Flood Modelling and Early Warning Systems for Downstream Communities of Koka Dam, Ethiopia

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Environmental Engineering & Engineering for Developing Communities

CSTPR Seminar Series

University of Colorado Boulder

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Climate Centre

International Federation of Red Cross and Red Crescent Societies

CENTER FOR SCIENCE & TECHNOLOGY POLICY RESEARCH

Acknowledgements

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ETHIOPIAN RED CROSS SOCIETY

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Ministry of Water, Irrigation & Electricity

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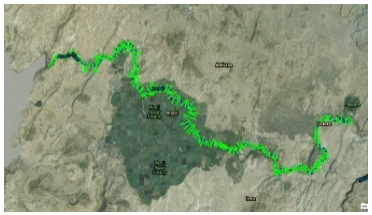
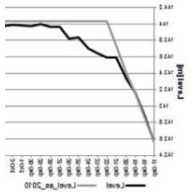
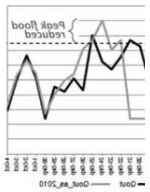
Research Overview: Objectives and Project Scope



Flood Modelling: Background and Findings

Community Assessments: Findings and Recommendations





Conclusion: Next Steps

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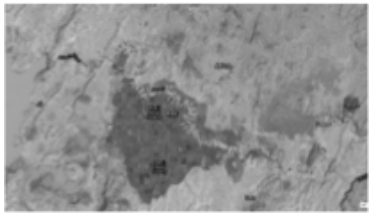

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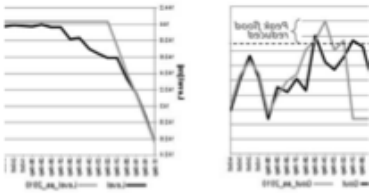

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ICRC

International Federation of Red Cross and Red Crescent Societies

Climate Centre

ETHIOPIAN RED CROSS SOCIETY

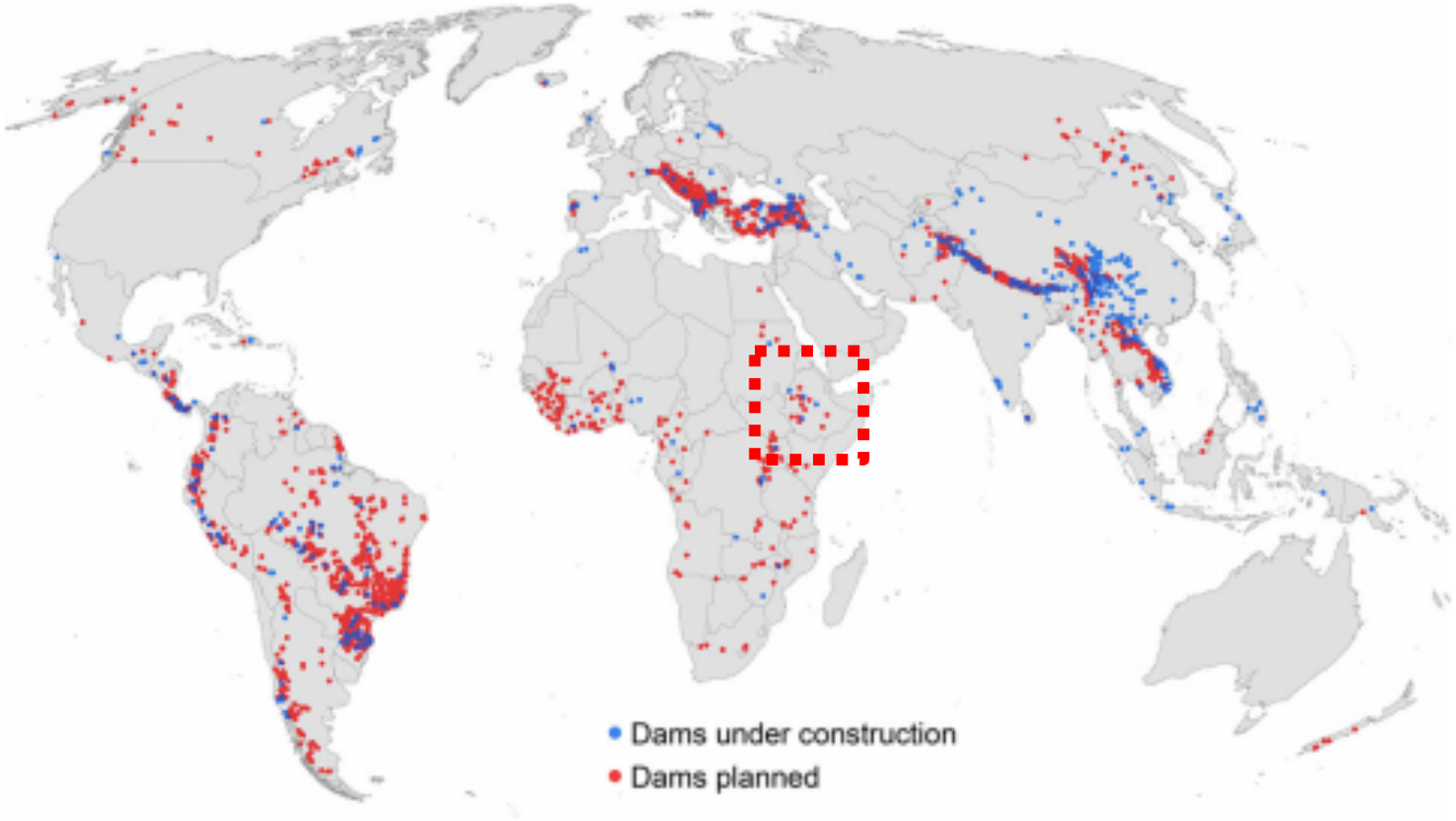
The IFRC carries out relief operations to assist victims of disasters, and combines this with development work to strengthen the capacities of its member National Societies.

The Climate Centre is a specialist reference centre of the IFRC that helps reduce the impacts of climate change and extreme-weather events on vulnerable people.

Ethiopia is the second most populous country in Africa and has hopes to be the continent's largest energy exporter.

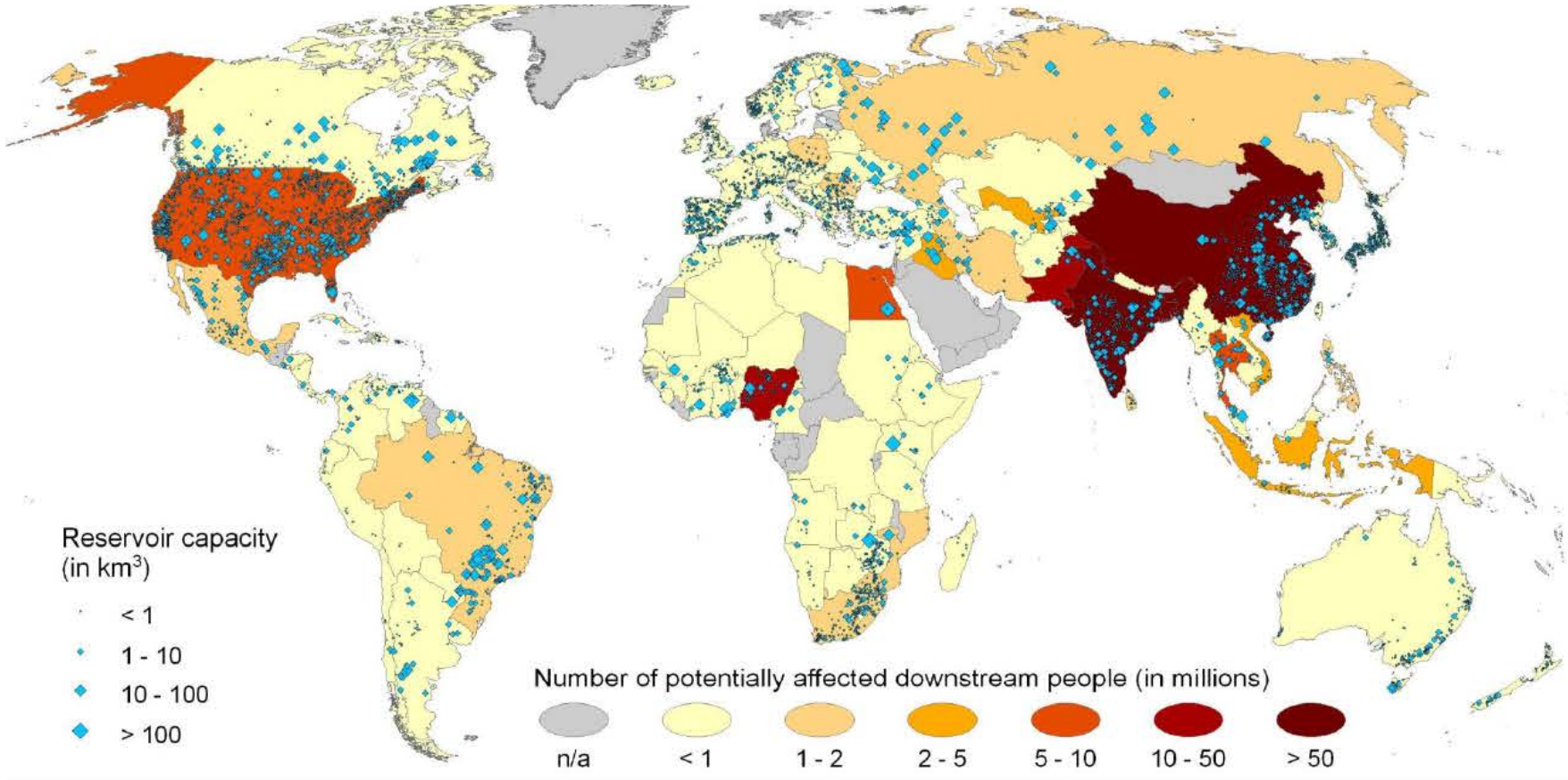
(https://www.wsj.com/articles/troubled-waters-egypt-and-ethiopia-wrangle-over-nile-dam-1516185001)

A 2014 study estimated that 3700 new hydroelectric dams (>1 MW) are planned or under construction, increasing global hydropower production by 73%.



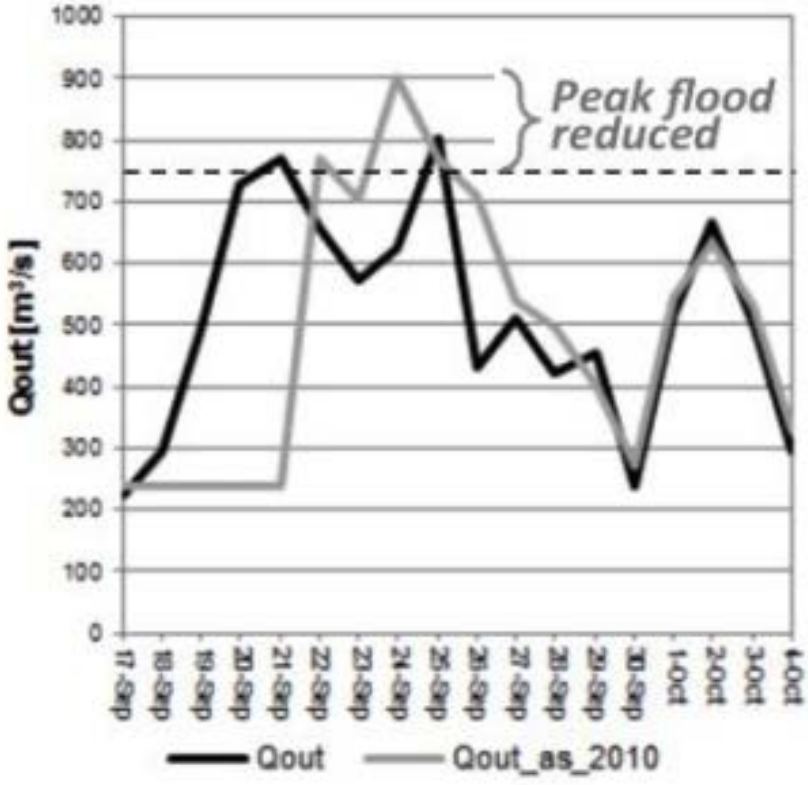
(Zarfl et al, 2014)

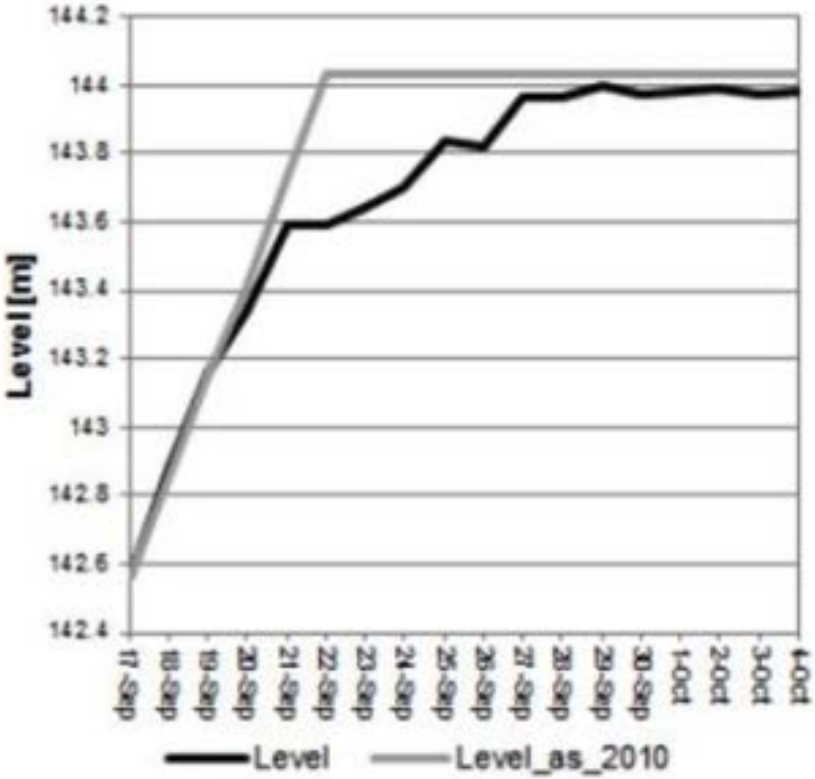
Populations living downstream of dams may have their livelihoods disrupted by dam-induced alterations of river flows.



(Richter et al, 2014)

The Climate Centre successfully piloted FUNES, a self-learning algorithm which uses minimal data inputs to improve the timing of water releases from hydroelectric dams, in 2016.





(Suarez and de Suarez, 2014)

This study focused on Koka Dam, Ethiopia's oldest hydroelectric dam, with the following objectives:

1. Identify forecasts of natural phenomena (e.g., precipitation, hydrology) that anticipate extreme events.
2. Assess what is known and what needs to be known to link forecasts with anticipated impacts.
3. Suggest actions worth taking once the forecast exceeds a predefined threshold of risk before the impacts materialize.
4. Outline proposed next steps for a forecast-based contingency plan.

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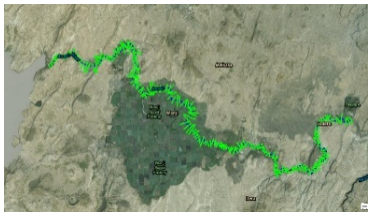

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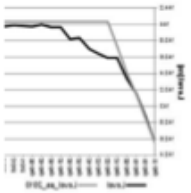

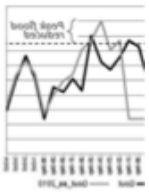

Conclusion: Next Steps

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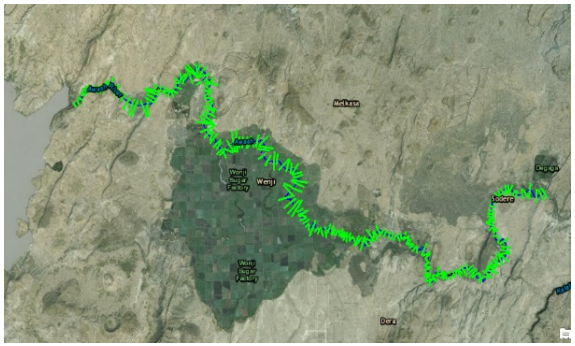
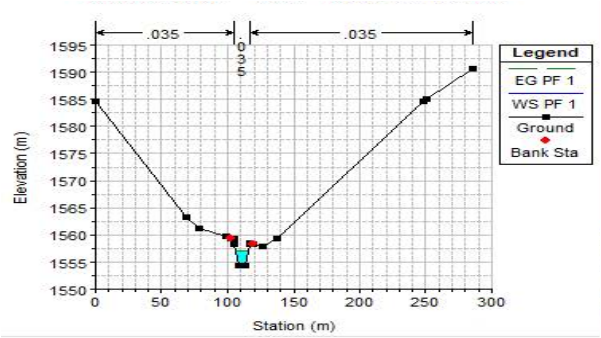
HEC-GeoRAS is a river analysis system that allows users to view results in a geospatial context.

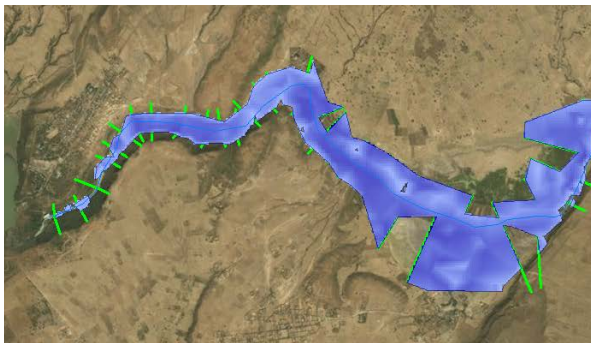
Geographic data developed in ArcGIS



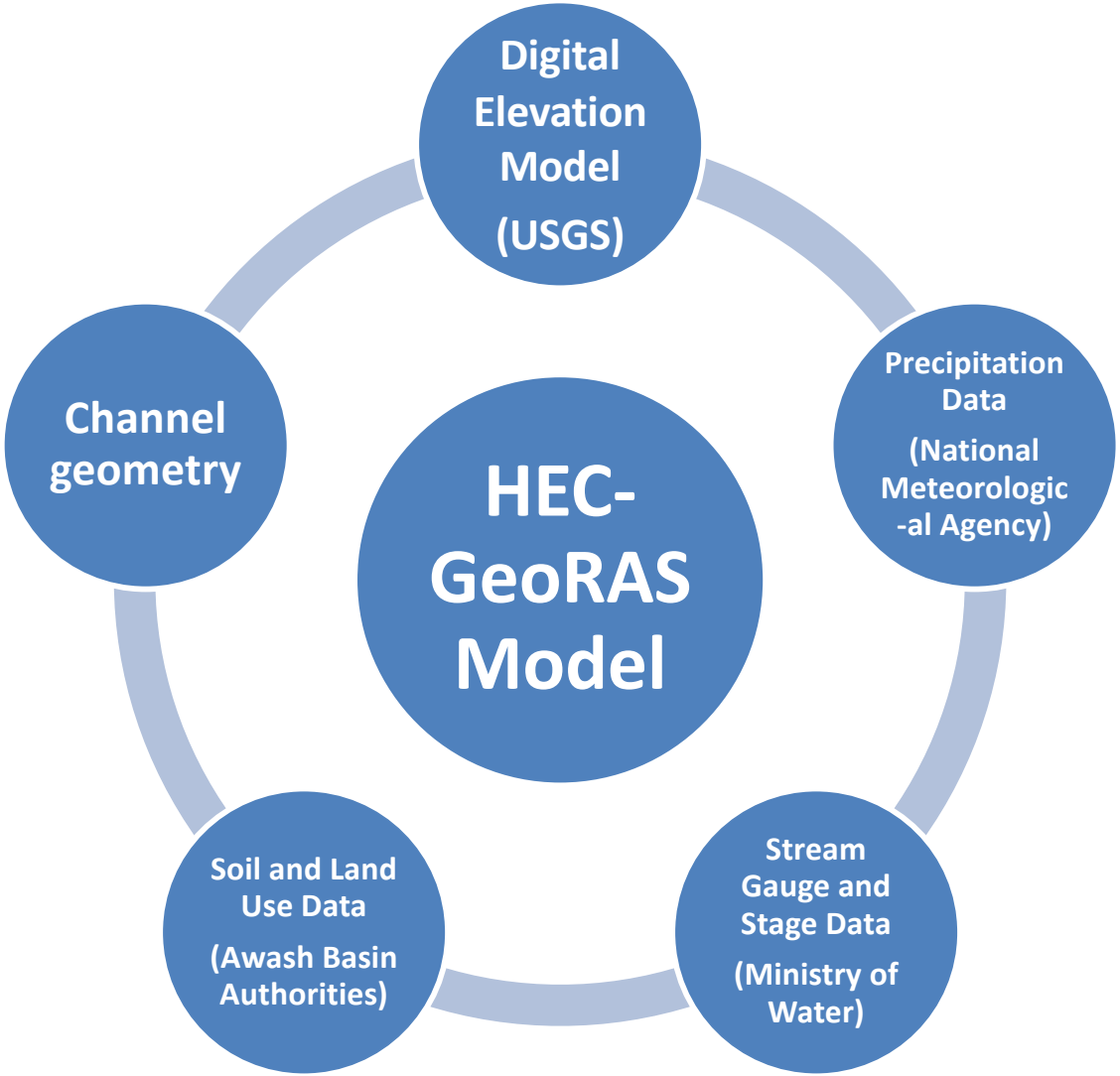
Geographic data imported into HEC-RAS for hydraulic modelling



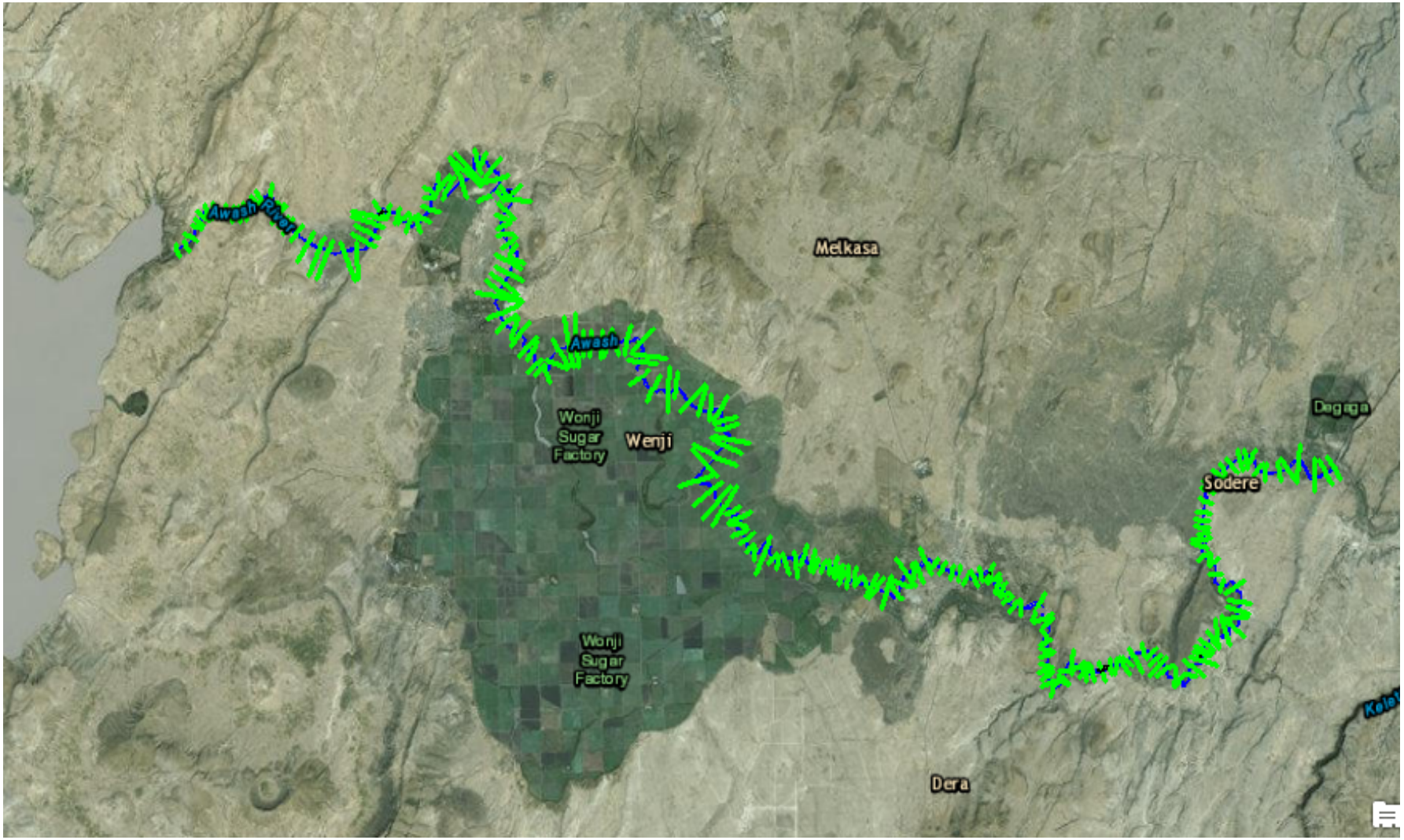
HEC-RAS results exported to ArcGIS for geospatial context



The modelling software requires a number of inputs to produce an accurate and reliable model.



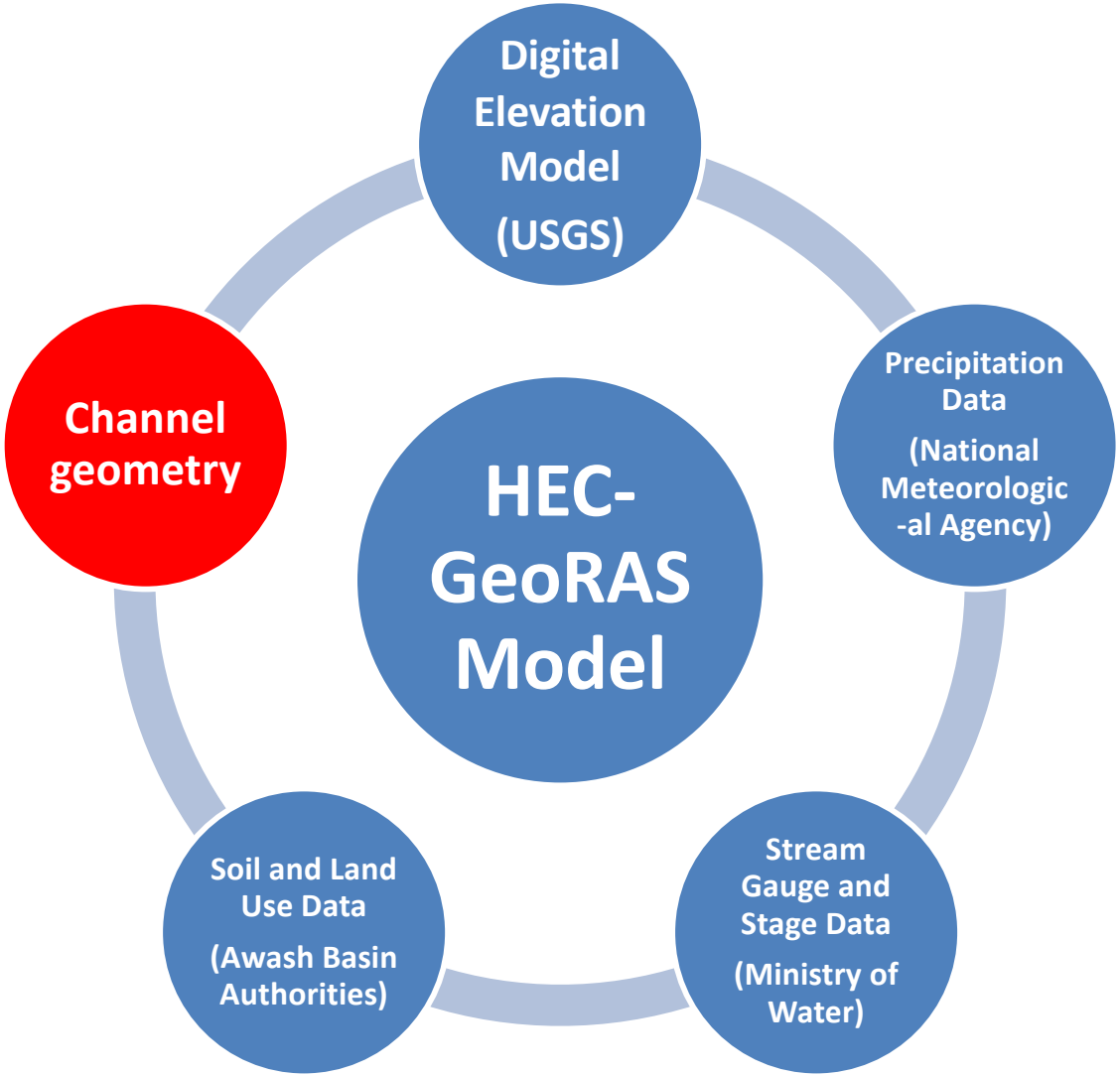
Flood modelling, using HEC-GeoRAS, was performed for downstream communities of Koka Dam.



A combination of precipitation and controlled releases likely result in downstream flooding.

Flooding primarily affects agricultural areas along Awash River.

The lack of available data presented challenges towards determining the *amount* of water that can be safely released from the dam.



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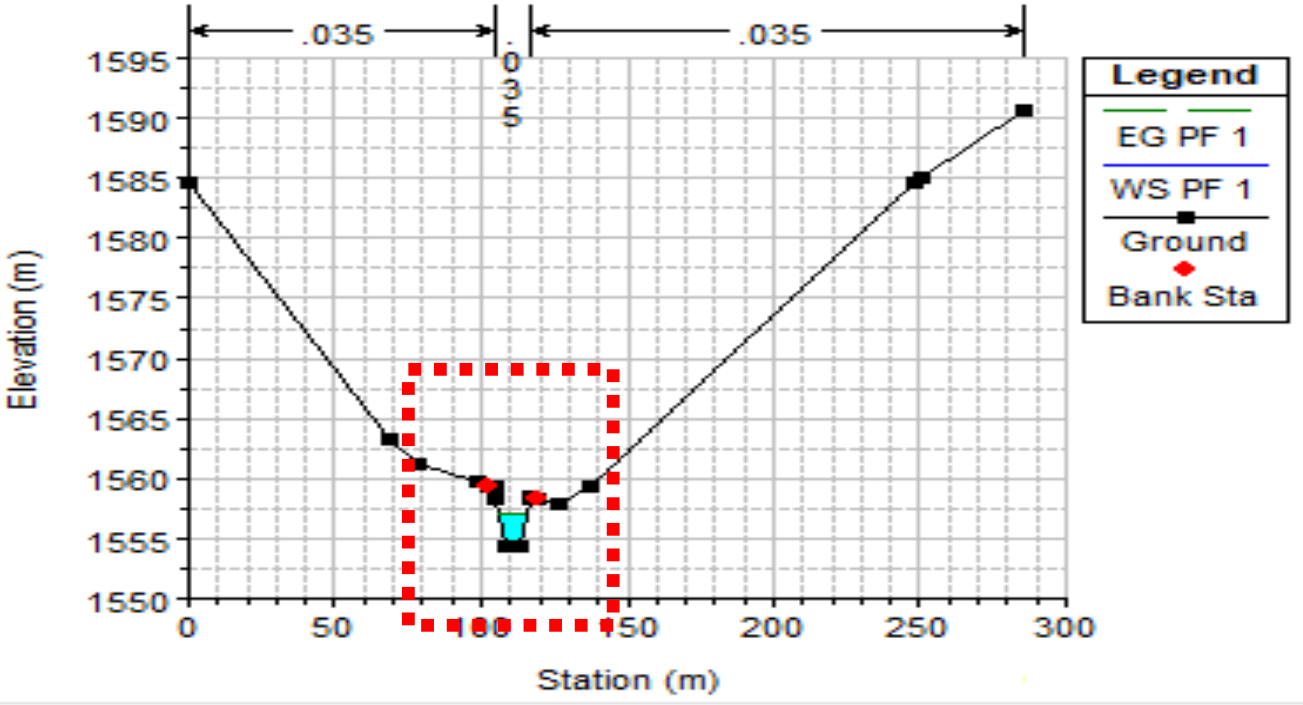
Channel geometry



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What's needed?

1. Recent stream gauge and stage data (most recent is from 2007).
2. Documentation of flooding dates in downstream communities to concretely link these events with natural phenomena.
3. Updated and ample channel geometry to estimate *how much* water can be released from Koka Dam without negative downstream consequences.
4. Maps of officially an unofficially constructed dikes.

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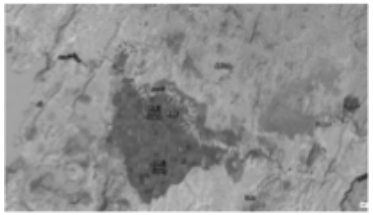

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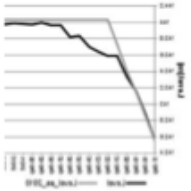

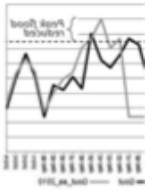

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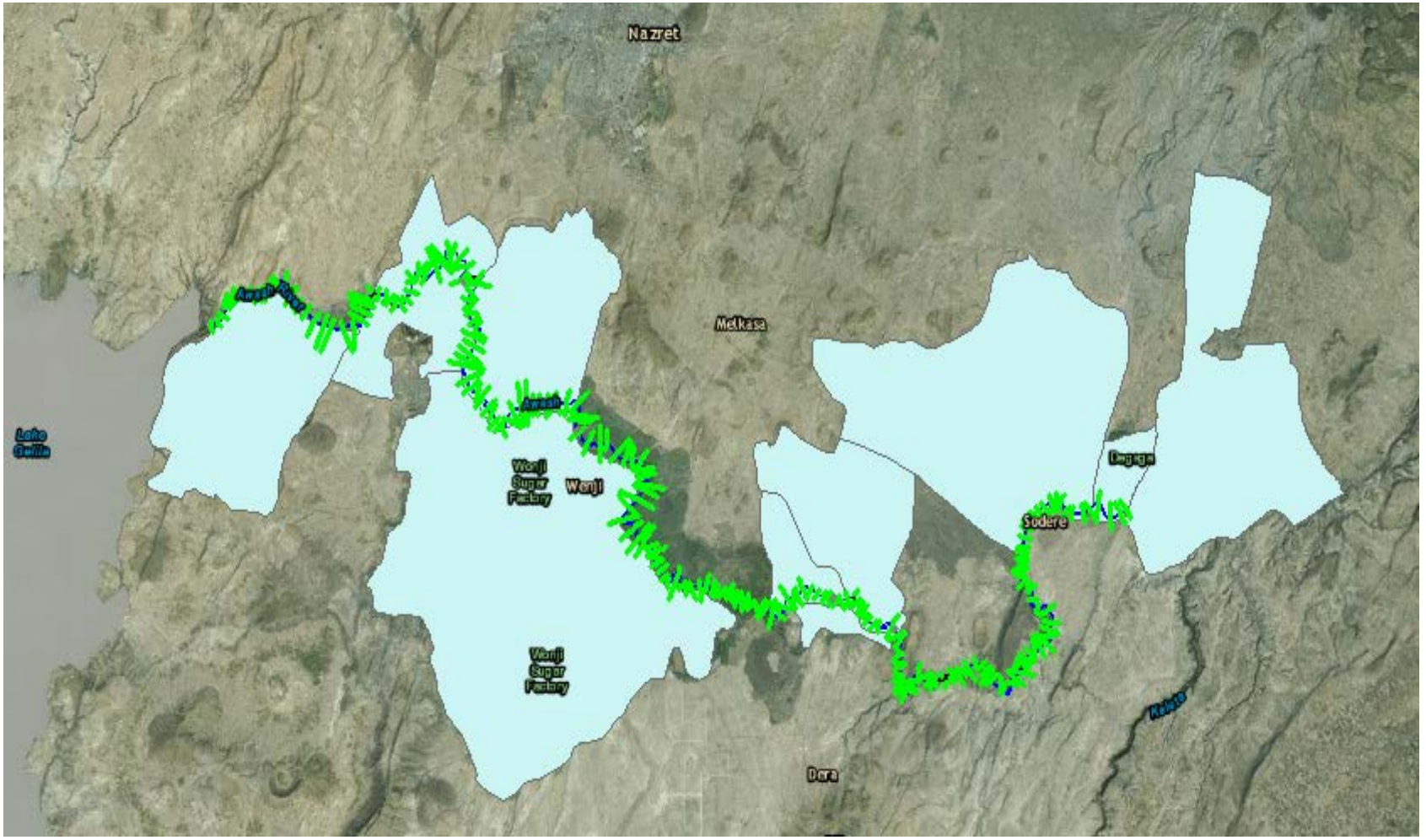
Assessments were performed in seven communities and two facilities downstream of Koka Dam.



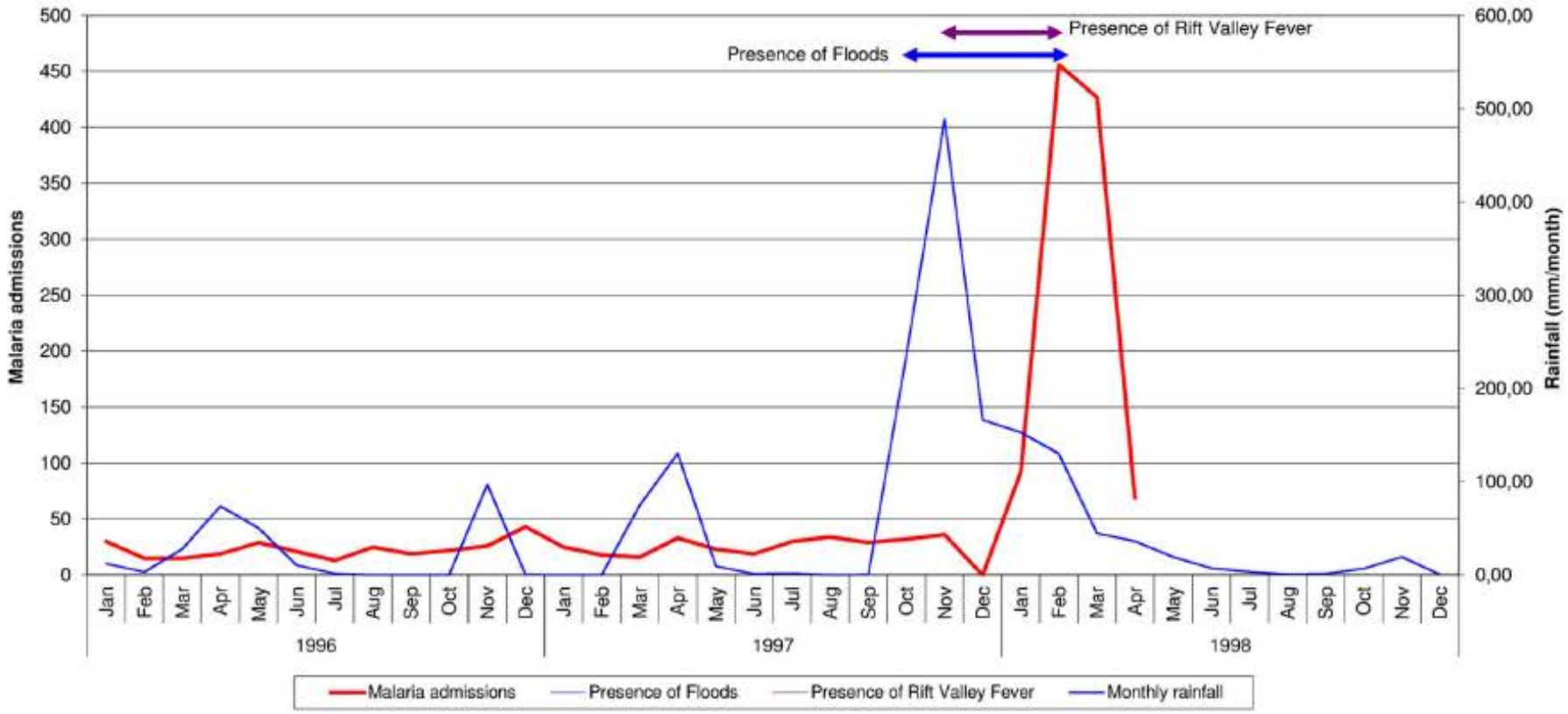
Assessments were performed in seven communities and two facilities.

Communities	Facilities
Kuriftu	Sodere Resort
Melka Adama	Wonji Sugar Factory
Botu Kurabu	
Bati Germana	
Qechachule Guja	
Koloba Bli	
Bato Degaga	

All informants reported flooding in their community or facility.

Flooding primarily impacts agricultural land, and the primary occupation of downstream communities is agriculture.

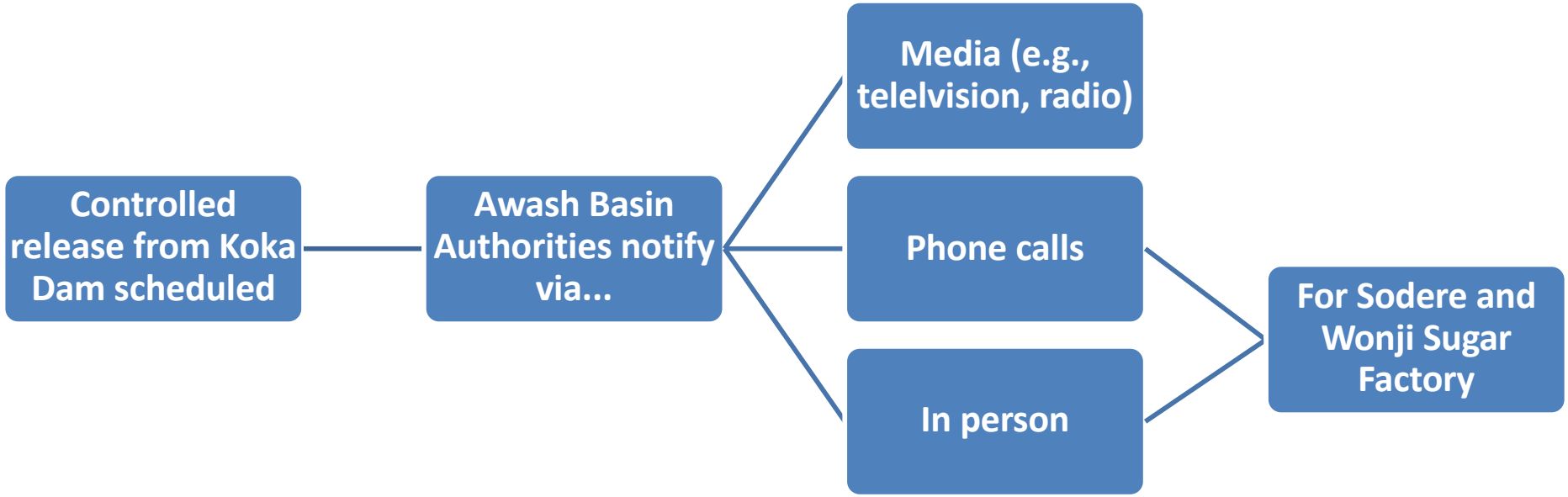
Over half of the informants also reported increased cases of malaria following flooding.



(Maes et al, 2014)

Minimizing flood impacts can allow communities to generate additional income, improve health, and improve their livelihoods.

The existing warning system is between the Awash Basin Authorities and downstream communities/facilities.



The two facilities were satisfied with the current *method* of notification. Communities has several recommendations:

In-person notification

Mobile phone notification:

- **Phone calls to central members of community, who will further disseminate information**
- **SMS text message notification**

Notifying local agricultural officers

All informants expressed desire for a change in the *timing* and *content* of the warnings, including:

Earlier notification, if possible.

- **Current early actions include moving livestock and irrigation pumps from the floodplain. More time would allow for additional preparation.**

Anticipated impacts associated with the floods.

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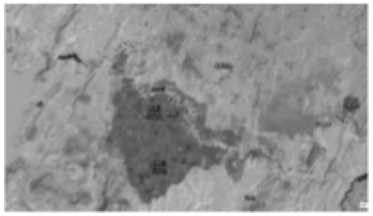

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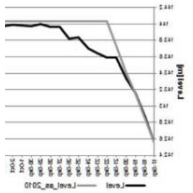

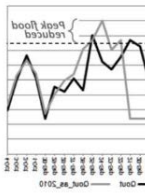

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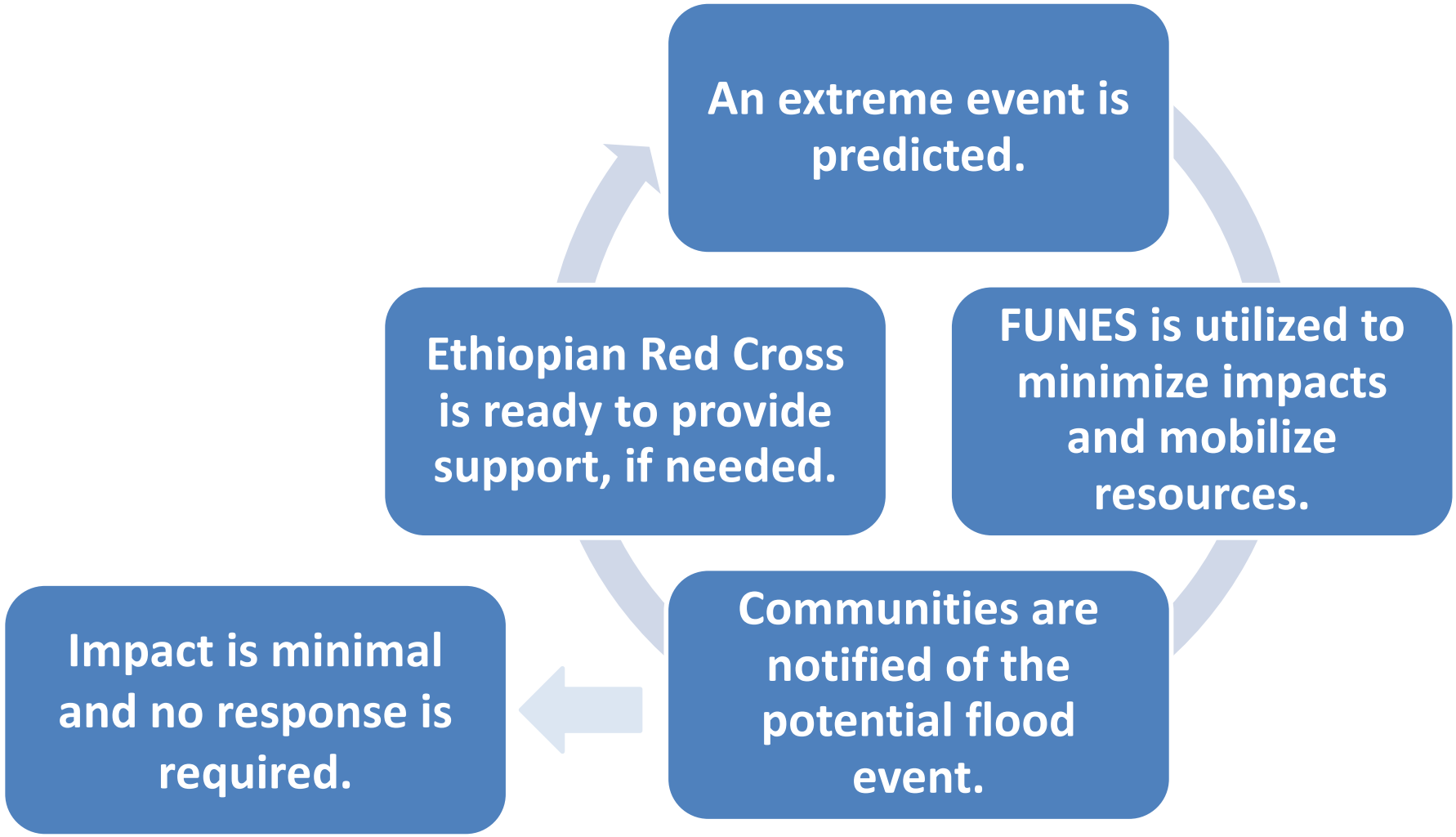
FUNES can be piloted on Koka Dam.



Infrastructure investments can provide long-term resilience.

Dikes can be built along the river to prevent flooding from the river.

Channels and canals can be built through farmland to direct flow from communities to river.

Minimizing flood impacts can allow communities to generate additional income, improve health, and improve their livelihoods.

Questions?

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