

# Innovations on the Nile over millennia offer lessons in engineering sustainable futures

By [Mike Muller](#)

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Africa is the continent [most vulnerable](#) to the impact of climate change. That's largely because many of its people and governments are too poor to do what's needed to cope under the expected new conditions.



An aerial shot of The Grand Ethiopian Renaissance Dam reservoir filling up. Taken in 2020. Photo by Gallo Images/Orbital Horizon/Copernicus Sentinel Data 2020

Yet Africa has a long and successful history of learning to live with changing climates.

Indeed, it's [believed](#) that the great civilisations along the Nile River in Egypt and the Sudan developed in response to climate pressures.

That history of adaptation should be tapped as the world confronts the challenges of the 21st century. As I have documented in a recent [paper](#), built infrastructure such as dams and canals have enabled African societies to grow and prosper over the centuries, contrary to the criticisms of modern environmentalists.

## Developing resilience

Between 4,000 and 6,000 years ago, North Africa enjoyed a wet climate and farming communities lived across what is now the [Sahara Desert](#). But as the region's climate dried, people migrated towards the Nile River, the most reliable remaining water source.

Many more people living close together, competing for limited land and water resources, needed new technologies and social rules to survive. This in turn required effective governance. The pyramids built by the Nile Kingdoms that emerged still stand as monuments to the success of those societies in coping with climate variability and change.

Nile communities achieved resilience by combining social and political innovations with engineered changes in their physical environment. In particular, they learnt to use the Nile River's floods to irrigate fields alongside the river, ensuring that they always had enough food to meet their needs.

Because the society's prosperity and stability depended on this agriculture, the river's flow was carefully monitored and recorded. Administrators were expected to make early predictions of droughts and floods so that they could plan food supplies and avoid destabilising famines and civil unrest, thus maintaining their rulers' reputations.

Centuries later, their records were used by [hydrological scientists](#) to develop new statistical methods, which are still being used by water resource managers around the world to analyse unpredictable river flows.

As the population grew, it was no longer enough to predict when the floods would be. More land had to be brought into cultivation to grow enough crops. So infrastructure was built, with canals to carry the water to new fields and shallow ponds to store it and extend the growing season.

But climate remained a challenge. When there was drought in Ethiopia or East Africa, the distant sources of the Nile, a weak flood meant a season of poverty for Egypt and the Sudan. The problems grew in the 19th century when, with the region now under British control, Nile irrigation was not only feeding the people but also supplying British textile mills with cotton.

The colonial authorities [warned](#) that unless more water was made more reliably available, there was a risk of "great falls in profits and increased danger of political unrest". So, encouraged by the British but paid for by the Egyptians, engineers were commissioned to build more barrages and canals to command more land. A dam built at Aswan, in Upper Egypt, stored enough water to allow two crops to be planted each year.

Still, the demand for water increased relentlessly, in the Sudan as well as in Egypt. The small dams didn't store enough water to supply Egypt's needs in a drought year which sometimes reduced the Nile's flow to less than half of its average.

To avert a potential crisis, the British government planned a complex scheme to store water in Lake Victoria in East Africa and release it when necessary for Egypt and Sudan. Part of this plan was to build the 360km Jonglei Canal to divert some of the river around the [Sudd swamps in Southern Sudan](#) where half of it is lost to evaporation (and which also emits huge amounts of the [greenhouse gas methane](#)).

When Egypt became [independent in 1952](#), it wasn't willing to stake its water security on projects in other countries. So it built its own project, the massive Aswan High Dam, [completed in 1970](#) which stores enough water to maintain supplies through the worst drought in 100 years.

The High Dam was [heavily criticised](#) on environmental and economic grounds. But it has kept Egypt water secure for 50 years even as its population tripled to over 100 million and its gross domestic product per capita grew.

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### Going forward

The challenge today is to emulate these successes. This will require societies to develop and agree on future strategies – and then implement them successfully.

While the Pharaohs could rule by decree, democracies are more complex.

Also, for African countries in particular, finance and technical support often comes with conditions. Engineering projects that involve building dams and canals that affect rivers and wetlands are still controversial.

So Ethiopia had to use its own very limited resources to build its Grand Ethiopian Renaissance Dam. Construction of the [Jonglei Canal](#) was stopped by civil war in 1984. South Sudan's government is now [considering](#) cooperation with Egypt to complete it. But it will have to convince the international development community that the impacts on the Sudd wetland are acceptable.

In both cases, the difference is that there's now wide agreement about the need to limit climate change. Both the Ethiopian Dam and the Jonglei Canal could contribute to that goal. The dam will produce clean electricity that will replace dirty diesel generators across the region. Aside from making more water available and supporting local agricultural development, the Jonglei Canal could reduce the Sudd's methane emissions that are aggravating global warming.

Other measures to use water more wisely and to reuse wastewater are also important. The Egyptian government has already taken measures to improve agricultural productivity and stop its farmers wasting scarce water on [thirsty crops](#) like sugar and rice.

The history of the Nile has demonstrated that water management infrastructure can provide resilience to climate challenges. Further engineering interventions along the Nile could generate clean electricity and expand irrigation to feed and create livelihoods for the people of the region. But decades of controversy about the Aswan and Renaissance Dams and the Jonglei Canal have shown that there has to be sufficient agreement among the parties concerned before such projects can proceed.

The threat of climate change could provide the catalyst for further progress. But without innovation and cooperation, the Nile communities face uncertain futures.

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