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# Harnessing smallholder potential for wheat production in Africa – reducing wheat import bills

Africa's wheat consumption is increasing for several reasons, including population and income growth, urbanization and changing lifestyles. Most African countries are thus spending millions of dollars on wheat imports each year. To reduce the amount of foreign currency spent on importing wheat, it is essential to use improved varieties and practices to increase Africa's domestic production quickly.

## Context, challenges and opportunities

This is the objective of the 2016-2021 project titled "Enhancing Smallholder Wheat Productivity through Sustainable Intensification in Wheat-Based Farming Systems of Rwanda and Zambia" (SWPSI). With financial support from the International Fund for Agricultural Development (IFAD) and the CGIAR Research Program on Wheat Agri-Food Systems (CRP WHEAT), the International Maize and Wheat Improvement Center (CIMMYT) is implementing the project in partnership with the Rwanda Agriculture and Animal Resources Development Board (RAB), the

## QUICK FACTS

**PROJECT** Enhancing Smallholder Wheat Productivity through Sustainable Intensification in Wheat-Based Farming Systems of Rwanda and Zambia (SWPSI)

**FOCUS COUNTRIES** Rwanda and Zambia (core countries), Madagascar, Mozambique and Tanzania (spillover countries)

**LEAD IMPLEMENTING INSTITUTION** International Maize and Wheat Improvement Center (CIMMYT)

**GOAL** Contribute to food security, nutrition and rural incomes, and reduce wheat import bills

**BENEFICIARIES** Smallholder farmers producing wheat and those with the potential to produce wheat under rainfed conditions; local traders, processors and consumers

**DATES** 2016-2021

**FINANCING** US\$1.5 million from the International Fund for Agricultural Development (IFAD) and US\$300,000 from the CGIAR Research Program on Wheat (CRP WHEAT)

Zambian Agricultural Research Institute (ZARI) and the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA). Alongside Rwanda and Zambia, which are the two core focus nations, Madagascar, Mozambique and Tanzania are included as spillover countries. Scoping studies on wheat production, marketing and consumption are conducted there to illustrate the opportunities and constraints existing in the wheat sector, while lessons from the core countries are also shared.

Wheat seed development and dissemination is one area where RAB is working to make Rwanda self-sufficient in the near future. In this regard, the Board registered a remarkable success with its recent release of 10 improved wheat varieties adaptable to a wide range of wheat agroecologies. After the release, RAB also gave smallholders training in seed multiplication and marketing to ensure they have continuing access to quality seeds resistant to rust and other diseases.

In Zambia, spot blotch and Fusarium head blight are the main biotic factors limiting rainfed wheat production and productivity. Developing and disseminating varieties resistant to these diseases is therefore a priority of the wheat-breeding programme at ZARI's Mount Makulu Agricultural Research Centre. Also under study is the creation of a wheat seed system suited to the needs of smallholders in Zambia. With the threats of disease and rust ever present, it is important that farmers are able to buy fresh seeds when the varieties they normally use are affected by pathogens.

## Setting objectives

The SWPSI project was developed to assess major constraints along the smallholder wheat value chain, propose possible technical and institutional solutions to identified constraints, facilitate linkages between smallholders and markets, and document success stories for use in the focus nations and other countries with similar agroecological conditions.



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## Solutions and results

Over the last three years, the project has been conducting research on germplasm screening for wheat rusts while running adaptation trials of selected varieties. It has partnered with smallholders in seed multiplication and disseminated improved wheat varieties in selected areas. Smallholder wheat value chains have been assessed to identify key challenges and formulate recommendations as to how different types of farmers can be included.

More than 20 trials of improved agronomic practices have been conducted both in Zambia and in Rwanda. These include the use of bed-and-furrow systems for saving seeds, and better weed control. Experiments with light machinery such as power tillers and planters were run to determine how they can save labour and seeds; and how crop establishment is improved by placing wheat seeds at a standard depth and density. Nitrogen fertilizer efficiency was another challenge identified in smallholder wheat production. Tests to determine how much fertilizer is required to optimize grain yields were conducted using NDVI (Normalized Difference Vegetation Index) handheld sensors, or "GreenSeekers". The devices register the level of nitrogen deficiency or surplus at different stages in wheat growth.

## From research results to impact

Early-generation seeds of improved wheat varieties were released to farmers multiplying seeds on a commercial basis in potentially suitable areas. Farmers producing and selling the improved seeds reported earning higher incomes, while neighbouring farmers who adopted the new varieties also saw their incomes rise through higher wheat sales.

## Innovations

Maximum wheat productivity and profitability under rainfed conditions can be obtained in Northern Rwanda. It is often assumed that this potential can be achieved by using improved varieties and more inputs. But studies conducted by CIMMYT and RAB found that increasing seeding rates and using greater quantities of nitrogen fertilizer did not improve yields as expected. Instead, the two elements identified as crucial to higher yields were frequent and timely weeding, and the introduction of labour-saving technologies. Weeding and labour saving were also found to increase wheat *profitability*, whereas higher input use diminished it in many cases. This was because seed, fertilizer and soil amendments represent most of the costs of



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producing wheat in the area. The findings underline the importance of considering increased yields in terms not just of productivity but of profitability too. For the fact remains that some yield-boosting technologies may not turn out to be worthwhile from an economic perspective. In sum, it was shown that resource-saving technologies (inputs and labour) may be as much in demand by African smallholders as yield-enhancing ones. This calls for a more balanced approach in current research and development, which at present tends to promote classic “Green Revolution” solutions for Africa.

Accordingly, the project is testing, developing and promoting smallholder wheat interventions that facilitate weeding, save labour, improve fertilizer use efficiency and reduce seeding rates without compromising yields. The use of direct seeders (needing no prior land preparation) powered by small, two-wheel tractors was found to cut labour requirements for crop establishment by a factor of 23, while also diminishing seeding rates fourfold on average. The use of bed-and-furrow planting instead of flat planting was found to cut seeding rates by an additional 25 per cent without compromising yields, while also facilitating weeding and other in-season operations like fertilizer top-dressing. Finally, the use of cheap handheld sensors such as “GreenSeekers” help ensure that an optimal amount of top-dressing fertilizer is applied.

The combination of these various technologies is expected to significantly improve wheat productivity and profitability in the area, and contribute to the reduction of national wheat imports. In delivering these technologies, it is also important to bear in mind that a high-yielding and profitable wheat field one season may be low-yielding and unprofitable the next season

depending on how cash, input, time, labour, etc. are apportioned between wheat farming and other more profitable livelihood options. These wide variations in wheat productivity and profitability account for the fact that wheat is not the main crop in Northern Rwanda. Resources are primarily invested in other, higher-value crops such as potatoes or vegetables, or other livelihood options (e.g. off-farm employment). But even as a secondary crop, wheat remains important in Northern Rwanda for food security, for the production of straw, an essential livestock feed, and as a break crop between potato cycles. That said, the adoption of improved technologies for a secondary crop can be problematic, particularly if those technologies are capital-intensive. Provision of mechanized services and fertilizer recommendations, for example by private rural entrepreneurs, may, however, be an effective way to deliver such technologies.



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#### CONTACT

##### Malu Ndavi

Lead Technical Specialist  
Strategy and Knowledge  
Department, IFAD  
Tel: +39 06 5459 2766  
Email: m.ndavi@ifad.org

##### Moti Jaleta

Agricultural Economist  
Socioeconomics Program,  
CIMMYT  
Tel: +251 116172309  
Email: m.jaleta@cgiar.org



Investing in rural people

International Fund for  
Agricultural Development  
Via Paolo di Dono, 44  
00142 Rome, Italy  
Tel: +39 06 54591  
Fax: +39 06 5043463  
Email: ifad@ifad.org  
www.ifad.org

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August 2019

## Innovation and direct benefits to farmers

Wheat in the highlands of Rwanda is produced by smallholder farmers, mainly as a cash crop. Survey data in Northern Rwanda show that, on average, they sell more than 70 per cent of their wheat at market – mostly to traders. But such farmers usually produce too little to attract large wholesalers and link local production to large millers in major cities.

An innovation platform on wheat was initiated in collaboration with COOAPAI (*Cooperative pour la Production Agricole et Augmentation des Intrants/Cooperative for Agricultural Production and Increased Use of Inputs*), a group with 45 members (25 women and 20 men). The cooperative is involved in potato production in rotation with wheat and climbing beans in Gataraga. Between the 2017B season and the 2019A season, the innovation platform distributed a total of 1,380 kg of the Nyaruka (882 kg) and Gihundo (498 kg) varieties to over 120 farmers and farmers' associations for further multiplication of quality seed. Strengthening community-based quality seed production complies with the Government of Rwanda's policy of achieving self-sufficiency in seed production and ending imports of wheat seeds by 2020.

## SUCCESS STORY

The project contributed to the development and official release of 10 new commercial bread wheat varieties in January 2017. This was achieved through the participatory evaluation and selection of promising varieties in the wheat-growing areas of Rwanda, including Gataraga, in Musanze District of Northern Province. The newly released varieties, namely Cyumba, Gihundo, Keza, Kibatsi, Majyambere, Mizero, Nyangufi, Nyaruka, Reberaho and Rengerabana, yield more grain and have other agronomic and quality traits prized by farmers, millers and consumers. Martha, a wheat farmer in Gataraga, told journalists and other participants at a field day in January 2017 that for the improved varieties, appropriate and timely farming and post-harvest management practices, plus sufficient rainwater, were key in boosting productivity.

Another farmer in Gataraga, Maria, also stressed that variety maintenance requires the continuous separation of off-types from fields planted to new varieties.

## Future directions

In order to support a marked increase in wheat production and productivity in sub-Saharan Africa, a functional wheat seed system, efficient wheat grain markets and supporting institutional and policy environments need to be in place. For this purpose, strengthening synergies between research organizations, private and community-based wheat seed multipliers, wheat seed marketing agents, farmers, traders, millers, and quality- and standard-controlling organizations is essential. The project is building innovation platforms harmonizing interventions among the key stakeholders in the development of the wheat sector at various levels. Due emphasis will be given to strengthening smallholders' wheat production and marketing systems to ensure they are included in wheat markets and value chains.