

# Summary of CPWF Research in the Limpopo River Basin

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About 14 million people live in the Limpopo River basin, and many depend on rain-fed agriculture for food and income. However, rainfall in the basin is highly variable, making farming difficult. Climbing temperatures, volatile rainfall patterns, and growing water demand from agriculture, industry, and urbanization further drive the need to work with smallholder farmers and find sustainable ways to diversify their agricultural production and strengthen their livelihoods. Historical inequalities in the basin have further removed smallholder farmers from policy processes and hampered equitable access to natural resources, including land and water.

## About the Limpopo River Basin

- The basin joins the countries of Botswana, Zimbabwe, Mozambique, and South Africa
- About 14 million people live in the basin, half of them in rural areas
- Poverty is widespread and persistent
- The basin contains ample water to support adequate livelihoods for all, but seasonal droughts and floods challenge agricultural production

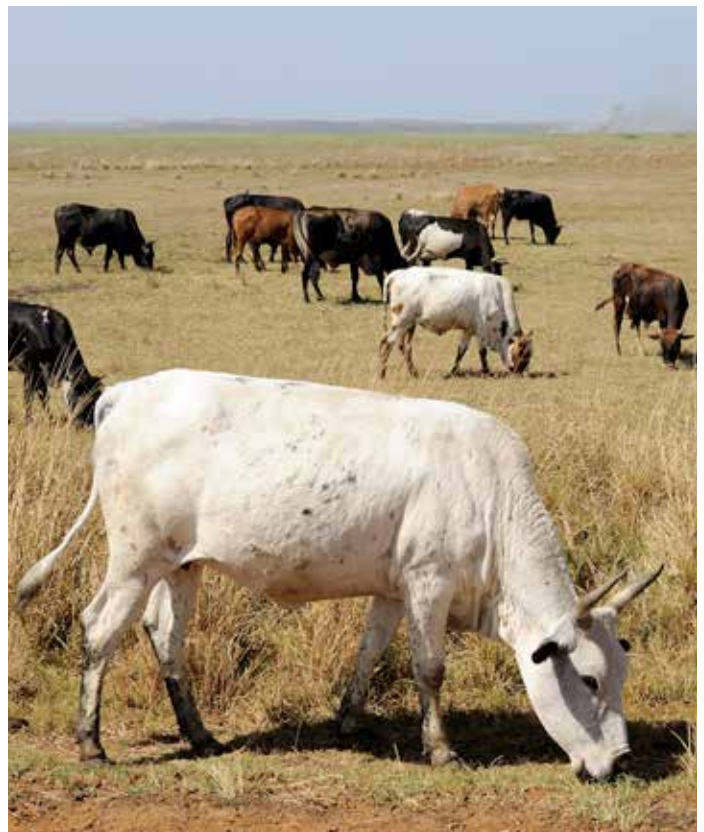
## The Limpopo Basin Development Challenge

In 2009, the CGIAR Challenge Program on Water and Food (CPWF) set out to “improve governance and management of rainwater and small water infrastructure in the Limpopo basin to raise productivity, reduce poverty, and improve livelihoods resilience.” Over the following four years, CPWF, led by the Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) and partners, coordinated five inter-connected research-for-development projects in the basin. The program was embedded within partnerships and networks that possessed regional legitimacy and could leverage change in this rapidly developing region. The Limpopo Basin Commission (LIMCOM) and the South African Development Community (SADC) strongly supported CPWF’s approach in the Limpopo River basin, and both institutions are planning to incorporate CPWF findings into ongoing work.

Among the six basins where CPWF worked during its second phase of research, the Limpopo basin is the driest. Annual rainfall in the basin varies between 200 and 1,500 mm, with much of the northern and western parts receiving less than 500 mm per year. In dry years, the upper part of the Limpopo River flows for 40 days or less. In the more productive areas of the basin, water supply is not meeting demand, and water users are known to experience competition over water and local water scarcity.

Chronic drought interspersed with occasional floods means that farming—whether rain-fed or irrigated—is risky. As a result, farmers hesitate to invest in new technologies, despite existing infrastructure for smallholder irrigation being largely dysfunctional.

CPWF's research shows that great potential exists for sustainable development within the basin. Among the opportunities for improving livelihoods in the basin is increasing the productivity of rain-fed crop and livestock systems through better water management. Central to this challenge is understanding the complex relationship between access to and control over natural resources, policy environments, and incentives and disincentives for smallholder farmers.



Livestock production is both socially and financially important to smallholder farmers in the Limpopo River basin.

A special issue of AgriDeal Magazine (2013) features an overview of CPWF's work in the Limpopo River basin. [Read the magazine online](#)

## Targeting Agricultural Water Management Interventions

Research suggests no hydrological limitation to doubling smallholders' production of staple foods in sub-Saharan Africa through use of better soil and water management techniques—yet adoption of such technologies remains extremely low.

The Targeting Agricultural Water Management Interventions (TAGMI) tool aims to help decision makers better match technologies to conditions and users, thereby increasing the likelihood of successful implementation, more efficient water use, and increased productivity.

The tool is based on both biophysical and socio-economic data. In addition to data about a district's social, human, physical, financial, and natural factors, the tool also relies on local knowledge and expert opinion collected through stakeholder consultations. Based on these inputs, the tool calculates the relative probability of success of an agricultural water management intervention in a given location in the Limpopo River basin.

The TAGMI tool uses behind-the-scenes Bayesian network models to assess an intervention's likelihood of success by estimating how different factors interact. Within the tool, a Bayesian network model exists for each technology within each country in the Limpopo River basin. These network models have been developed through a consultation process, merging various sources of knowledge, including from academics, peer science literature, policy makers, development agents, and local farmers.

The tool offers a map-based visualization of the Bayesian models' results, conveying the spatial differences in the likelihood that soil and water conservation, small-scale irrigation, or small reservoirs can be successfully adopted across districts.

The TAGMI tool is available at [www.seimapping.org/tagmi](http://www.seimapping.org/tagmi)

# Messages

*Technology alone cannot increase agricultural productivity, nor can it reduce poverty. While technologies are necessary, significant investments in an enabling environment and systemic incentives are necessary to improve the livelihoods of smallholder farmers.*

While CPWF determined that opportunities exist to significantly increase agricultural productivity—namely by out scaling various water management technologies such as conservation agriculture, small-scale irrigation, and small reservoirs—technology alone is not the answer.

The potential success of any water management technology depends on more than biophysical factors: socio-economic, institutional, political, and market factors contribute to determining whether or not a given technology will be successfully adopted. CPWF recognized the wide diversity

of determining factors in the development of the Targeting Agricultural Water Management Interventions (TAGMI) tool, which guides decisions on where to invest in out-scaling of which water management technologies.

In addition, CPWF found that project conceptualization, design, and implementation are critical to the success of water management interventions—so much so that the quality of project implementation can make good technologies fail or marginal technologies succeed. Therefore, careful project implementation, including consultations with relevant stakeholders throughout the lifetime of the project, is essential to successfully implementing, scaling out, and ensuring sustainable agricultural water management technologies.

*Identifying or creating incentive mechanisms is critical to ensuring long-term and sustainable uptake of small-scale agricultural water management technologies.*

CPWF research shows that no single technology has been broadly adopted across the Limpopo River basin. This finding underscores the basin's diversity and suggests that integrated solutions—planned across sectors and disciplines—are necessary to solve the complex water and food issues faced by smallholder farmers and rural communities.

Development, installation, or rehabilitation of water infrastructure should be done with multiple use systems in mind. Single-use water systems or technologies can limit the utility of the investment to the local community. Single-use systems are also vulnerable to sabotage, vandalism, or failure owing to misuse by those in need of water for other purposes. Facilitating multiple uses of a single source has the potential to bring together a wide range of water users and to create a collaborative or cooperative management system. The more people who are able to benefit from a single water source, the better.

Further technical, institutional, and policy support can help foster the kind of change, growth, and development that will secure the livelihoods of the rural poor. One key question is, which incentive structures can spur change in behavior across levels and scales?

## Creating Incentives for Uptake of Agricultural Technologies

In the Limpopo River basin, livestock production is both socially and financially important to smallholder farmers. Owning livestock is an indicator of wealth. Cattle are used to pay bride prices and school fees, to acquire and store wealth, to spread the risk in mixed farming systems, and for meat and milk. Livestock are a crucial financial buffer and act as a sort of savings account for farmers, who can liquidate their assets—by selling off livestock—when needed. The biggest challenge to this system is to ensure that livestock have enough feed to make it through the dry season and frequent droughts, when livestock mortality is generally high.

One promising solution is for farmers to grow fodder crops on part of their land, enabling them to provide feed for their animals throughout the dry season or to sell feed to other farmers.

CPWF carried out on-farm trials with farmers, which shows that the best option for many farmers, who traditionally grow maize, is to introduce velvet bean (*mucuna*) in rotation with maize. Velvet bean has the ability to improve soil fertility by fixing nitrogen, it can serve as livestock feed, and when grown in rotation with maize it improves maize yields. This type of rotation cropping provides a win-win solution.

However, even good, efficient, and proven technologies may not be adopted by farmers. Reasons may include that farmers

have not heard of a particular technology, cannot access seed, or that they find the technology too laborious or unfeasible.

CPWF helped identify and highlight incentives for farmers to grow fodder for livestock through innovation platforms in Zimbabwe. These platforms brought together value chain actors, including input suppliers, farmers, traders, and processors, and allowed these actors to explore challenges and opportunities related to agricultural production and profitability.

Through innovation platform exchanges, stakeholders were able to find solutions that helped align farmers' production and market requirements. Notably, in one instance, the platform contributed to a strong local market for goats, where the value of one goat increased from US\$10 to US\$60.

CPWF found that after a functional market had been established, better and more reliable pricing served as an incentive for smallholder producers to invest in improved production systems—including growing fodder and food in combination. Innovation platforms spurred a virtuous cycle in which farmers' self-esteem and confidence improved and a more bio-diverse and productive farming system emerged.

Read more about innovation platforms on [www.waterandfood.org](http://www.waterandfood.org)

## Poverty Mapping

CPWF developed a basin-wide, district-level poverty map, which uses measurements of poverty similar to those employed by governments. The map reveals a significant decline in the proportion of people living below US\$1.25/day between 2002/03 and 2009/10 in Botswana, Mozambique, and Zimbabwe. However, South Africa showed an increase of nearly 8 percent in rural poverty over that same period.

The worst affected constituency is Mozambique, which, at 37.9 percent, has the largest share of rural population living below the poverty line among the four countries. Despite a slight fall of the poverty rate, the absolute number of poor people has increased in line with population growth.

CPWF found that food insecure households across the basin are more likely to be large; with orphans; headed by people with little education; without well-off relatives; with a mentally and physically challenged family member; and headed by either an elderly person, a child, or someone who is chronically ill.

The poverty map can help identify and locate poor areas and provide information on biophysical and social characteristics that constrain development. Policy makers and researchers may be interested in the spatial distribution of poverty, as it can shed light on disparities in welfare across regions, helping decision makers to better target programs and interventions aimed to alleviate food insecurity and poverty. In addition, mapping is a crucial visualization tool, which enables transparent negotiations among communities and states.

Read the working paper entitled 'Rural Poverty and Food Insecurity Mapping at District Level for Improved Agricultural Water Management in the Limpopo River Basin' on [www.waterandfood.org](http://www.waterandfood.org)

*The research-for-development agenda for southern Africa cannot be outsourced; national governments and regional institutions must lead the effort and guide their international partners.*

Regional and national organizations must have a strong say in identifying the research agenda in southern Africa. By aligning research with existing regional or national agendas, researchers are more likely to achieve uptake of their findings, ultimately contributing to outcomes and impact.

The Limpopo River basin is home to many statutory and traditional institutions that mediate access to natural resources. An emerging basin commission, four national governments, numerous provincial

institutions, districts, wards, and traditional authorities influence who has which sort of access to what land and water. Gender plays an important role in determining access and control of land and water.

Despite a decision to involve stakeholders in integrated water resources management, links and communication between decision makers at all levels and end users of water resources remains weak. Furthermore, the lack of integration between the water, land, and rural development sectors, each with its own goals, makes reducing rural poverty even more difficult.

Regional, national, and local ownership of the research-for-development agenda is a prerequisite for successful interventions.

*The cause-effect relationship between water, food, and poverty is multi-dimensional and has not been adequately researched.*

In the Limpopo River basin, rural poverty generally remains widespread and persistent. CPWF research shows that in South Africa, rural poverty has in fact increased—despite development programs and initiatives—over the past decades, while it has decreased in other Limpopo basin countries. Rural poverty levels are still highest in Zimbabwe and Mozambique.

Beyond establishing appropriate institutions, an enabling policy environment, and sufficient incentive mechanisms, CPWF has identified two types of interventions that can help battle poverty and the impending effects of climate change in the basin:

- 1. Investments in water capturing or storage at local and landscape scales.** Water is scarce in large portions of the basin. Few users or locales have all the water they need, all of the time. A wide range of rainwater harvesting technologies have been tested and rolled out across the region. Technologies include roof rainwater harvesting, which has great potential to increase household resilience and food security, and field-level rainwater harvesting, which can help preserve the natural resources base and reduce risk during droughts. Options do exist for the rural poor to capture and store water for more effective use, higher productivity, and greater food security.
- 2. Increase of water use efficiency.** Techniques and technologies exist that allow farmers to increase the return of every drop used by carefully managing water and soil for crop nutrition. For example, promotion of feed or fodder production in dry land areas may offer a viable alternative or activity for diversification. Feed or fodder production can contribute to household food security in at least two ways: first, it can be used to feed livestock in the homestead, preparing them for sale at the market or household consumption; second, fodder can be sold to generate cash income.

## The Role of Women in Limpopo Basin Farming

Within the Limpopo River basin, as in sub-Saharan Africa at large, agriculture is being feminized. In the Guyu-Chelesa irrigation scheme in southern Zimbabwe, for example, about two-thirds of the plot owners are women, and it is women who cultivate practically all the plots. However, despite the majority of farmers being women, extension workers were targeting their information and trainings toward men.

Therefore, CPWF engaged agricultural extension workers in the area to advise them on how to make agricultural extension services available to women. For example, collecting firewood was an activity that took up a large part of female farmers' time. After the establishment of a scheme that eased women's access to firewood, women had more time available—time they could spend participating in trainings and meetings aimed to increase agricultural productivity and production. In the same way, extension workers realized the benefit of scheduling meetings and trainings at times that did not collide with women's other responsibilities, such as sending children

off to school, farming, and cooking. With meetings taking place at times convenient to women, more women were able to participate.

Another example of CPWF empowering women in agriculture occurred in the Zhulube irrigation scheme, also in Zimbabwe. Here, married women contribute significant labor to production of cash crops, with little time left for growing crops of their choice. During the winter wheat crop in 2012, CPWF supported local women to allocate a small plot to vegetable production. As a result, households were able to meet their cash crop production goals while meeting their own vegetable consumption needs, with excess crops sold for income.

CPWF aimed to recognize female farmers' vast contributions to agricultural production and to ensure that they were able to harvest the fruits of their labor. Practical evidence shows that if women are empowered and have control over farming benefits, household livelihoods will improve.



Farmers, especially female farmers, need better training.



Basin residents face contrasting hardships of periodic floods and prolonged drought.

# CPWF Projects in the Limpopo River Basin (2010 – 2013)

## Targeting and scaling out led by Stockholm Environment Institute

The L1 project sought to help policy makers, investors, and other stakeholders in the basin target and scale out agricultural water management interventions to improve the productivity and resilience of smallholder farmers. The project developed the Targeting Agricultural Water Management Interventions (TAGMI) tool. This evidence- and knowledge-based decision support tool maps the likelihood with which a given intervention will be successful in different locations across the basin. L1

## Small scale water infrastructure led by Agricultural Research Council, South Africa

The L2 project set out to improve the design, development, rehabilitation, and management of small-scale water infrastructure in the basin. It synthesized and analyzed what is known about the successes and failures of small water infrastructure systems and used this work as a foundation for developing rehabilitation guidelines. The project inventoried and classified small water infrastructures in the basin to assess the extent of dysfunctional infrastructures and to help prioritize solutions for improving sustainable access to water for the rural poor. L2

## Farm systems and risk management led by International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

The L3 project aimed to find ways for capitalizing on new or rehabilitated water infrastructure and rain-fed conditions, through improvements in water management, crop and crop-livestock system management, and agro-ecosystem management. The project carried out participatory modeling with farmers to explore various crop/livestock production and investment options to increase food security and reduce risk. In addition to economic return, each option was assessed for water use efficiency, something which is especially crucial to food security in dry areas. L3

## Water governance led by WaterNet

The L4 project set out to address issues of water rights, water management, and water governance. By carrying out a basin-wide, cross-scale analysis of governance structures in the basin, it provided evidence and insights into the wide range of strategies and approaches available for ensuring equitable access to increasingly scarce water resources. Empirical evidence shows that fair and just systems are prerequisites to poverty reduction among rural communities and that fairness depends on the management systems that control access to water resources. L4

## Learning for innovation and adaptive management led by Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN)

The challenge for the coordination and change (L5) project was to ensure that CPWF research in the Limpopo River basin was relevant to regional, basin, national, and local stakeholders and addressed real needs across those levels. The project's mandate was to coordinate research projects that were well integrated, coherent, and that generated high-quality research. The project facilitated CPWF making relevant contributions to strengthening integrated management of rainwater in the basin. L5



# Recommendations

## Align with Existing Organizations and Networks

For development partners, strategic partners, and development agencies, alignment with established programs, such as the Comprehensive Africa Agriculture Development Programme (CAADP), and national policies on food, water, environment, and development is essential. Such organizations should take care to understand local development contexts and to build upon existing initiatives, partnerships, and networks. If each new program starts from scratch, little real impact can be achieved within a project life cycle.

## Target and Adapt Technologies and Institutions

Implementing agencies have a critical role in brokering knowledge between various groups in the research-for-development chain. Not all smallholder farmers are the same, nor do they have the same resources, goals, or responsibilities, and therefore no one-size-fits-all technologies exist. Targeting and adapting technologies and institutional arrangements deserve more attention and investment than has been given in the past.

## Engage Early and Often with End-Users

Researchers hold a unique position in trying to address the challenges faced by rural populations and natural resources in Africa. The situation is critical and exacerbated by climate change. Researchers and their agencies need to be willing to engage early and often with next- and end-users in order to design relevant research and answer pressing research questions. Only research based on real-life needs will offer options and opportunities for rural populations to drive their own development under changing climatic conditions, while valuing the natural resource base.

## Treat Farmers as Partners

Farmers in the Limpopo River basin need the language and confidence to speak up and engage the research, extension, and policy-making communities. Farmers are the ultimate stakeholders—they make strategic decisions every day and their livelihoods depend on making the right choices. Measures should be taken to engage farmers in high-level decision-making processes, giving farmers access to more and better options to choose from. Farmers need to be seen and treated as partners in their own development.

## Partners

Agricultural Research Council–South Africa [Agricultural Research Council–Zimbabwe](#) AGRITEX [Food, Agriculture and Natural Resources Policy Analysis Network](#) GDARD [Global Water Partnership](#) ICRISAT [International Water Management Institute](#) International Water Management Institute–South Africa (IWMI) [Limpopo Department of Agriculture](#) Progress Milling [Rural District Council Gwanda](#) Stockholm Environment Institute [Universidade Eduardo Mondlane](#) University of Botswana [University of KwaZulu–Natal](#) University of Witwatersrand [University of Zimbabwe](#) WaterNet [World Vision](#)

## About CPWF

The CGIAR Challenge Program on Water and Food was launched in 2002. The CPWF aims to increase the resilience of social and ecological systems through better water management for food production (crops, fisheries and livestock). We do this through an innovative research and development approach that brings together a broad range of scientists, development specialists, policy makers and communities, in six river basins, to address the challenges of food security, poverty and water scarcity.

The CPWF is part of the CGIAR Research Program on Water, Land and Ecosystems. WLE combines the resources of 11 CGIAR centers and numerous international, regional and national partners to provide an integrated approach to natural resource management research. The program goal is to reduce poverty and improve food security through the development of agriculture within nature. This program is led by the International Water Management Institute (IWMI).

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