IWMI
International Water Management Institute

Water Issue Brief - 16
Putting research knowledge into action

Integrated water solutions for climate change adaptation in West Africa

The context

Water-related natural disasters are major obstacles to human well-being and sustainable development. Almost three quarters of all natural disasters between 2001 and 2018 were related to water (UNESCO and UN-Water 2020). Climate change has made extreme weather events more severe by altering their frequency, timing, intensity and duration. In West Africa, climate change impacts manifest especially through floods and droughts. Without adequate adaptation and mitigation measures, hundreds of millions of people will be at greater risk of hunger, disease, energy shortages and poverty due to water scarcity, pollution or flooding.

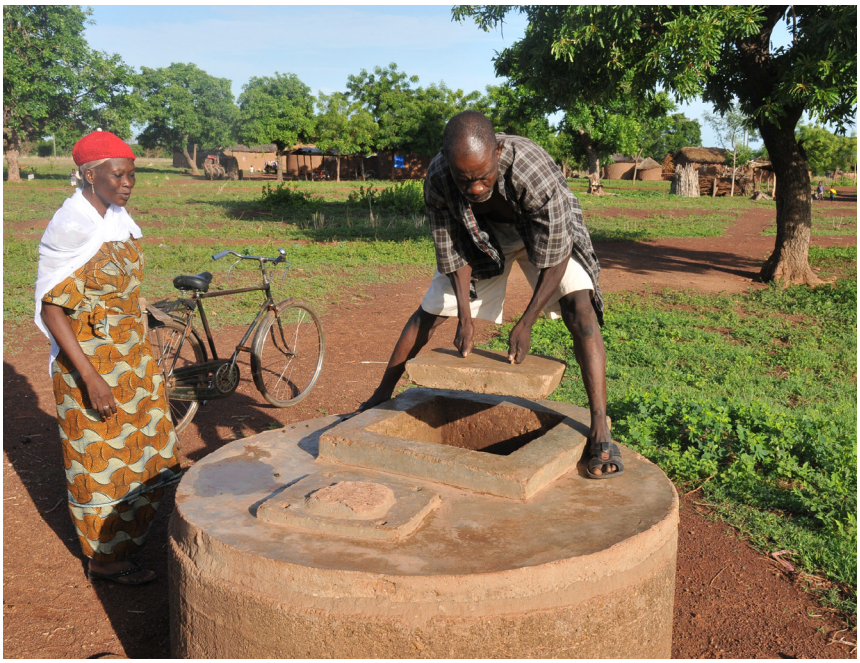
Key messages

- Climate change projections call for adaptation and mitigation measures at different scales and the use of integrated water solutions.
- Early warning systems and climate-resilient water storage infrastructure are crucial for combatting drought.
- Measures should be promoted that enhance water-use efficiency, participatory and inclusive water landscape plans, risk and vulnerability assessments, and demand-driven digital innovations.

Key issues

In recent decades, water shortages in sub-Saharan Africa have become more intense and less predictable. Climate change is expected to aggravate the situation further by affecting temperatures, rainfall patterns, and the frequency and intensity of storms. According to the Intergovernmental Panel on Climate Change (IPCC) (Niang et al. 2014), West Africa will be particularly hard hit. Largely dependent on rain-fed agriculture and already vulnerable to floods and droughts, the region faces declining crop yields by as early as 2050 if the projected global temperature increases are realized.

Climate change adaptation and mitigation measures are, therefore, essential to ensure long-term food security and sustainable development. Water is at the heart of all these measures. Applying decades of experience in water management at national, river basin and municipal levels, the International Water Management Institute (IWMI) is working to improve climate resilience and reduce risks for vulnerable communities across West Africa. We do this by equipping people and societies with the knowledge and solutions needed to anticipate, withstand and recover from the impacts of climate change.



Climate-resilient water storage facilities in Ghana are helping farmers to combat drought (*photo:* Felix Antonio/IWMI).

Getting ahead of disaster risks

EM-DAT, the international disaster database, estimates that floods and droughts affect about 3 billion people each year. Poor communities are particularly vulnerable because of their limited capacity to cope. This not only worsens social inequality but also places a massive financial burden on states.

To help prepare for extreme weather events, IWMI and partners have developed models to forecast and monitor droughts and floods on national and regional scales. In terms of flood monitoring, we combine spatial hydrological modeling, satellite imagery and artificial intelligence to determine threshold levels of runoff while projecting the potential extent and duration of flooding. As extreme weather events caused by climate change become more frequent, these results are helping to inform disaster management planning, alert farmers when flooding is likely and enable insurance companies to verify claims for flood-related crop losses.

To complement these monitoring tools, IWMI has developed a range of climate-smart agriculture (CSA) solutions. We give high priority to farmers who depend on rain-fed agriculture and are thus most at risk from climate variability. Our capabilities include climate scenario analysis, identifying ways for smallholders to store water in the rainy season for use in the dry season, adapting soil and water conservation measures to specific conditions, and finding sustainable ways to improve farmers' access to water for irrigation.

We are now using IWMI-designed analytical tools to identify and address various aspects of the institutional, regulatory and financial landscape to accelerate the uptake of these CSA solutions. If taken to scale, they have the potential to transform smallholder agricultural productivity and livelihoods. As agriculture expands in and around cities, farmers in urban areas stand to benefit as well.

Using digital innovations to inform better water management

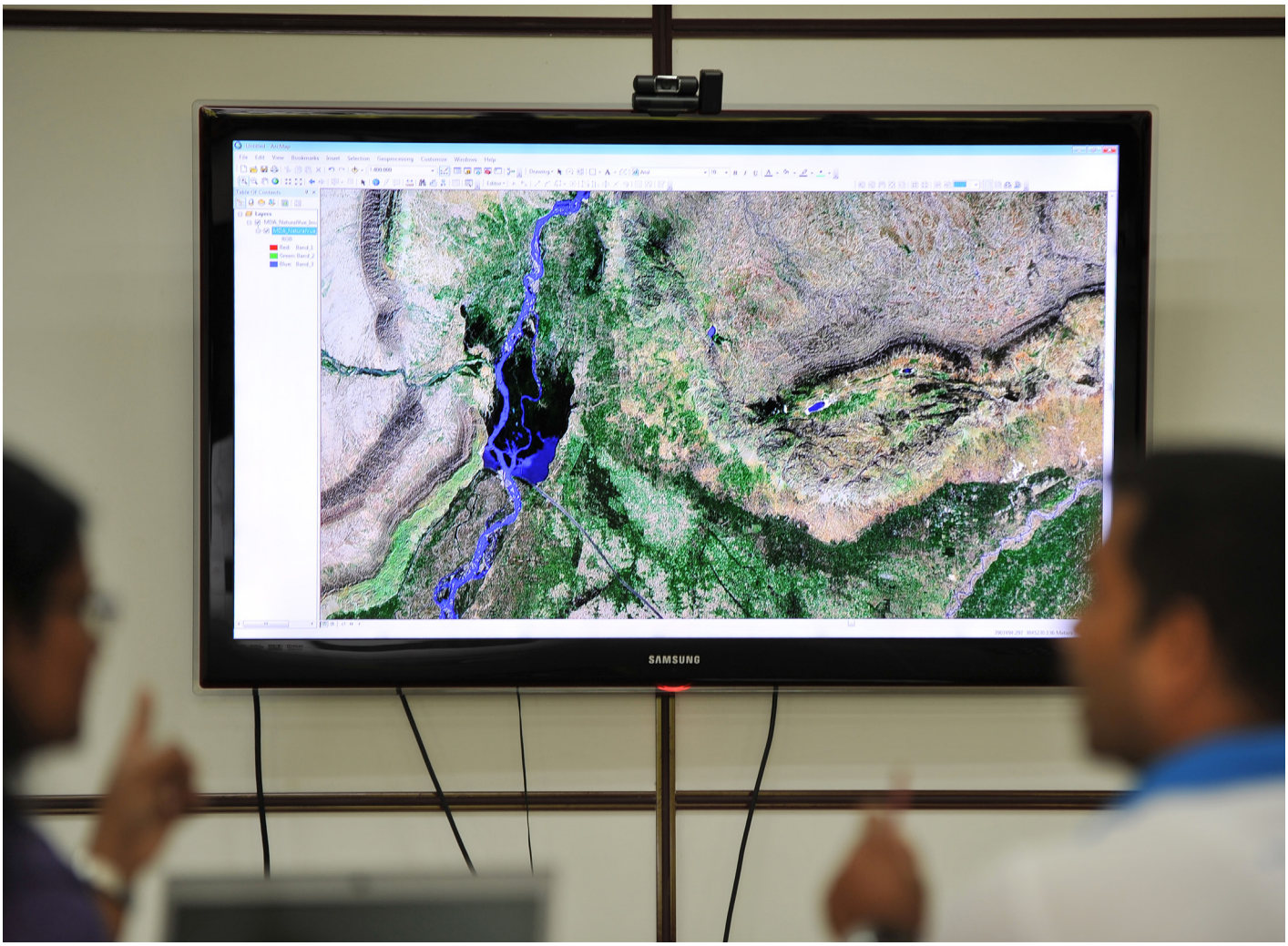
A partnership between IWMI and Digital Earth Africa aims to support forecasting and monitoring models by enabling fast access to water data. Earth observation satellites collect vast amounts of data over Africa every day, some of which can be used to measure and monitor water. Leveraging state-of-the-art remote sensing and data management technologies, the partnership organizes petabytes and decades worth of satellite data – updated daily – into an analysis-ready 'open data cube'.

IWMI is currently developing demand-driven applications for the open data cube that can deliver timely and quality information to policy makers, communities, farmers and others. The first of these applications is for water accounting. This is a means to take stock of available water resources in order to arrive at informed water management decisions. These include balancing water allocations across different sectors or understanding the downstream implications of new irrigation schemes. Water accounting is particularly relevant in the context of transboundary waters, where conflicts may arise between countries over the distribution, use and management of shared water resources.

Optimizing built and natural water infrastructure

IWMI's water accounting work is complemented by research on the role of built and natural infrastructure in water management and access. Investment in dams, small reservoirs and other built infrastructure to store water is expanding in West Africa. While making an important contribution to economic growth, these investments come at a high cost to the environment and the people who depend on natural resources for their livelihoods.

Farmers attending a demonstration of in-situ water harvesting techniques in Nigeria (*photo:* Sander Zwart/IWMI).



IWMI staff members analyzing a satellite map (*photo:* Neil Palmer/IWMI).

IWMI has a long history of helping to alleviate the negative impacts of built water infrastructure. In Ghana, for example, IWMI researchers assessed how changes in dam operations can improve environmental flows in the Lower Volta River Basin, thus enhancing ecosystem health (Mul et al. 2015). A key aim was to identify optimal configurations of built and natural water infrastructure, such as wetlands and floodplains, and how they can operate together to assist farmers in adapting to climate change impacts.

Creating inclusive water landscapes

In Burkina Faso, we worked closely with communities to explore the role of small reservoirs in underpinning rural livelihoods that have been ravaged by successive droughts (Forkuor et al. 2020). IWMI scientists first mapped and characterized over 1,000 small reservoirs identified from satellite imagery. Next, they categorized these reservoirs according to the pressures imposed on them by factors such as population growth and soil erosion.

About 75% of the reservoirs fell within high- or moderate-impact zones, putting them at greater risk from increased sediment loads and pollution caused by agrochemicals and poor sanitation. Meetings with reservoir users and other stakeholders helped raise awareness of these issues, prompting the implementation of mitigation measures.

At the same time, access to small reservoirs is not always equitable, especially with regard to gender. Moreover, conflicts have increased in recent years as a result of competition between different users and damage caused by higher numbers of livestock to irrigated crops. Researchers concluded that engaging groups such as vegetable growers and livestock keeper associations through participatory methods is essential for enabling local water committees to manage conflicts between reservoir users while safeguarding sufficient and varied food production. We are now building on this experience, combining participatory tools to co-develop, implement and monitor inclusive water landscape plans that are embedded in communities.

The way forward

IWMI's work has highlighted that new strategies and solutions are needed for more productive and sustainable water use under changing climatic conditions. By providing solid evidence to guide the removal of technical, economic, social, financial and institutional barriers to the expansion of sustainable water management, particularly for agricultural use, we are paving the way for sound policy making and investment decisions. Coupled with an increasing understanding of how we can capitalize on advanced technologies such as big data platforms, modeling tools and remote sensing systems, we can improve climate change adaptation and mitigation for millions of people across West Africa.

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The International Water Management Institute (IWMI) is an international, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center and leads the CGIAR Research Program on Water, Land and Ecosystems (WLE).

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