Irrigation, Schistosomiasis, and Droughts

By

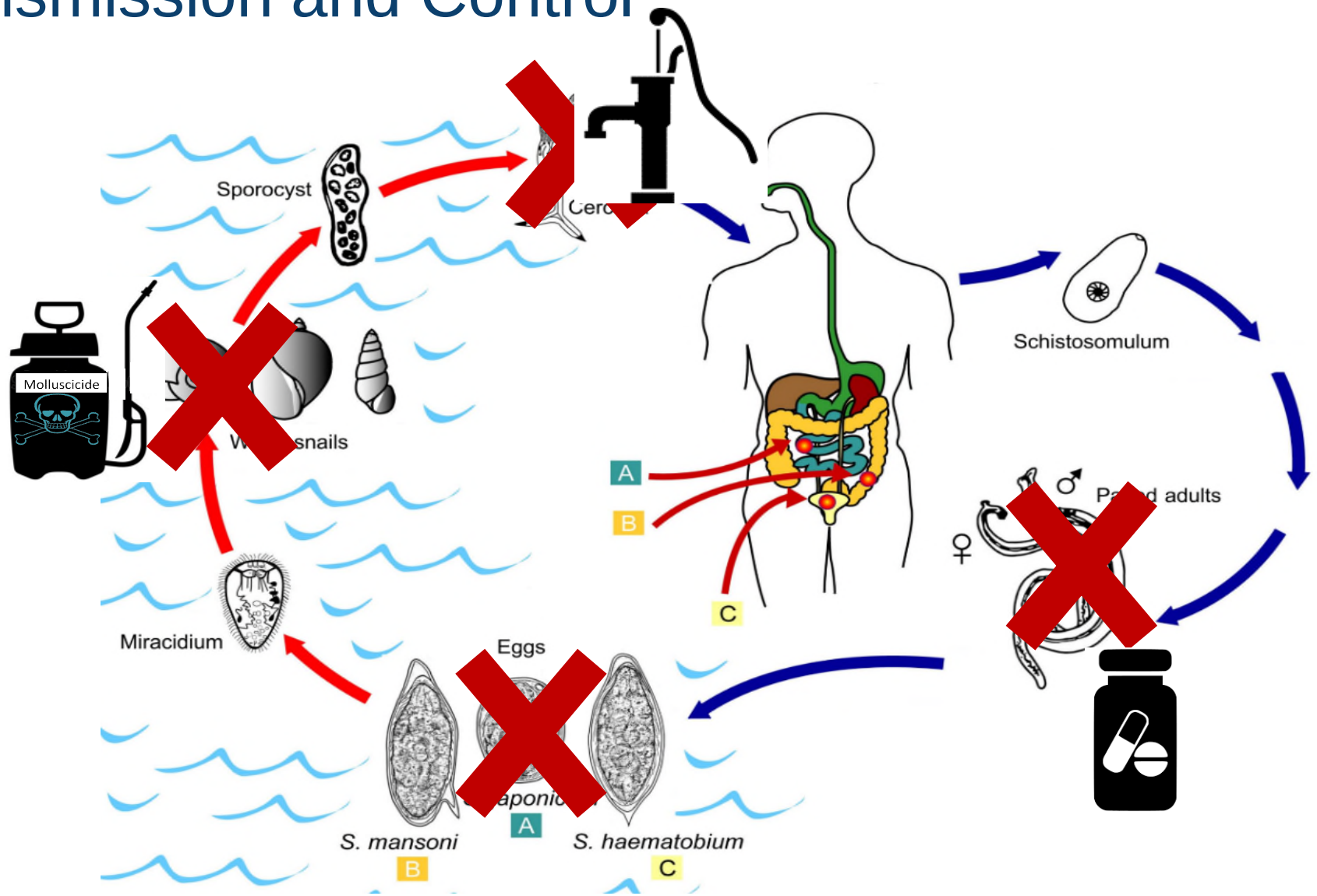
Dr May Sule

Outline

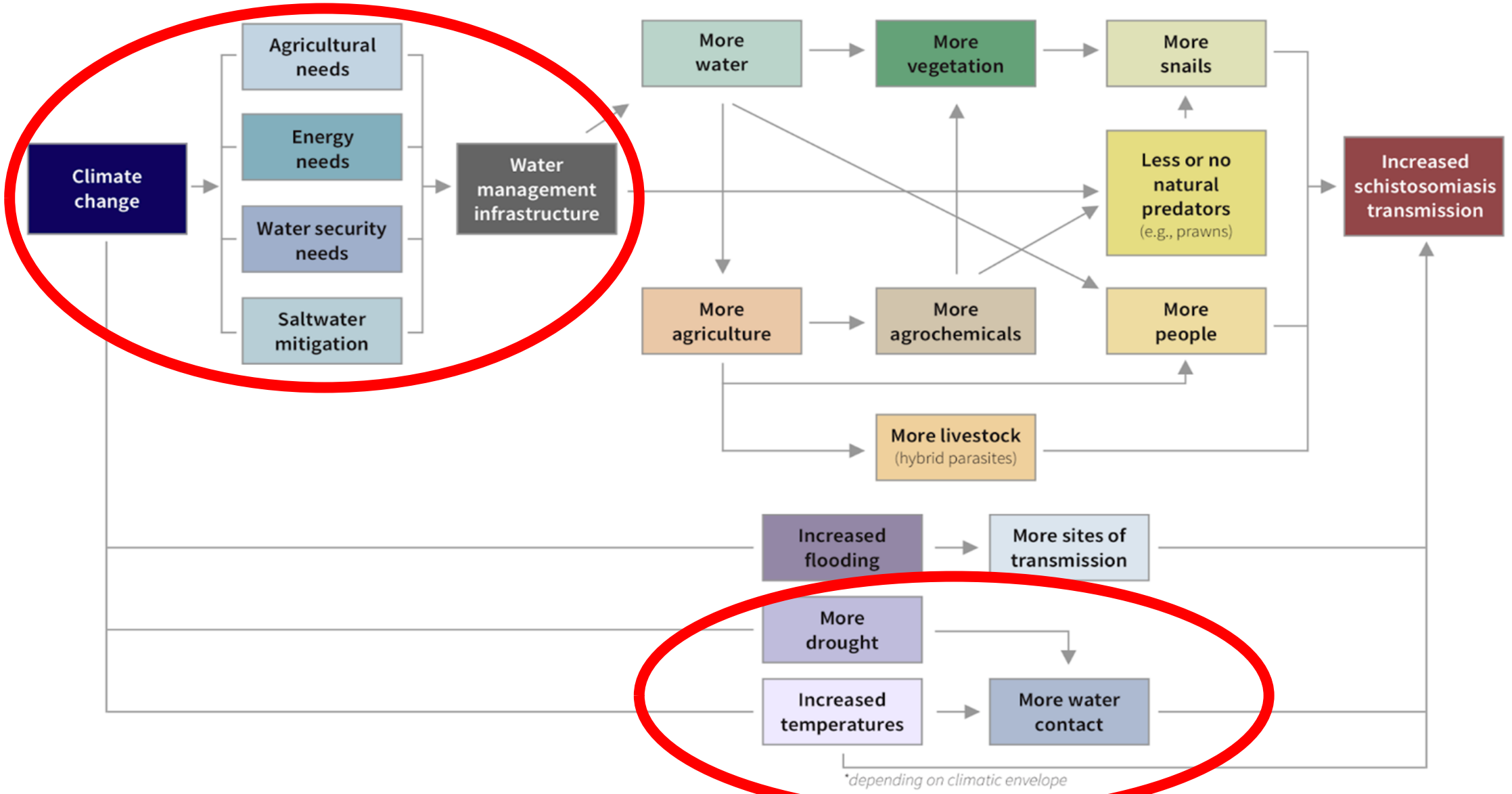
1. What is Schistosomiasis?
2. Impact of climate change
3. Irrigation, drought and water development
4. AMCOW IAA Project update:
    - Good and bad examples of cases
    - Member states engagement
    - Lessons learnt and recommendations

Schistosomiasis (Bilharzia) or snail fever

Transmission and Control



Adapted from CDC (2012) life cycle diagram;
Interventions credited to: May N Sule

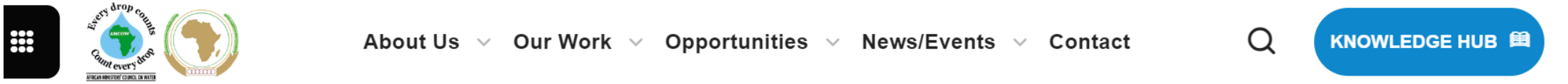


Multiple pathway in which water management infrastructure may affect the transmission risk for schistosomiasis due to climate change

Irrigation

- large dams, including dams built for hydroelectric power and water supply
- large-scale irrigation systems e.g.
  - irrigated sugar cane cultivation
  - decentralized irrigated rice cultivation etc.
- small dams, especially earthen dams in semi-arid climates
- miscellaneous human activities that impact upon surface water, including aquaculture, mining, and the drainage of wetlands.

AMCOW IAA update



An Effective Mandated Organ of the African Union's Effort to Assure Water Security in Africa

The African Ministers' Council on Water (AMCOW) was formed in 2002 in Abuja Nigeria, primarily to promote cooperation, security, social, economic development and poverty eradication among member states through the effective management of the continent's water resources and provision of

Project aim: To provide guidelines and policy recommendation on integrated approaches for delivering adequate water infrastructure and Schistosomiasis (Bilharzia) control in an era of global changes.

Reason for collaboration: The project is directly linked to Strategic Priority 1 of the AMCOW Strategy 2018 – 2030.

Focus countries: 55 countries (i.e. all member states).

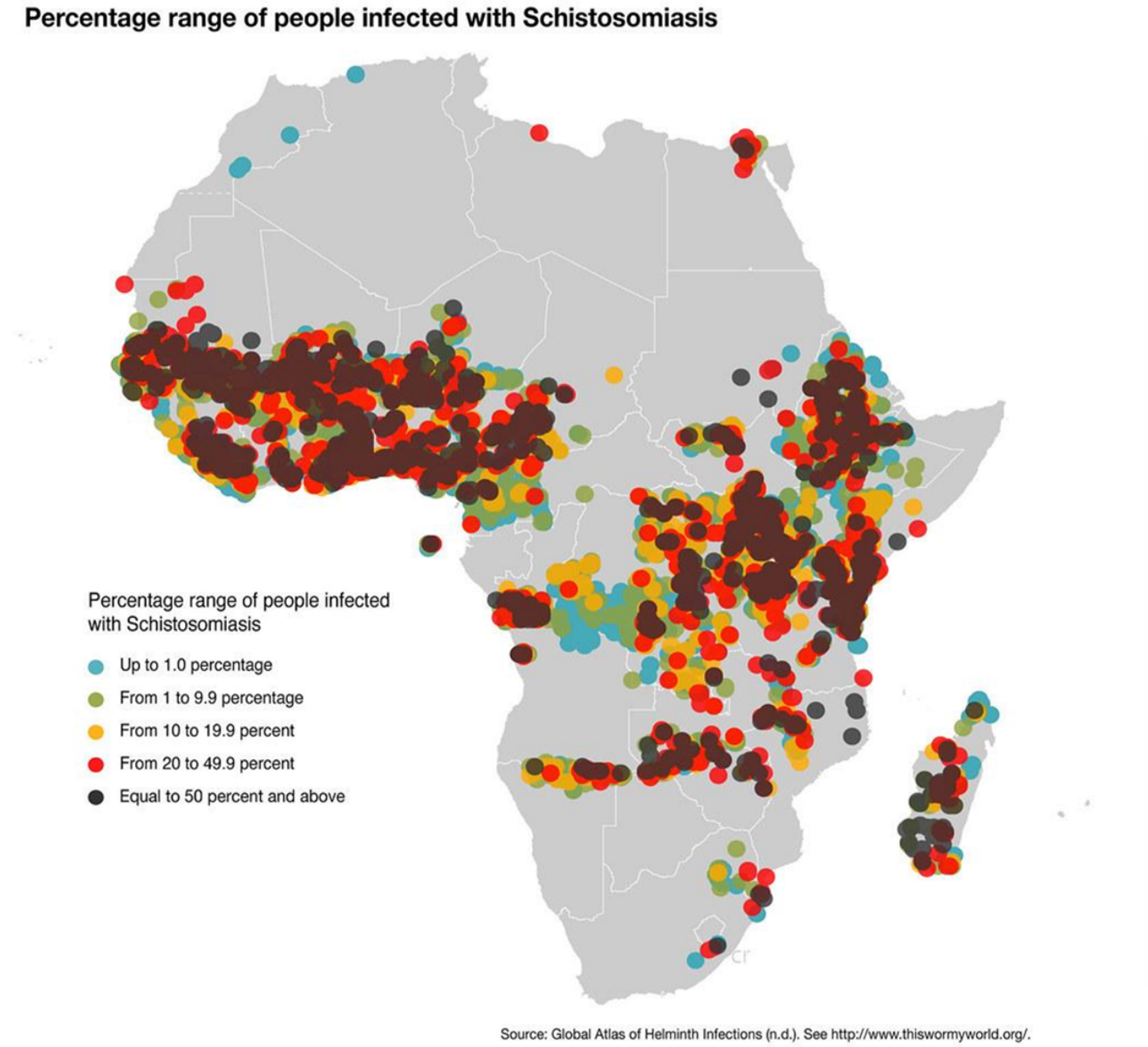
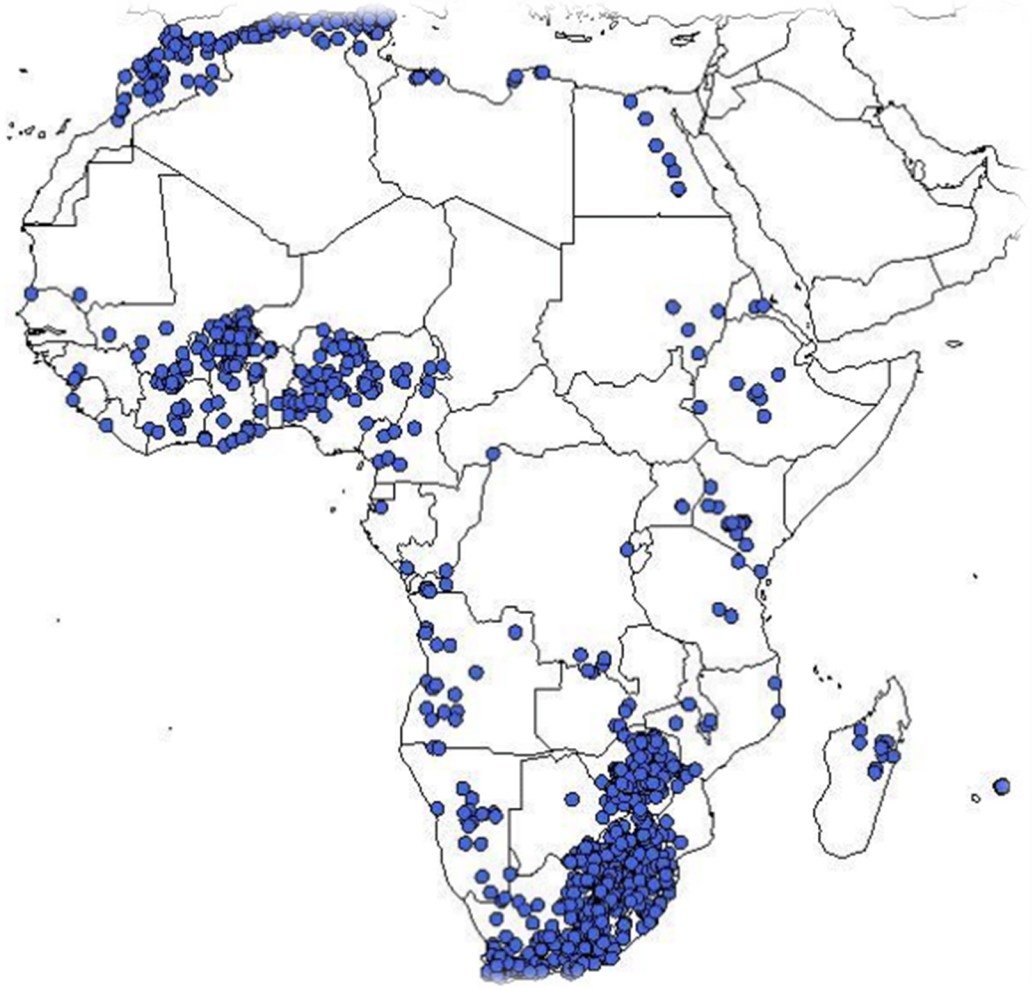


Image credit: Grida- Arendal (2020) https://www.grida.no/resources/13747

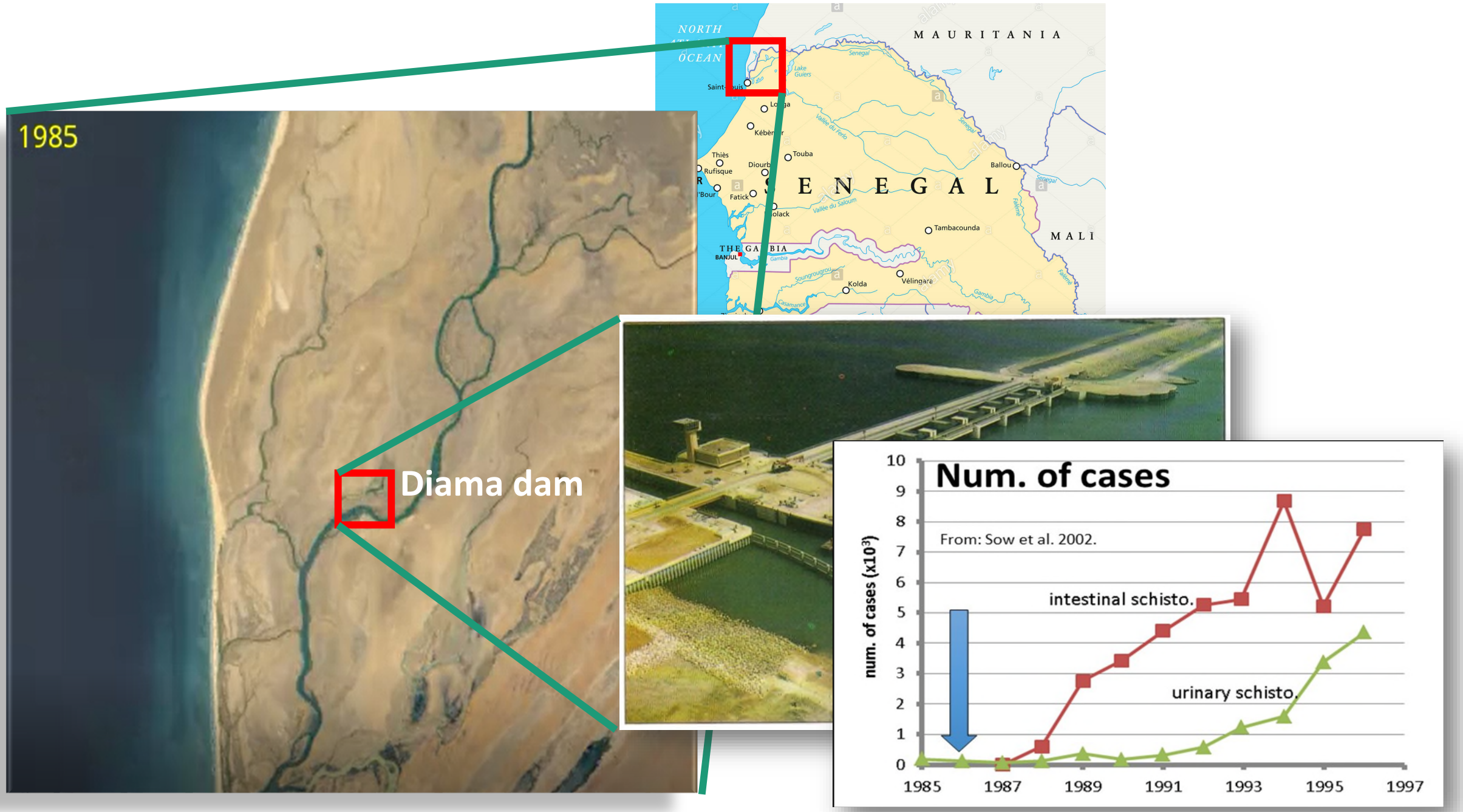
Distribution of dams and reservoirs



Source: FAO Geoportal database; survey data from 2011, https://www.researchgate.net/figure/Distribution-of-water-storage-dams-and-reservoirs-across-Africa-Source-FAO-Geoportal_fig10_329643995

Methodology

- Review of literature from journal articles, academic research, grey literature including WHO, FAO, IWMI and World Bank.
- Relevant search terms were used. There were no temporal limits or language restrictions that were set for the search.
- The bibliographies of selected studies were also searched for relevant references and studies. All articles that had relevant literature for the 46 countries were identified and then those with sufficient data were considered. 102 studies were included.


1985
Diama dam
NORTH
OCEAN
MAURITANIA
SENEGAL
MALI
THE GAMBIA
BANJUL
Saint-Louis
Lompoul
Kébémer
Thiès
Rufisque
Diourbel
Touba
Fatick
Kolack
Ballou
Tambacounda
Vélingara
Kolda
Senegal
Lake Guiers
Vallée du Ferlo
Vallée du Saloum
Gambia
Soungrougrou
Casamance
Falémé
Num. of cases
From: Sow et al. 2002.
intestinal schisto.
urinary schisto.
num. of cases (x10³)
0
1
2
3
4
5
6
7
8
9
10
1985
1987
1989
1991
1993
1995
1997

PNAS

Precision mapping of snail habitat provides a powerful indicator of human schistosomiasis transmission

Chelsea L. Wood[a,1], Susanne H. Sokolow[b], Isabel J. Jones[b], Andrew J. Chamberlin[b], Kevin D. Lafferty[c,d], Armand M. Kuris[d], Merlijn Jocque[e], Skylar Hopkins[f], Grant Adams[a], Julia C. Buck[g], Andrea J. Lund[h], Ana E. Garcia-Vedrenne[i], Evan Fiorenza[a], Jason R. Rohr[j], Fiona Allan[k,l], Bonnie Webster[k,l], Muriel Rabone[k,l], Joanne P. Webster[l,m], Lydie Bandagny[n], Raphaël Ndione[n], Simon Senghor[n], Anne-Marie Schacht[n], Nicolas Jouanard[n,o], Gilles Riveau[n], and Giulio A. De Leo[b]

ARTICLE

DOI: 10.1038/s41467-018-03189-w OPEN

Agrochemicals increase risk of human schistosomiasis by supporting higher densities of intermediate hosts

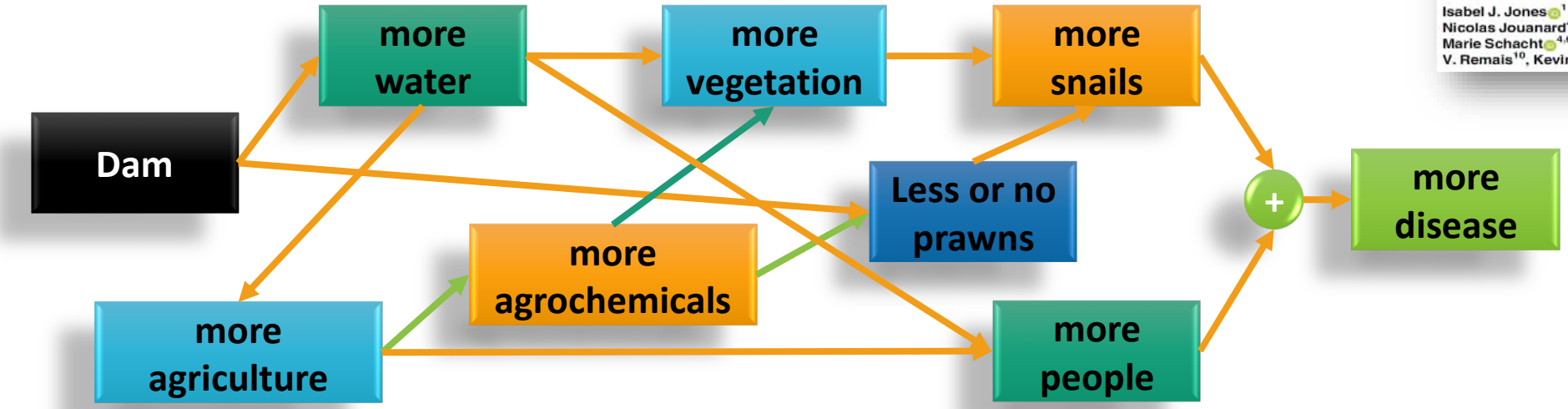
Neal T. Halstead[1,14], Christopher M. Hoover[2], Arathi Arakala[3,4], David J. Civitello[5], Giulio A. De Leo[6,7],

PLOS NEGLECTED TROPICAL DISEASES

RESEARCH ARTICLE

Schistosome infection in Senegal is associated with different spatial extents of risk and ecological drivers for *Schistosoma haematobium* and *S. mansoni*

Isabel J. Jones[1]*, Susanne H. Sokolow[1,2], Andrew J. Chamberlin[1], Andrea J. Lund[3], Nicolas Jouanard[4,5], Lydie Bandagny[4], Raphaël Ndione[4], Simon Senghor[4], Anne-Marie Schacht[4,6], Gilles Riveau[4,6], Skylar R. Hopkins[7,8], Jason R. Rohr[9], Justin V. Remais[10], Kevin D. Lafferty[11], Armand M. Kuris[12], Chelsea L. Wood[13], Giulio De Leo[1,2]



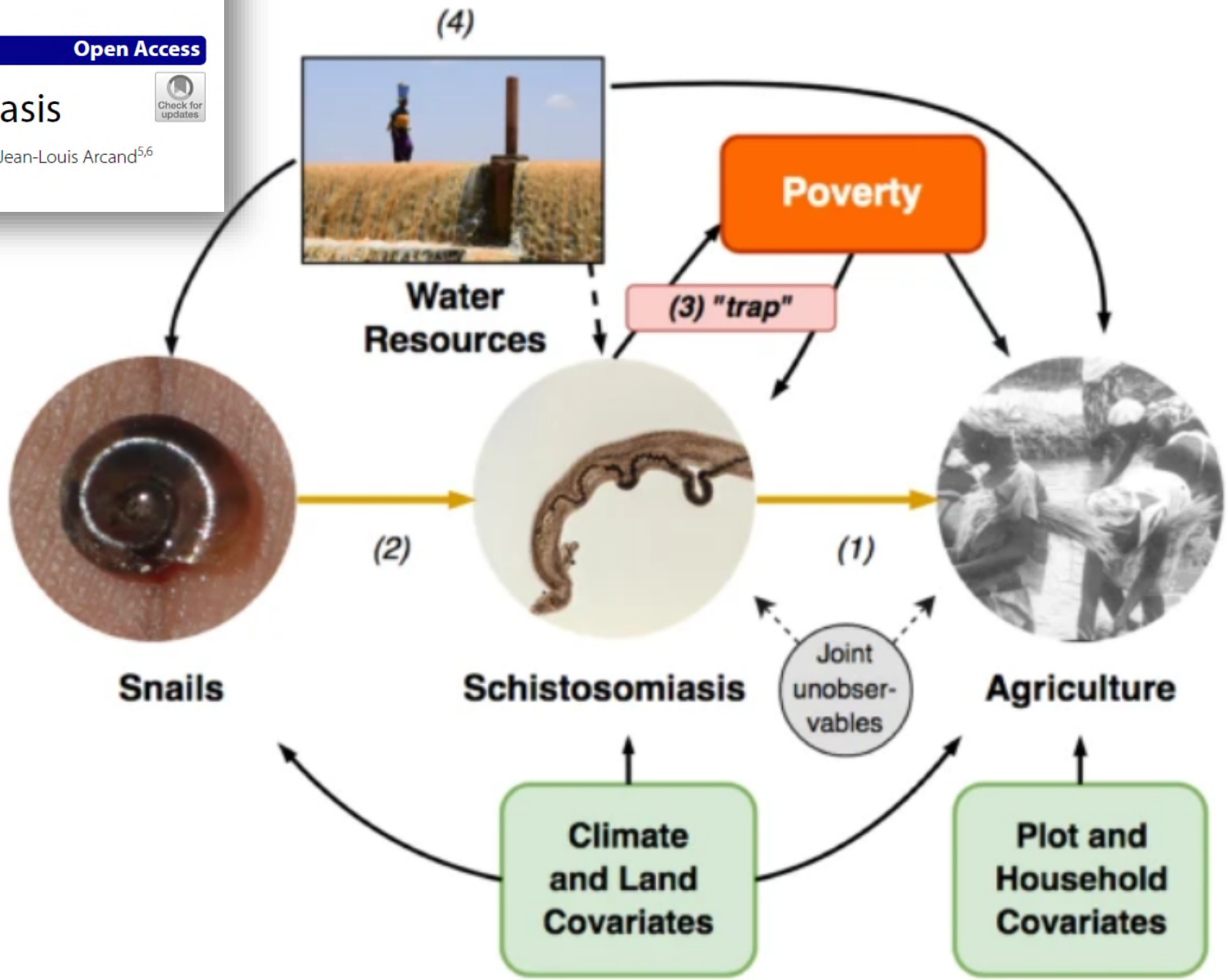
Rinaldo *et al. Infectious Diseases of Poverty* (2021) 10:134
https://doi.org/10.1186/s40249-021-00919-z

Infectious Diseases of Poverty

RESEARCH ARTICLE Open Access

The economic impact of schistosomiasis

Daniele Rinaldo[1*], Javier Perez-Saez[2], Penelope Vounatsou[3,4], Jürg Utzinger[3,4] and Jean-Louis Arcand[5,6]



Burkina Faso

- The poorest households engaged in subsistence agriculture bear a far heavier disease burden than their wealthier counterparts, experiencing an average yield loss due to schistosomiasis of between 32 and 45%.
- Returns to water resources development are substantially reduced once its health effects are taken into account:
- villages in proximity of large-scale dams suffer an average yield loss of around 20%, and this burden decreases as distance between dams and villages increases.

JOURNAL OF AFRICAN ECONOMIES, VOLUME 7, NUMBER 2, PP. 185–207

Impact of Schistosomiasis on Rice Output and Farm Inputs in Mali

Martine Audibert and Jean-François Etard[1]
CERDI, Clermont-Ferrand and ORSTROM, Bamako

 | SMALL-SCALE IRRIGATION DAMS, AGRICULTURAL PRODUCTION, AND HEALTH: THEORY AND EVIDENCE FROM ETHIOPIA

Small-Scale Irrigation Dams, Agricultural Production, and Health: Theory and Evidence from Ethiopia

Lire Ersado

https://doi.org/10.1596/1813-9450-3494

Science & Society

The Burden of Livestock Parasites on the Poor

Cassidy L. Rist,[1,2,*]
Andres Garchitorena,[3,4]
Calistus N. Ngonghala,[3]
Thomas R. Gillespie,[1,2,4] and
Matthew H. Bonds[3,4,5]

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Twenty-year economic impacts of deworming

Joan Hamory[a], Edward Miguel[b,c,d], Michael Walker[c], Michael Kremer[d,e,1], and Sarah Baird[f]

Egypt

- Reduced prevalence of infection from 40% to <3% by 2006
- Despite Egypt's tremendous progress in reducing prevalence to <1% between 1984 to 2016, final control effort has been insufficient
- Snail has extended its distribution from the Nile Delta and is now present throughout the country along the tributaries of the Nile

Decline in Schistosomiasis Prevalence

	1935	1983	1988	1993	1996	2000	2004	2005	2006
S. haematobium	48	35	11.9	6.6	5	3	1.6	1.4	1.2
S. mansoni	32	38.6	15.4	14.8	11.9	4.2	1.9	1.6	1.5

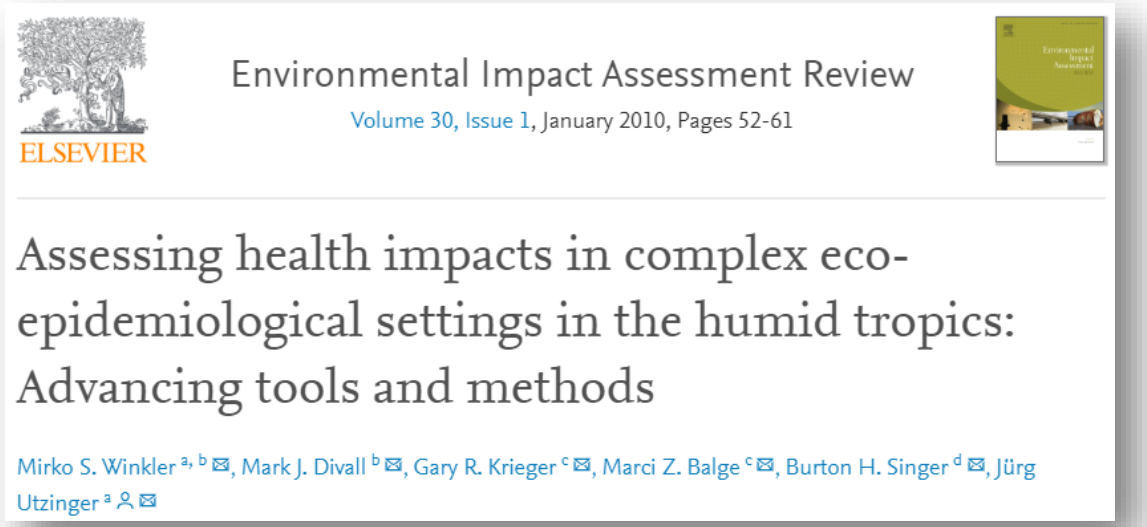
Source: The National Schistosomiasis Control Program, quoted from WHO(2007)

Key Snail Control Measures

- Flow regulation
- Drainage projects
- Concrete lining of channels
- Introduction of Predators

Image Credit: https://www.egypttoursportal.co.uk/egypt-day-trips/aswan-tours/tour-to-aswan-highlights/

Analysis of Environmental Impact Assessments



While the science is strong…

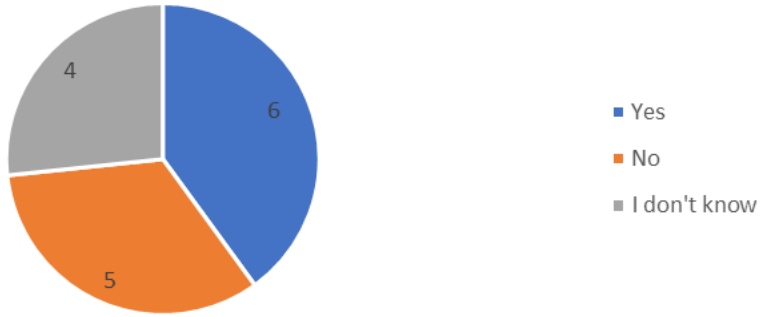
- Health impact assessments seldom done in LMICs
- Health is also poorly integrated into environmental impact assessment more generally
- An analysis of nearly 30 Environmental impact assessment (GSA EWG, in progress) shows that this is the case specifically for schistosomiasis

- Interventions ***before*** the construction of dams and other water management infrastructures

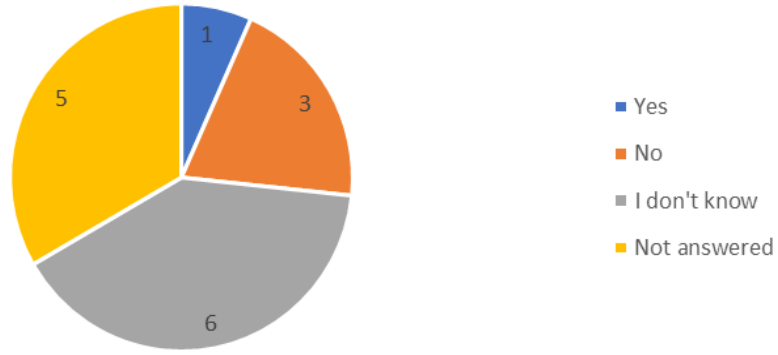
- Interventions ***for existing dams*** to manage and mitigate transmission risk

Some preliminary findings (15 countries)

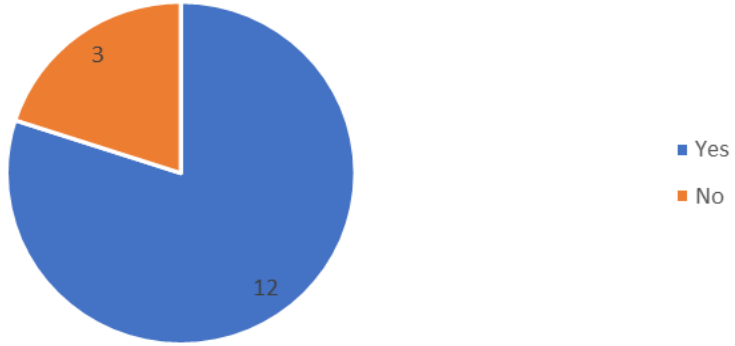
Do you have guidelines and/or recommendations for designing hydropower, dams or other water storage/energy infrastructure?



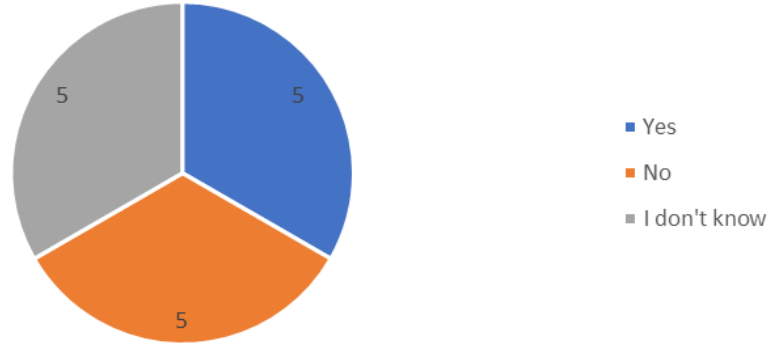
Do your guidelines/recommendations take into account schistosomiasis prevention in the design of these structures?



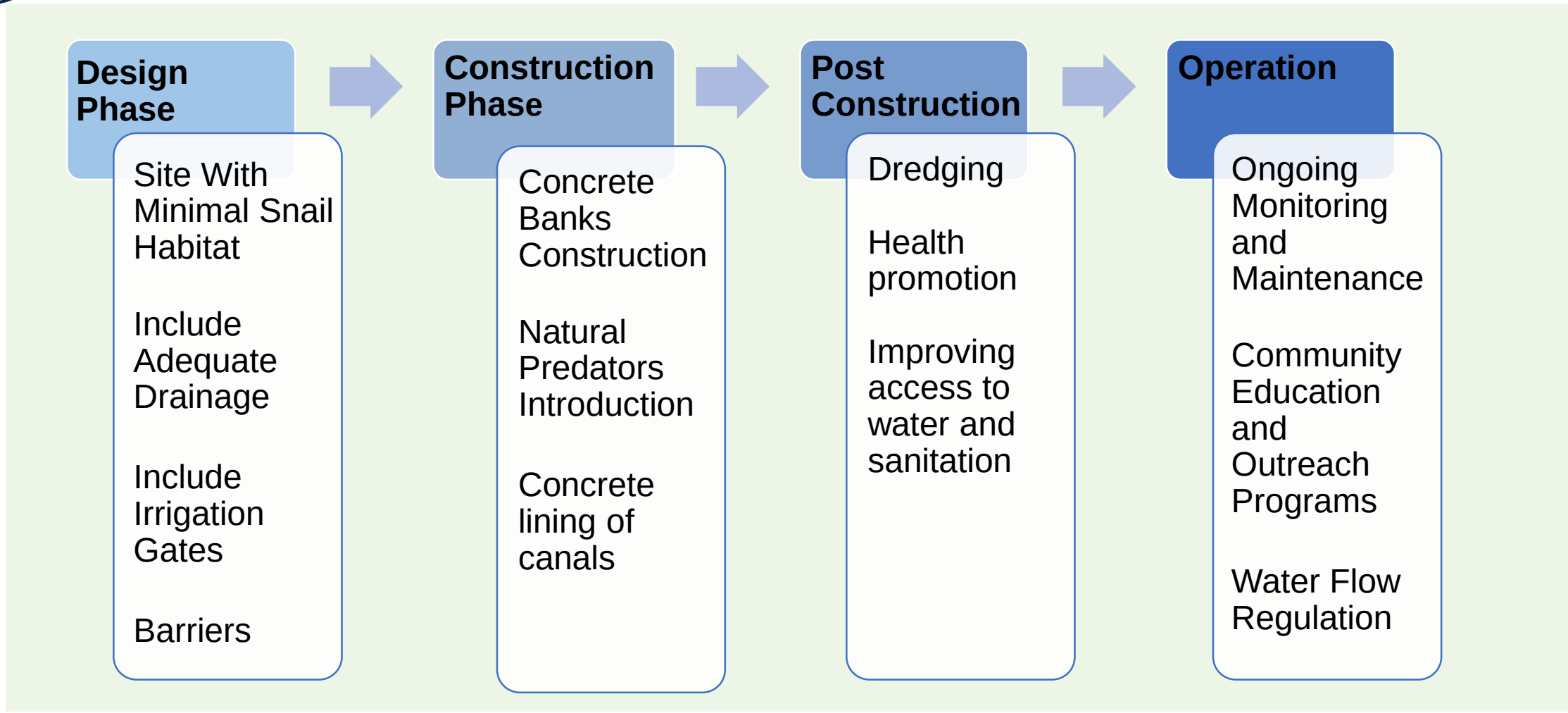
Do you have guidelines/recommendations/checklists for environmental impact assessments?



Does the EIA guidelines/recommendations/checklists cover infrastructure recommendations for schistosomiasis control?



Recommendations



Droughts and land use change for agricultural expansion and intensification

- Risk and mitigation strategies need to be investigated *during project development* and explicitly addressed in the associated Environmental Impact Studies

- Adequate financial resources need to be set aside to support
  - Disease Surveillance*
  - Water supply, Sanitation and more… (universal WASH coverage)
  - Environmental interventions such as mechanical removal of vegetation
  - Local access to health care, Mass Drug Administration*
  - Education and prevention*

- Inter-ministry, inter-agency collaborations is key to address this complex and multifaceted health-environmental problem

  → Ministry of Waters, of Health, of Environment, Agriculture, Industry, Education, etc.

Acknowledgement:

GSA Engineering Working Group members: May Sule, Giulio De Leo, Anouk Gouvras, Andrea Lund, Ao Yu, and David Rollinson

WSD 2022/23 students: Ibrahim El Lahham, Mutinta Munkombwe, Patricia Nasike, Mohammed Shahid, Moses Olitiku

Thank you!