A transdisciplinary approach to understanding water-related risk in the Awash river basin, Ethiopia

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Introduction

The Awash River basin in Ethiopia is of high economic importance in the country, with productive activities contributing around 30 percent to national GDP. Population growth, urbanisation, irrigation expansion and emerging industries are putting pressure on the quality and quantity of available water resources. Droughts and floods are endemic and have devastating economic and social impacts. In 2015, Ethiopia experienced one of the most severe droughts in recent history and floods recur annually. Managing uncertainty is one of the greatest challenges for mitigating water-related risks in the basin.

Geographically, the Awash basin has an area of 114,123 square kilometres and an estimated population of around 18.6 million. It is an endorheic basin that only flows within Ethiopia and is shared by five regional states. The location of the Awash basin in Ethiopia can be seen in Fig.1. The upper Awash basin is in the highlands and the altitude decreases and the landscape becomes increasingly dry downstream, towards the Northeast of Ethiopia (see Fig.2).

Previous research has used global, regional and basin scale hydro-climatic models to inform decision-making around optimum investments in water-related risk management. However, these analyses have often overlooked the question of who will benefit from such investments and via what mechanisms.

This research innovatively integrates basin scale climate hazard mapping and water resources allocation modelling with risk perspectives from interviews and discussions with different water users at the woreda (district) level in order to move towards an understanding of how different water users experience water-related risks in the basin.

The main research questions are:

1) How can a transdisciplinary approach improve our understanding of water-related risk in the Awash basin?
2) What is a tolerable level of water-related risk for all water users?

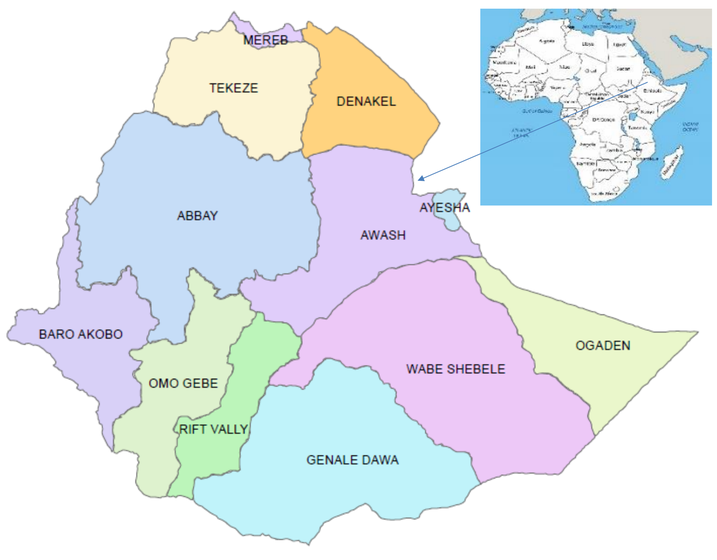

Fig. 1. Location of the Awash basin in Ethiopia

Fig.2: Photographs in the upper, middle and lower Awash basin (left to right) showing the increasingly dry climate into the lowlands

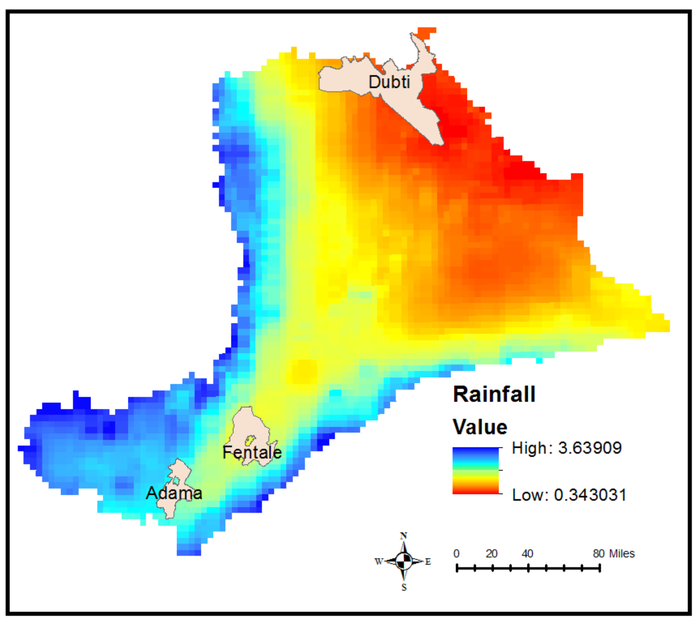

Fig. 3. Selected districts in the Awash basin for social research and average annual rain rate (mm/day) (1981-2016)

Methods and Materials

This research is a case study of the Awash river basin in Ethiopia that adopts a transdisciplinary approach involving the co-production of knowledge across disciplines with strong input from in-country stakeholders to shape the research design, in particular, in collaboration with the Awash Basin Authority (AwBA) a federal organisation of the Ethiopian government responsible for managing water resources in the basin.

The methods used are:

1) Climate hazard mapping using CHIRPS climate data from 1981-2016. This is used to explore different risk thresholds relating to drought and flood events and to model the frequency of consecutive water hazards.
2) Water resources allocation modelling using river flow data to explore how different allocation scenarios will influence the vulnerability of different water users to water-related risk.
3) Social research methods, namely focus group discussions, semi-structured interviews and a mixed qualitative and quantitative business water-use survey to capture water-related risk perceptions of water users in three districts in the basin: Adama (upper,) Fentale (middle) and Dubti (lower).

Results and Conclusions

A transdisciplinary methodology allows an iterative approach to climate and hydrological modelling that reflects people's lived experiences. This allows a more holistic understanding of water-related risks that capture the vulnerability of different water users at different points in the river basin.

Exposure to water-related risk is shaped both by biophysical processes and management of water resources. According to best estimates by the AwBA, water demand does not currently outstrip supply but will do at current rates of population growth and industrial expansion. However, water is currently not being managed equitably meaning that some water users get better access than others. At times of drought, there is insufficient regulation and enforcement to prevent large water users upstream abstracting more than their fair share.

We find that water-related risk is not homogenous and consists of social and economic dimensions. The main water users include: large scale irrigators, small scale irrigators, factories, urban centres and rural communities. There are risks to economic productivity as well as well-being and sustainable development. It is important to note that men and women are vulnerable to water-related risks in different ways.

Adaptive capacity of water users is influenced by water source and access to water technologies. Water users utilising groundwater were found to be more resilient to extreme events and sophisticated water pumping technologies led to less impact on production.

Vulnerability to water-related risk varies according to position within the Awash basin. Overwhelmingly, water users in the upper and middle of the Awash basin were found to be less vulnerable to water-related risk than users in the lower basin. This has strong implications for water resources management which has, thus far, failed to evenly distribute risk across the basin and its water users.

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