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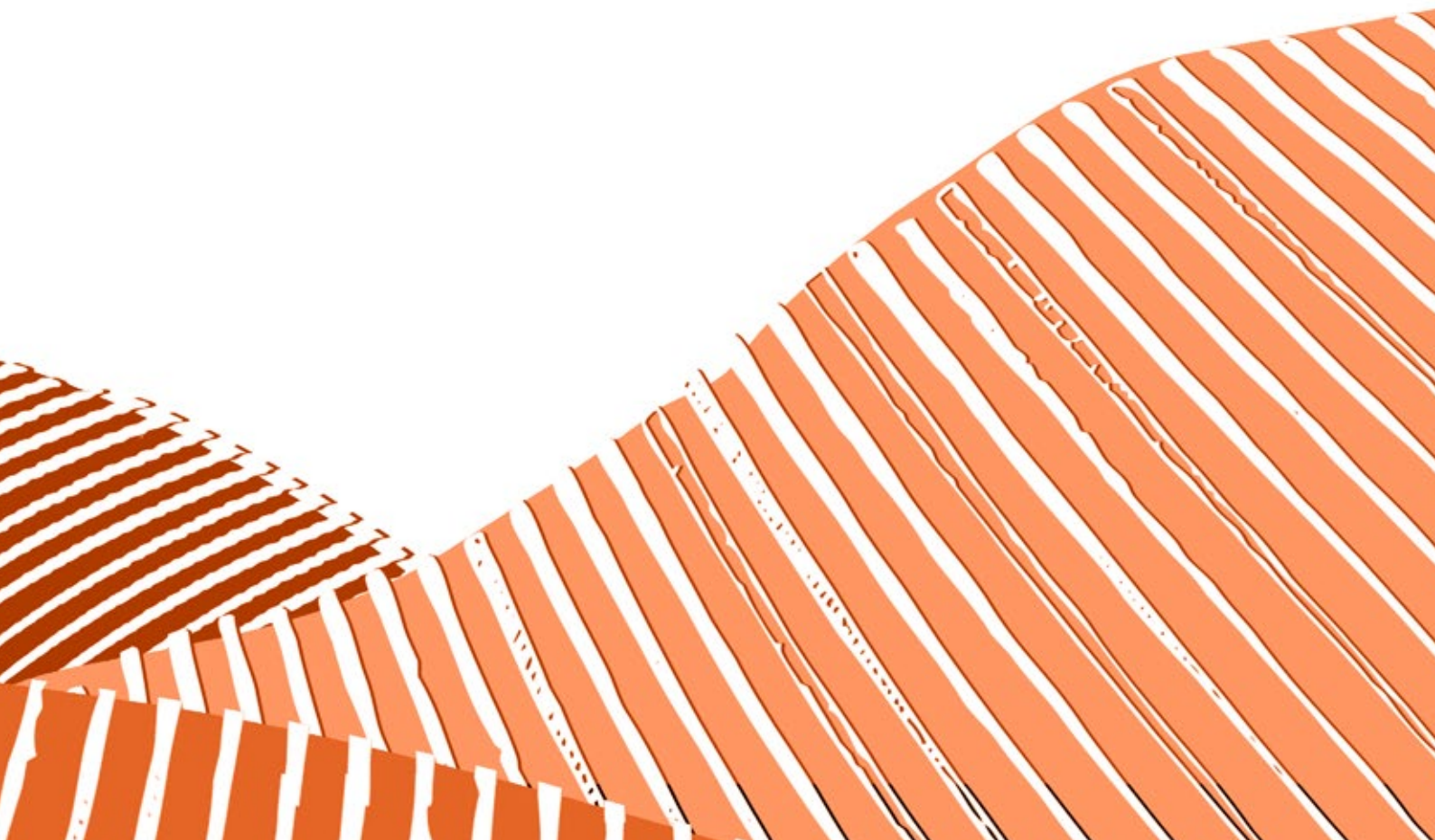
RUFORUM Case Studies

Analysing, Adapting, Innovating: Growing a Robust Agricultural Research System in South Sudan



Analysing, Adapting, Innovating: Growing a Robust Agricultural Research System in South Sudan

The achievements of Dr Jimmy Lamo, a former Forum masters student, include pioneering Uganda's first rice-breeding programme. After working on rice breeding for his Rockefeller Foundation-supported PhD at the African Centre for Crop Improvement in South Africa, he returned to the National Crops Resources Research Institute (NaCRRI) in Namulonge, Uganda, determined to breed thriving new rice varieties for the country. During the first five years of his work at NaCRRI, he saw five new rice varieties released in Uganda, with additional candidate varieties expected for release on an ongoing basis.

Lamo says his training under Forum (the predecessor programme to RUFORUM) endowed him with an analytical mind and a can-do attitude. For his PhD thesis, he worked to adapt disease-resistant varieties of wild rice for consumption, and needed to experiment with cross-breeding in order to produce plants whose grains did not scatter to the ground as soon as they were ripe. Unable to get his hands on the kind of expensive, purpose-built vacuum pump needed for removing the delicate florets of the rice grains – a necessary technique for cross-pollinating rice plants – he improvised, fashioning a vacuum pump from a conventional household vacuum cleaner.

On Lamo's return to NaCRRI, he began supervising students of RUFORUM (the Regional Universities Forum for Capacity Building in Agriculture), an advanced research and training network and consortium of 55 African universities in 22 countries. Among these students was Maurice Mogga from South Sudan, who was on an MSc scholarship funded by SCARDA (Strengthening Capacity for Agricultural Research and Development in Africa), a programme managed by RUFORUM on behalf of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), and the Forum for Agricultural Research in Africa (FARA). Lamo enjoyed orienting new students to the field, and working with them to find a research gap for their theses that, as he puts it, is "*important and achievable*". He is very passionate about this, since for his MSc study he too was similarly trained and mentored under Forum.

Mogga and other SCARDA graduates have since moved on to fill key research roles within their home-country national agricultural research institutes. Both Mogga and his colleague Luka Opio Atwok, who trained under RUFORUM at Makerere University, are now back in South Sudan, their home country.

Mogga and Atwok's experience and knowledge gained at Makerere left them capable of acting as change agents back home: able to be proactive and to navigate the system. But a lot is happening very quickly, and there are too few shoulders to bear the weight. "*As South Sudan keeps improving, agriculture will move from basic subsistence to supporting entire industries,*" says Dr Richard Edema, who is leading training of MSc-level plant breeders at Makerere University.

Plant breeder and RUFORUM graduate Maurice Mogga inspects plants that are part of the observational trials of Longe 10H hybrid maize, at Palotaka Basic Seed Centre.

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>
> Dr Richard Edema

On the research station at Yei, about 160 km southwest of Juba in South Sudan, Mogga and Atwok wander through rows of maize, cassava, sorghum, cowpeas, groundnuts and rice that they planted here. When South Sudan celebrated its first birthday as an independent nation in July 2012, the two researchers were busy in these fields, planting the crops that now grow. With sharp eyes, they examine various leaves, cobs and heads for spots and signs of wilt – but for the most part they are pleased with what they see.

The field trials represent an important step in the journey towards a viable agricultural research system for the war-scarred young country. For example, planted here are some 20 new varieties of upland rice that Mogga acquired during a trip to Mali. Adjacent to the rice grow assorted cassava varieties, being tested for resistance to cassava mosaic disease. Across the pathway, Atwok's maize plants tower high above the researchers' heads. To show how much of an improvement these new varieties are proving to be, Mogga points to the patch planted with an old rice variety that locals use, which is stunted and has sparse, thin panicles by contrast. Other local varieties grow too tall, causing their stalks to break off before the panicles have matured. Most of the new varieties appear to be flourishing, particularly when compared with varieties planted from seeds available to local farmers. Those scraggly, stunted varieties are also planted here in the same soil, but they grow reluctantly, the maize cobs anaemic, the rice panicles sparse.

South Sudanese farmers have probably been relying on these very same seed varieties for their subsistence since the 1970s, Atwok guesses. The decades-long civil war between Sudan and South Sudan ensured that agriculture in the region never advanced beyond the most basic subsistence levels.

The approach that Mogga and Atwok adopt is to select five to ten of the most promising varieties of each new test crop for farmers to test in their fields and give feedback. As Mogga explains: "*We don't want to reinvent the wheel; we want to leapfrog so that we take the basic varieties from other countries, field-test them, and use the best ones and adapt them for our local conditions.*" This is done in Yei's seed laboratory, which has the equipment needed for producing seeds, as well as sorting them and testing their quality.

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>
> Maurice Mogga

Monitoring progress of white sorghum (Kari mtama-1) breeder seed multiplication trials at Palotaka

Mogga and Atwok (right) on farmer field visits in Yei River County (South Sudan)

Unlike the case on much of the African continent, and indeed across the world, where intensive agriculture has exhausted soils and diminished yields, in South Sudan rural farmers, isolated in the war, found themselves unable to access seeds, inputs and markets, and were reduced to the most basic levels of subsistence farming. The result is that the potential for agriculture in these rich and lightly touched soils is bigger than oil, which was the main source of revenue before a dispute with Khartoum shut down the pipeline (since reopened), Mogga explains.

When South Sudan attained its independence in July 2011, after 50 years of almost continual civil war, the agricultural system was needing to be rebuilt, virtually from scratch. Crop yields were poor. Seeds were unavailable. Roads were in a dire state, making distant markets almost impossible to access. The country's hard-won peace promised the opportunity to develop small-scale commercial agriculture to its potential – not only to increase food security but also to jumpstart South Sudan's ailing economy. And, indeed, food production increased by an impressive 35% between 2011 and 2012. Two years of civil war within South Sudan since December 2013, however, have meant that poor harvests, displacement of communities and food insecurity remain real and ongoing challenges. For now, particularly given the latest civil war, food insecurity remains widespread, with the United Nations World Food Programme (WFP) warning that more than 5 million people in South Sudan (around 40% of the population) face severe food shortages in 2016.

Before doing their MSc degrees at Makerere, Mogga and Atwok were both employed in the national agricultural research system in South Sudan. Given the magnitude of the challenges they saw, and being the only trained plant breeders in the country at the time, they hardly knew where to begin in order to make a dent. An easy option would have been to sit behind their desks and hope that things would improve. But, as Atwok points out, that is not how RUFORUM graduates operate. He explains that they were prepared to take on all related responsibilities and attempt to tackle what needed to be done. "*We are doing everything,*" says Atwok. "*I am the technician, the scientist, the administrator.*"

Now, joined by an additional six MSc-trained plant breeders, also trained at Makerere University in Uganda, they can share the load somewhat. The task nevertheless remains daunting.

The relationships that Mogga and Atwok built through RUFORUM have proved invaluable to the researchers' efforts. For example, working at Namulonge put them in an ideal position to leverage support from AGRA (Alliance for a Green Revolution in Africa) for developing the new seed systems and value chains that South Sudan needs. A three-year grant from AGRA, conferred at the end of 2011, provided funding to connect agricultural research with farmers and seed companies. The grant, which provided

Plant breeder and RUFORUM graduate Luka Opio Atwok

Mogga pictured among the high-yield NERICA rice varieties being introduced to boost food security in the country

funding for crop improvements targeting seven major varieties – maize, rice, sorghum, cassava, beans, cowpeas and groundnuts – included scholarships for the six masters students already mentioned. Of those students, two, namely Susan Ayot and Nancy Loro, are currently implementing AGRA-supported improvement programmes in beans and groundnuts respectively in South Sudan. The AGRA grant also enabled Mogga and Atwok to complete their PhDs at the African Centre for Crop Improvement (ACCI) at the University of KwaZulu-Natal in South Africa: Mogga is due to complete his PhD in 2017 at the ACCI, while Atwok will finalise his PhD at the West Africa Centre for Crop Improvement (WACCI), University of Ghana, in 2019.

Mogga and Atwok have also obtained seeds and germplasm through the relationships forged with other key bodies: the Kenya Agricultural Research Institute (KARI), Uganda's National Agricultural Research Organisation (NARO), the International Institute for Tropical Agriculture (IITA), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and CIMMYT (the International Maize and Wheat Improvement Center).

Above all, Mogga sees himself as a facilitator who is helping to create valuable linkage between farmers, seed companies and markets, which will allow locals to stand on their own two feet. "*As government, we provide the link,*" he says. "*We bring to the farmers the ideas and the technologies, and then the system goes on.*"

"As government, we provide the link. We bring to the farmers the ideas and the technologies, and then the system goes on."

Maurice Mogga

Mogga and Atwok work with local farmers to grow NERICA (New Rice for Africa) rice varieties for seed to be made available to local communities. At one such place, about an hour's drive down muddy roads from Yei, a group of farmers display the neatly spaced fields where the new seed crops grow. During the war, says farmer Rose Inga, people randomly broadcast seeds on the ground, instead of planting them in the neat rows necessary for maintaining purity and quality control. The men would never help with the backbreaking task of weeding. And after planting a good field like this, as the harvest approached she would often be forced to flee because of the fighting, and crops would regularly be left rotting in the ground. "*You would move from one village to another,*" she says. "*Now we are happy because we plant, we harvest, we eat, we sell, and then we plant another crop.*" Women and men alike are now learning the new techniques, she says, and pitching in with weeding. Produce is no longer simply a food source, but is also becoming a source of income, with farmers transporting surplus produce by bicycle to sell in Yei.

Back in Yei, Aaron Ware and his company Century Seeds represent another piece of the puzzle falling into place. With virtually no border controls, South Sudan had become a dumping ground for poor-quality seeds, he says. South Sudanese by birth, after years in the seed business in Uganda, where he specialised in sesame, Ware returned home in 2011 and set up a shop with start-up funding from AGRA, USAID and the African Enterprise Challenge.

Working with the Ministry of Agriculture in South Sudan, Ware procures certified seeds from the National Seed Authorities of Kenya and Uganda, and sells them locally to NGOs and small-scale farmers who, he says, make up about 60% of his business. "*I saw how access to improved seed has made a difference in Uganda. I wanted to do the same in South Sudan,*" Ware explains. New seeds are already making a big impact. When Ware arrived in Yei, almost all of the vegetables at the market were imported; now up to 90% of them are grown locally, he says.

Visiting scientists and researchers are keen to learn from South Sudan's plant-breeding efforts and innovations.

I saw how access to improved seed has made a difference in Uganda. I wanted to do the same in South Sudan."

Aaron Ware

While this is certainly progress, this area, South Sudan's fertile green belt, is the only one of the country's six agro-ecological zones where the agricultural research system has made inroads. Each zone is characterised by dramatically different terrain, cultures and ecologies, meaning that upcoming researchers there will have to repeat many of the same kinds of research and innovation processes that Mogga, Atwok and their colleagues have been involved in.

Nevertheless, things have already come a long way since the Comprehensive Peace Agreement was signed back in 2005. That was the year young Mogga arrived at the research station here, determined to return to the land of his father's birth after growing up in exile in Kenya and Uganda. He recalls how his colleagues presented him with a military uniform to wear so that, as a newcomer, he would not stand out in the heavily militarised community.

In Atwok's case, when the area in which he grew up was razed by fighting, he enrolled at the University of Juba, which at the height of the conflict in 1989 had relocated to Khartoum, its southern campus having been claimed by the Northern mujahedeen occupying the town. Unable to return home after he graduated in 1997, Atwok spent the next eight years drifting around Khartoum, working odd jobs for survival. Returning to Juba after peace arrived, he was posted to the research station in Palotaka, near his home village.

Given constraints ranging from insecurity to the lack of transportation and fuel, Mogga and Atwok quickly realised that without further training they would make little headway in the tattered system. "*When we first came to the Ministry we were not scientists; we just had our basic degrees,*" says Atwok. "*There was nothing happening on the ground, and we didn't know how to start.*"

The timing of their RUFORUM scholarships was perfect. Atwok, who evaluated the resistance levels of different varieties of maize to maize streak virus for his thesis, worked at three different research stations in different parts of Uganda, and was able to begin thinking about which varieties might grow well across the border in the similarly lush and equatorial zone of South Sudan. In Palotaka, where Atwok serves as acting director, all the same crop varieties have been planted in similar formations to Yei. "*This place is a hotspot for diseases, so we are torturing them seriously, and the local variety is dying! It cannot tolerate it at all,*" says Atwok.

Now, with Sudan's split between north and south formalised at independence, to some extent the tense arrangements of the old order have been unravelling and decoupling. Yet new and wholly independent institutions in South Sudan are still in the process of forming. Meanwhile, the University of Juba managed to re-assemble itself and joined the RUFORUM network in August 2011.

High-level research and analytical skills and techniques, coupled with the enthusiasm and grit to adapt and innovate, mean that people like Mogga, Atwok and their plant-breeding colleagues will continue to be invaluable assets in South Sudan's commitment to strengthening its agricultural research system.

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