


A blueprint to account for schistosomiasis transmission risk in Water Resource Development Programs

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Slide hands-out available here:
shorturl.at/uFW27



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Acknowledgment

- **GSA Engineering Working Group**
 - May Sule (co-chair), Anouk Gouvras, David Rollinson, Michael Templeton, and more...
- **Additional collaborators**
 - Andrea Lund (postdoc), Ao Yu (Stanford GS), Erika Veidis (Stanford HPH program manager)
 - Andy Chamberlin (Stanford), Gretchen Daily, Lisa Mandle (Stanford Natural Capital project)







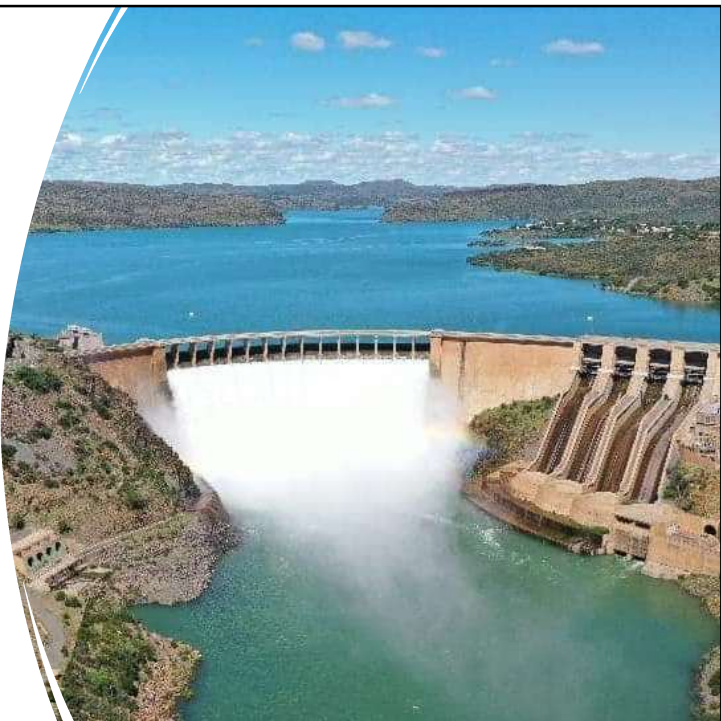





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Outline

- Impact of water resource development programs (WRDP) on schistosomiasis transmission risk
- Considerations on schistosomiasis transmission risk in the Environmental Impact Assessment (EIA) of WRDP (or lack thereof)
- The way ahead: a blueprint to connect knowledge to action and include schistosomiasis transmission risk in WRDP EIA



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- **WRDPs**
construction of dams, dikes, irrigation canals, channels, water reservoirs, development of irrigated agriculture,...

are a *cornerstone of human civilization.*

They support:

- Agriculture expansion and intensification
- Hydropower generation
- Prevention of saltwater intrusion in coastal areas
- They can buffer against extreme climatic events (draughts and floods)
- and supply water for growing urban centers

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Food production

Increased health because of improved nutrition

Decrease

Cases of illness such as malaria and schistosomiasis

Increase

Increased vectors of human pathogens

• And, yet, WRDPs have come along also with undesired, ignored and generally neglected impacts on human health, by boosting transmission of *water associated diseases* such as malaria and schistosomiasis.

nature sustainability REVIEW ARTICLE
<https://doi.org/10.1016/j.nature.2023.08.020>

Emerging human infectious diseases and the links to global food production

Jason B. Rohr^{1*}, Christopher B. Barrett², David J. Civitello³, Meghan E. Craft^{4,5}, Bryan Dallas⁶, Giulio A. DeLeo⁷, Peter J. Hudson⁸, Nicolas Jouanard⁹, Karina N. Nguyen¹⁰, Richard S. Ostfeld¹¹, Justin V. Ramalho¹², Gilles Rivaaux¹³, Susanne H. Sokolow¹⁴ and David Tilman¹⁵

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Relationship between WRDP and schistosomiasis

1958

Bull. Org. mond. Santé | 1958, 18, 691-734
Bull. Wld Hlth Org.

DISTRIBUTION OF THE INTERMEDIATE HOSTS OF BILHARZIASIS IN RELATION TO HYDROGRAPHY

With Special Reference to the Nile Basin and the Sudan

EMILE ABDEL MALEK
Reader in Parasitology, University of Khartoum, Sudan

1979

1999

HEALTH IMPACTS OF LARGE DAMS

ENVIRON IMPACT ASSESS REV 1999;19:113-123
© 1999 Elsevier Science Inc. All rights reserved.
655 Avenue of the Americas, New York, NY 10010

Leonard B. Lerer
Health Consulting Office, Medical Research Council, South Africa

Thayer Scudder
California Institute of Technology

2006

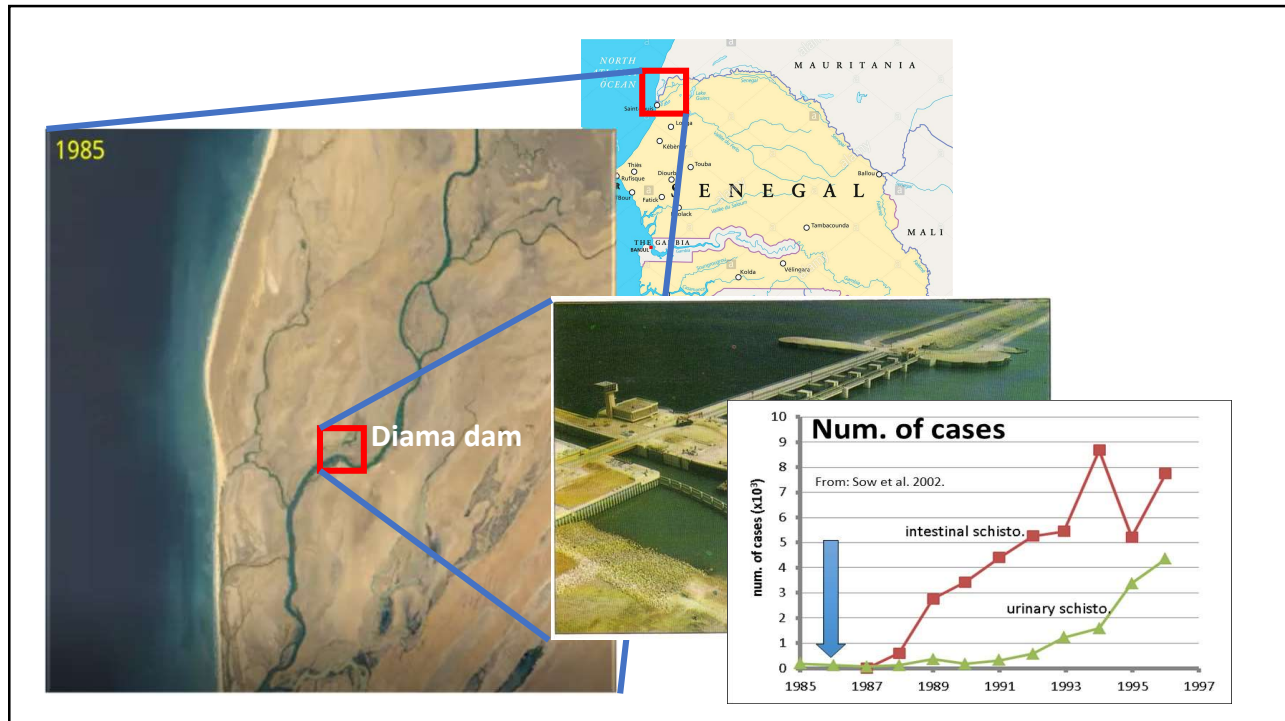
Review > *Lancet Infect Dis.* 2006 Jul;6(7):411-25. doi: 10.1016/S1473-3099(06)70521-7.

Schistosomiasis and water-resources development: systematic review, meta-analysis, and estimates of people at risk

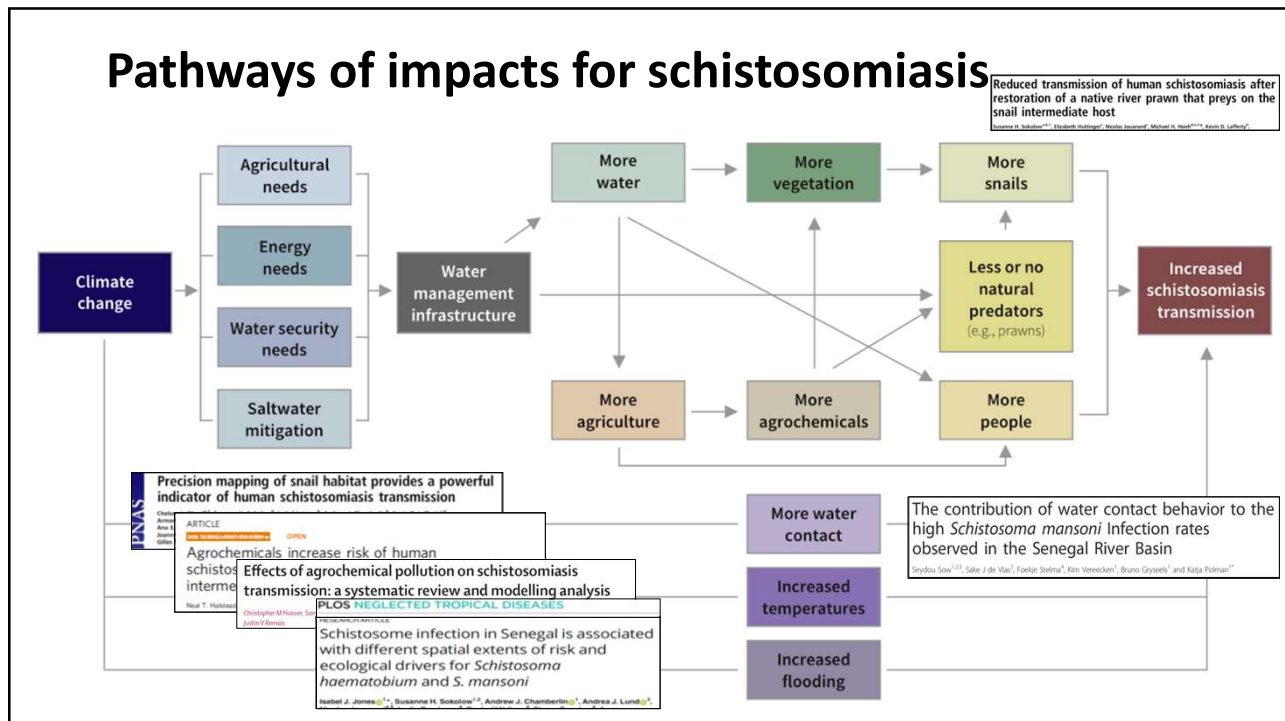
Peter Steinmann¹, Jennifer Keiser, Robert Bos, Marcel Tanner, Jürg Utzinger

1999

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Environmental Justice problem

- **The negative health outcomes of WRDP affect disproportionately the poorest among the poor**
 - **Lack of opportunities to engage in the economic development**
 - **Lack of access to:**
 - piped water (↑ exposure), preventive care and health care (↑ vulnerability)



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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-Saez², Penelope Vounatsou^{3,4}, Jürg Utzinger^{1,5} and Jean-Louis Arcand^{1,6}

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 Etard¹
CERDI, Clermont-Ferrand and ORSTROM, Bamako

Science & Society
The Burden of Livestock Parasites on the Poor

Cassidy L. Fitt^{1,2,4},
Andrés García-Iñareta^{1,3,4},
Calistus N. Ngonghala³,
Thomas R. Gillespie^{1,2,4} and
Matthew H. Bonds^{3,4,5}

Twenty-year economic impacts of deworming

Joan Hamory¹, Edward Migush^{1,2}, Michael Walker¹, Michael Kremer^{1,2}, and Sarah Baird¹

No Access | 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

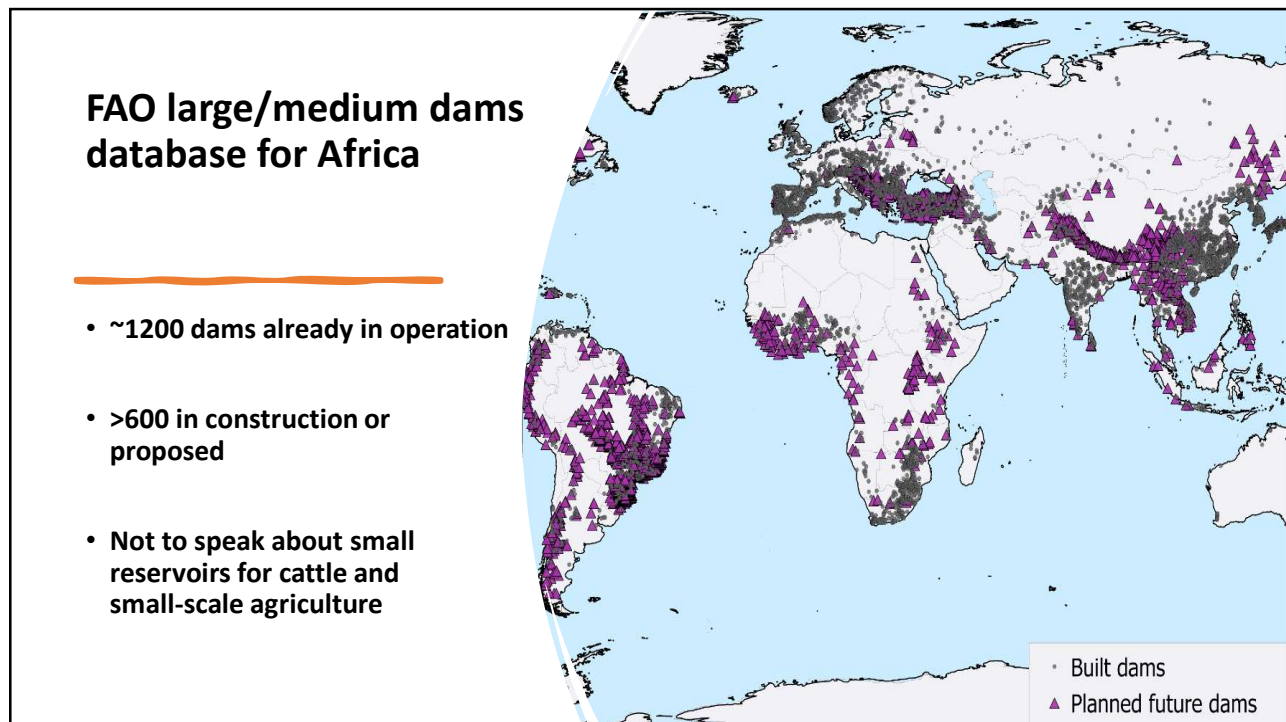
Lire Ersado
<https://doi.org/10.1596/1813-9450.3494>

Not only health: schistosomiasis may dwarf the economic benefits that dams intend to generate

- 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%.
- [Economic] 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.

excerpt from Rinaldo et al. 2021

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Outline

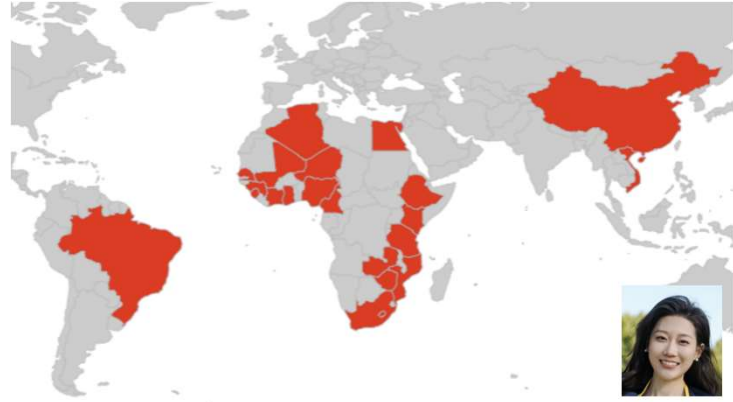
- Impact of water resource development programs (WRDP) on schistosomiasis transmission risk
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What we did (Yu et al.)

Identified 58 publications
addressing the impacts of
42 dams across the globe

- 40 case studies from peer-reviewed journals
- 18 EIA official reports




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We found: (Yu et al.)

- **31.0% products provided some assessment of potential impacts before construction started**
- **All the 18 EIAs included some health impact discussion on infectious disease topics (e.g., malaria, HIV, schisto), although the disease analysis is often shallow**
 - 12 EIAs (66.6%) did not mention schistosomiasis
 - 6 EIAs (33.3%) mentioned schistosomiasis and include disease projection after dam construction
 - 5 of these EIAs (27.8%) proposed schistosomiasis solutions to reduce potential adverse health outcomes caused by the proposed dam

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Environmental Impact Assessment Review
Volume 30, Issue 1, January 2010, Pages 52-61

Assessing health impacts in complex eco-epidemiological settings in the humid tropics: Advancing tools and methods

Mirko S. Winkler^{a,b}, Mark J. Divall^b, Gary R. Krieger^c, Marci Z. Balge^e, Burton H. Singer^d, Jürg Utzinger^{a,d}

ehp Environmental Health Perspectives

HOME ISSUE IN PROGRESS ARCHIVES COLLECTIONS AUTHORS REVIEWERS ABOUT

Vol. 116, No. 8 | Review

Integrating Human Health into Environmental Impact Assessment: An Unrealized Opportunity for Environmental Health and Justice

Rajiv Bhatia and Aaron Wernham

Published: 1 August 2008 | <https://doi.org/10.1289/ehp.11132> | Cited by: 61

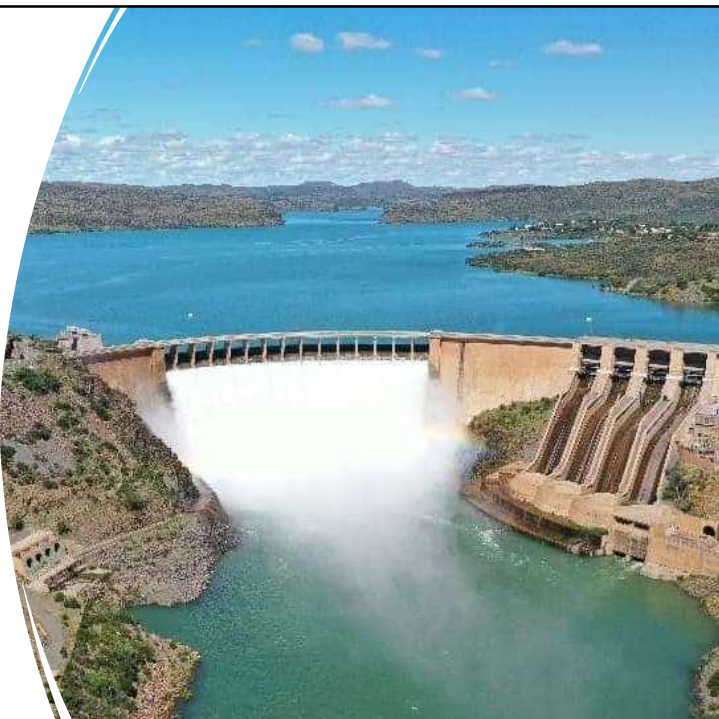
While the science is strong...

- **Health impact caused by increased risk of schistosomiasis transmission seldom assessed in the WRDP EIA in tropical and subtropical regions**
- **Health is generally poorly integrated into environmental impact assessment**
- **Gap → opportunities!**

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GSA-EWG proposition

- To integrate a *Health Impact assessment* specifically focused on schistosomiasis in Water Resource Development Programs

- Opportunity to target multiple SDGs



- Leverage the existing administrative/procedural framework provided by the *Environmental Impact Assessment (EIA)* of Water Management Infrastructure (WMI)

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Why EIA?

- EIA is "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made"

source: International Association for Impact Assessment

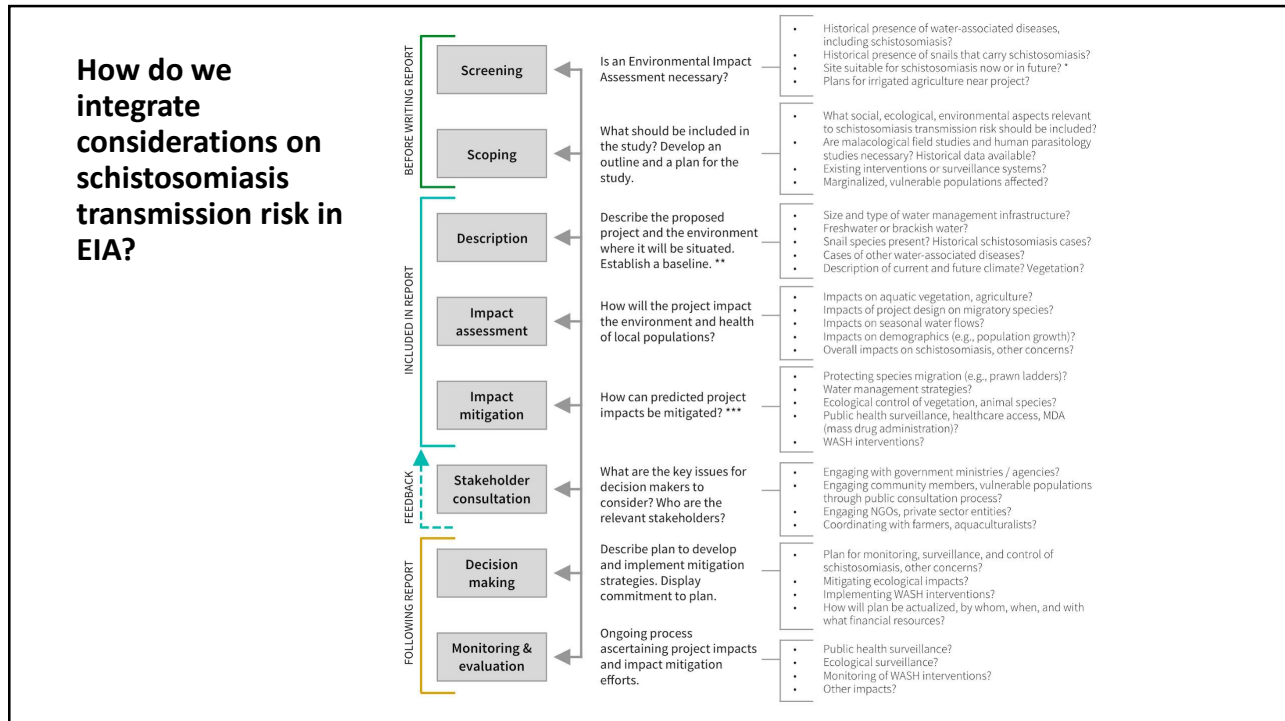
- By promoting "the widest range of beneficial uses of the environment without degradation, risk to health or safety", EIA explicitly includes the possibility of assessing impacts on human health (Thondoo & Gupta, 2020).

- By 2012, 192 of 193 UN countries have EIA legislation

Systematic Literature Review of Health Impact Assessments in Low and Middle-Income Countries

by Meelan Thondoo^{1,2,3,4,*}, David Rojas-Rueda^{1,3,5}, Joyeeta Gupta², Daniel H. de Vries² and Mark J. Nieuwenhuijsen^{1,5,6,7,*}

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A menu of interventions

Construction phases	WMI Structural design and operation management	Set of environmental Interventions	Public Health interventions
Before construction	<ul style="list-style-type: none"> Location, size, design of ladders for migratory species, etc. 	Gather state of the art information on: <ul style="list-style-type: none"> Historical data on veg/snail/natural enemies status quo climatic envelope Social-economic determinants 	<ul style="list-style-type: none"> Historical data status quo Design WASH intervention
During construction		<ul style="list-style-type: none"> Monitoring of vegetation and snails 	<ul style="list-style-type: none"> Surveillance Build WASH interv.
During operation	<ul style="list-style-type: none"> Management of water levels, flow, simulated floods and draughts Retrofitting existing dams with ladders for migratory species 	<ul style="list-style-type: none"> Monitor/evaluation/surveillance (malacology, eDNA, etc.) Environmental control <ul style="list-style-type: none"> management of agrochemicals Molluscicides/biopesticides Biological control, including: <ul style="list-style-type: none"> biological control by habitat manipulation (Rohr et al. 2023) augmentative biological control classical biological control 	<ul style="list-style-type: none"> Monitor, evaluation, surveillance WASH Education, behav. change/community engagement Citizen Science Treatment (point of care, MDA, community wide)

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Stakeholder engagement

- African Ministers' Council of Water (AMCOW)
- Ministries of the Environment, of Health, of Agriculture
- Development Banks (WB, African DB), other financial mechanisms (GIF)
- Industrial/Private stakeholders
 - International Hydrological Association
 - International EIA consulting companies
 - National EIA consulting companies

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Conclusions



- The science on the impact of WRDPs on schisto is rock solid
- The time is now to connect knowledge to action!
 - GSA EWG White Paper (in preparation)
 - GSA EWG EIA Checklist/Guidelines
 - GSA EWG menu of interventions to minimize, mitigate negative health outcomes
 - A free, user-friendly health impact assessment software application for schistosomiasis transmission risk for the EIA of WMI, by NatCap & GSA (stay tuned, for GSA 2024!)

Please, contact me @ deleo@stanford.edu if you have access to Env. Impact Statements of dams in your country!!

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