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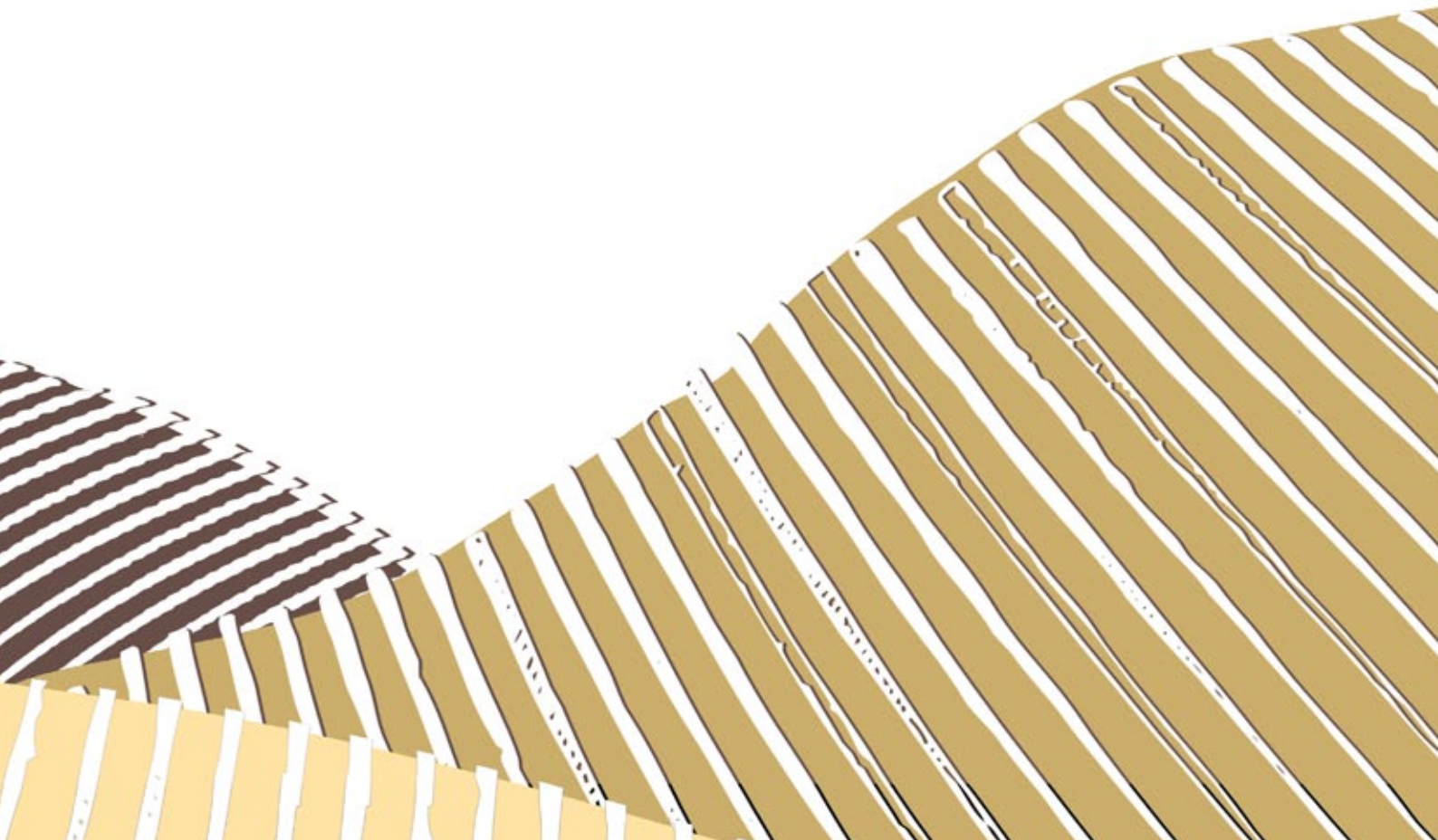
RUFORUM Case Studies

The University of Zimbabwe: Building Smallholder Farmers into the Soya Value Chain, and Rebuilding Linkages Between Universities and Farmers



The University of Zimbabwe: Building Smallholder Farmers into the Soya Value Chain, and Rebuilding Linkages Between Universities and Farmers

Sheunesu Mpepereki's fascination with the humble soya bean began while he was studying for his master's degree at North Carolina State University in the 1980s. Hearing one of his lecturers explain that per unit area, the soya plant is the world's most efficient biological system for producing protein, he decided then and there that he was going to work on promoting the cultivation of soya amongst smallholder farmers back home in Zimbabwe.

"I thought of protein and malnutrition back at home, and that was it, I was off and flying," recalls Mpepereki, now a professor of soil science at the University of Zimbabwe.

Building a career on soya research was not going to be easy at the University of Zimbabwe back in 1988, the year he returned from overseas. As colleagues informed him, soya was grown by the country's white commercial farmers, and the crop was considered too sophisticated for cultivation by smallholder farmers—the group that the university's agronomy department was mandated to serve.

Involving Smallholder Farmers in Soya Production

Prof. Mpepereki resigned himself to working on cowpeas and sugar beans instead – but it wasn't long before he found his opportunity to follow his dream and turn his focus to soya. With funding from the Rockefeller Foundation, he spent several months of a sabbatical travelling around Southern Africa collecting samples of the soil bacteria rhizobium, and encountered by chance a group of smallholder farmers who were in fact cultivating soya.

As soya beans are nitrogen-fixing legumes, rhizobium are nitrogen-fixing bacteria, and rhizobium offers a low-cost and effective way for farmers to improve their soil quality and crop yields without having to apply nitrogen fertilisers, Prof. Mpepereki wanted to explore its potential for helping smallholder farmers faced with deteriorating soil quality. The idea was for farmers to rotate between planting soya and the staple crop maize – and the hypothesis was that this system would improve soil health and therefore crop yields, with the added benefit of an additional soya crop, to bring in extra cash and improve household nutrition. However, nobody knew if the bacterium would even survive in Zimbabwe's acidified and severely depleted soils.

> *"The relationship between the soya bean, the bacteria and the environment – this was unknown. We needed to look at the agronomy, and how to manage the crop under smallholder conditions."*
>
> Prof. Mpepereki, professor of soil science at the University of Zimbabwe.

In 1995, Prof. Mpepereki received a Rockefeller Foundation Agricultural Sciences Career Fellowship, which enabled him to commence exploratory work with smallholder farmers during his sabbatical leave. The following year, he received a grant from RUFORUM, a project of the Rockefeller Foundation at the time, which included funding for the training of two Master of Philosophy students, and enabled him to work on both researching and promoting the technologies of soya adoption and rhizobium inoculation amongst smallholder farmers.

Quickly, he realised that it was not enough to simply promote the technologies. If smallholder farmers were to grow soya, they also needed a market for their produce. "*The soya must put food on the farmers' tables, and money in their pockets*," he says. "*That became our guiding principle*."

The solution, recalls Prof. Mpepereki, was to *"mobilise people along the value chain."* Working with a number of RUFORUM-sponsored MSc students over three grant cycles, he cultivated relationships with Agritex, the government extension service, and visited Olivine Industries, a manufacturer of soap and cooking oil, and the major Zimbabwean company trading in soya, convincing them to buy from smallholder farmers. He also worked closely with farmers unions, in order to set up systems for gathering up the small amounts of soya produced by individual small farmers, so that this produce could be sold in commercial volumes.

Prof. Mpepereki received the 2009/10 Impressa award for outstanding soya-bean research

"All this was none of our business as soil scientists, but we had the problem of what to do with the soya beans, so we brought all these other players onto this platform, which was built as we tried to find our way," he recalls.

The researchers also developed links with local NGOs, which have strong relationships with farmers in remote rural communities, and are also constantly searching for ways to help improve livelihoods in these communities. *"Most projects fail because when you pull out, everything collapses,"* says Prof. Mpepereki. *"We tried to make sure this programme was integrated into all of our chains and processes."*

A Cushion from Economic Crisis

In a nutshell, he believes, the project has served to mainstream soya bean production amongst smallholder farmers, generating an industry which has even helped to cushion small farmers from the worst of Zimbabwe's economic crisis. The project also served to support the development of research at the university. As the project grew, RUFORUM funding allowed for several crops of MSc students to complete research on different aspects ranging from soil health to socio-economics.

One student, Patrick Kasasa, completed his master's research on the socio-economics of the value chain, and has since gone on to work for the Community Development Technology Trust, an NGO, focusing further on opening market access for smallholder soya farmers.

While Zimbabwe's economic crisis hit soya hard, it at the same time offered farmers something of a cushion from starvation, because of the high nutritional content of soya, as well as the better profit margins that crop fetches, when compared with maize, according to Mr Kasasa. All in all, he estimates that around 100,000 people, including farmers and their families, have benefitted across the country from the soya programme.

"People have gained tangible assets from soya," he says. *"Their children are in school; they have bought cattle, built better houses, asbestos and iron sheet roofing, agricultural implements and ploughs."*

The programme has brought impressive benefits to the university as well, and in 2010 Prof. Mpepereki received the prestigious Impact Research in Science in Africa (IMPRESA) Award, convened by RUFORUM, NEPAD, and the European Union. *"I can't think of any single programme of funding in African universities that has generated the same amount of research outputs that have a tangible impact on people, on careers, publications and improving academic profiles,"* says Prof. Mpepereki.

Despite such strengths, however, the programme was badly diminished in the midst of Zimbabwe's turmoil. Extension services collapsed, and buyers and seed companies vanished, as the government relaxed import tariffs, encouraging a flood of cheap food imports into the country in order to stem hunger.

Without current funding support, the programme has had to downscale. While Prof. Mpepereki says he still travels to give demonstrations to interested farmer groups, the university has not been able to sustain the levels of direct involvement in the value chain that made the programme a success in the past. While NGOs and government remain involved, they also have not been able to sustain the programme through Zimbabwe's economic crisis.

"We are still the reference point for information about soya," says Prof. Mpepereki. *"But the momentum has been lost tremendously."*

The same applies to the university's research activities more broadly. While Prof. Mpepereki hopes that the programme can be revived now that Zimbabwe's economy is recovering, additional RUFORUM-sponsored grants at the university are helping to boost research in other areas.

Reviving the Links Between the University and Farmers

"Originally, the department had a very strong link with farmers, but with the economic crisis, Zimbabwe had more than ten years where nothing could be done, and now we're having to reestablish those linkages," says Dr Upenyu Mazarura, another principal investigator, who supervises two MSc students working on the disease of soft rot in potatoes.

These lifelines of support for research from RUFORUM are very important, she believes, because economic recovery has not reached people living in the rural areas, where the formal economy does not extend, and where agricultural yields have been declining in recent years due to factors of climate change, soil degradation, and the unavailability of inputs such as fertilizers which are prohibitively expensive to most smallholder farmers.

Smallholder agriculture is performing currently at levels far from optimal. Targeted research can go a long way towards

improving the situation, particularly when researchers focus on simple solutions that can make a big difference – leading to improved yields for farmers; finding biological controls for pests that eat away their harvests; and offering new approaches to help farmers work under conditions of soil exhaustion and unpredictable weather patterns due to climate change.

The potato, for example, presents a promising alternative to maize, the country's national staple – yet its potential is currently not being realised, due to a high prevalence of soft rot, a soil-borne disease which infects potato tubers underground, resulting in losses of between 20 and 60 percent of the crop.

Taking a typical RUFORUM approach, two master's students working under Dr Mazarura are researching the problem from two complementary angles designed to shed synergistic light on the patterns of the disease. While Ms Vongai Paradza is looking at how the disease spreads in the plants in terms of their physiology, Ms Colleta Mantsebo is investigating the ways in which the practices of the farmers may either prevent or contribute to the problem.

The University Council was so impressed with their research outlines that it has recommended that their MScs be upgraded and they turn their research into dissertations, according to Dr Mazarura.

Disease Control for Potato Production

So far, the researchers have carried out surveys on ten farms around Harare to begin to map the extent of the disease. As no chemical controls are available to combat soft rot, the most promising avenue is to find ways to manage the disease through passive controls such as adjusting irrigation and soil preparation methods, according to Ms Mantsebo.

For example calcium nitrate, a fertiliser, has been shown to strengthen the potato's resistance to soft rot, because it strengthens the cell walls of the tuber, while the infection weakens them.

Ms Paradza, meanwhile, will use polymerase chain reaction (PCR) techniques in order to zero in on the genetic patterns that influence the disease.

Ideally, one solution is to grow potato seed in a high-altitude quarantined area in order to ensure that the seed is disease-free. However the reality is that most farmers cannot afford new seeds, and so use the same contaminated lines over and over again, aiding the spread of the disease, according to Dr Mazarura.

From the combined results of their work, the two students plan to produce a booklet for farmers with guidelines on techniques to avoid potato soft rot. If the disease can be contained, the potato has the potential to alleviate worsening food insecurity in the country.

> *"The university is trying to open the eyes of policymakers to see that the solutions are right there. If we were able to make it possible for farmers to plant potatoes today, within three months they will have food to bridge the hunger gap."*
>
> Dr Mazarura

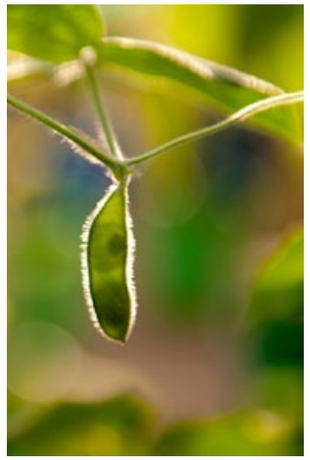
Maximising the Productivity of Fallow Land

Another grant project, meanwhile, is looking at the question of why agricultural land in some rural farming communities is increasingly being left fallow, and whether these areas can be used productively, for example by introducing livestock.

Studying satellite images of rural farming areas over the past 30 years, Principal Investigator Dr Emmanuel Manzungu, along with his two students Bruce Tavirimirwa and Linda Mtali, realised that the amount of land under cultivation in these dense, rural farming areas fell by half over that period.

While Ms. Mtali, who graduated in 2011, was using remote sensing techniques to map out which areas of land were being abandoned, and why – Mr. Tavirimirwa is looking at the possibility of introducing livestock grazing on this fallow land.

The land is being abandoned for a number of reasons – while HIV/AIDS has taken a deadly toll in rural areas, young people are also increasingly giving up farming and moving to the cities, leaving behind a shortage of labour. There are also environmental push factors, as soil depletion, poor rainfall, and the unpredictable weather patterns associated with climate change make farming a losing prospect.



In spite of land reform, more than half the population still lives in poor, overcrowded, and inhospitable communal farming areas, eking out subsistence livelihoods and relying increasingly on remittances sent from family members living abroad. While the land itself has always been dry and unyielding, the problem for rural people earning as little as $100 per year is that they often cannot afford fertiliser which might make farming more viable. *"The poverty itself has made it impossible to finance agriculture,"* says Dr Manzungu.

The traditional land tenure system works in such a way, that if a farmer cultivates a particular area, that area is considered hers. As soon as she stops cultivating the land, it reverts to the community.

The idea of introducing livestock to the abandoned farming areas would involve introducing new species of low-maintenance, drought-tolerant grass to the land, changing the vegetation structure in order for it to support animal life, particularly goats, to stimulate local livestock economies.

While an area of 34 degraded hectares is needed to support a single animal, the goal of the project is to reverse the degradation enough to reduce that need to ten hectares per animal, according to Mr Tavirimirwa, who is employed as an animal scientist by the National Agricultural Research Department.

The project has had a catalytic effect, according to Dr Manzungu. After working in government, Mr Tavirimirwa has found the opportunity to engage directly with local communities and do valuable field work, and hopes to draw on the experience when he returns. The project has produced two students, as well as a paper for publication – but Dr Manzungu sees that as just the beginning.

"It's given us a base, a platform. For us, it's a seed to look for more money and hope we can address the larger question of what can you do in rural areas where agriculture is declining, and what the people who are living there can do."

Participatory Research in Rural Communities

Meanwhile, another research team, led by Dr Florence Mtambanengwe, has worked using participatory action research with two different rural communities, in order to explore the question of why so often communities do not adopt new technologies introduced by researchers or NGOs, even when they have been proven to fulfil unmet needs.

The object of the research was to create collaborative processes in communities, designed to harness these new technologies in ways that communities can benefit from them.

The researchers worked in two different areas for comparison. One was an old and socially cohesive communal area, where families had lived side by side for 100 years. The other community, by contrast, had been created in 1983 as part of a government resettlement programme aimed at de-congesting rural communal areas.

Working in these communities, the students set up learning centres where they could engage directly with community members and also demonstrate some of the innovations. *"It's a cycle,"* she explains. *"You identify stakeholders, meet with the community, diagnose a problem, and hear from the community what is missing, what they want."* Then, the researchers and the community collaboratively come up with strategies for making progress towards achieving the desired outcome – and the cycles of planning, doing, and reflecting continue.

In this case, the issue at hand was the familiar problem of soil fertility. In addition to the two communities where the researchers worked, they also kept tabs on a third community where they did not engage, which served as a control group.

In the learning centres, the participants used integrated soil fertility management techniques, making use of locally available materials such as leaf litter and compost to enrich the soil, as well as experimenting with methods such as rhizobium inoculation in their crops. The researchers worked with a partner organisation, the Soil Fertility Consortium for Southern Africa, that had been working on the ground with the communities on soil fertility management over several years. The project also involved extension workers, produce buyers, and others enmeshed in the value chain.

At the learning centres, the farmers would conduct the plantings and spacings themselves, learning new techniques by doing. The collaborative approach was empowering for farmers, according to Tinashe Mashavave, one of the students, who studied the biophysical and social aspects of farmers' adoptions of the technologies. *"They're used to the top-down approach of information-sharing, and receiving information from the extension workers,"* he says. *"But you find that education was not a major driver in this project. Rather, they learned by doing, by their observations."*

Improving Post-Harvest Storage

Another project, meanwhile, involves helping smallholder farmers to manage the storage of their crops after harvest, tackling another major issue that contributes to poverty and food insecurity. While researchers have typically tackled food security issues from the perspective of agronomy and crop protection, this project seeks to address a pervasive yet hidden problem, and help small farmers keep their harvested crops safe from pests.

"We are now trying to recognise the importance of what happens after the harvest in terms of food security," explains Dr Brighton Mvumi, the project's Principal Investigator. *"Many times, farmers are forced to sell their crops prematurely because they don't have the skills to manage the grain and keep it safe from pests."*

The issue is particularly important for Zimbabwe and its Southern African neighbours, as this region only has one harvest a year. For this reason, grain prices often fluctuate wildly over the year, following the law of supply and demand: in April, at harvest time, farmers who can't store their grain are forced to sell their produce at a low price, because the market is flooded with stock. By the time sellers have run through their stocks at the end of the year, however, farmers can sell at a premium. At the same time, they retain the self-sufficiency of feeding themselves throughout the year.

"It's strategic to have your own food," Dr Mvumi explains. *"There are sudden spikes in food prices linked to global trends, like oil prices. Farmers now need to store more food, and store it for longer. We need to make sure that they have sufficient technologies to support this."*

Farmers also face mounting threats from new and increasingly destructive inspect species. They have always had to sacrifice a portion of their crops to hungry pests. In addition to the standard variety of pests that nibble away at farmers' grain stashes, however, a new and far more devastating menace called the large grain borer has also recently appeared on the scene.

One aspect of the research involves setting up both farm and field station trials to test the efficacy of different storage materials. Another aspect involves studying the behaviour of insects within the storage environment, in order to develop pest management strategies. In the process, the aim is also to minimise the use of pesticides. In both cases, as with the Chiyenka project, the researchers aim to work closely on the ground with farmers.

For Richard Wafa, one of two MSc students working on the project, post-harvest storage is a familiar problem. *"My parents are smallholder farmers, so I have been involved in agriculture since I was young,"* he says.

Mr Wafa is looking at the post-storage dynamics and ecology of sorghum pests. He has designed experiments to test the extent to which the infestation begins in the field, as pests are harvested and stored along with the grain and continue to feast on it through the storage season – as well as the extent to which pests that subsequently infest the grain after storage play a role. Gaining a better understanding of these dynamics will help researchers to develop better management techniques. He will also test the efficacy of different storage materials for protecting the grain.

His colleague, Honest Machekano, another MSc student, will run experiments to learn more about the various pests that afflict maize. He will set traps around grain storage areas in order to map out the timing and behaviour of insects such as the maize weevil and the red flower beetle, which advance upon stored maize, and whose populations boom at different times throughout the storage season. The experiment will help farmers develop techniques for guarding against losses, such as harvesting early or shelling the maize quickly, he says.

The second part of his research will involve developing biopesticides to further help keep the insects at bay. He will work on developing different combinations of materials, such as diatomaceous earth along with other biopesticides, and then will field test the combinations that produce the best lab results.

The arrival of the large grain borer, he believes, may have been one unforeseen consequence of importing cheap maize from neighbouring Zambia and Mozambique, as the government relaxed quarantine rules in order to expedite food imports in response to the crisis.

Mr Machekano also hopes that these new pest control methods will offer viable alternatives to the far more toxic organophosphates which currently serve as the primary pesticides. *"There are a lot of safety issues,"* he says. *"People think they may be gradually poisoning us; manufacturers are being challenged to demonstrate safety, and the costs are huge. Yet we depend on these organophosphates in Africa, so we need to be testing these newer technologies."*

The project will also help to address the country's shortage of post-harvest entomologists, says Dr Mvumi. *"We realised that if I am to drop dead today, we don't have any post-harvest entomologists around, so we need to create a critical mass to keep the science alive, to carry on and teach,"* he says.

Supporting Urban Agriculture

Urban agriculture is another under-researched area where support from RUFORUM grants is making a difference. In the midst of Zimbabwe's economic collapse, increasing numbers of city-dwellers are turning to farming – a practice which city officials previously did not tolerate, but have lately been compelled to accept as a bolster for urban food security.

The project, led by Dr Simon Madyiwa, seeks to optimise various soil and water management techniques for the urban environment. Most urban agriculture relies on rain-fed agriculture, for example – as well as illegal wastewater usage – so there is a huge need to look at the city's (often crumbling) urban infrastructure in order to set up efficient systems to make the most of this limited resource.

One of the MSc students, Blessing Nyamasoka, completed a baseline survey of the various techniques used by urban farmers, such as the use of fertilisers, animal manure, and domestic sewage sludge on crops, collecting soil and plant samples in order to document the yields and nutritional and heavy metal content associated with different practices.

Her colleague, Armweell Shumba, then followed up on the survey to devise ways of optimizing the most promising technologies, such as mulching, manuring, and usage of ridges and furrows for water and soil conservation. In the laboratory, he ran experiments to measure how the various forms of manure released nutrients, and how this ultimately affected crops.

As the researchers completed their field work between 2009 and 2011 (currently they are both writing their theses), they were able to explore a dynamic and emerging sector, where systems of governance and land tenure were evolving due to changing circumstances. *"There is the notion that people don't take urban farmers seriously,"* says Ms Nyamasoka. *"But they are serious about what they do. They are serious about feeding their families."*

Over the past few years, however, the urban farming sector has slowly begun to come into its own, becoming more organised, as farmer groups have formed and three government extension workers have been assigned to serve the sector. The complexities of the sector range from the uncertainties land tenure, as most people grow their crops on parcels of land that they don't actually own, to the crumbling urban infrastructures upon which urban farmers rely.

One issue that Dr Madiywa has been exploring, for example, concerns organic pollutants and heavy metals such as cadmium and lead, which enter urban soils through contaminated wastewater, while the city's inadequate infrastructures cause additional problems such as inadequate sewerage treatment. There is a huge need to establish clear guidelines for safe levels of contaminants in soils, he says, so that "*we can say, if you have such a concentration of lead or cadmium in the soil, you should not grow a crop like cabbage, but you could go ahead and grow a crop like wheat.*"

As with a number of the other research programmes described above, the researchers see their work so far as just the beginning, and hope to use it as the base upon which to build more lasting and comprehensive research programmes. In the future, urban farming will only increase, according to Dr Madiywa.

> *"It is tradition for our people to grow crops. There is a new generation of people who don't have roots in the rural areas anymore. The town is their home, and they are likely to continue to carry out urban agriculture."*
>
> Dr Simon Madyiwa

AUTHOR/RESEARCHER: Megan Lindow
DESIGN AND LAYOUT: Natalie van der Walt

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