



Drought Resilience in East African Dryland Regions

DRIER



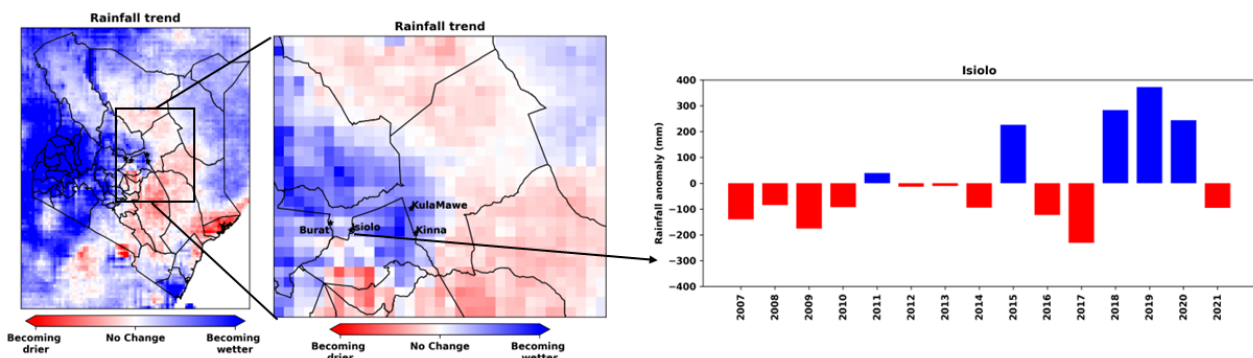
The DRIER project is a collaboration between universities in Kenya, Ethiopia and the United Kingdom. Our aim is to strengthen understanding of the changing regional water balance in the drylands of East Africa, by integrating the hydrological, climatic and social dimensions of this change.

In Kenya we have focussed most of our work on **Isiolo** county, and especially the wards of **Burat** and **Kinna**, with some hydrological model analysis also for the wider **Ewaso Ng'iro** river catchment. Together with analysis of climatic data, and modelling of water stores, we have also undertaken detailed research at community level in Burat and Kinna, with the aim of understanding better people's reliance on different water sources and their experiences of the impacts of drought. In this research briefing we bring information from these sources together to summarize some of our learnings to date.

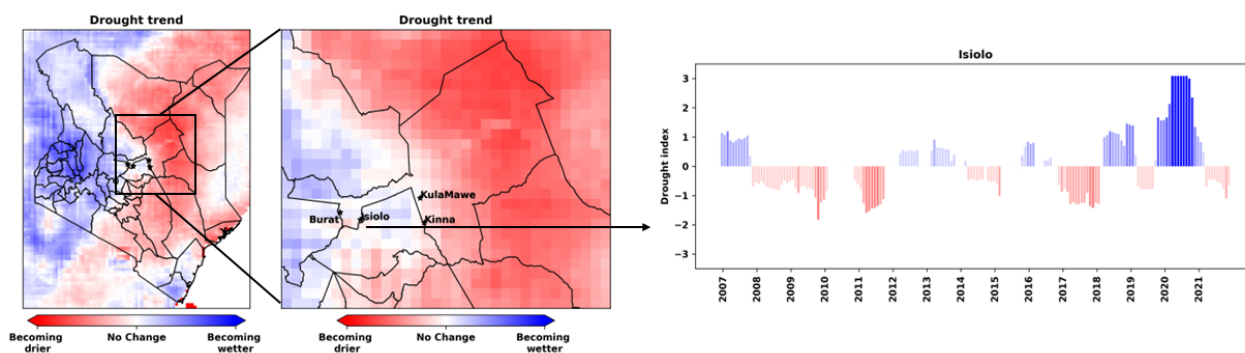
CHANGING RAINFALL & DROUGHT PATTERNS - OBSERVATIONS & EXPERIENCES

As part of our research work the team has been analyzing rainfall and drought trends over the last 40 years, at a countrywide scale and for specific areas within Kenya, including areas within Isiolo county.

The maps below show rainfall trends over the last 40 years, and a chart indicating rainfall anomalies for Isiolo town since 2007. The long-term rainfall trend for Isiolo county shows some division, with the west tending to become wetter and the east becoming drier. In most of the recent years, Isiolo town area experienced below average rainfall, although rainfall was above average in the 2018 -2020 seasons.



Here we show a similar set of figures for drought trends, calculated using the index SPEI-12 (Standard Precipitation Evapotranspiration Index for 12-month period). The national map reveals that the drought pattern is becoming more severe in eastern Kenya, in contrast to the west. This is mirrored within Isiolo county, with a strongly increasing drought trend in the eastern part of the country, but conditions largely unchanged or slightly less severe in the western part. The drought index chart for Isiolo town shows considerable variation from year to year, though with very clear abnormally dry and abnormally wet periods spanning multiple seasons.



Much of our discussion with community members in Burat and Kinna turned to the problems of drought, how it is changing in people's perceptions, and the impacts that prolonged drought brings for people's livelihood and wellbeing. Many of the experiences people expressed are shared in all the dryland sites where we worked in both Kenya and Ethiopia.

One of the key things to emphasize is that changes in drought patterns have both direct and indirect effects, and tend to increase the challenges many people who live here have in maintaining their livelihoods and ways of life. By definition, extended dry periods have severe direct effects on the vital resource of water – reducing soil moisture and affecting most sources of water that people use for drinking, domestic use and for their crops and animals. This all brings many further problems, affecting people's incomes, schooling and health, and sometimes increasing conflict both between community members and with outsiders.

As examples, these are some of the things people told us about the impacts of drought:

“Those farmers who rely on rainwater, mostly end up not harvesting because they either experienced short rain or the rain was very little. It has wasted much of our time and money trying to do farming hoping there will be rain, but it fails” (Burat)

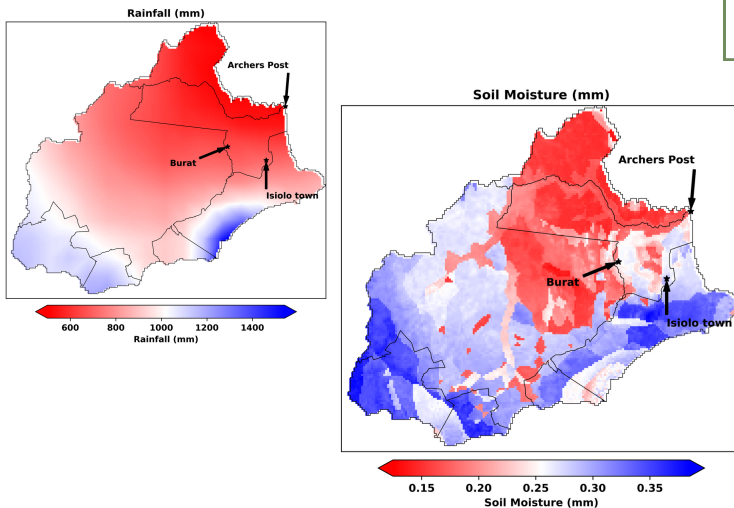
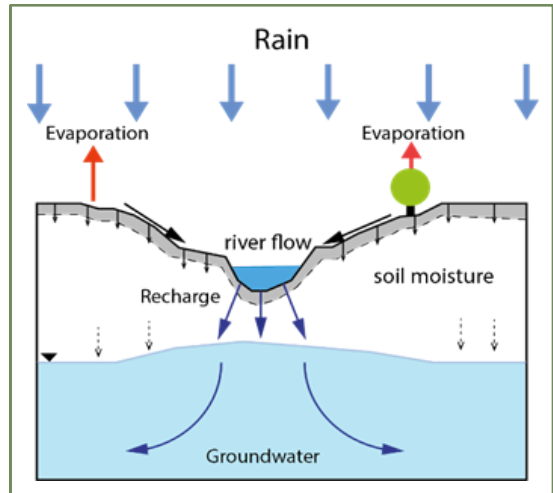
“We cannot do without water, so my family goes through a lot to access water. We use containers to get water from the river. The river itself is very far from my home, but do we have a choice? Of course no, we just have to persevere. It is very tiresome to carry water from the river to my home. It is also time consuming because it's far” (Burat)

“There will be scramble for water which will result in fights and raids” (Kinna)

“But in this case, the communities would have to migrate with their animals in search of food and good pasture, and this would be inconvenient for families. Women are left behind to look after the children and old men and women.” (Kinna)

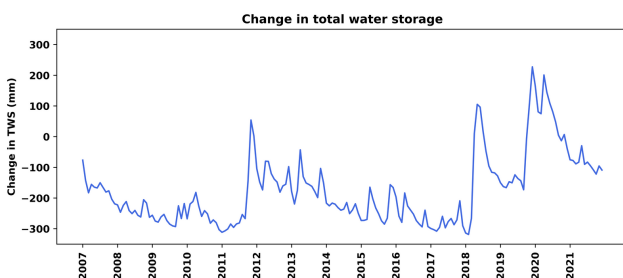
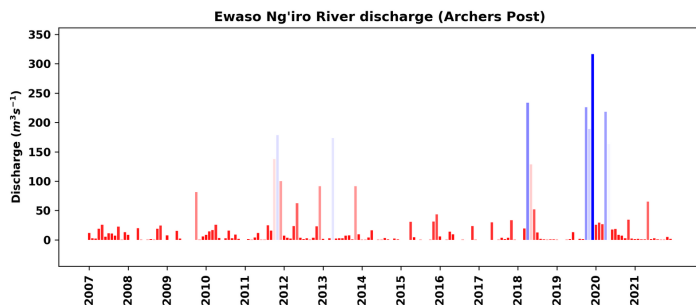
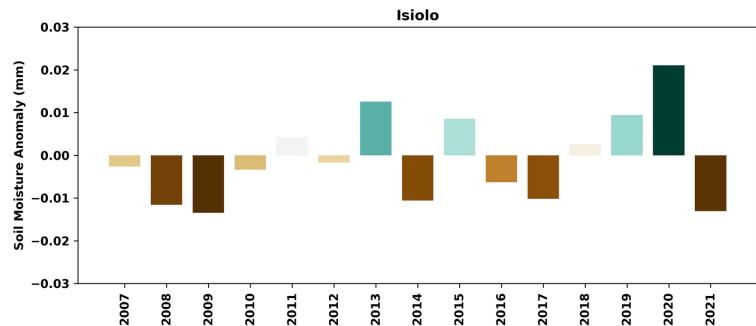
UNDERSTANDING THE DYNAMICS OF WATER AVAILABILITY

When analyzing changes in water availability within the dryland environment it is essential to consider the different aspects of the hydrological cycle – not just precipitation processes, but also the passage of water through the soil, rivers and groundwater, and the changing patterns of evaporation and transpiration depending on the temperature and the intensity of rainfall.



Soil moisture, for example, is obviously a parameter of key interest for rainfed farming and pastoralism, because of the implications for crop and grass growth. The maps here show how average rainfall and soil moisture differs across the upper catchment of the Ewaso Ng'iro river, highlighting lower levels of soil moisture in much of the lowlands, including parts of western Isiolo.

Here we show variation in the soil moisture condition for Isiolo town over recent years. In most of the past 15 years the level of soil moisture was much lower than expected. In the 2019-2020 season the area experienced higher soil moisture than expected.



In the project we are also undertaking modelling of river flow and groundwater dynamics in response to changes in rainfall, in the upper catchment of the Ewaso Ng'iro. Measurements at Archer's Post indicate that the Ewaso Ng'iro river had a low level of discharge in many of the past 15 years. Similarly, the total water storage level (which is an indication of groundwater storage) was low since 2007 and did not rise again until 2020.

In our discussions with communities, people described how they try to cope with changes in water availability, especially during extremes. Water shortages result in households having to change behaviour to access water, with various impacts, including costs and time spent obtaining water. Drought also forces some people to change their productive activities.

“We buy water from the kiosk in the nearby church. Those without money have to go very far to get water from Isiolo river which at least doesn't completely dry but it's far ” (Burat)

“That area has its own borehole that was drilled for the purpose of farming. We connect pipes to irrigate the land. In case of drought we just plant vegetables as there is not enough water to use for both livestock and farming.” (Kinna)

We spoke separately with women and men in all the places where we worked. Mostly, people talked about the same problems during drought conditions. But some things were mentioned more often by women, such as distance to travel to find water, especially for domestic water, and how the pollution of water sources tends to intensify.

“The borehole is completely exhausted. Everyone will turn to upstream water. The water may not be costly but the cost of medication will be high especially for the children unless the water is treated.” (Kinna)

“Water quality is very poor, very dirty when drought is serious.... when water is very little it turns to salty taste... a funny smell appears in water, the river colour turns from clear to brown and green, and there are also some small insects” (Burat)

KEY IMPLICATIONS of this research approach

- Our data analysis shows significant drought trends in the region over the last 40 years (an increase in drought intensity and frequency) which has important implications for livelihoods
- Our modelling shows the dynamic of water stores (soil moisture, river flow, groundwater) in response to climatic changes. While total seasonal rainfall is important, so is the evaporative demand which removes water from the surface, and the intensity of rainfall which affects how much rain can enter the rivers and recharge the groundwater.
- Where available, deep boreholes are most people's preferred source of water in both Burat and Kinna wards, especially during dry and extended drought periods when they are the most dependable source.
- However, some use other, often more distant, sources simply because they are unable to afford paying for the borehole water, and most of these are used by livestock as well as humans, even when visibly turbid and polluted.
- The work underlines the value of learning both from scientific data and from peoples' experiences, and considering these together to plan sectoral responses in specific dryland locations.

The DRIER (Drought Resilience in East African Dryland Regions) project is a collaboration between the University of Nairobi, Kenya, Addis Ababa University, Ethiopia, and the University of Bristol, University of East Anglia and Cardiff University in the United Kingdom. The project is funded by the Royal Society, grant number CHL\R1\180485. For further details: the lead researcher in Kenya is Oliver Wasonga, University of Nairobi (oliverwasonga@uonbi.ac.ke) and the overall lead for the project is Katerina Michaelides, University of Bristol (Katerina.Michaelides@bristol.ac.uk)