IWMI
International Water Management Institute

Solutions for Improved Water Management in West Africa's Smallholder Agriculture

Facing risks, fueling growth, feeding people

Agriculture is the backbone of the economy in West Africa, employing 60% of its labor force and contributing 35% of its GDP.[1] The sector currently consumes close to 80% of the region's water resources, a situation that cannot be sustained in future. Population pressure, coupled with economic growth and rising energy consumption, will boost demand for water, intensifying competition between industrial, domestic and agricultural uses. Helping farmers improve their water management is critical, if they are to succeed in feeding more people with less water and cope with climate change impacts. Most of West Africa's farmers are smallholders, and their production depends primarily on rainfall.

The International Water Management Institute (IWMI) works with partners across the region to identify means by which farmers in diverse settings can use agricultural water more efficiently. With emphasis on smallholder production, we help find ways to enhance the resilience of farming systems and intensify production sustainably, while also helping put in place more effective institutional arrangements that support both rainfed and irrigated agriculture. In collaboration with diverse partners, IWMI contributes to the agricultural policy of the Economic Community of West African States (ECOWAP) – the regional component of the African Union's Comprehensive Africa Agriculture Development Programme (CAADP).

Diverse skills and experience

IWMI has three decades of experience in implementing research-for-development projects with multidisciplinary teams. Our work on agricultural water management in West Africa, as described in the sections that follow, aims to improve farmers' access to irrigation, and provide tools and methods that permit more efficient water use. This work helps countries build resilience in the face of climate-related risks, while opening new pathways to sustainable growth.

Monitoring floods and droughts

IWMI develops and uses tools based on modeling and remote sensing to monitor droughts and floods on a regional scale. In 2014, our researchers helped develop the South Asia Drought Monitoring System, and now we are working on a similar tool for southern Africa. Also building on experience in Asia, we provided emergency-response maps showing crop damage caused by major floods in the Niger River Basin during 2015, and these proved useful for disaster management planning.

Climate-smart rainfed agriculture

IWMI gives high priority to helping farmers who depend on rainfed agriculture adapt to climate variability. Our capabilities include identifying ways for smallholders to store water in the rainy season for use in the dry season, adapting soil-water conservation measures to specific conditions and finding sustainable ways to improve farmers' access to irrigation. On this basis, IWMI contributed importantly to the report *Scientific, Political and Financial Landscape of Climate-Smart Agriculture in West Africa,* published by the CGIAR Research

Sprinkler irrigation in northern Ghana.

[1] *https://cgspace.cgiar.org/rest/bitstreams/56232/retrieve,* page 3

Program on Climate Change, Agriculture and Food Security (CCAFS). Our researchers subsequently tested a variety of interventions, such as rainwater harvesting, solar-powered groundwater pumping and small reservoirs, all of which show much potential.

Storing water for dry spells

In response to successive droughts, West African governments have built hundreds of ponds and small reservoirs. These better enable farmers to diversify production by providing water for crop irrigation, livestock, fishing and groundwater recharge as well as for various nonfarm productive activities and domestic uses. To help make better use of these facilities, IWMI researchers have mapped water storage and identified appropriate options for handling such issues as water quality and gender equality in the ownership and use of small reservoirs. Our research on the economics of using small reservoirs for vegetable production has shown they can support two crop cycles per year, with good returns on investment.

Groundwater irrigation

IWMI's research encompasses all aspects of groundwater use and management, from resource mapping and aquifer hydrology to the selection of technologies for pumping and creation of incentives for sustainable water use. To help unlock West Africa's significant potential for groundwater irrigation, IWMI uses the latest technology to quantify groundwater resources. In Botswana and South Africa, for example, we and our partners employed state-of-the-art helicopter-borne technology for this purpose, which shows potential for application in West Africa. In 2016, IWMI launched the Groundwater Solutions Initiative for Policy and Practice (GRIPP) to support sustainable use of groundwater resources.

Solar-powered irrigation

Solar-powered irrigation holds much potential for increasing agricultural production in West Africa, but unregulated pumping of groundwater with "free" energy could rapidly deplete this resource. Following a recent assessment of the potential for solar-powered irrigation in Ethiopia, IWMI has undertaken similar work in Ghana and Mali, using a business model approach.

Irrigation in Ghana's Upper East Region.

Enhancing large-scale irrigation

Decades of IWMI research on large-scale irrigation have shown that institutional rather than technical issues are usually to blame for poor performance. In response, the Institute advocates involving farmers in decisions about water management, an approach that many governments have adopted. An irrigation-benchmarking tool developed by IWMI quantifies the performance of large-scale irrigation schemes, based on parameters such as seasonal and total irrigated area and water-use efficiency. The tool has helped managers avoid land degradation, optimize yields and monitor recovery of water charges to pay for operations and maintenance. Given renewed interest in large-scale irrigation for Africa, we are updating the tool to include social and ecosystem indicators. An initiative funded by the World Bank, for example, aims to more than double irrigation across West Africa from 400,000 to 1 million hectares by 2020. An IWMI study on the past performance of large-scale rice irrigation in the Sahel region found that 7 out of 10 schemes constructed by the World Bank during 1970-1990 met economic targets, contributing significantly to rice output and incomes.[2]

Optimizing irrigation water use

When irrigating crops, small-scale farmers generally follow blanket recommendations, regardless of the climatic, soil and other conditions. IWMI is identifying ways to optimize water use in irrigation and thus help farmers to avoid overwatering and lower expenditures on fuel for pumping. One of the tools we have tested is the Wetting Front Detector – essentially a series of tubes containing calibrated floats, which are buried in the ground around crops. When the soil water reaches a particular level, the floats automatically rise, indicating that the required saturation level has been reached. Early results from studies in Ghana suggest that the tool enables farmers to reduce irrigation water by 13% and labor requirements by 14%, compared to current practices.

Equitable water management

IWMI has considerable expertise in determining the social, gender and institutional arrangements that are required in order for communities to adopt improved agricultural water management technologies. The approach we use for this purpose, referred to as Integrated Water Resources Management (IWRM), involves coordinating the development of water and land resources in an equitable manner that enhances economic and social welfare without undermining vital ecosystems.

---

[2] The economics of rice production in large-scale irrigation schemes in Sahelian West Africa: new perspectives and priority questions, IWMI Economics Report (June 2014)

Combining "natural" and built water infrastructure

Investment in levees, dams, irrigation channels and other built infrastructure is set to expand in West Africa. While contributing importantly to economic growth, such investments also come at a high cost to the environment and poor people who depend on natural resources for their livelihoods. IWMI has a long history of helping alleviate the negative impacts of dams. In 2006, we led the establishment of the Ghana Dams Dialogue, a 60-member platform aimed at bringing together dam-affected communities, hydropower authorities and government ministries and reducing the social impacts of dam-building projects. Now run by a Ghanaian team, the platform is considered a model for promoting dialogue and sharing lessons learned on dam development. IWMI researchers are currently assessing how changes in dam operations can enhance environmental flows in Ghana's Lower Volta River Basin, thus enhancing ecosystem health. A key aim is to determine how combinations of built and "natural" infrastructure (such as wetlands and floodplains) can help farmers adapt to climate change impacts.

Putting our capacities to work

IWMI has contributed to a number of major initiatives exploring how agricultural water management can increase food production and enhance livelihoods. These include the AgWater Solutions Project, which operated in five African countries and two Indian states during 2009-2012. The project concluded that, given supportive institutional structures and investments, smallholder irrigation can change the lives of millions of people. The project's findings inform the ongoing Feed the Future program Innovation Lab on Small-scale Irrigation in Ethiopia, Ghana and Tanzania, which, with our input, is piloting high-potential technologies.

Making the most of small reservoirs

A 3-year program in Burkina Faso explored the role of small reservoirs in underpinning rural livelihoods. IWMI scientists first mapped and characterized more than a thousand reservoirs identified from satellite imagery. Next, they categorized these according to the pressures imposed on them by factors such as population growth and 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 reservoirs users and other stakeholders helped raise awareness of these issues, prompting the implementation of mitigating measures.

IWMI researchers also assessed the unplanned Bapla and planned Navrikpè reservoirs to determine their impact on livelihoods and agriculture. Farmers around Bapla recorded an increase in vegetable production 59-82% after the reservoir was built, while those around Navrikpè reported an increase of 55-81%.

Access to the small reservoirs is not always equitable, however, particularly 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 keepers associations through participatory methods is key for enabling local water committees to manage conflict between reservoir users.

Managing climate extremes in Nigeria

In 2012, flooding in Nigeria submerged hundreds of thousands of acres of farmland and forced 1.3 million people from their homes. In response, the federal government and IWMI launched a project aimed at finding water management solutions that can boost agricultural output and food security, while enhancing resilience to climate change impacts. Implemented in three states, the project had two main aims. The first was to reduce flooding risks through forecasting systems and mitigation plans. The second was to enhance dry-season farming by introducing a range of agricultural water management approaches.

Small reservoir at Baare village in Ghana's Upper East Region.

To build capacity for reliable flood forecasting, IWMI researchers used space-borne radar altimetry and hydraulic modeling to create an application that provides 5-day river-height forecasts for the Niger-Benue river system. Its main purpose is to guide disaster planning – for example, by alerting authorities when vulnerable areas need to be evacuated. The app also shows potential for helping farmers decide when they can use receding floodwaters to grow crops.

To achieve the project's second aim, researchers examined biophysical parameters, such as soil types, and socioeconomic factors, like distance to markets. On this basis, they created suitability models and held stakeholder consultations to identify the crops and water management approaches that are best suited to different conditions. The researchers concluded that the top priority is to promote supplementary irrigation in rainfed agriculture, using motorized pumps to withdraw water from rivers, small reservoirs and wells.

The way forward

IWMI's research has shown that improving agricultural water management has considerable potential to increase food production and enhance livelihoods. Across West Africa, farmers are taking matters into their own hands by investing in small-scale water storage and irrigation technologies. Governments and development organizations can support this trend through new investment in agricultural water infrastructure, enabling policies, and technical and financial advisory services.

In order for such initiatives to yield sustainable outcomes, however, they must incorporate inclusive business models and context-specific governance arrangements. IWMI provides science-based evidence to ensure that such interventions translate into tangible benefits for farmers. As an independent broker working across sectors to stimulate action, we welcome opportunities to expand our partnerships for improved agricultural water management.

Our team

- Zenebe Adimassu – Agricultural Water Management
- Marloes Mul – Hydrology
- Bedru Balana – Resource Economics
- Everisto Mapedza – Social Science (Gender and Institutions)
- Solomie Gebrezgabher – Business Economics
- Josiane Nikiema – Environmental Science
- Philip Amoah – Environmental Microbiology
- Katharina Felgenhauer – Social Science (Public-Private Partnerships)
- Olufunke Cofie – Soil Science
- Timothy Williams – Agricultural Economics

Contact:

Timothy Williams (t.o.williams@cgiar.org), Director, Africa
Olufunke Cofie (o.cofie@cgiar.org), Principal Researcher and Head, West Africa Office

Africa regional office and West Africa office

c/o CSIR Campus
Agostinho Neto Road, Council Drive
Airport Residential Area
PMB CT 112, Cantonments
Accra, Ghana
Tel: +233 302 784753/4 or +233 289 109561/+233 544 088 277
Email: iwmi-ghana@cgiar.org

IWMI is a non-profit scientific research organization focusing on sustainable use of water and land resources in developing countries. It is a CGIAR Research Center and leads the CGIAR Research Program on Water, Land and Ecosystems (WLE). CGIAR is a global research partnership for a food-secure future.

www.imwi.org www.cgiar.org

IWMI International Water Management Institute | CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

November 2017