Protecting the Vulnerable from Floods: The Role of Research

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Outline of Presentation

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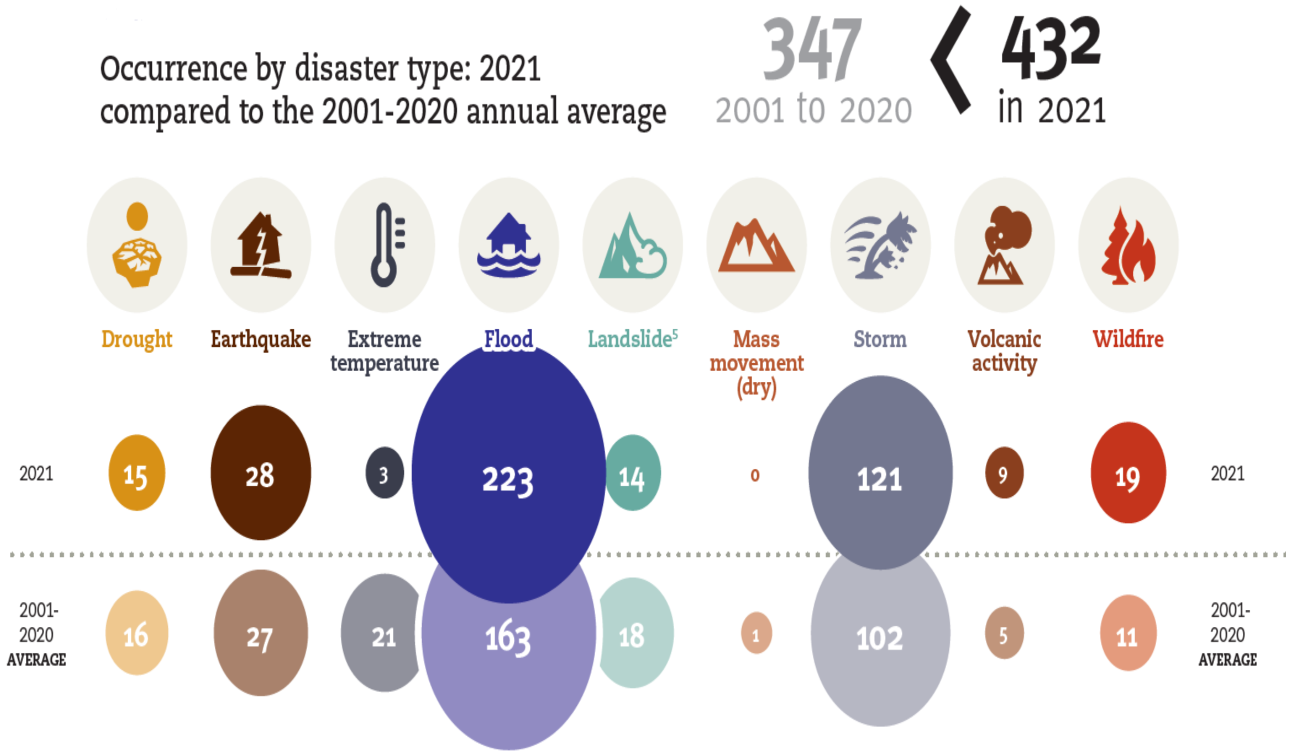
  - Global Perspective of Flooding
  - Flooding: National Effects at a Glance
  - Flooding Issues Faced

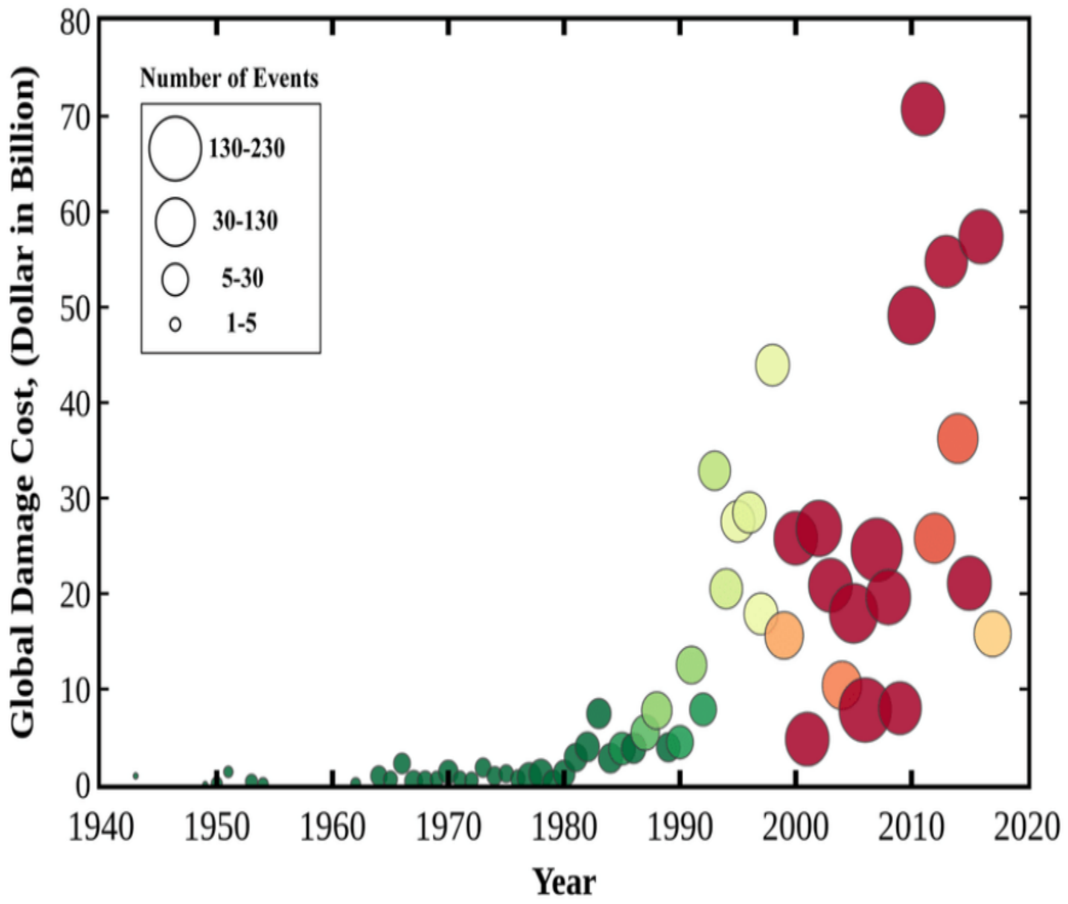
- The Way Forward
  - Importance of Research
  - The Power of Collaborations in Research
  - Donors Corner
  - SDGs and Flood Research

- The Research Tools for Impact as Conclusions

Global Perspective of Flooding



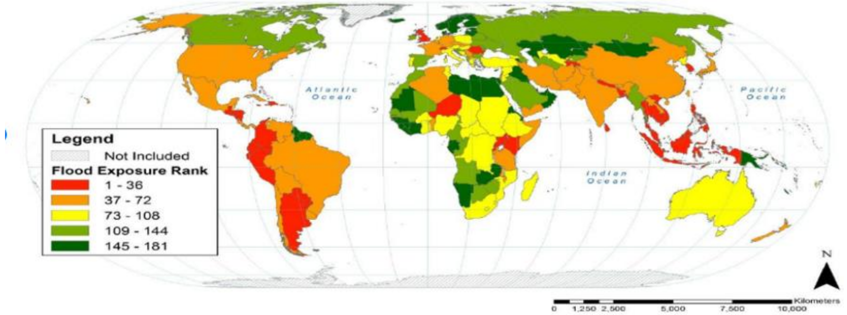
Center for Research on the Epidemiology of Disasters (2021)

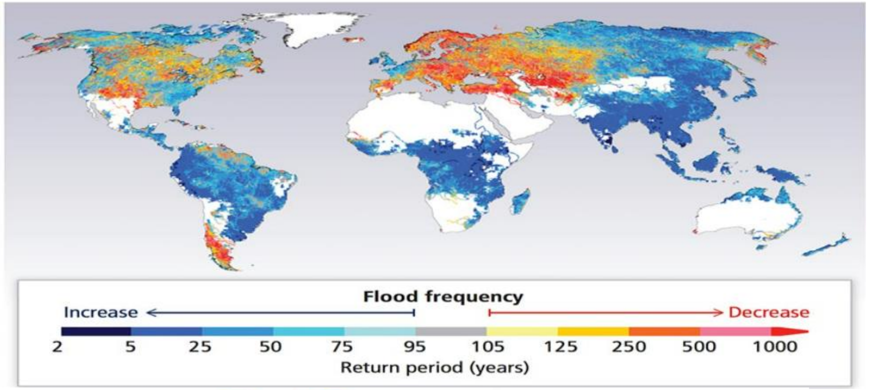


Munich Re (2020)

Global Perspective of Flooding (ii)

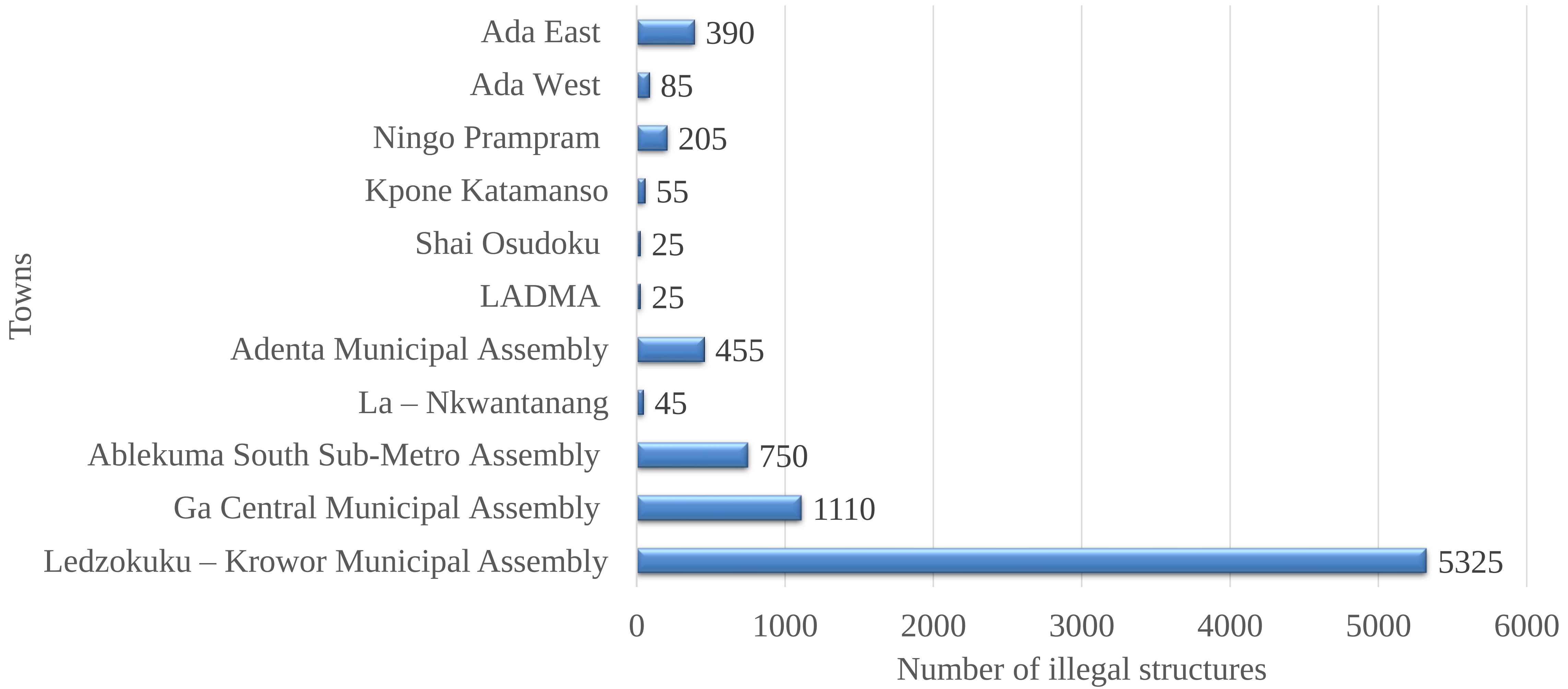
- Globally, flood frequency is predicted to increase across 42% of the earth's land regions (Polka, 2018).
- The U.S, South America, Africa, and Asia have to prepare for extreme flooding every 2 – 50 years.
- Of the 2.2 billion people exposed globally to flooding, an estimated 89% of those at risk live in low- and middle-income countries, and 587 million of them live in poverty.





Flooding: National Effects at a Glance

Flood in Accra and Illegal structures on waterways



(UNCT GHANA, 2015)

Flood in Accra and Fatalities

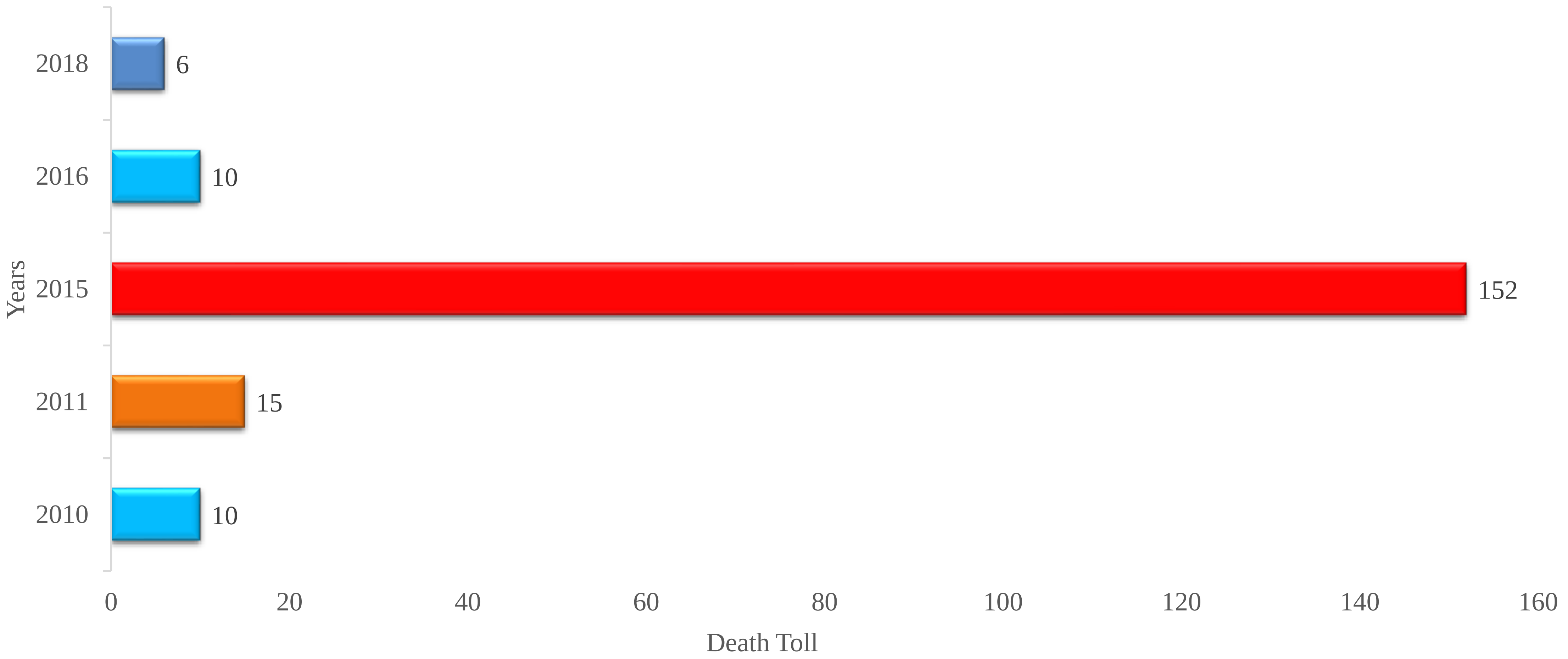


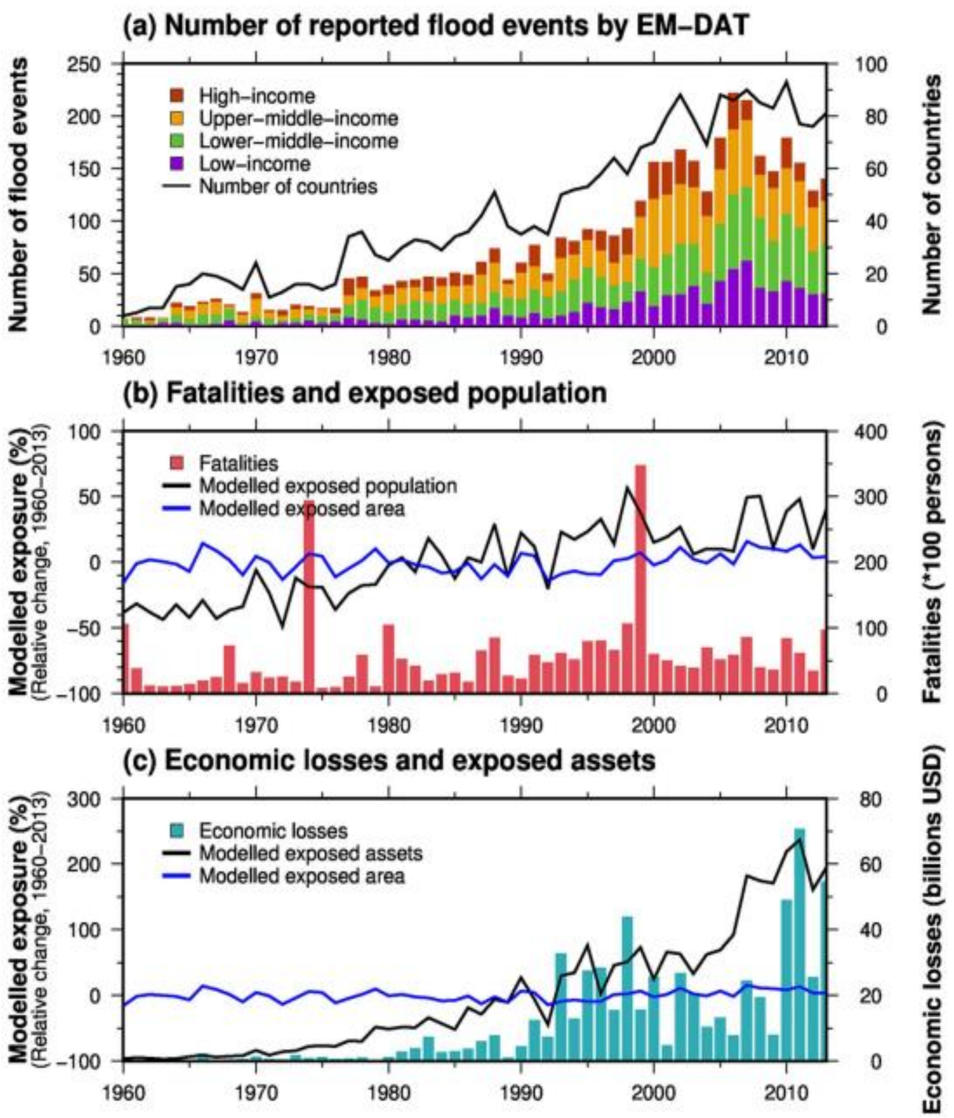
Fig. 9 Death Tolls (Okyere et al., 2013; Amoako and Boamah, 2014; Asumadu-Sarkodie et al., 2015; Tabiri, 2015; Kwang and Matthew Osei, 2017)

Floods and Adaptations among the Urban Poor

- The adaptations to floods in these suburbs include dredging of streams, erection of embankments around houses, moving property to higher grounds, building a network of raised walkways and building houses on stilt. (**Campion and Venzke, 2013)**

The Flooding Issues Faced

- The number of flood events reported in the EM-DAT disaster database has increased since the 1960s
- This increased reports are mainly due to improvements in data accessibility and information gathering. Climate Change as driver?????
- EM-DAT shows an increasing trend in flood-related fatalities and economic losses between 1960 and 2013 (1.5% per year for the annual total number of reported fatalities and 6.3% per year for the value of reported economic losses. *Tanoue et al., 2016)*



Preparing for extreme flooding every 2 – 50 years

Availability of Data/Information for

- Planning
- Investment into Flood Management

The Way Forward …….

Research

Research

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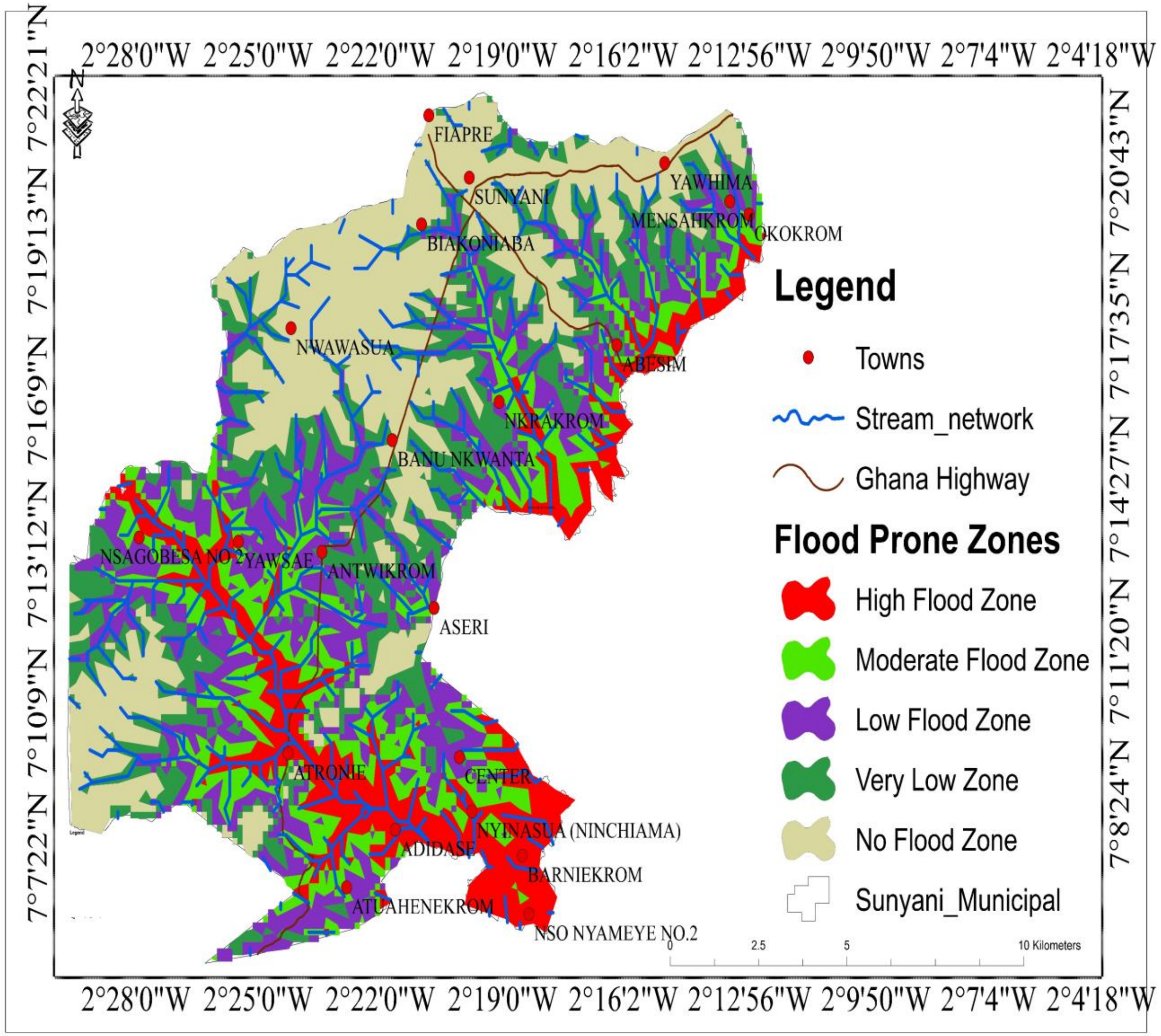
Research

Using Digital Elevation Model to Predict Flood Vulnerability in the Accra Metropolis and Sunyani Municipality

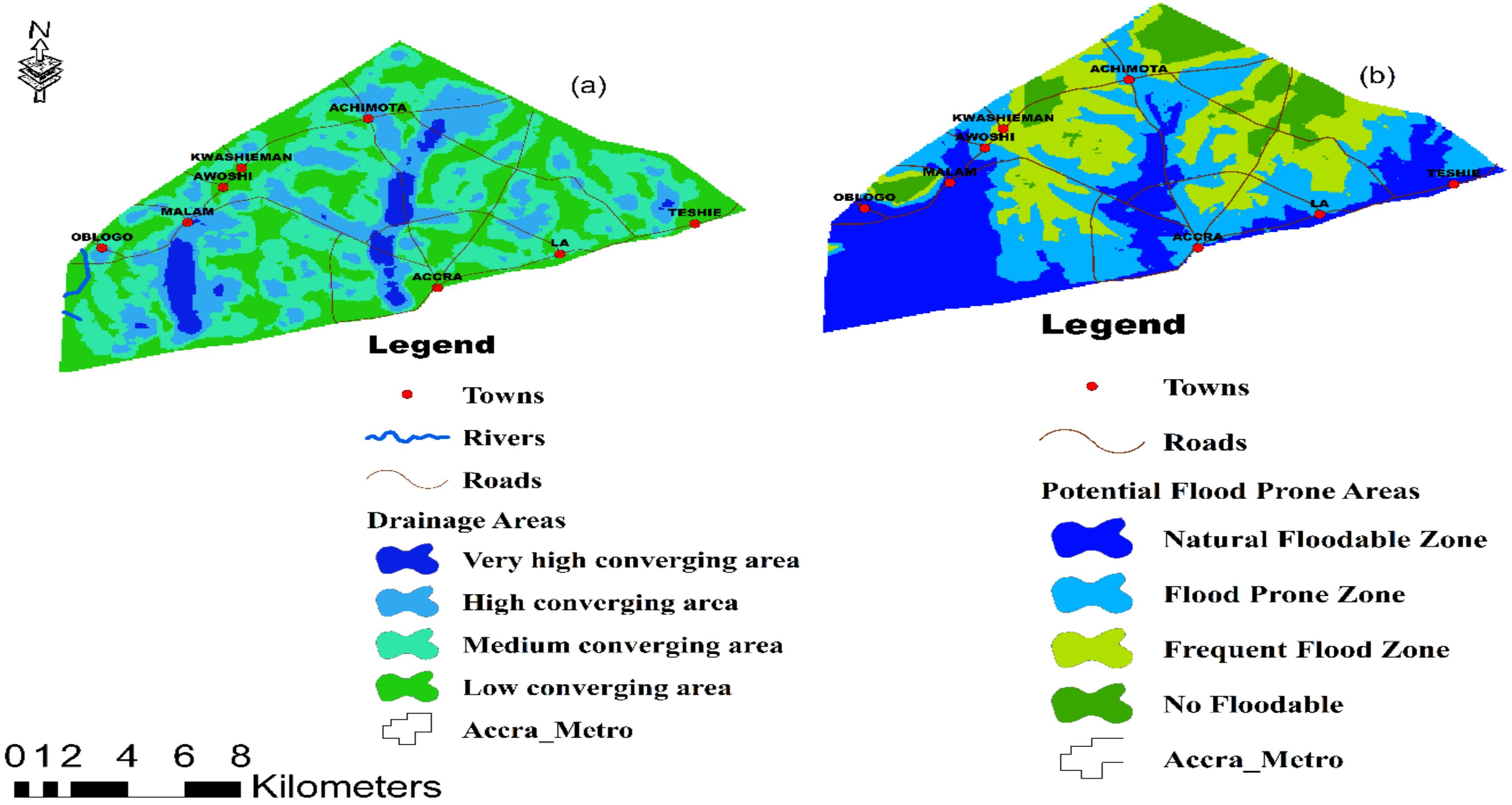
Kabo-bah and Dekongmen (2021)

High Flood Prone zones within low lying areas



Kabo-bah and Dekongmen (2021)

Delineate Flood Prone zones within Accra



Drainage density map and (b) map of floodable areas map (*Kabo-bah and Dekongmen (2021)*)

Research Built around Collaborations

Addressing the Flooding Issues

- Negative impact of climate change and anthropogenic effects
- Solution to these issues calls for **applied research** that will inform city planning, investment and insurance
- Effective and impactful research thrives on **highly skilled personnel**
- **Human resources development** and **impactful research** require **collaborative efforts**

Power of Collaborations: Donors Corner

Regional Water and Environmental Sanitation Center (RWESCK)

- US$13.5 million dollar World Bank and Government of Ghana Grant
- One of the ACE for impact projects by the World Bank
- Capacity building for post graduate training in water engineering and environmental sanitation.
- Hosted under the Civil Engineering Dept., KNUST

Water Resources and Environmental Sanitation Project

- 3.5 Million Euros from the Netherlands Government
- Capacity building for post graduate training in water engineering and environmental sanitation.
- Project was managed by the Civil Engineering Dept and IHE-Delft

Power of Collaborations: Donors Corner

West African Science Service Center on Climate Change and Adapted Land Use (WASCAL)

- 3 Million Euros from the German Government
- Initiated to develop effective adaptation and mitigation measures to climate change
- Geographical focus of WASCAL is on 13 Countries in West Africa including Benin, Burkina Faso, Nigeria, Ghana, Cape Verde ….

Research Collaborations

Regional Water and Environmental Sanitation Center (RWESCK)

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Furiflood Project

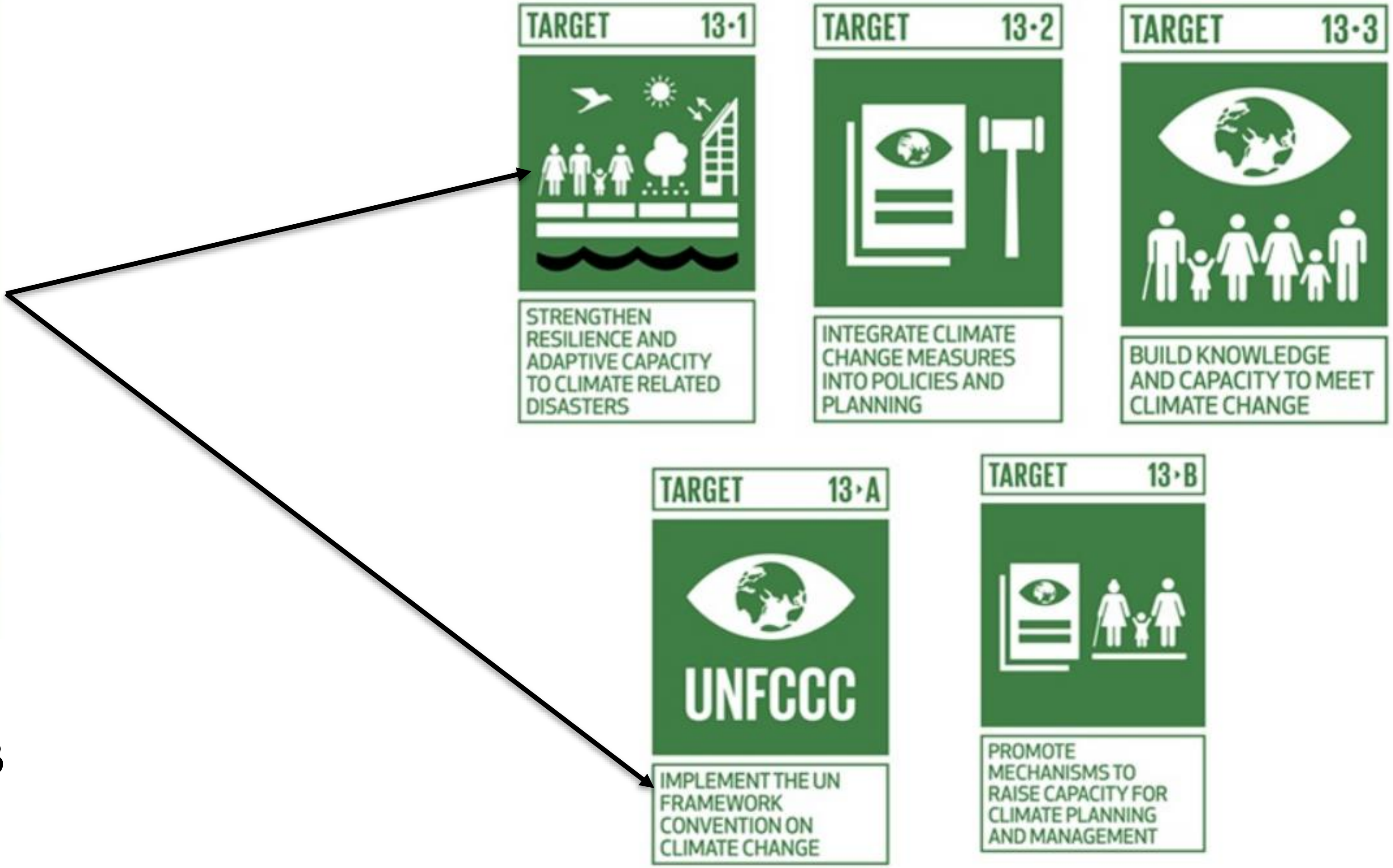
- KNUST works with national and international partners.
- The aim is improve the quantification of current and future extreme precipitation and flood risk in West Africa underpinned with science-based decision making
- Thematic areas: inventory of past flood events, flood hazard mapping, flood risk assessment, future precipitation extremes.

West African Science Service Center on Climate Change and Adapted Land Use (WASCAL)

- Initiated to develop effective adaptation and mitigation measures to climate change
- Geographical focus of WASCAL is on West Africa with focus on Benin, Burkina Faso and Ghana
- Present in 13 West African Countries

SDGs and Floods

Sustainable Development Goal 13



Information Development to Protect the Vulnerable - Research

Immediate Actions for Future Sustainability

1. Curriculum Upgrade on the Use of Remote Sensing and GIS Applications for Water Management
2. Collaboration between Academia and the Sector
3. Development of Early Warning Systems

The Research Tools for Impact

1. Potential of remote sensing and its combination with hydraulic modeling for flood monitoring and damage assessment.
   - ❑ Hydrology and Hydraulics are very well developed into computational Hydraulics

2. Special focus on advanced approaches to land cover classification and change detection from remote sensing in flood applications
   - ❑ Satellite remote sensing and Earth observation (EO) as inputs to disaster monitoring and damage assessment

3. Multidisciplinary approach in Remote Sensing, Geophysical Sciences, Hydraulics and Hydrology

thank you

Satellite images for flood monitoring and assessment

- Remote sensing for flood response and management

- Joining hydrology/hydraulics and remote sensing

  Key ideas and overall architecture Land cover,

  3D buildings, changed/flooded areas from remote sensing

  Vulnerability, elements at risk, and damage

- Experimental examples and case studies

Remote Sensing vs. Flood Risk

Prevention and prediction phases

Improved predictions of hydro-meteorological processes by mapping land cover and water bodies from EO

Mitigation and risk assessment phase

Often out-of-date cartography; time consuming in situ surveys.

Improved elements-at-risk and vulnerability assessment by mapping land cover and buildings through remote sensing image analysis

Monitoring and management phases

Multitemporal remote sensing image analysis (before vs. after event) allows assessing the flood impact (flooded areas, ground changes)

Need for a methodology that incorporates hydraulic modeling to estimate damage from these EO-derived thematic products.

Joining hydrology/hydraulics and remote sensing

- **Key Ideas**

1. Land cover ► Elements at risk

   EO-based land-cover classes are reorganized into classes of elements at risk that show similar behaviors with respect to flooding.

2. Elements at risk ► Vulnerability

   Classes of elements at risk are assigned proper loss functions so that damage is known as a function of hydraulic forcing.

3. Flooded/changed areas ► Flood exposure indicators

   Through physically-based hydraulic models constrained to EO-based flooded or changed areas, water-depth maps and other hydraulic parameters can be computed as best estimates of the real condition.

4. All derived information is merged to map the actual damage.