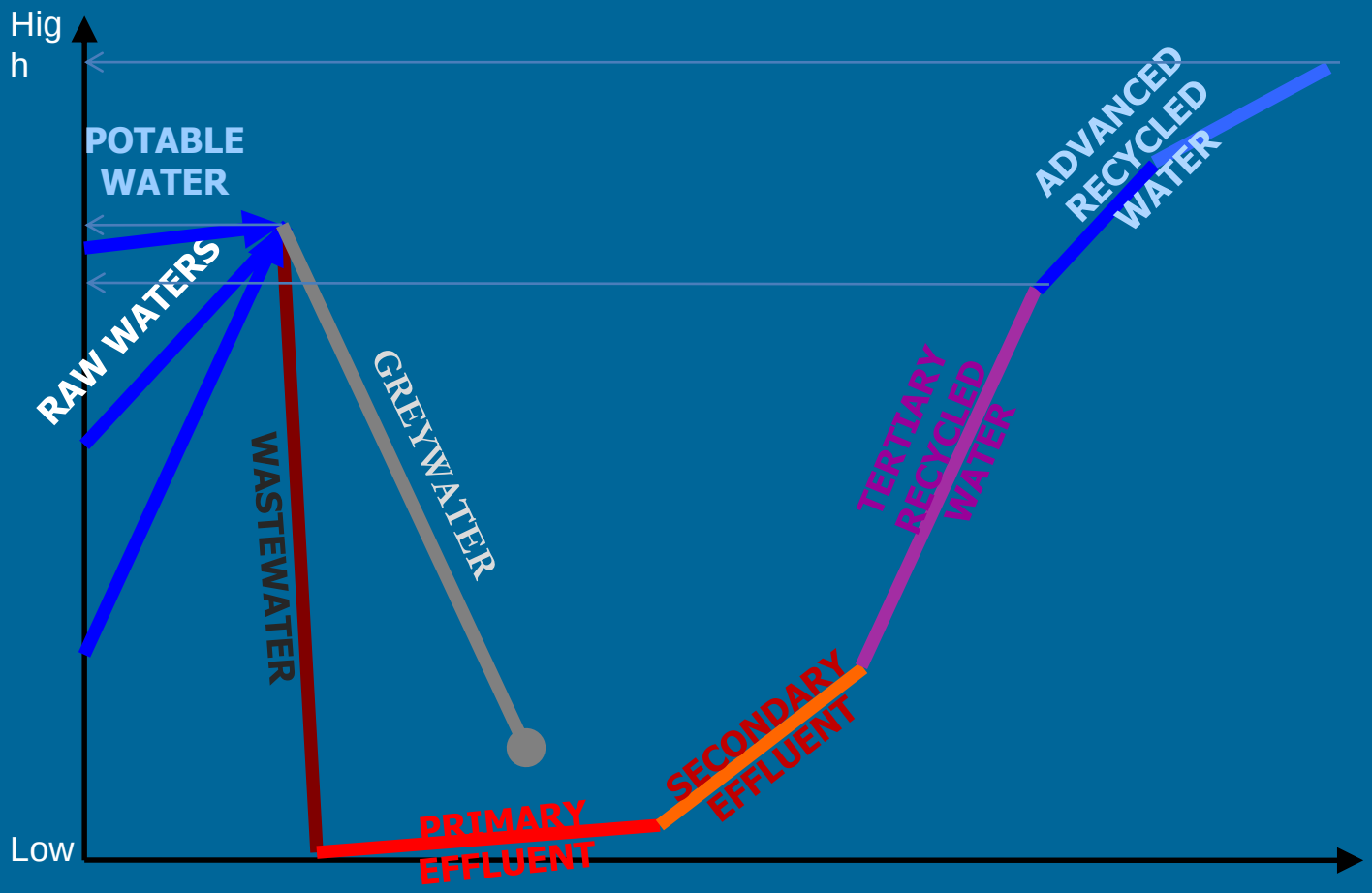
Water Reuse Applications in Food Production

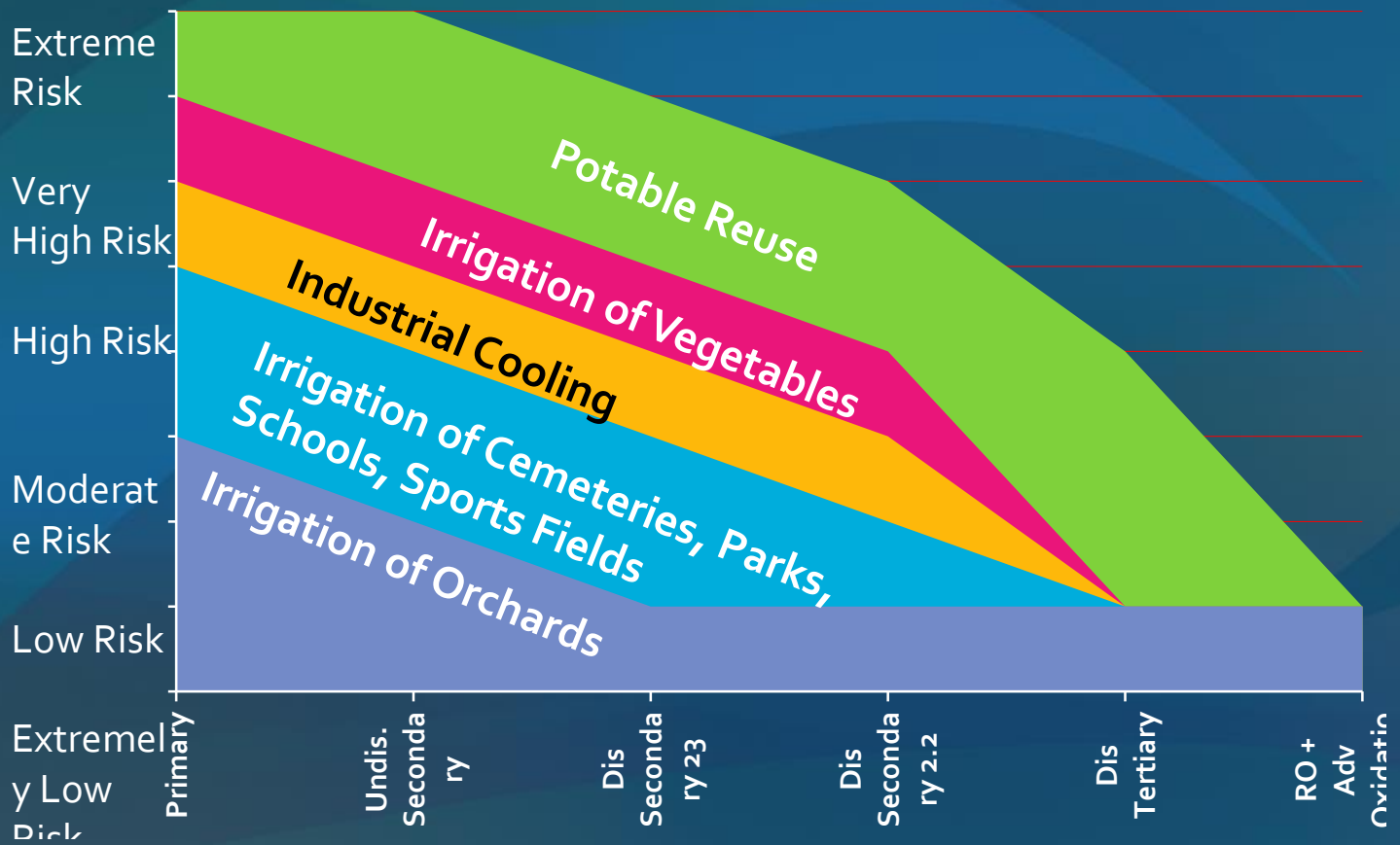
- Processed Food Crops
- Seed Production
- Tree Crops
- Crops Commonly Cooked
- Root Crops
- Aquaculture and Hydroponics
- Leafy Vegetables

QUALITY OF WATER



Increasing Levels of Treatment, Monitoring, Enforcement, Safety Measures

Risk Vs. Use Vs. Treatment



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MONTEREY FIELD PILOT RESEARCH

- Thousands of Samples
  - Plant Edible Parts
  - Plant Residual Tissue
  - Soils
  - Runoff Water
- Analysis of Variance

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FIELD RESEARCH RESULTS

- No Natural Virus Detected In Recycled Water
- Seeded Virus Five-Log Removal
- Crop Quality, Yield Was Unaffected
- Worker Safety (Medical Exams)
- Heavy Metals Were Below Detection Limit
- Wholesale Buyers' Acceptance
  - Market Research
  - Positive Responses

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Full-Scale Use of Recycled Water

- 5,000 Hectares of Vegetables
- 20 Years with Successful Production
- Transition from Artichokes to Strawberries

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One Health

- Driver for change in the way we deal with public health issues.
  - Food safety, control of zoonoses
  - Ecosystem health/provisioning services (food, water and recreation)
- Stimulus for closer collaboration between sectors
  - Human and animal health, environment agencies.
  - Supported by WHO, OIE and FAO

The health of humans, animals and the viability of ecosystems are inextricably linked

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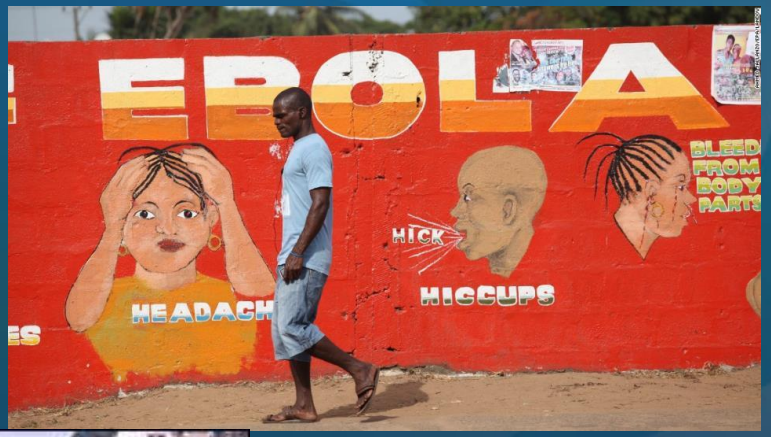
Zoonoses

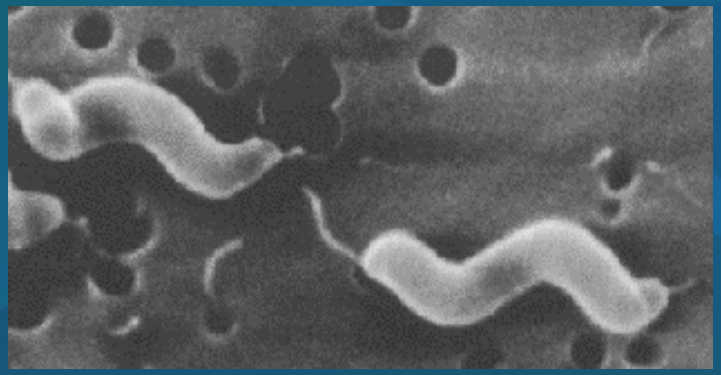
- 60% of ~1500 human infectious disease agents zoonotic.
- Emerging infections: over 75% zoonoses
- Zoonoses of importance for water pathway
  - Livestock
  - Wildlife



Waterborne zoonotic infections include:

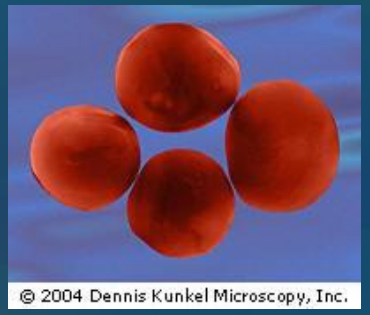
Protozoa

- *Cryptosporidium*
- *Giardia*
- *Toxoplasma*
- …. others

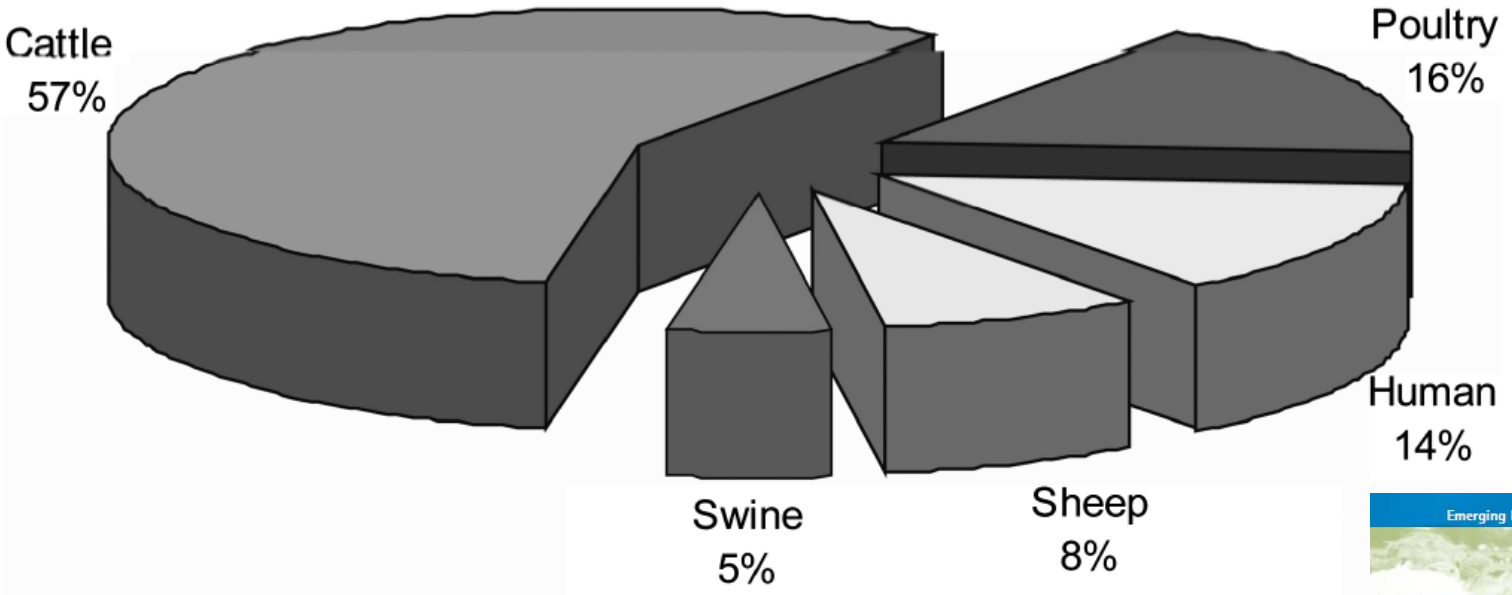


Bacteria

- *Campylobacter*
- *Salmonella*
- *E. coli* O157
- *Leptospira*



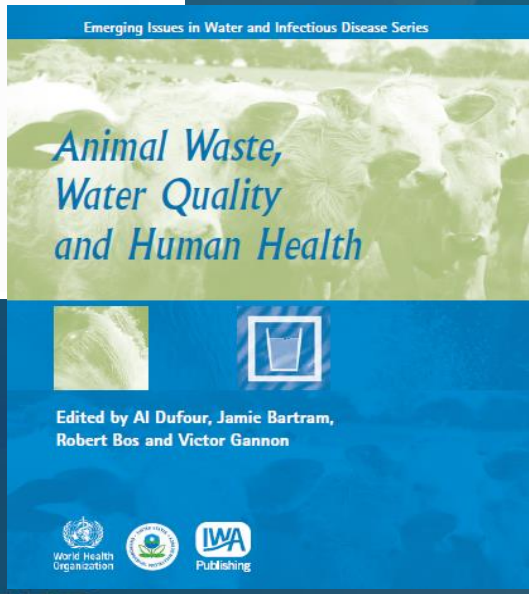
Global human and agricultural sources of fecal pollution



2.62 x 10^{13} kg/year - 2007

Source: FAOSTAT - website

Domestic animals 85% of faecal waster



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Faecal outputs of cattle…and humans in New Zealand

- Cattle: Number of defecations
  - 9 – 16, average 12 per day
  - Total output of 25kg per cow per day.
- 9 million cattle in NZ
- 230,000 tonnes faecal material per day…
- 84 million tonnes per year…
- Humans 800 tonnes per day
  - But treated before discharge

Source Dr Brent Gilpin ESR Ltd

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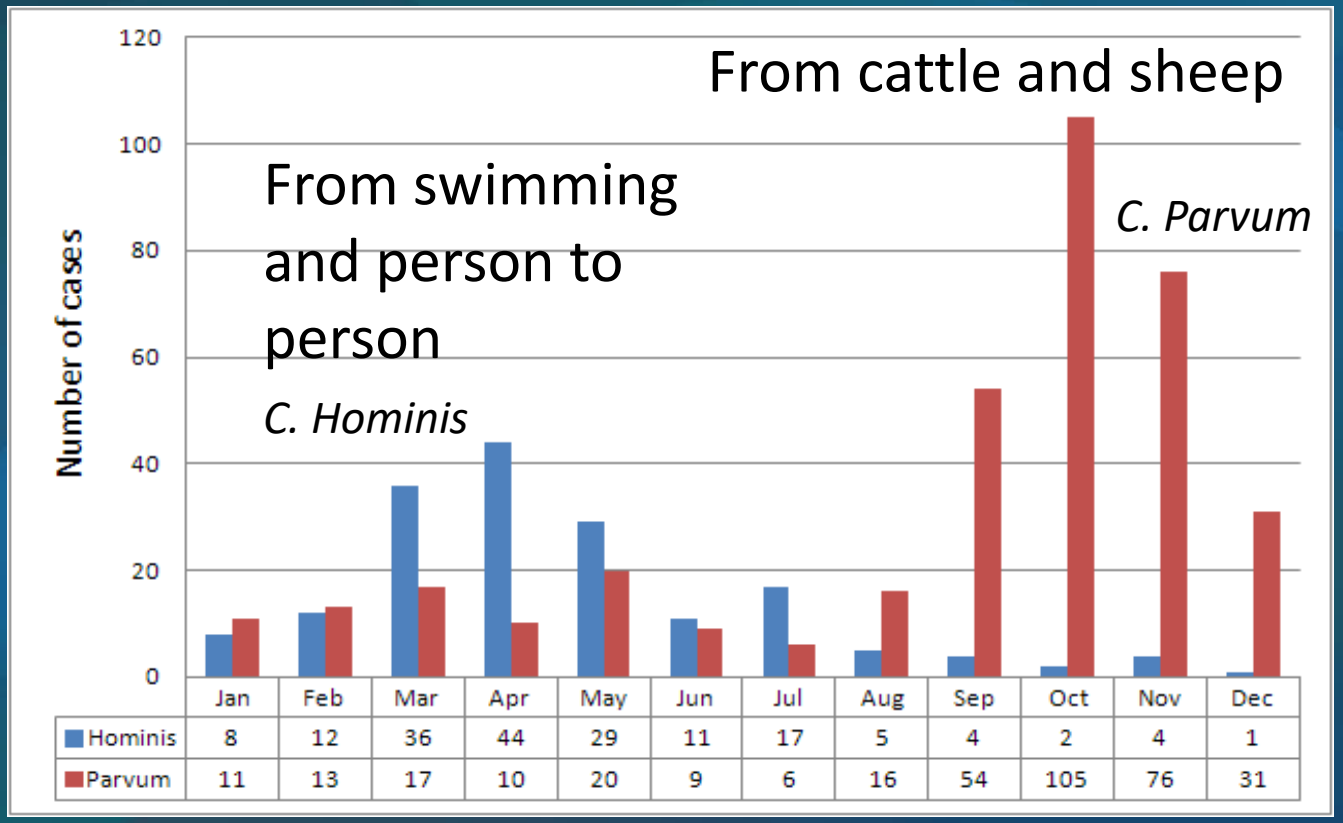
Pathogen Prevalence in Calves

J. Al Mawly et al./The Veterinary Journal 203 (2015) 155–160

Enteropathogen	9 to 21-day-old calves	1 to 5-day-old calves
Rotavirus (total)	158/797 (19.8%)	86/429 (20%)
Coronavirus (total)	49/797 (6.1%)	23/429 (5.3%)
C. parvum (total)	126/797 (15.8%)	25/429 (5.8%)
Salmonella spp. (total)	4/797 (0.5%)	3/429 (0.6%)

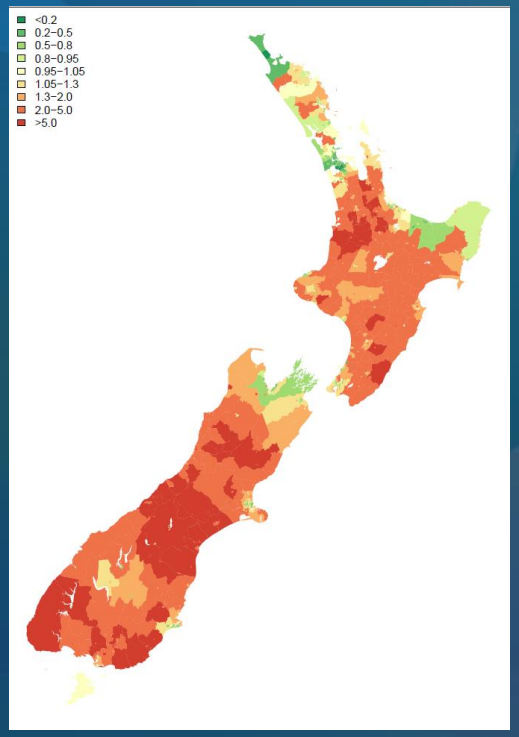
Up to 10^8 oocysts / g faeces

Cryptosporidium: two species



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hominis	8	12	36	44	29	11	17	5	4	2	4	1
Parvum	11	13	17	10	20	9	6	16	54	105	76	31

Cryptosporidiosis strongly associated with dairy cattle density



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Drivers for the emergence of waterborne zoonoses

- Changing patterns of water use
- Population factors: growth, migration
- Increasing travel, recreational activities
- Water scarcity, climate change, severe weather
- Conflicts and disasters
- Urbanization and habitat encroachment
- Changing diet (animal protein/fresh vegetables)
- Intensification of livestock (e.g. feedlots)

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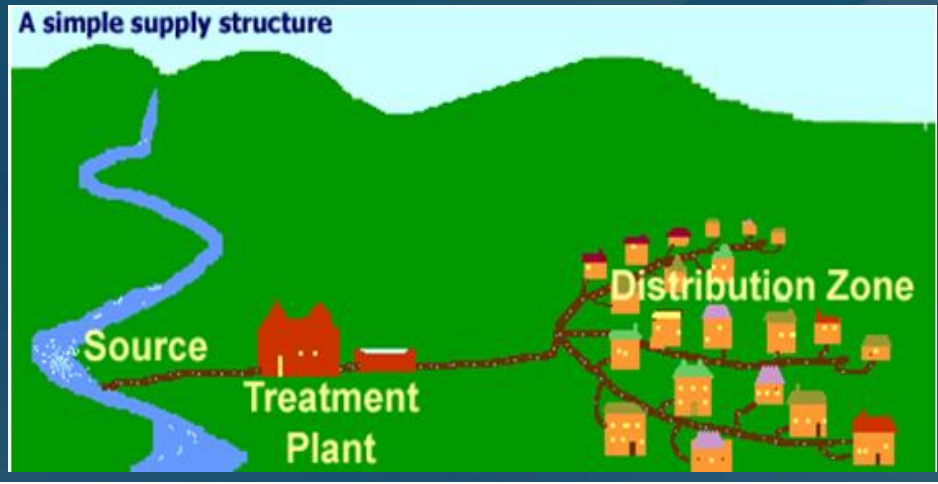
Controlling waterborne zoonoses

- On farm
  - Prevent transmission between animals
    - Vaccination (e.g. leptospirosis)
    - Hygiene barriers/biosecurity
    - Reduce stocking density
  - Prevent contamination of surface water
    - Manure/slurry management (incl. ponds, wetlands)
    - Fencing, bridges and culverts
    - Riparian planting
- Off farm
  - Water treatment
  - Recreational water guidelines



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Surface Run-off – Riparian Buffers / Barrier strips

- Run-Off a key source of contamination
- Effectiveness of riparian buffers depends on a range of factors:
  - slope, rainfall intensity, soil type etc
- Buffers
  - can be effective in light rain
  - less effective in heavy rain

Diffuse

Point-source

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Irrigation Management

- Irrigation can promote surface run off especially if soils are saturated
  - Important for effluent irrigation
- Avoid irrigation immediately after grazing
- Border dyke worse than overhead irrigation
- Match irrigation to soil type

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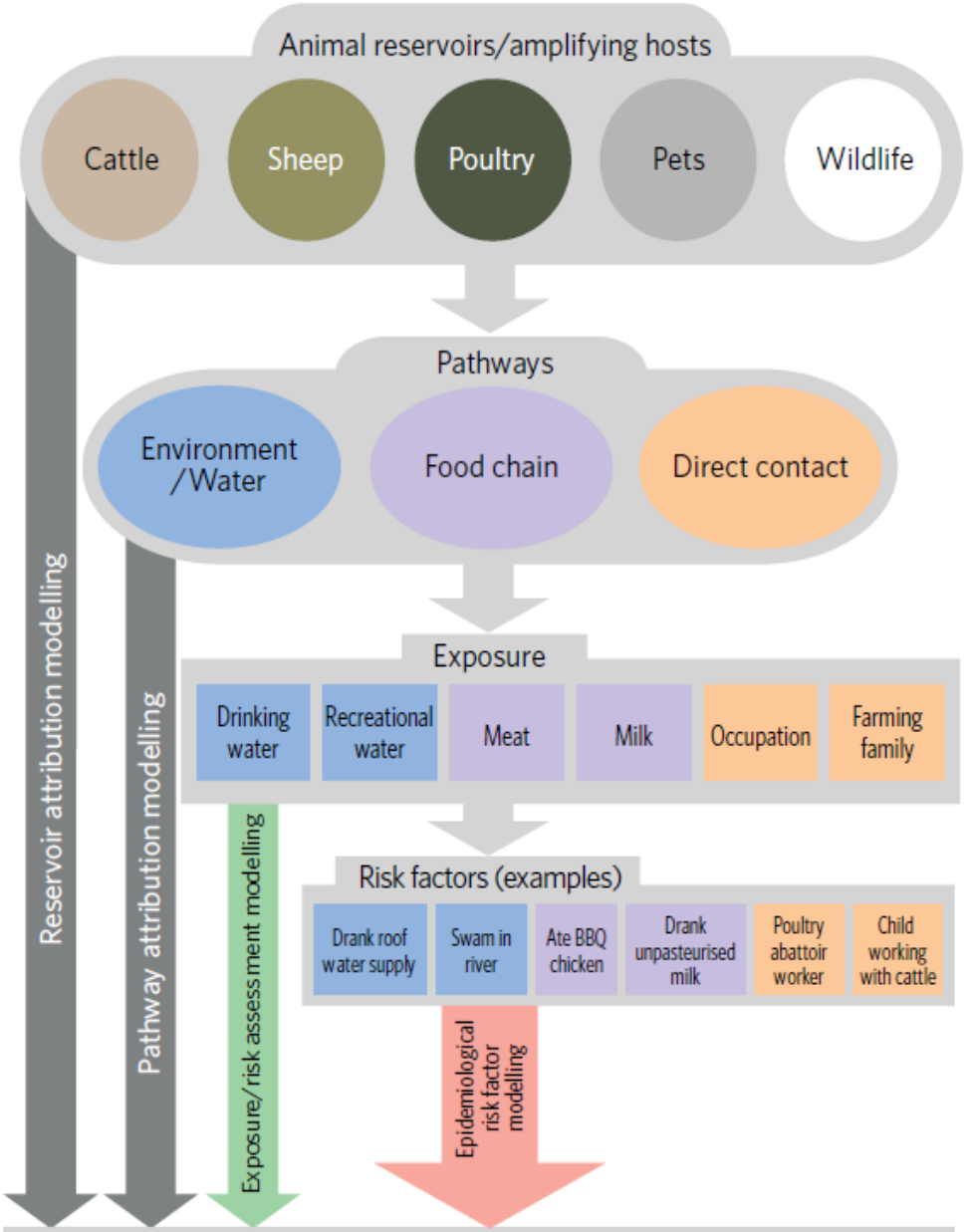
Source tracking and attribution

- Source tracking
  - Identifying likely source of pollution
  - Chemicals, microbes
- Source/reservoir attribution
  - An estimation of the relative contribution of different 'sources' to the burden of human illness…. to inform policy for prevention and control.
  - Applied to identify sources of pollution of surface water with pathogens

Source Attribution Framework



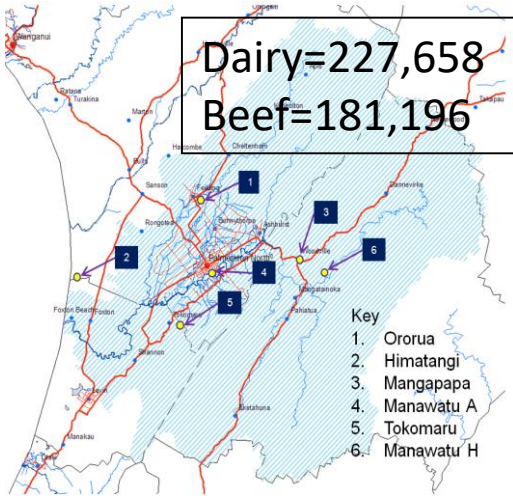
Information to inform policy for reducing zoonoses

Wagenaar, French and Havelaar, 2013.
Clin Infect Dis, 57, 1600-7
Preventing Campylobacter at the source: why is it so difficult?

Campylobacter sources in water

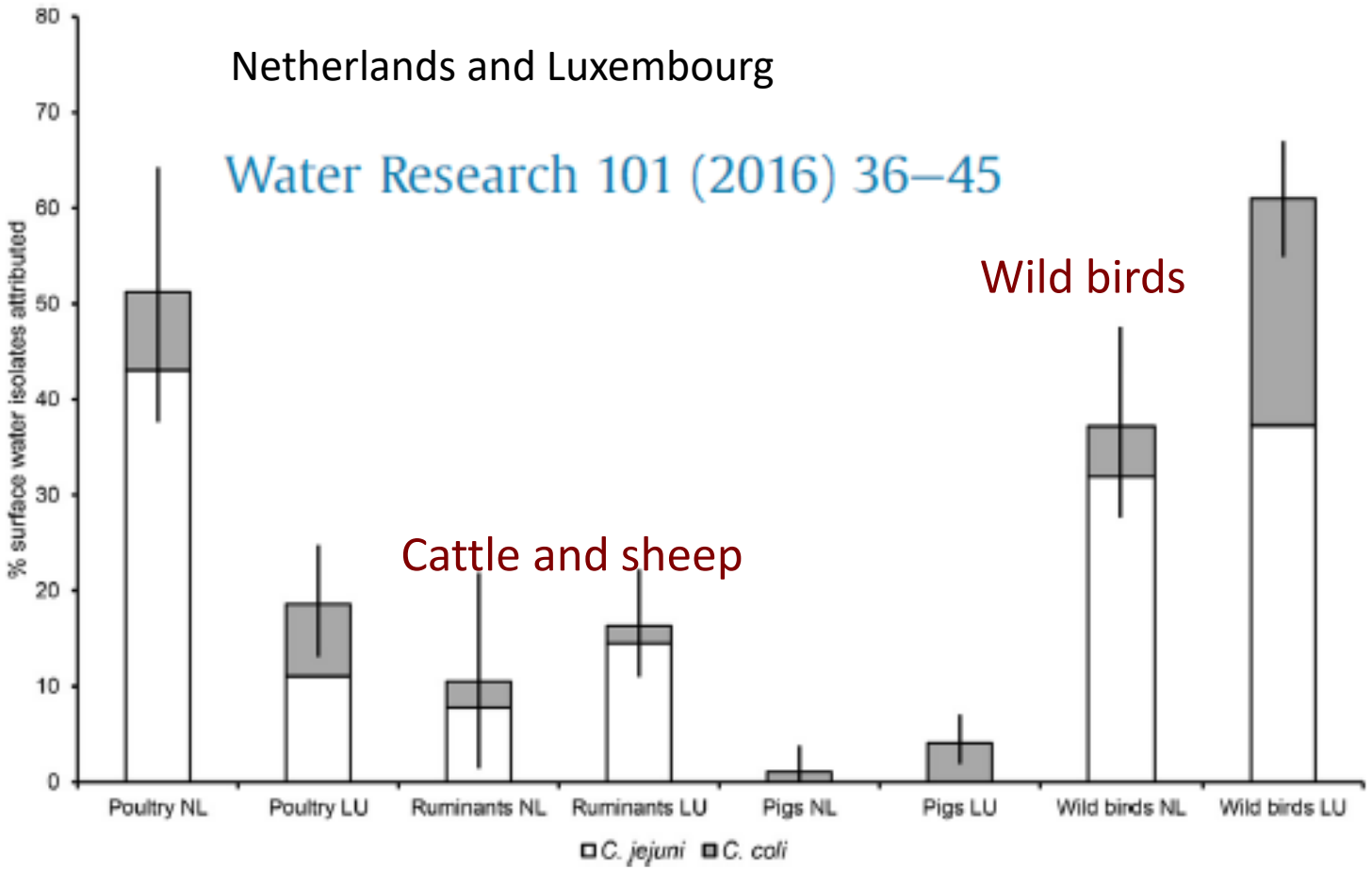
Based on molecular techniques and evolutionary modelling

Most *Campylobacter* in water wildlife – even in dairy catchments



French et al 2011

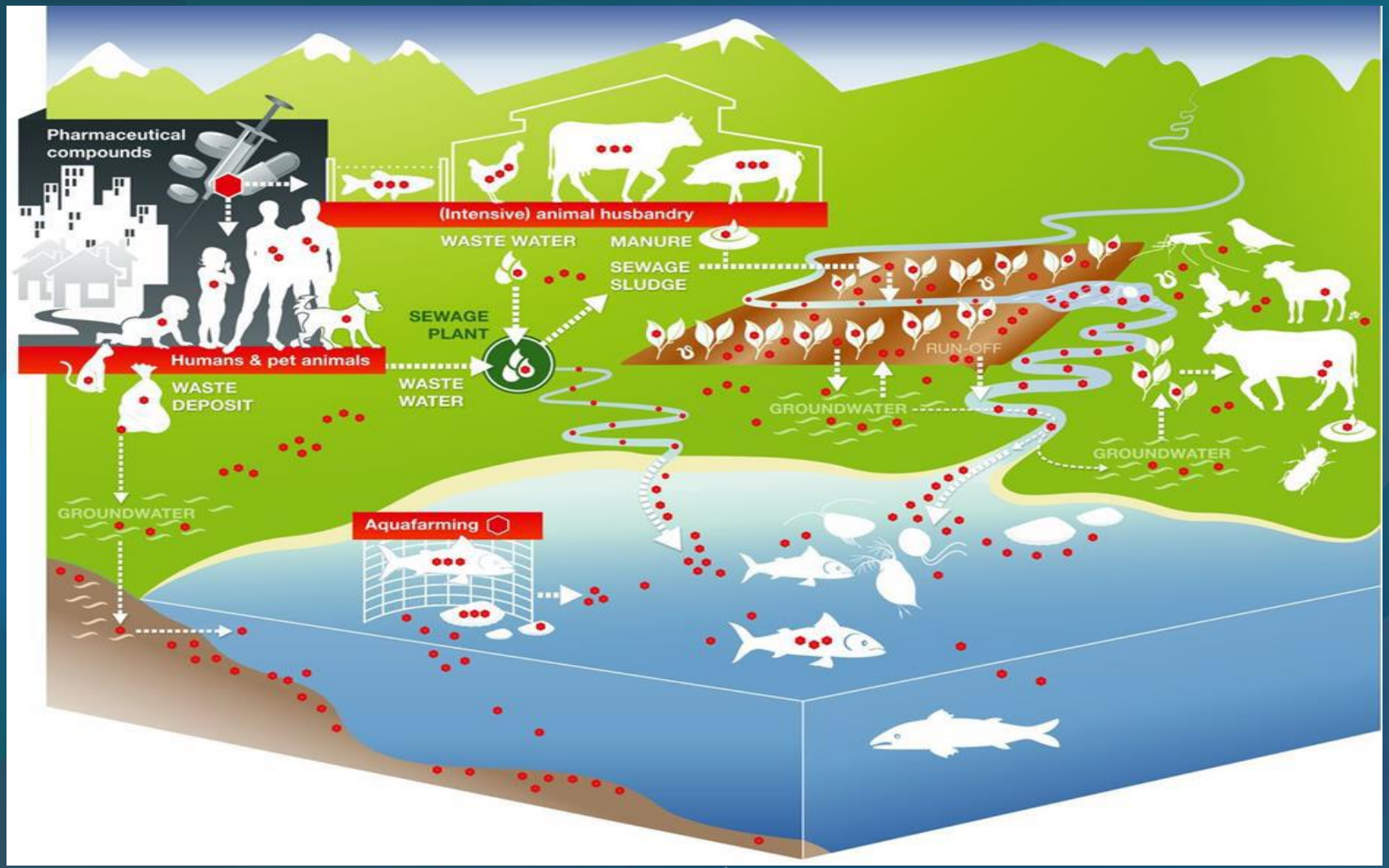
Similar finding in recent Dutch study



Quantifying potential sources of surface water contamination with *Campylobacter jejuni* and *Campylobacter coli*

Lapo Mughini-Gras [a, b, *], Christian Penny [e], Catherine Ragimbeau [c], Franciska M. Schets [a], Hetty Blaak [a], Birgitta Duim [b, f], Jaap A. Wagenaar [b, d, f], Albert de Boer [d], Henry-Michel Cauchie [e], Joel Mossong [c], Wilfrid van Pelt [a]

FAO ATLASS Tool for AMR



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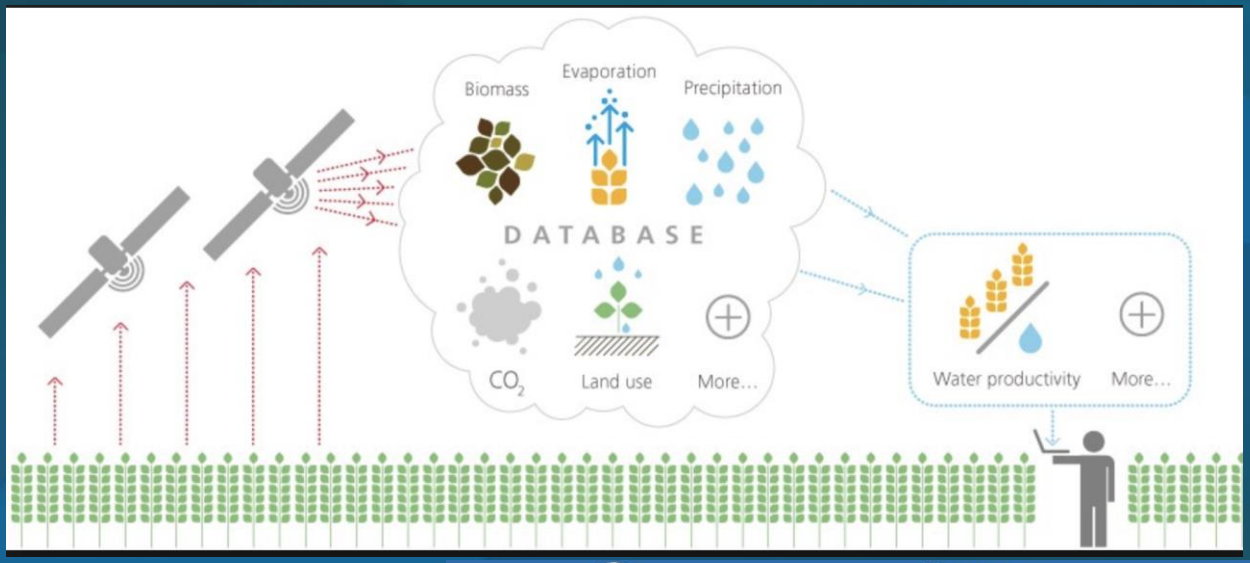
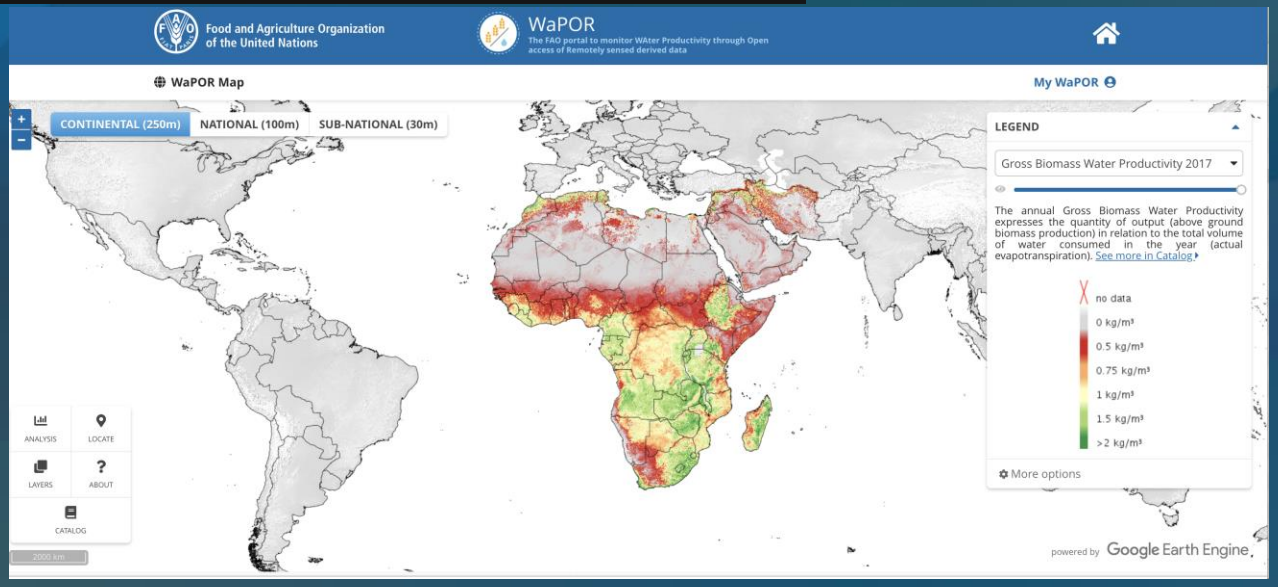
FAO Aquastat database and WaPOR measures crop water consumption, water use with potential for overlays with health and source tracking





One Water One Health Hot Issues:

- Water quality affected by animal waste and its consequences for human and animal health are important. Domestic animals and wildlife important source of human waterborne infection
  - Contamination of surface and groundwater
- Risk management of AMR attributable to antibiotics contamination of water resulting from use in livestock
- New techniques being developed for source tracking and attribution
  - Will complement other models of risk and exposure (e.g. catchment models)
- Need to design more effective mitigation measures
  - On-farm and off-farm
  - Water use fit-for-purpose standards and system monitoring
- All requires a systems 'ONE WATER ONE HEALTH' approach
  - Considering human, animal and environmental health

Future of One Water:

Living water smart (Infrastructure and Social Change)

- Promotion of future 'one water' infrastructure (drinking water, wastewater, water reuse, stormwater), management systems & social outreach (expansion of WaterSense, Water Sensitive Cities, adaptive management approaches to support economic incentives to yield social change)

Water for healthy ecosystems

- Assess, repair and manage the inland and coastal water ecosystems for water quality and quantity and human and aquatic life health; manage sustainable water yields and aquatic inputs, all of which need to be expressed in dollar values

Tools & biohydroinformatics Community to national-scale tools for integrated LCA, RA & water footprint information to provide decision-makers with tools for water systems (drinking water, wastewater, ecosystems, groundwater ...); hydrological models for planning and close-to-real-time management of urban, riverine and groundwater systems based on telemetry from novel sensors and 'smart' infrastructure and data from health informatics

SDGs Promote Integration

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