



# **Sustainable land and water management, including integrated watershed management strategies, to ensure food security**

-

## **Floods and disruption of flow regimes**

*Zita Sebesvari*

*United Nations University*

*Institute for Environment and Human Security*

# IPCC Special Report on Land 2019



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## Table 7.1 Land-climate risks – 10 hazards

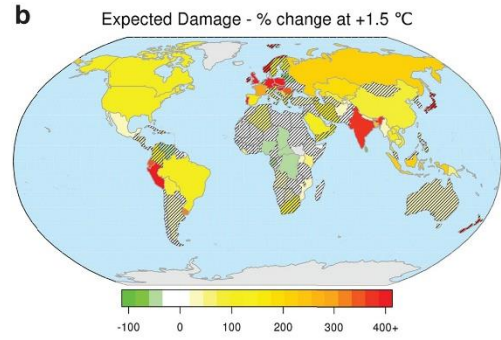
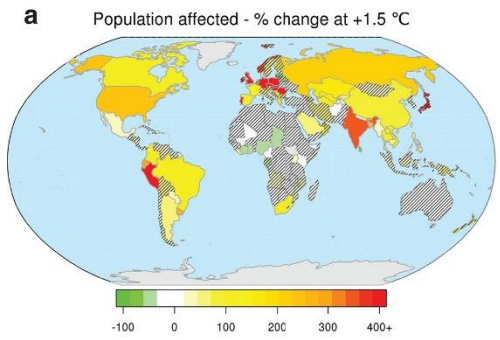
Land-climate-society interaction hazard	Exposure	Vulnerability	Risk	Policy response (indicative)	References
<b>Extreme events in multiple economic and agricultural regimes</b>	Global	<ul style="list-style-type: none"> <li>– Food-importing countries</li> <li>– Low-income indebtedness</li> <li>– Net food buyer</li> </ul>	<ul style="list-style-type: none"> <li>– Conflict</li> <li>– Migration</li> <li>– Food inflation</li> <li>– Loss of life</li> <li>– Disease, malnutrition</li> <li>– Farmer distress</li> </ul>	<ul style="list-style-type: none"> <li>– Insurance</li> <li>– Social protection encouraging diversity of sources</li> <li>– Climate smart agriculture</li> <li>– Land rights and tenure</li> <li>– Adaptive public distribution systems</li> </ul>	<p>nasir et al. 2003, Schmidhuber and Tubiello 2007; Lipper et al. 2014a; Lunt et al. 2016; Tigchelaar et al. 2018; Casellas Connors and Janetos 2016</p>
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# Global projections of river flood risk in a warmer world

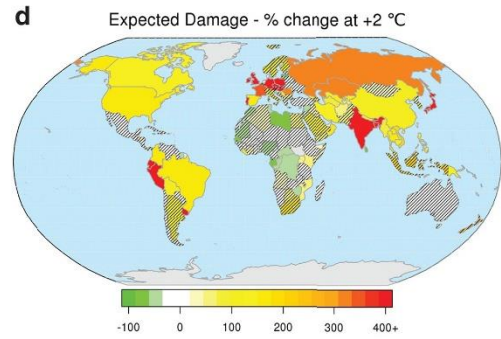
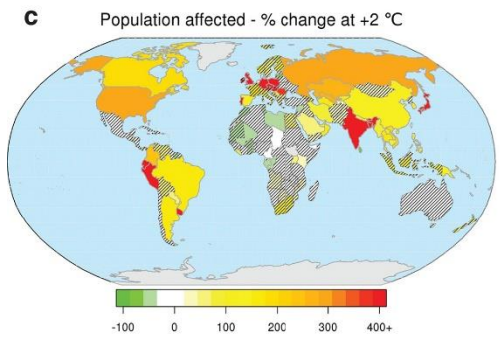
## Population affected

## Expected damage

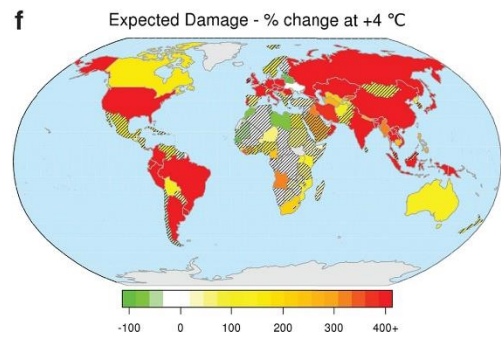
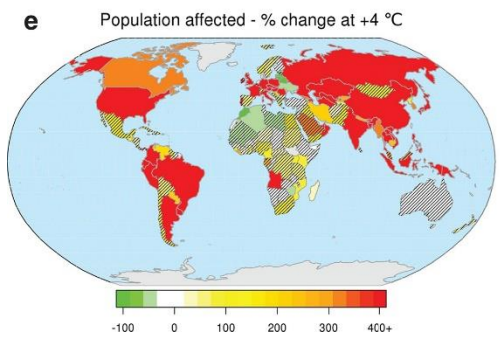
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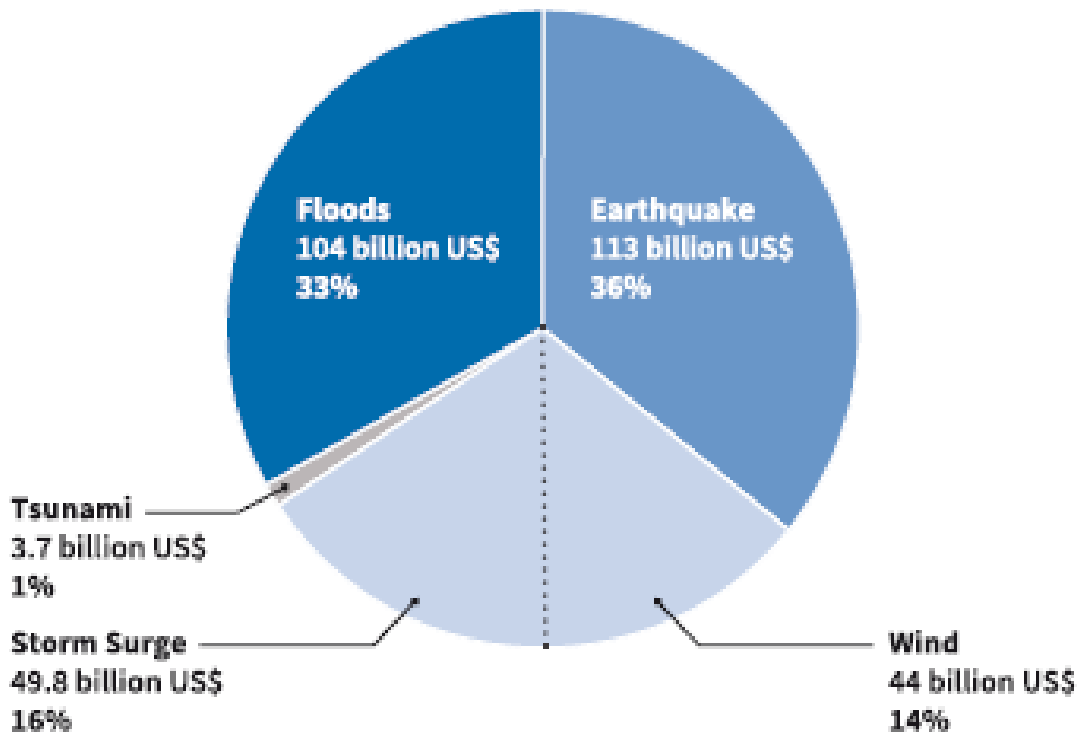
# Contribution of different hazards to average annual losses (AAL)



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(Source: UNISDR with data from Global Risk Assessment.)

GAR 2015, p 65

# Relative flood losses - Disproportionate impacts

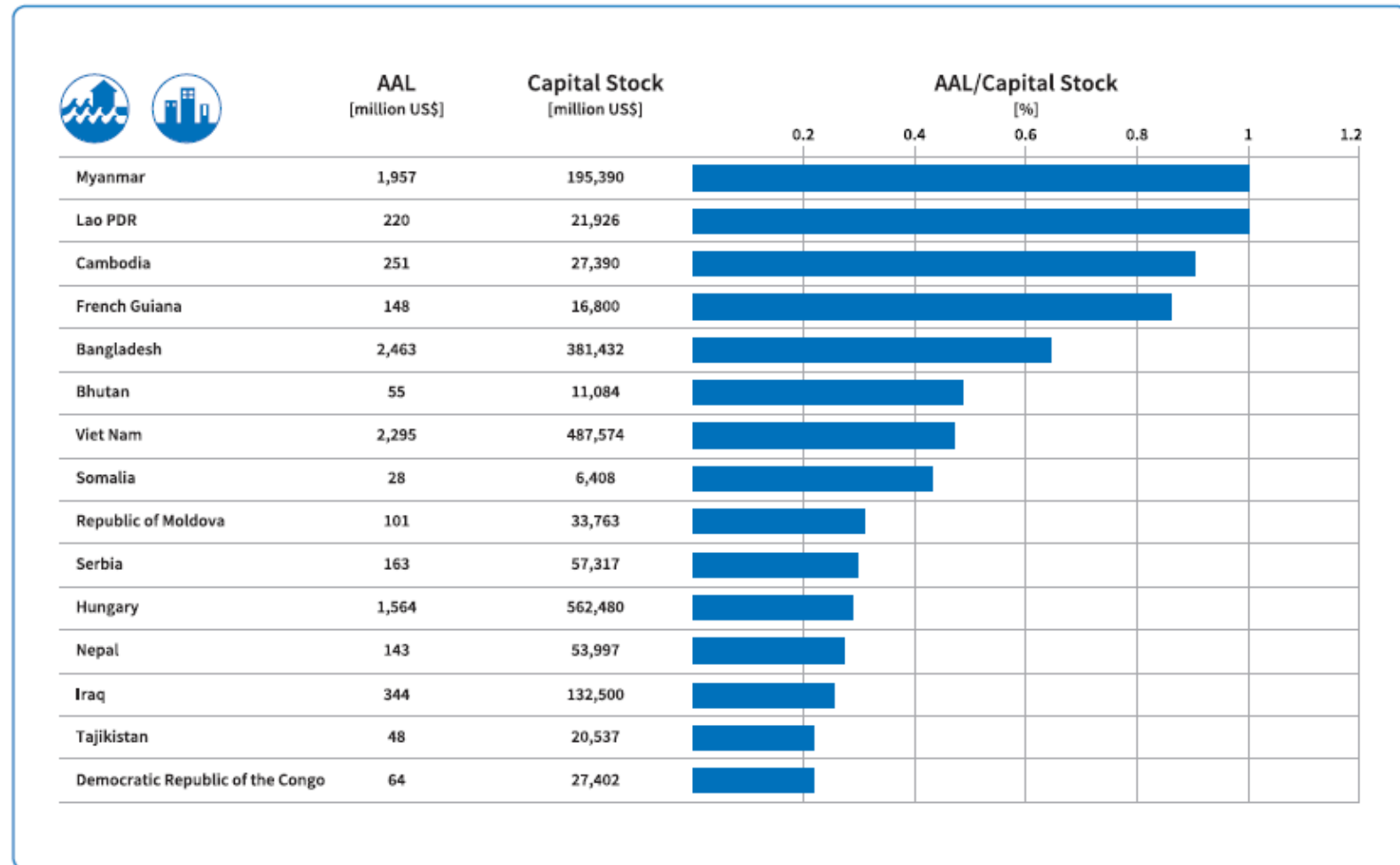


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**Figure 3.20** Top 15 countries: Flood AAL in relation to capital stock (excluding SIDS)



(Source: UNISDR with data from Global Risk Assessment and the World Bank.) GAR 2015, p 65

AAL: average annual losses

# Disproportionate impacts



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- Climate change alters the frequency and intensity of rainfall, floods and droughts, causing **significant impacts on agriculture and food production.**
- While food shocks and stressors affect all people, **women, indigenous populations, subsistence farmers, pastoralists and fishers are disproportionately affected.**

Source: UN-Water Policy Brief on Climate Change and Water 2019



In regions where basic food production and hunger are significant concerns, **addressing climate adaptation – especially through water-related impacts – is essential to reduce long- and short-term threats to food security**

Source: UN-Water Policy Brief on Climate Change and Water 2019

# Example: Mono River basin Benin and Togo



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CLIMAFRI project: Implementation of climate-sensitive adaptation strategies to reduce flood risk in the lower, transboundary Mono River basin in Benin and Togo

- Research project 2019 - 2022
- **Overall objective**  
Reduce current and future flood risks by jointly developing **and implementing a river basin information system with climate sensitive adaptation strategies.**
- **Consortium:** 5 partners from Germany, 5 partners from Africa  
Universities, private enterprise, ministries, regional organization WASCAL

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# Context and motivation



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Source: D. Sellen, World Bank  
<https://blogs.worldbank.org/african/benin-under-water>

- Recurrent flooding in the region with severe impacts
- High uncertainty about future flooding impacts under climate change conditions

## Demand oriented research project:

- How to manage water in the region?
- How to manage water in a sustainable way?



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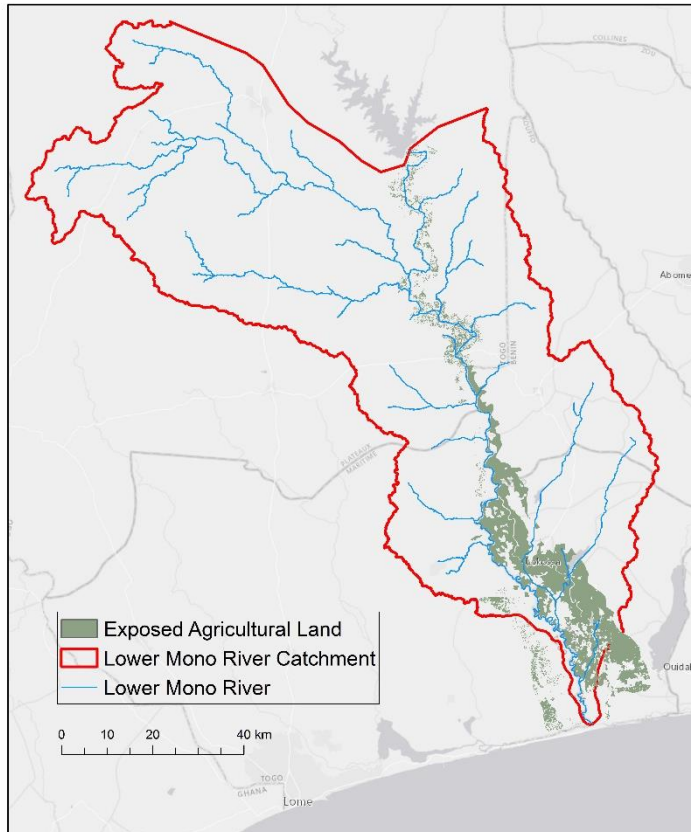
# Agriculture: a heavily impacted source of livelihood



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Exposed agricultural land for a 10-year flood (modeled hazard)

- Agriculture, forestry and fishing make up about one fourth of the GDP of both countries.  
Source: World Bank (2019)
- In the communities in the study area, between 20% and 80% of the population are working in the agricultural sector  
Source: INSEED (2017), INSAE (2013)

*“The extent of the flood damage this year is chilling. 9,258 households were reportedly affected, and most of their houses, storage facilities and fields of various crops were destroyed.”*

– La Nation Benin on the 2019 floods



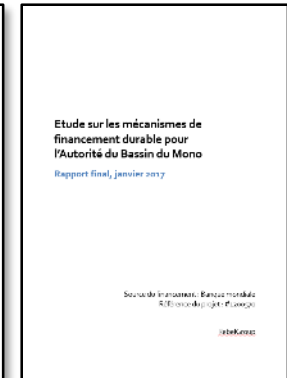
# Targeted research project



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- In 2014: The ABM Authority (*Mono Basin Authority*) was formalized by Togo and Benin.
- Mandate: "sustainable" management of the Mono River basin
- Since October 2019: Authority in place and operational



# Mono River Information System

## Key elements of the Mono River Information System:



Flood hazard tool (hydrological and hydrodynamic models)



Risk tool (Exposure, Vulnerability, Risk)



Scenarios (climate change, land use change)



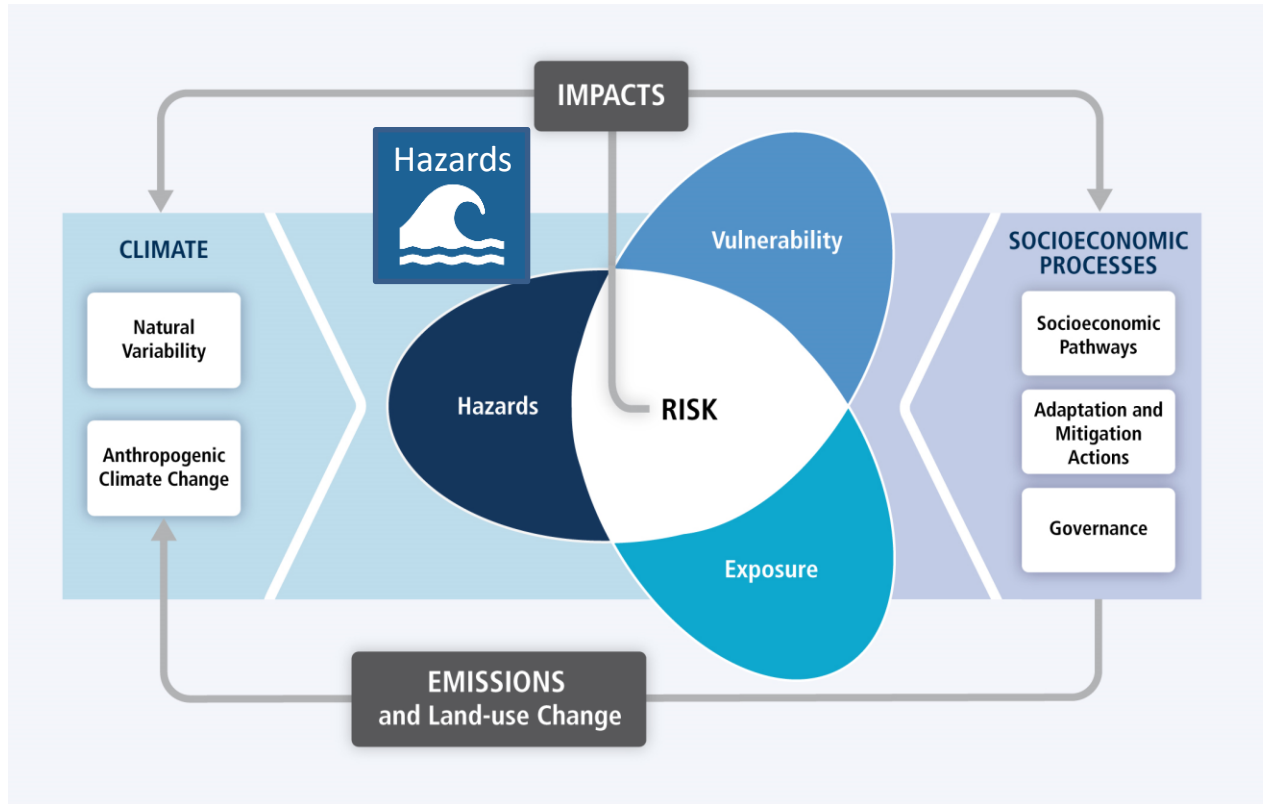
Database



# „Risk tool“: Indicator-based assessment



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IPCC (2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.



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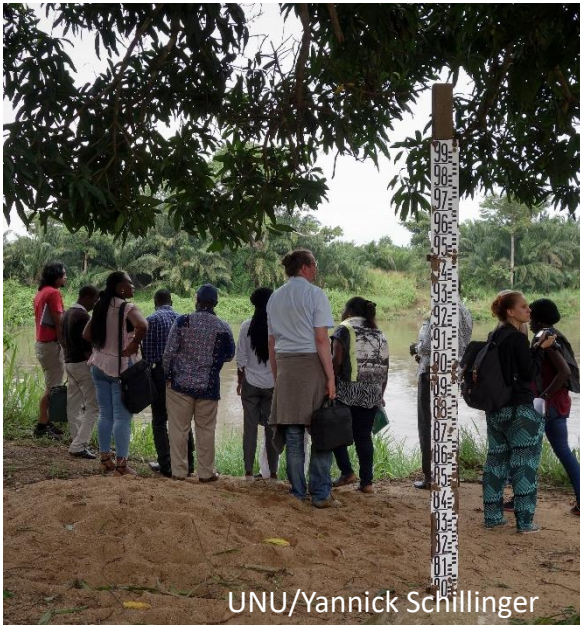
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# Risk based on indicators



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UNU/Yannick Schillinger

First field visit, June 2019



Multi-scale participatory indicator development approaches for climate change risk assessment in West Africa

Danielle M. ...



Quantitative Assessment of Vulnerability to Flood Hazards in Downstream Area of Mono Basin, South-Eastern Togo: Yoto District

Abravi Etessean Kissi<sup>1</sup>, Georges Abbevi Abbey<sup>2</sup>, Komi Agbokpa<sup>2</sup>, Aklesso Egbendewe<sup>2</sup>

<sup>1</sup>Departement de Géographie, WASCAL, Université de Lomé, Lomé, Togo

<sup>2</sup>Centre de Recherches et de Recherches, Université de Lomé, Lomé, Togo



GIS Analysis of Flood Vulnerable Area in Benin-Owena River Basin Nigeria

Adebayo. H. Oluwasegun

Received 08 02 2014; Accepted 27 04 2014; Published online 06 06 2015

**Abstract:** The frequency and intensity of flood disasters have become serious issues in the national development process of Nigeria as flood disasters have caused serious environmental damages, loss of human lives and other heavy economic losses, putting the issue of disaster reduction and risk management higher on the policy agenda of affected governments, multilateral agencies and NGOs. The starting point of extensive flood disaster mitigation efforts is to identify the areas with higher risk levels and conduct out appropriate preventive and response mechanisms. This research paper explains the potential of Geographical Information System (GIS) in data capture, processing and analysis in identifying flood prone areas for the purpose of planning for disaster mitigation and preparedness, using Benin-Owena river basin of Nigeria as a case of analysis. The data used in this study were obtained from FORMELU and were entered and used to develop a flood risk information system. Analysis and capability of the developed system was illustrated and shown.

**Keywords:** Flood, Geographical Information System (GIS) Risk, River Basin, Vulnerability.

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... of the study. Flood



UNU/Arianna Flores-Corral

Community workshops in  
Batonou and Athieme,  
October 2019

Regional literature review, 27  
peer-reviewed articles

Library of drivers

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# Agriculture related indicators



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## Agriculture as exposed element

Identified driver	Data
Exposed cultivated area	✓
Exposed livestock	
Exposed storage facilities	

## Drivers of vulnerability within agricultural sector

Identified driver	Data
Economic activity in flood sensitive sector (agriculture, fishery, forestry)	✓
Percentage of subsistence small scale farmers	
Usage of diverse crop varieties	
Use of flood resistant crop	
Presence of agricultural extension services	



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# Flood Risk Management Plan



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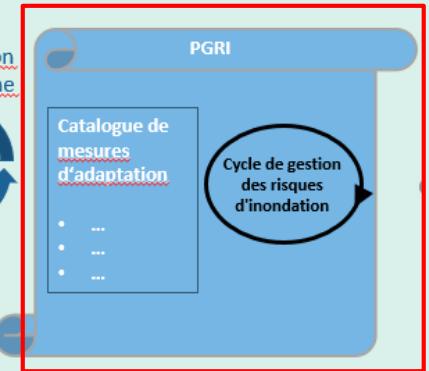


## Mono River Information System

### Flood Risk Management Plan



Application  
du système



**= a result of applying the Mono River Information System!**

Key elements of the Flood Risk Management Plan:

- 1.) Technical documentation of scenario results
- 2.) Catalogue of adaptation measures
- 3.) Cost-benefit analysis of selected measures and scenarios
- 4.) Recommendations on reducing current and future flood risk



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# Adaptation measures



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## Flood-risk adapted land use plans

Reforestation

Use of temporary flood barriers

Inform public about flood risks

Insurances

Establishment of an effective communication system

River dredging

Natural retention zones

Construction of temporary shelters

Dykes

Restoration of mangroves

Relocation of communities

Development of an early warning system

Train focal points on flood risks and response

## Impoundments

Capacity building of institutions and affected communities

River bank stabilization

## Use of flood-resilient crops



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# Main CLIMAFRI outputs

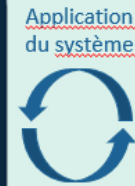


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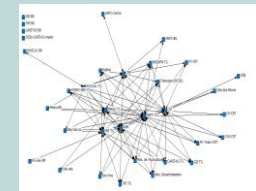


## Mono River Information System

### Flood Risk Management Plan



## Stakeholder Community Communication Strategy



## Capacity Building Training of Trainers Curriculum



CLIMAFRI CLIMAFRI TOT KIT		
OVERVIEW	TOPIC A	TOPIC B
TRAINING HANDBOOK	TRAINING SLIDES	TRAINING SLIDES
SUGGESTED AGENDA	VIDEO LESSONS	VIDEO LESSONS
CURRICULUM	EXERCISES	EXERCISES



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## Table 7.1 Land-climate risks – 10 hazards

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<b>Disruption of flow regimes in river systems</b>	<ul style="list-style-type: none"> <li>– 1.5 billion people, Regional (e.g., South Asia, Australia)</li> <li>– Aral sea and others</li> </ul>	<ul style="list-style-type: none"> <li>– Water-intensive agriculture</li> <li>– Freshwater, estuarine and near coastal ecosystems</li> <li>– Fishers</li> <li>– Endangered species and ecosystems</li> </ul>	<ul style="list-style-type: none"> <li>– Loss of livelihoods and identity</li> <li>– Migration</li> <li>– Indebtedness</li> </ul>	<ul style="list-style-type: none"> <li>– Build alternative scenarios for economies and livelihoods based on non-consumptive use (e.g., wild capture fisheries)</li> <li>– Define and maintain ecological flows in rivers for target species and ES</li> <li>– Experiment with alternative, less water-consuming crops and water management strategies</li> <li>– Redefine SDGs to include freshwater ecosystems or adopt alternative metrics of sustainability Based on Nature's Contributions to People (NCP)</li> </ul>	<p>Craig 2010; Di Baldassarre et al. 2013; Verma et al. 2009; Ghosh et al. 2016; Higgins et al. 2018; Hall et al. 2013; Youn et al. 2014</p>

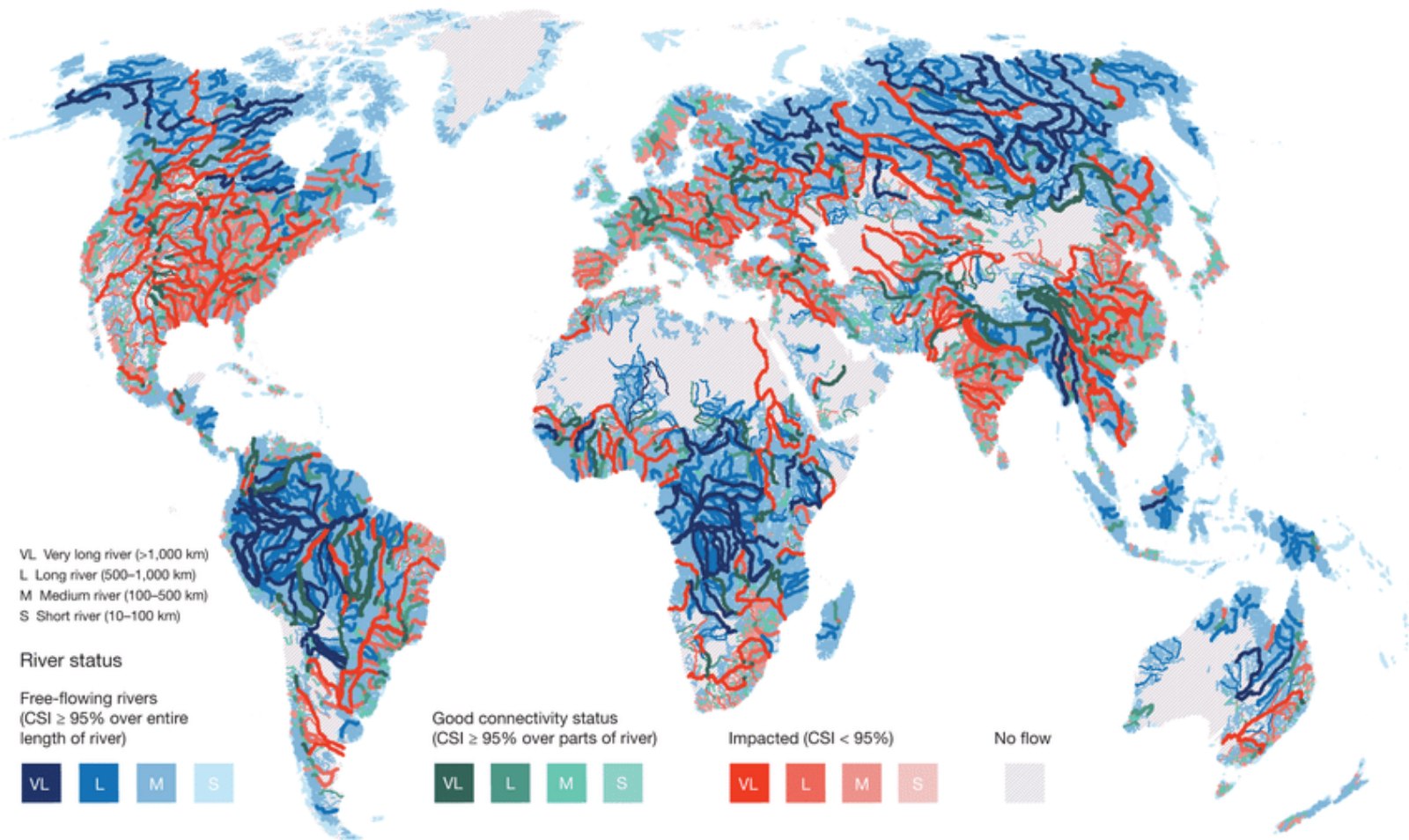
# Map of the world's free flowing rivers



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# Freshwater Fish Extinction as a global threat



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[www.unu.edu.cn/ehs](http://www.unu.edu.cn/ehs)

**What:** Overall, 80 freshwater fishes have been declared extinct by IUCN, with 16 only in 2020!

10 more have been declared Extinct in the Wild and 115 are classified as 'Critically Endangered Possibly Extinct'.

**Where:** Globally

**Why:** Overfishing, pollution and dam construction – tradeoff with demand for fish, irrigation and clean energy

**Impacts:** Loss of biological control for water quality, loss of livelihoods and food insecurity

The Chinese Paddlefish was declared extinct in January 2020



Chinese paddlefish stamp and postcard - Unknown author (Electronic version published by Vancouver Island University, 2001)

# The big picture



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## One Fish, Two Fish, No More Fish?

It's not looking good for **freshwater fish**, or for the **communities who depend on them**. Here are the stats.

**43%**



of freshwater fish catch comes from 50 **low income, food deficit countries**.



**1 in 3**



freshwater fish species are threatened by extinction.



**Conserving and restoring freshwater environments** is the only way to protect the world's fish - and the people who need them!



In the last 50 years, populations of migratory fish have fallen by



**75%**



In the same time period, populations of larger fish species have fallen by



**94%**



Sources: <https://www.bbc.com/news/science-environment-56160756>  
<https://www.worldwildlife.org/stories/one-third-of-freshwater-fish-face-extinction-and-other-freshwater-fish-facts>

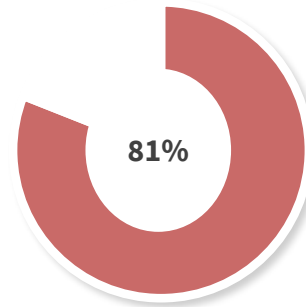
OUR DAILY PLANET

# Freshwater fish and food security



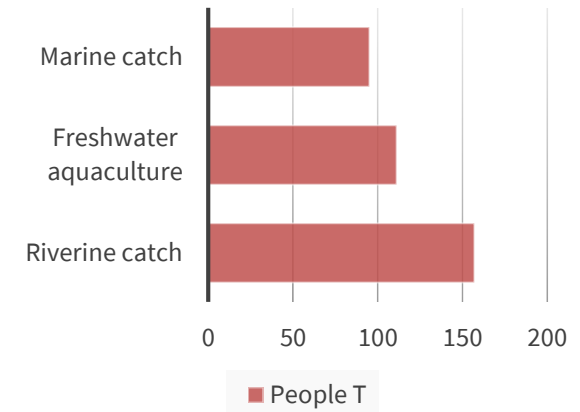
Freshwater fishes provide the equivalent of the total animal protein consumption of:

**158 million**  
People worldwide



Nutritional dependence on freshwater fisheries occurs in nations below global median GDP

**1 Ton of inland catch** supports the total annual consumption of animal protein of **157 people**



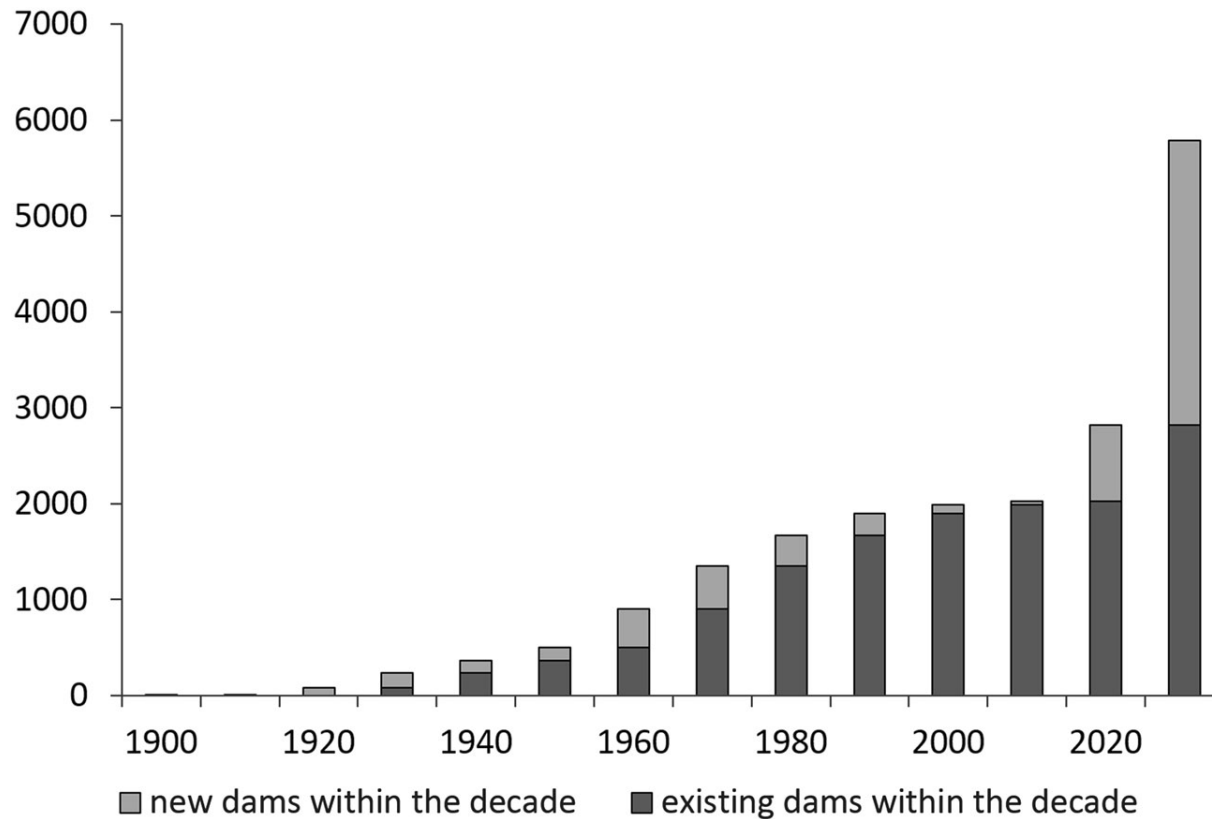
Data from McIntyre et al., 2016

While ocean issues seem to have more social media coverage, losses linked to freshwater ecosystems and inland fisheries are also highly relevant for food security.

At least **43% of wild freshwater fish harvest comes from 50 low-income food deficient countries** (WWF, 2021), where access to other forms of quality food is limited. However, these aspects are “typically ignored or overlooked in policy and global debates on food security” (FAO, 2018).



# Dams under construction or planned



Zarfl et al., 2015





# The trade-off

*Dams illustrate the brilliance and arrogance of human ingenuity. They generate **one-sixth of the world's electricity** and irrigate **one-seventh of our food crops**. They have **flooded land areas** the size of California, **displaced a population** the size of Germany's, and turned freshwater into **the ecosystem most threatened by species extinction**.*

*Bosshard, 2015*



## Orinoco river report card - Colombia



WWF, 2016



Map of the Orinoco River basin, highlighting the Colombian portion that is included in this report.

WWF, 2016

**Report cards** can track the status of important species and systems over time. Consider a **human nutrition** indicator among the indicators of basin health, with the main goal to assess **the capacity to provide enough food in the basin.**

# THANK YOU!



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