



DIRTY HANDS, FINE MINDS

The Story of an Agricultural Research
and Training Network in African Universities



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FOREWORD

The Comprehensive African Agricultural Development Programme (CAADP) provides the framework for continent-wide agriculture policy. CAADP aims to achieve at least a 6% growth in the agriculture sector to reduce poverty and food insecurity in Africa – an ambition that will require world-class services in outreach, credit delivery and the development of value chains and technology. This needs to be supported by the appropriate investment in human capital to deliver the services that are necessary to achieve growth and to address current and future issues within the sector.

The RUFORUM programme described in this book draws on solid international experience, which illustrates how universities are central to achieving successful agricultural transformation. RUFORUM aims to build quality institutions closely linked to the agricultural spectrum – farmers, suppliers, processors and consumers. This book shows how the RUFORUM member universities are building strong ties to business enterprises to provide role models, case studies and attachment opportunities. Collaboration among universities gives students, staff and – most importantly – farmers access to the knowledge and facilities held within the ambit of those universities. By pooling their efforts through networking, RUFORUM members have greater abilities to achieve their strategic goals in terms of training and impact-oriented research. The outputs are graduates well versed in their chosen disciplines, and increased capacity at the less well-endowed universities.

This creates a powerful partnership of scientists, farming communities and development agencies (both private and public). It encourages the efficient and swift transformation of agricultural production through harnessing the best of skills in a collaborative, ‘learning by doing’ manner in which all feel ownership and pride. Existing structures are improved and enhanced to build change through an evolutionary rather than a revolutionary approach. Young people, through quality university training, contribute directly and bring new ideas and innovations into the sector. This is cost-effective, brings the best of developing country and international expertise together in a problem-solving format, and can be rapidly scaled up to reach the poor quickly and effectively.

The RUFORUM strategy, which is detailed in the chapters of this book, draws on multiple channels and players to allow choices to emerge and be tested. Ultimately, the best of those have been adopted. This strategy fits comfortably into the increasingly practised participatory framework for development, which facilitates the empowerment of the poor and disadvantaged. With its foundation of good science, directed by farmers’ needs and informed by the commercial, social and

ecological environments of developing countries, this strategy serves to provide gains not only for the better-off producers, but also for the poor and excluded. It is an African strategy, developed and implemented by Africans and undertaken for the benefit of Africa’s premier industry: agriculture. The African Union applauds the efforts of RUFORUM and urges African governments to strengthen investment in human capital through networks such as RUFORUM.

*HE Nkosazana Dlamini-Zuma
African Union Commission Chair*

ACKNOWLEDGEMENTS

Charting the growth and expansion of RUFORUM from its genesis to the present day was an exercise that embodied one of our core values – creation through teamwork and networking. We would like to thank Malcolm Blackie, John Lynam, Joyce Mook, David Ngugi and Bharati Patel for giving of their time to recount with admirable clarity the 12 years of Forum, the predecessor that provided the inspiration for RUFORUM. They are among the hardworking pioneers who understood the critical role of universities in working with farmers to achieve Africa's green revolution. Their vision – which included an appreciation of MSc training as a means of underpinning public research – would never have come to fruition without the Rockefeller Foundation, which ran Forum as one of its programmes out of its Food Security Division. Ten years ago, the Rockefeller Foundation was instrumental in bridging the gap between Forum and RUFORUM. In an act of faith, it provided the seed funding for a fledgling organisation that had yet to establish a track record.

RUFORUM introduced the concept that domestic universities – not foreign ones – should drive the research that would expand agricultural output in Africa. The vice-chancellors of the universities that became the founding members of the RUFORUM network are forever in our gratitude. They assumed ownership, thereby assuming financial responsibility too, without hesitation and shepherded RUFORUM through the growing pains of its early years. Others who proved to be vital in the early and later years include Kay Leresche, Patrick Okori, Moses Osiru and Paul Woome. More recently, the Bill and Melinda Gates Foundation stepped in as RUFORUM's core funder, consistently providing wise counsel along the way. It has enabled us to scale up our programmes and transform RUFORUM into a powerful voice and champion for higher education. We are also grateful to our other development partners from Europe and the Americas who have given us the benefit of their global perspective and experience.

RUFORUM is a network of friends who collaborate to produce good science. They are the staff and PIs at agriculture faculties, the students who are conducting research for their masters and doctorates, the farmers with whom they collaborate. We are inordinately proud of our alumni – those who head departments in national and international research institutes; the extension workers in ministries of agriculture; the planners who formulate macro-policy; the entrepreneurs who market new seed varieties. But if asked to choose the face of RUFORUM, it would be one of the hundreds of students who have presented their research findings in public forums with a professional confidence that was not in evidence 20 years ago. With the ongoing support of our ever-expanding RUFORUM family, we look forward to achieving even greater things in the future.



ACRONYMS

ACP-EU	African, Caribbean and Pacific Group of States-European Union	ILRI	International Livestock Research Institute
AERC	African Economic Research Consortium	IT	information technology
AGM	annual general meeting	JKUAT	Jomo Kenyatta University of Agriculture and Technology
AGRA	Alliance for a Green Revolution in Africa	kg	kilogram/s
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa	km	kilometre/s
BMGF	Bill and Melinda Gates Foundation	Maksoy	Makerere soybean
BSc	Bachelor of Science	M&E	monitoring and evaluation
CAADP	Comprehensive African Agricultural Development Programme	MSc	Master of Science
CARP	Community Action Research Programme	NaCCRI	National Crops Resources Research Institute
CD	compact disc	Namsoy	Namulonge soybean
CGIAR	Consultative Group on International Agricultural Research	NARO	National Agricultural Research Organisation
CIAT	International Center for Tropical Agriculture	NARS	national agricultural research system/s
CIP	International Potato Center	NEPAD	New Partnership for Africa's Development
DAAD	<i>Deutscher Akademischer Austausch Dienst</i> [German Academic Exchange Service]	NERICA	New Rice for Africa
DFID	Department for International Development	NGO	non-governmental organisation
EDULINK	Cooperation Programme in Higher Education	P'kwii	Popular Knowledge Women's Initiative
FARA	Forum for Agricultural Research in Africa	PABRA	Pan African Bean Research Alliance
GDP	gross domestic product	PhD	Doctor of Philosophy
GMO	genetically modified organism	PI	principal investigator
HIV/AIDS	human immunodeficiency virus/acquired immunodeficiency syndrome	PINEP	Pastoral Information Network Programme
ICIPE	International Centre for Insect Physiology and Ecology	RAB	Rwanda Agricultural Board
ICRAF	World Agroforestry Centre	RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics	SADC	Southern African Development Community
ICT	information and communications technology	SCARDA	Strengthening Capacity for Agricultural Research and Development
IDRC	International Development Research Centre	TEEAL	The Essential Electronic Agricultural Library
IITA	International Institute for Tropical Agriculture	USAID	United States Agency for International Development

INTRODUCTION

At the National Crops Resources Research Institute in Namulonge on the outskirts of Kampala in Uganda, Luka Atwok Opiyo ventures forth almost daily to his outdoor laboratory – a stand of maize on a hillside. Even though the plants are well irrigated and carefully tended, they look stunted and discoloured. This delights Luka, who recently earned his MSc in plant breeding from Makerere University and studies resistance to turicum leaf blight and maize streak virus.

Africa is the seat of hundreds, possibly thousands, of diseases and pests that have for centuries ravaged farmers' crops. Maize is one of the continent's most important staple food crops, but harvests are frequently infected with

bacteria, viruses and fungi. Turicum leaf blight, with its characteristic cigar-shaped lesions on the leaf, can blight up to 70% of a crop. Maize streak virus, which renders leaves spotty and streaked, is even more virulent. It has been known to wipe out entire fields. Both are endemic in eastern Africa. Scientists have developed maize varieties resistant to either one or the other disease. Luka is trying to breed a new maize variety that would resist both. 'We can't adopt European research, as the ecological conditions are entirely different,' he explains.

Luka is from South Sudan, a country that in 2011 voted to secede from Sudan six years after signing a peace agreement that ended a hard-fought civil war. When Luka returned home to join the agriculture ministry's National Research Institute, he swelled the ranks of scientist to three. There was not a single plant breeder in the country. Now he and his colleague Maurice Mogga, also a plant breeder with the National Research Institute, divide their time between South Sudan and Namulonge. Having recently earned



RUFORUM reshapes the way agriculture is taught, emphasising the problems that beset farmers – climate change, environmental degradation and the diseases and pests that lay waste to crops.

their MScs in plant breeding from Makerere University, the two scientists are now working to rebuild an agricultural research system destroyed by neglect and apathy brought on by Sudan's half-century civil war. Says Maurice:

Scientifically speaking, we don't know anything about maize or rice or cassava. I intend to establish a programme for maize, beans, sorghum and rice breeding for disease resistance. It's going to be a lot of hard work, but we're going to rebuild the institute.

The challenges Luka and Maurice are facing, while more extreme than in other countries in the region, are not unique. They have been shaped by decades of shifting macro-policies on agriculture and education which, many would argue, have had far-reaching, unintended consequences.

RUFORUM is the impetus for this resurgence of intellectual prowess on university campuses through exposure to a network of people, ideas and organisations around the world and a restructuring of curricula to make them relevant to today's needs.

One way of making the agriculture sector resilient to all these dangers is through cutting-edge research that is specifically relevant to local environments and that promotes development policy and economic growth for the millions of farmers whose income hovers near the poverty line. Enter RUFORUM, the Regional Universities Forum for Capacity Building in Agriculture, the collaborative consortium of 32 universities spread

across eastern, central and southern Africa. RUFORUM was constituted in 2004 to align university research to the needs of smallholder farmers through competitive grants for masters students to conduct community participatory research.

RUFORUM is reshaping the way agriculture is taught. In the past the curricula of agriculture faculties paid little or no attention to considerations such as climate change or intensive farming methods. In fact, staff tended to remain in their 'ivory towers' rather than donning a pair of gumboots and walking in the fields with farmers. Yet diseases and pests are laying waste to crops. And rising energy prices have triggered competition with biofuels for arable land, which has invested borderline ecologies with a new importance. Today's problems demand new solutions, which call for different courses to be taught.

RUFORUM also upgrades the skills of faculty staff who teach doctoral programmes. The majority of them, having achieved their own PhDs or MScs through research, had little idea of how to oversee coursework. But with RUFORUM they learn about quality assurance, the delivery of lectures, and scientific writing, as well as pressing contemporary issues such as biotechnology and climate change. RUFORUM is the impetus for this resurgence of intellectual prowess on university campuses through exposure to a network of people, ideas and organisations around the world and a restructuring of curricula to make them relevant to today's needs.

Just as important, RUFORUM graduates are equipped to solve the problems of a changing world. They will be at the forefront of Africa's Green Revolution, re-vamping agricultural research institutions

and advising governments on policies best suited to increasing crop yields.

Small-scale agriculture remains the wellspring of livelihoods and development for 70% of Sub-Saharan Africa's population, contributing 35% of the region's GDP.

This publication chronicles RUFORUM's evolution over the past 20 years as it has developed into a diverse network that transforms communities, universities, research methods, extension systems and policy decisions across the region. Once marginalised, universities are now increasingly being recognised by African governments as indispensable for producing the local knowledge that is critical for grappling with the host of complex challenges faced by African agriculture – from markets and value chains to food security, ecological sustainability and climate change – and for harnessing the opportunities presented by increased Pan-African cooperation under the New Partnership for Africa's Development (NEPAD) and the Comprehensive African Agricultural Development Programme (CAADP).

Small-scale agriculture remains the wellspring of livelihoods and development for 70% of Sub-Saharan Africa's population, contributing 35% of the region's GDP.¹ Yet the sector has underperformed, due to the barriers farmers face in accessing the markets, technologies, infrastructure and knowledge they need to flourish. Climate change and energy access pose further adaptive challenges to farmers and researchers.

Meanwhile, a dramatic demographic transition is under way. Africa is rapidly becoming both younger and more urbanised. About 80% of the Sub-Saharan African population is below the age of 34. Such changes pose daunting challenges for the future of a region that already struggles with rising food insecurity, malnutrition and population displacement. Even so, opportunities abound – particularly with the emergence of new technologies and of innovations, which have the potential to move farmers from subsistence to prosperity.

Universities play a critical role in creating a pipeline of talent and generating scientific discovery to support these transitions. Within this larger context, RUFORUM has been the conduit for hundreds of young researchers who are pursuing reputable careers, and for pioneering methods, such as the Mbili intercropping system in Kenya that now benefit tens of thousands of people in farming communities. Research has supported the uptake of 'orphan' crops, like amaranth and sorghum, and the development of new markets and enterprises. Collaborations have opened up new pathways and possibilities for smallholder farmers to realise their potential for being innovators and entrepreneurs as well as farmers.

These are some of the trends that are highlighted in the following chapters. They trace the course of RUFORUM's growth from a concept to a fully fledged organisation of international stature. They tell the stories of the people who have played a part in this evolution. They record the part RUFORUM has played in researching new crop varieties, linking farmers to markets through innovative value chains, improving yields through intercropping systems, introducing new techniques such as conservation

agriculture for farmers working ecologically fragile land, and much more.

Chapters 1 to 4 outline the history of RUFORUM's growth. Chapters 5 and 6 look at the regional training programmes, which are pioneering models of post-graduate education designed to fill the gap left by generations of brain drain and under-investment in higher education. The regional training programmes have become the hallmark of RUFORUM's contribution to nurturing a new generation of African scientists.

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Chapter 7 charts how RUFORUM has been the catalyst for linking universities to national agricultural research systems. Chapter 8 relates how the network has served to bring researchers and

universities into alignment with both macro-policy processes like CAADP and grassroots agrarian communities through participatory research, especially the Community Action Research Programme (CARP). Through such engagement, researchers have served as bridges between these two worlds, joining conceptual theory to practice by developing the research that leads to new value chains and innovation platforms.

Chapter 9 examines RUFORUM's contribution to strengthening member universities so that they are better equipped to support and drive innovation, knowledge and policy development. Chapter 10 looks at how the internal structures of the network have evolved, and how information and communications technology (ICT), monitoring and evaluation (M&E) and a gender policy have been deployed throughout the network.

Finally, Chapter 11 explores how the ideas, technologies and innovations issuing from RUFORUM's member universities have reverberated throughout the region to reach a wide community of people who will ultimately benefit from this knowledge.

Note

1. RUFORUM grant proposal to BMGF, January 2009

CHAPTER 1 FORUM LOOKS TO THE FARMERS

In the 1960s the work of scientists at universities and national agricultural research institutes was of a calibre that kept pests and crop diseases in check. But during the 1970s and 1980s industrialisation became the development mantra. As government interest in the agriculture sector faded, experienced scientists moved on and were not replaced. It was the commonly held view that families were able to live reasonably well off the land except when the rains failed. When planners mentioned crops, their concern was not to feed their fellow countrymen but to grow cash crops for export to bolster foreign exchange reserves. Consequently investment in research and postgraduate agriculture degrees virtually dried up. Instead donors urged governments to educate the masses and to industrialise. New catch phrases were bandied about – universal primary education and expanding the manufacturing base. At some universities, budgets were cut by 80%, partly because of the institutions' lacklustre performance and failure to meet investors' expectations. The decline was to continue. In the 1990s, among 27 African countries, half experienced a drop in the number of researchers.²

The fallout from this neglect was considerable. There were no funds to upgrade laboratories and classrooms or to pay faculty staff salaries that were commensurate with their experience, expertise and hard work. While the intake of students increased by a

factor of 17, the money did not keep pace. Auditoriums were packed, but there was no chalk for writing on the blackboard. Because there was no money, students failed to get hands-on laboratory and field experience. The demoralised faculty began to look for jobs elsewhere. Inevitably, standards dropped. Courses were not updated to reflect contemporary issues such as biotechnology and climate change. This diluted the quality and relevance of graduate work. The students' enthusiasm dimmed. They migrated to other disciplines or, for those who could afford it, to universities outside Africa.

The knock-on effect showed up in the national agricultural research organisations. They sent some of their scientists overseas to be trained but could not afford to do this with all of them. The staff that were recruited from African university campuses did not have the requisite skills to meet the demands of the job. The ranks of scientists with doctoral degrees began to thin. In many cases, research stations were being managed by scientists with only a bachelor degree. To make matters worse, research scientists who went abroad to get their degrees tended to stay there, lured by generous salaries and state-of-the-art laboratories. Even though there was a rise in the demand for food crops from steadily growing urban populations, price controls on staple foods robbed farmers of their incentive to produce. Instead of improving farming

methods to produce higher yields, they retreated into subsistence. Africa was losing an entire generation of agricultural scientists to brain drain just when they were needed the most.

Public expenditure on agriculture averaged about half of what was being spent in Asia, where the Green Revolution was flourishing. Asian output was literally rooted in high-yield wheat and rice varieties that had been developed then released to farmers in the 1960s through initiatives supported by the Rockefeller Foundation. International research organisations had tried to import the Asian model into Africa without much success. It was hardly surprising. While Asian climate zones tend to be homogeneous, African ecosystems can change within a few hours' drive. And with its reliable water supplies, good infrastructure and developed markets, Asia had a clear head start on Africa.

Decision-makers at the international research organisations soon realised that African problems called for uniquely African solutions. Yet there was no guarantee that African universities were capable of turning out graduates equipped to meet the challenge. The conventional curricula ignored considerations such as climate diversity and intensive farming methods. Faculty were of the opinion that their job was to teach, not to take into account what farmers needed.

Postgraduate degrees were part of the answer, but governments and donors favoured strengthening the individual over the institution. They believed that students should travel outside Africa to win their doctorates. This higher education model had obvious limitations. It could not be implemented on a large scale. This meant that countries would

never be able to create the critical mass of skills and knowledge needed to revitalise and reform agriculture systems and, by extension, move farmers out of poverty.

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This was the environment at the beginning of the 1990s, when a coterie of like-minded visionaries decided there had to be a major shift in how agriculture was taught. Not only had the continent to be able to feed itself, they said, but agriculture should be an engine of economic growth for the masses. And for that to happen, the agriculture sector had to rebuild its human capital. At the centre of this thinking was the prestigious Rockefeller Foundation, the philanthropic organisation that had been the mainspring of the Green Revolution.

Prof. Malcolm Blackie, a Zimbabwean with an abiding passion for education and agriculture, was already in the vanguard of academic revival. In 1980 he had been invited to establish a faculty of agriculture at the University of Zimbabwe. According to Malcolm, the university – in fact Zimbabwe's entire agriculture system – was divorced from the reality

of the daily lives of smallholders. The research stations were well funded and staffed, but they existed to support the large commercial farms. Most graduate training was done in South Africa, where there was no tradition of research linked to the needs of small farmers. Such was the demoralised state of the agriculture faculty that, the year he arrived, the faculty had an intake of just six students even though the entry standards were low.

Malcolm was fortunate enough to be sent Prof. Carl Eicher, one of Africa's pre-eminent agricultural development experts, to help him upgrade his department. Within three years the student intake had increased to 100 even though the university had raised the bar for entry requirements. But it was not all plain sailing. Malcolm knew that in order to achieve excellence, the agriculture faculty needed postgraduate students with innovative theories that Zimbabweans could put into practice in their fields. However, the government research centres refused to allow the faculty to use their premises, claiming the university should stick to what it knew best – academic research. And donors were not interested in postgraduate programmes. 'Funding a few African students to work in their own country and with their own farmers was not a priority,' says Malcolm.

In 1986 Malcolm was recruited into the Agricultural Sciences Division of the Rockefeller Foundation as a field scientist. His job was to create a programme for agricultural research in southern Africa. At one of the staff meetings he met Joyce Moock, then a Rockefeller associate vice-president. Behind her unassuming manner lay an enviable clarity of vision. Joyce was convinced that masters-level graduates were the

fulcrum for agricultural expansion:

If you're going to do a deep investment in science, then you want to make it at PhD level for germplasm and things like that. But where are the leverage points if you only have a little bit of money? If you're building the base for higher education to eventually regenerate quality PhDs, and you also want to affect the undergraduate curriculum, the leverage point is at masters level. What's more, people are more likely to be persuaded to stay in the country for a masters degree than a doctorate – so the sticking power is stronger.

Joyce commissioned Malcolm Blackie and John Lynam, who headed Rockefeller's Food Security Division in Kenya, to review the agriculture faculties of nine universities³ in five southern and eastern African countries. Their task was to assess the faculties' potential for conducting applied and adaptive research on smallholder food-production systems. Their findings echoed the stumbling blocks that had ambushed the programmes at the University of Zimbabwe when Malcolm was dean. The rundown state of the facilities did not attract good students. There were few opportunities for field work. Graduate funding was hard to come by. Professors struggled to make ends meet. Most critically, research topics did not reflect the farmers' priorities.

Rockefeller had always valued indigenous knowledge as well as human capital, but upgrading the universities was well beyond its means. However, developing quality masters programmes at the better endowed universities of eastern and southern Africa was a realistic objective. In 1992 Rockefeller established the Forum for Agricultural Resource Husbandry – better known as Forum – with a start-up tranche of US\$350,000. Forum's area

of operation covered the five countries where Rockefeller had programmes: Kenya, Malawi, Mozambique, Uganda and Zimbabwe. For the next six years (1993–1998) the annual allocation was US\$900,000. In 1999 it was increased to US\$1.3 million. At Forum's zenith, Rockefeller's Food Security Division was allocating US\$2 million annually.

Bringing training back home to Africa was a cost-effective and sustainable way of replenishing the continent's ranks of high-performing scientists.

The blueprint for Forum was a groundbreaking model used by the African Economic Research Consortium (AERC), which had been established in 1988 under the auspices of Rockefeller and Canada's International Development Research Centre (IDRC). The AERC programme was intended to resurrect a robust professional community. Grants were made competitive and open to institutions in a number of countries in order to elicit strong proposals. Forum offered faculty staff modest competitive grants of US\$60,000 for masters students. The grants broke with convention in that they were contracts with individual principal investigators (PIs) rather than open-ended, non-specific awards to universities. Proposals had to include an external partner – a farmers' organisation, a supply firm, an NGO – and the research had to be relevant to the partner. Proposals were reviewed initially by specialists in the field and ultimately by a small advisory panel. The advisory panel did not make the awards, but it was implicit that ignoring their advice would need sound justification. Priorities were set locally –

not by Rockefeller. Funds were disbursed directly to the universities, and grantees were expected to report back regularly on their progress.

Rockefeller envisaged that the graduates would acquire practical orientation and strong problem-solving skills to enrich the agriculture sector when they entered it as trainers, extension workers and programme managers in national research organisations and development agencies. Bringing training back home to Africa was a cost-effective and sustainable way of replenishing the continent's ranks of high-performing scientists.

Malcolm Blackie and John Lynam advanced this thinking further. They knew that farmers did not have access to low-technology solutions to increase yields. This made it virtually impossible for farmers to capitalise on any policy improvements being handed down by the government. Why not involve farmers in the early stages of varietal selection, Malcolm and John reasoned, so that plant breeding was tailored to local soil and rainfall patterns. This meant moving away from research institutes, and planting in farmers' fields where they could evaluate and monitor the crops themselves. By collaborating with farmers and listening to their solutions as well as their problems, researchers could come up with interventions that made practical sense. The theory was sound but risky. Donors had never shown enthusiasm for funding participatory research. Even so, it was decided that grant proposals would be evaluated on their strategic importance to smallholder food production. In other words, an application was judged on the merits of its benefit to small farmers and whether the outcome would be easy to apply in smallholdings. Proposals were expected to focus on resource husbandry in

the form of crop, pest, soil and water management.

Rockefeller viewed Forum as a work in progress. The programme would recalibrate and improve as it went along. This pertained to the universities as well as their scientists. A Student Development Fund was created to provide equipment to university laboratories. Another objective was to improve the university curricula. As grantee students pursued their research, they were encouraged to give feedback to Forum whenever they encountered obstacles. Access to TEEAL (The Essential Electronic Agricultural Library) and supplemental training in biometrics were both introduced as a result of concerns raised by students.

A tight group of like-minded scientists was actively involved in shaping Forum during its fledgling days. Prof. David Ngugi, Robbie Mupawose and Andy Wilson were the founding members of the Forum advisory board. David, a Kenyan, was dean of the agriculture faculty at Nairobi University. Robbie served as the permanent secretary in Zimbabwe's agriculture ministry. And Andy was Zimbabwe's chief research officer. He later headed Britain's agricultural research development programmes in what was then the ODA (Overseas Development Assistance). Dr Bharati Patel and Paul Woomeer were also among those who put their energy and faith into the creation of Forum. A common thread ran through the group's thinking. They had noted Africa's emerging food deficits and judged that food security should be the primary goal of the agricultural development agenda. The responsibility for achieving this, they argued, lay with well-trained, free-thinking African scientists.

Bharati Patel, who had been one of

only 70 graduates in Zambia at the time of the country's independence in 1964, had studied fungi and nematode interactions for her PhD in plant pathology. During the 1980s she had headed the research department in Zambia's Ministry of Agriculture and then joined the governing board of the



As head of Forum, Bharati Patel encouraged independent thinking, innovation, and publication in internationally recognised scientific journals. As a result, the careers of MSc graduates advanced rapidly.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. It was while she was at ICRISAT that she attended a meeting in Nairobi where the creation of Forum was being discussed. Malcolm Blackie and David Ngugi were there too, as was Bob Herdt, Rockefeller's director of agricultural sciences.

Bharati's jovial nature and passion for her work were evident. She got the best out of people while having the foresight to pre-empt problems. In 1992 Bob asked her if she would run Forum. She declined, saying she needed to recharge her batteries first, and suggested he hire someone else. Rather than take no for

an answer, Bob kept the appointment open. Meanwhile, Malcolm was running the Forum programmes for Zimbabwe and Malawi out of Lilongwe in addition to his regular assignments. John, in Nairobi, was his counterpart for Kenya and Uganda.

Once faculty and the farmers they worked with understood the principles of the programme, the uptake expanded rapidly. Forum quickly became too big to be run by Malcolm and John on a part-time basis. It needed someone professional who could give it their full attention. A year later, in 1993, Bharati wrote to Bob to say she was ready to come on board. 'Welcome home,' Bob replied. 'These are your terms of reference. Respect everyone. Reply to emails within 72 hours. Have faith people are doing the right thing. Don't be a policewoman.' With this blessing Bharati joined Malcolm in Lilongwe in a posting at Forum's helm that was to last for the duration of the project.

'These are your terms of reference. Respect everyone. Reply to emails within 72 hours. Have faith people are doing the right thing.'

One of the first things Bharati did was to hire a soil scientist, affiliated with the University of Nairobi, called Paul Woomeer. She assigned him the task of creating training programmes. Paul was later to assist Forum researchers in examining the role of grain legumes in integrated striga management and designing the Mbili (the Swahili word for 'two') maize-legume intercropping technology that disrupts pest and disease cycles. Mbili technology also

introduced symbiotic nitrogen fixation. It was adopted wholesale by farmers in western Kenya.

Forum created three types of grants – preparation, initial and supporting – to ensure that as many good ideas as possible saw the light of day. Preparation grants supported further grant development by funding surveys and pilot studies. One-year initial grants allowed PIs to recruit students, carry out literature reviews and conduct preliminary research. Each supporting grant was for US\$60,000, which was disbursed to a PI and two students for a period of two to three years.

'I wanted to raise the bar but not make it so high that no one could jump over it. It was hard at first. No one wanted to apply for a grant and not get it,' Bharati explained. Progress was slow because the applicants were trying to second-guess Rockefeller's priorities, while Forum was looking for research that attended to farmers' priorities. In another departure from convention, rather than turn down proposals that were off the mark but offered potential, Forum nurtured them through several versions until they were of a standard that met Bharati's raised bar. It was 18 months before Forum made the first grant, but once the research concept was understood, the programme took off.

Bharati added a further degree of rigour to the Forum programme by stressing equality, transparency and learning through doing. She treated the students and faculty equally. She required the students to organise the retreats and meetings. She taught grantees proposal writing. And she encouraged students to debate with their supervisors. The students in turn tested Bharati. 'The Zimbabweans got me in and out of

the Land Rover 100 times to see if I could take it,' she says. 'That was in the Zambezi Valley, where it's darned hot. I visited as many field trials as I could, and I told them I could drink them under the table.'

'The harvest was so big they had to buy a lorry to take the crop to market.'

In 2000 Bob Herdt flew out from New York to accompany Bharati on a Zimbabwe trip to visit some of the field trials. They were hosted by Sheunesu Mpepereki, a professor of soil science at the University of Zimbabwe, and the PI for a grant to enhance soybean yields in smallholder maize-based cropping systems. Says Bharati:

The harvest was so big they had to buy a lorry to take the crop to market. We went the whole hog in that project, even concocting recipes with soybean flour. All the farmers wanted trials in their fields. When the whole village turns out to thank you and when the shops are emptied with the money made from the harvest, then you know you're getting somewhere.

In 1994, two years after Forum's formation, Bharati, John Lynam and Malcolm Blackie approved a grant to support the *African Crop Science Journal*, a peer-reviewed international quarterly that publishes original research papers. One of Bharati's goals, she says, 'was that Africans find their place in the scientific community and that they don't feel second class. I think we've achieved that. African scientists now have a confidence you didn't see before.'

By the time the programme was concluded, 12 years after it had begun,

nearly 250 students had already graduated, with 220 of them getting their theses published, many of them in the *African Crop Science Journal*. Most of the graduates had returned to their positions as faculty staff, or scientists at national and international research institutes. Others had gone on to do PhDs. Grantees had found their careers advancing rapidly because they had been published in internationally recognised scientific journals. Several had become deans, department chairs or full professors. Participating universities had ventured into new fields such as biotechnology and biosafety. The universities were retaining their staff, expanding their programmes and forging international and regional alliances.

'When the whole village turns out to thank you and when the shops are emptied with the money made from the harvest, then you know you're getting somewhere.'

Judged by any yardstick, Forum was a success. It was time to take the concept a step further and hand over the reins to African scientists and academics.



Notes

2. *World Development Report 2008, Agriculture for Development*, World Bank
3. Egerton University, Kenyatta University, Moi University, University of Nairobi, Bunda Agricultural College, Eduardo Mondlane University, Makerere University, Africa University, University of Zimbabwe

CHAPTER 2 THE UNIVERSITIES STEP IN

The Rockefeller Foundation had expected that Forum would be in operation for at least five years. As it turned out, the programme continued for a dozen years. By 2003, its final year, the greater part of Rockefeller's commitment of US\$14.5 million had been used to award 314 grants to PIs at universities in Kenya, Malawi, Mozambique, Uganda and Zimbabwe.⁴ About half the students had researched methods to improve crops or subjects related to this. Another third had worked on topics related to soil. Fewer than one out of five had opted to do research involving social science. Less than a handful had chosen animal science.

Forum had been instrumental in rehabilitating agriculture faculties, raising teaching standards and, in some instances, improving curricula. The rate of completion of MSc degrees had accelerated from up to seven years to an average of 2.7 years. This was partly due to making programmes residential. The other reason was that students and PIs alike were given stipends to cover living costs. They no longer had to supplement their incomes during the research period by taking on outside consultancies.

Forum had also supplied computers, laboratory and field equipment, and TEEAL so that students could read literature that previously had been inaccessible. Students surveyed after graduation said that by working side by side with farmers in the fields and being

part of participatory rural appraisals, they had learned how to take farmers' problems to the laboratory and find solutions.

As mentioned in the previous chapter, by the time that Forum came to an end, most of its alumni had returned to their jobs at universities or national and international research institutes. Almost without exception, their ambition was to continue their studies with a doctorate, although only some were able to do so. In general though their careers were boosted by their Forum involvement, and several of the university participants went on to advance in the hierarchy of their institutions. University curricula were also improved by the universities' Forum participation, with institutions venturing into new fields such as biotechnology and biosafety. Overall, the universities were retaining their staff, expanding their programmes and forging international and regional alliances.

As further proof of the programme's effectiveness, contacts initially made through Forum had evolved into formal collaboration between universities. In one instance, because Mozambique's Eduardo Mondlane University and Zimbabwe's Africa University did not have accredited MSc programmes in agricultural science, the grantees arranged to have students registered and supervised by counterparts at the University of Zimbabwe.

Another example of Forum's effectiveness was a collaborative proposal on small-holder soybean production. It had been prepared by investigators from the University of Malawi – where there was experience in on-farm research – and an investigator in the biological-nitrogen-fixation laboratory at the University of Zimbabwe. The project developed new soybean varieties that did not require inoculation with specific rhizobia bacteria before planting. These 'promiscuous' soybean varieties held great potential for cultivation by resource-poor farmers because they were able to nodulate with naturally occurring rhizobia and to fix nitrogen effectively. Existing commercial soybean varieties required the purchase of expensive artificial inoculants. The new varieties eliminated these costs. Zimbank (the Zimbabwe Banking Corporation) was so impressed by the project that it committed additional research funding. And a Zimbabwean seed company ensured the project's continuation by providing eight postgraduate fellowships. The support was particularly welcome as it came at a time when Zimbabwe government funding for research was virtually non-existent. The government acknowledged the project's success by asking the University of Zimbabwe to lead a national programme on strengthening farming systems.

As part of its Forum involvement, in Kenya the University of Nairobi had provided legume inoculants for on-farm trials conducted by Moi University to improve soil fertility. The package combined a slow P-release rock phosphate, a nitrogen source (urea), an inoculant, and a legume-crop seed. The phosphorus combined with residual fixed nitrogen and organic inputs from the legume enhanced soil fertility and crop productivity over several seasons. Known as Prep-Pac, it was taken up by

entrepreneurs for distribution following the successful validation of its profitability by farmers in western Kenya.

Through Forum, participating universities had seen firsthand the benefits of working with small-scale farmers, extension officers and others involved in agricultural development. Interdisciplinary research projects had brought together faculty members from different departments. However, the greatest plus was that grants approved by Forum had sent students and faculty to the field. Before Forum, students rarely spent time with farmers. Most postgraduate research had been limited to laboratories, secondary literature and, where they existed, university farms. Now researchers were linking farmers' basic problems to the macro perspective of planning and policy. As a result, they were gaining a greater sense of social responsibility through their genuinely useful contributions to development.

Forum had achieved most of what it had set out to do. It had brought training back home to Africa and proved that its approach was a cost-effective and sustainable way of replenishing the continent's ranks of scientists of international stature. National agricultural research institutions had begun to retain and slowly attract good scientists. And by redirecting the thrust of research to the farmers, universities were now active collaborators with national research programmes. Forum's initial intention had been to create graduates with a practical orientation and strong problem-solving skills that would enrich the agriculture sector when they entered it as trainers, extension workers and programme managers in national research organisations and development agencies. This vision was becoming a reality.

'An organisation owned and directed by Africans offered a level playing field that could build a diversified funding base. It was a leap of faith to back away and test whether Forum had both the stability and creativity to grow. Rockefeller took a managed risk, which turned out to be a very good thing.'

Despite Forum's success, there was still a considerable way to go along the path to reform. An exodus of qualified personnel to better-paid jobs abroad had created a greying scientific population. Most national research systems employed fewer than 100 scientists. Nearly two-thirds of them were over the age of 50. This held true for public universities as well. And there were other problems. Universities were still not talking to one another enough. Cross-faculty collaboration – agriculture and medicine being one example – did not exist. And curricula did not approach learning from a holistic viewpoint. Overall, there had been no fundamental institutional reform to enable the mass production of practical, field-oriented scholars.

Joyce Moock observes:

Forum needed to expand to the next stage. It was time to hand over the reins to African scientists and academics. It was logical. Forum was the first competitive grants agricultural programme in southern and eastern Africa. If it remained a Rockefeller Foundation project, no other funder would support it. An organisation owned and directed by Africans offered a level playing field that could build a diversified funding base. It was a leap of faith to back away and test

whether Forum had both the stability and creativity to grow. Rockefeller took a managed risk, which turned out to be a very good thing.

In 2002 Rockefeller redirected the thrust of its agricultural strategy away from Forum objectives, to promote soil productivity, access to markets, and improved crop varieties using marker-aided selection and selective biotechnology. The timing was right to hand over the Forum concept to the universities. The foundation commissioned a report that would provide the framework for phase two of the programme.⁵ There were three objectives: place programme management in African hands; retool strategy to accommodate changing needs and opportunities; and package and market the programme to broaden donor support. It was a rite of passage common to projects where fresh concepts have been validated through practice. Ideas tabled by a group of dedicated professionals had gained currency through their implementation. Now they needed to undergo the transition from donor programme to a formally recognised African institution.

The deans of the participating faculties understood the importance of transforming Forum into a permanent entity, but the vice-chancellors had yet to be persuaded. It fell to the three men tasked with writing the report to bring them on board. Team leader Prof. David Norman was a professor emeritus of agricultural economics at Kansas State University. Earlier that year Rockefeller had funded him to conduct a feasibility study for creating an MSc degree programme in agricultural and applied economics that would be used at several universities on the continent.⁶ He was later to be inducted as a distinguished fellow of the African

Association of Agricultural Economists for his contributions to agriculture in Africa.

'The programme was attractive to them because it trained researchers to write proposals and advised them on research designs and statistical packages. At the same time, research that had already been published was uncovering new problems such as the sociological implications of adoption technologies. Some of the findings were crying out to be commercialised.'

His colleague Harris Mule had headed the advisory committee that successfully guided the proposal for this MSc programme to fruition. As the permanent secretary in Kenya's finance ministry, Harris had earned kudos for his thoughtful oversight of policy and planning. Since his retirement from the civil service he had been consulting in macroeconomic policy, economic governance and agricultural development.

David Ngugi, a genial man with a passion for education, sat on the Forum advisory board. He was ideally suited to the task of assessing universities and winning over a dozen or so vice-chancellors to the notion of piloting a renaissance in agricultural education. During the 1980s he had been dean of agriculture at Nairobi University. He had spent the 1990s in Malawi as the World Agroforestry Centre's (ICRAF) regional coordinator for southern Africa. While there he had run a regional training programme in agriculture and forestry for university students.

David explains:

Universities in Kenya, Uganda and Zimbabwe were knocking on Forum's door for funding. The programme was attractive to them because it trained researchers to write proposals and advised them on research designs and statistical packages. At the same time, research that had already been published was uncovering new problems such as the sociological implications of adoption technologies. Some of the findings were crying out to be commercialised. It was getting complex. We couldn't move forward without broadening the funding base. We were aware that donors tended to commit geographically. We only worked with 10 universities. We had to spread ourselves wider.

The faculty deans and the heads of department had long been converts to the Forum concept. Improved curricula, financial stipends to underwrite intensive teaching, on-farm learning, publishing opportunities and up-to-date equipment had added lustre to institutional reputations. The trick was to persuade their vice-chancellors of these benefits. The team visited the Eduardo Mondlane University in Mozambique; Kenyatta and Moi Universities, the Jomo Kenyatta University of Agriculture and Technology (JKUAT) and the University of Nairobi in Kenya; the University of Malawi; and Makerere University in Uganda. The marketing exercise went better than expected. The vice-chancellors had always competed among themselves for development assistance. The Forum concept offered an opportunity to amalgamate their individual strengths to gain a collective competitive edge over other universities. They were also attracted by the concept of ending their intellectual isolation through inter-university cooperation. When the conversation turned to sustainability,

the vice-chancellors did not balk at the annual US\$5,000 subscription. Their ivory towers were being dismantled without a murmur of protest.

By this time Bharati Patel had resigned from Forum, and Dr John Lynam had been appointed as an interim coordinator until an African could be found to replace Bharati. It was a part-time post in addition to his job as associate director of the Food Security Division in Rockefeller's Nairobi office.

'It actually went very smoothly. The sub was sufficiently high to show commitment. That was part of the philosophy,' says John. He continues: *They realised that being part of this regional consortium provided institutional linkage. It gave them access to fora such as ASARECA (the Association for Strengthening Agricultural Research in Eastern and Central Africa) and FARA (the Forum for Agricultural Research in Africa) and CAADP. It was the sort of networking that leads to developing projects with donors.*

Universities had limited access to research findings. The government budget line for research was destined for the national research organisations. So if professors wanted to do research they had to be motivated enough to go and look for funding. There were very few programmes that provided grants on an individual basis. A dedicated programme for research and publishing was something to hang on to tight.

By 2003, the final year of Forum operations, the stage was set for the launch of the Regional Universities Forum for Capacity Building in Agriculture, which soon became known by its acronym, RUFORUM. In January 2004, 10 vice-chancellors from five countries signed

a memorandum of understanding.⁷ By June it was operational. In August 2005 support for the venture was formalised in an endorsement signed by NEPAD and the minister for education from each of the member countries. That same month a 10-year strategic plan (2006–2015) and a five-year business plan (2006–2010) were approved at the first annual general meeting (AGM). Both documents had been formulated by RUFORUM members and government development managers and were tailored to national needs. They emphasised partnership, networking and practical results.

'If professors wanted to do research they had to be motivated enough to go and look for funding. There were very few programmes that provided grants on an individual basis. A dedicated programme for research and publishing was something to hang on to tight.'

Tanzania's Sokoine University of Agriculture and the University of Zambia were admitted into RUFORUM at the 2005 AGM, bringing membership to a dozen. No one could have been more pleased than Sokoine's dean of agriculture, who had lobbied hard for admission at Forum's 2002 biennial meeting. Sokoine was known to have one of the strongest agriculture faculties in the region, but in those early days funding for RUFORUM was uncertain. It was felt that, despite Sokoine's reputation, it was too soon to expand membership beyond the countries where Forum already had a presence. The inclusion of Tanzania and Zambia was not only a vote of confidence in the universities but also

in RUFORUM's ability to secure funding for an expanding organisation.

The first governance body to be constituted was the board of directors.⁸ It consisted of one vice-chancellor from each RUFORUM member country plus three members representing the scientific community and the private sector. It had been agreed that the leadership would rotate annually. The founding chair was the vice-chancellor of Makerere, Prof. John Ssebuwufu. In the early days this dynamic man had been the driving force in winning over his colleagues to the benefits of coalescing as a consortium. His vice-chair was Prof. David Rubadiri, the outgoing vice-chancellor of the University of Malawi. He had been recognised at the first AGM for his outstanding contributions to education and literature in Africa. Ssebuwufu was subsequently replaced by Prof. Livingstone Luboobi, while Rubadiri

was followed by Prof. Kadzimira Zimani.

As it turned out, allocating one vote per country became a contentious issue, particularly for Kenyans as five of their universities were paid-up RUFORUM members. It soon became clear that each university wanted a seat on the board. As John Lynam puts it: "You can pay your subs, but you can't have a voice." It wasn't a good recruiting slogan.' It was agreed in 2006 to expand board membership to all RUFORUM member universities.

The Technical Advisory Committee, which was also constituted in 2004, consisted of six representatives from among the RUFORUM member faculties and six representatives from outside the university system. Its job was to oversee the competitive grants programme. A prerequisite was to have a gender balance of six women and six men. The



Uganda's Makerere University is one of RUFORUM's 10 founding members. As the network's first chair, its then vice-chancellor, Prof. John Ssebuwufu, offered the secretariat accommodation on campus

founding chair was Prof. Kay Leresche, a policy economist and former chair of the Department of Agricultural Economics at the University of Zimbabwe. A perennially committed friend of RUFORUM, she has remained on the committee ever since and was voted back in as chair in 2008. By the end of the first year, the committee had awarded 34 competitive grants and five nurturing grants to polish proposal-writing skills.

Once the board had been constituted and RUFORUM had become a legal entity as a non-profit limited company,⁹ the hunt began for a chief executive for the regional secretariat.

'She was really tough so she drove standards up. She would never allow the students' work to sit on their PIs' desks for months on end. And she insisted the students had a proper chance to present their data.'

One candidate stood head and shoulders above the rest. He held a PhD in plant pathology from Ohio State University and had been the PI for seven Forum grants, primarily for research on cowpeas. His name was Prof. Adipala Ekwamu. He had already made a name for himself, not only for his research but as the editor of the *African Crop Science Journal* and as a lecturer in the Department of Crop Science at Makerere. His passion for education and the persuasive alchemy of vision, charisma and compassion that he brought to his work made him an obvious choice. At the time, Adipala was being interviewed for secretary general of the Consultative Group on International Agricultural Research (CGIAR). RUFORUM won out because,



Founding Executive Secretary Prof. Adipala Ekwamu has a PhD in plant pathology and a vision for RUFORUM grantees. They must surpass his own impressive track record in field research.

he says, 'I have always enjoyed working with graduate students and moulding them to become better than me.'

Bharati had left big shoes to fill. The hallmarks of her tenure had been empathy, fairness, transparency and integrity. 'Bharati had done a superb job,' comments Malcolm Blackie. 'She was really tough so she drove standards up. She would never allow the students' work to sit on their PIs' desks for months on end. And she insisted the students had a proper chance to present their data.' At the closing ceremony of Forum's fifth – and last – biennial meeting, held in Entebbe in August 2002, Bharati received four standing ovations. She heartily endorsed Adipala's appointment. 'I'd always said I'd hand over to somebody after 10 years. I had my eye on Adipala, but it wasn't decided by me. It was decided by the universities.'

Joyce Moock recalls Adipala as having a magnetic personality that made him

popular with faculty heads. *They wanted him to take the leading role. I remember meeting him in Kenya and asking him what he wanted to accomplish. He said he wanted employable graduates. He was concerned about their career track. But his vision went beyond that. He wanted satisfied farmers who increased their income and contributed to economic growth through agriculture. He wanted to support research that paid attention to value chains and marketing and that adapted to the changes in the land and climate.*

In addition to assuming Bharati's responsibilities, Adipala was expected to fundraise and manage an independent secretariat. It initially consisted of a finance officer, Jacob Makobu; a programme associate, Patricia Masanganise; a secretary, Hellen Kongai; and Francis Latigo and Jackson Lubega, the two drivers. Adipala's first task was to

demonstrate to Rockefeller and potential donors that there would be no hiatus in the quality of research and that the financial management would continue to be transparent.

Beyond that, Adipala had to consider the shape and scope of the RUFORUM mandate. Forum had restricted research grants to agronomy, crop improvement (including weed management) primarily for maize and bananas, soil and water conservation, pest and disease management, socio-economics and agricultural economics. Of the funding allocated to grants, 68% had gone to crop-related research, 21% to soil-related technology, 10% to social science and 1% to animal science.

The programme had never approved grants for livestock production or pure plant breeding. Plant breeding, which is long term, was considered to be the purview of national research institutions.



Driver Francis Latigo, one of the original six-strong team when the secretariat started up in 2004.

However, the universities' PIs had been putting forward persuasive arguments that research should extend to livestock and dairy production, food processing and aquaculture. Fish ponds were becoming popular in Kenya and Malawi and aquaculture was already on the curriculum at Moi University and the University of Malawi's Bunda College of Agriculture.

The report led by David Norman had suggested that confining research to maize and bananas was too narrow, particularly as millet and sorghum were the staples in many of the mini ecosystems covered by RUFORUM. Based on the principle of achieving food security, the report said, research had to include other types of cropping systems, aquaculture, smallholder dairy production, small ruminants, natural resource management and agroforestry. Curricula needed serious review in other areas too. Students were weak in biometrics, especially the analysis of on-farm data. Neither were they proficient at using the internet, email and computers. The report suggested a course on management, marketing, budgets, business plans and economic data analysis.

On the governance side, there had been an imbalance of grant allocations. Under Forum, Makerere had received the lion's share (38%). This was largely due to the faculty's preliminary internal review system that ensured that proposals were of a high standard before they were submitted. To guarantee an equitable distribution of resources, it was decided that 20% of the grant budget would be earmarked for less advantaged universities so that they could develop their human capital. In addition, no single university would receive more than 30% of the balance of the funds.

For the first few months after RUFORUM's inception, the board members held their meetings with John Lynam in Nairobi hotels. Then Makerere University, with strong backing from the Ugandan government, offered RUFORUM accommodation rent-free in one of the red-brick staff houses on campus. It stands half-hidden by a hedge on the slope of a hill, topped by a clay-tile roof. The secretariat set up shop in its bedrooms and around a large table in what was once the living room. RUFORUM is housed there to this day.



Notes

4. *An Assessment of RUFORUM*, Peeter Pats, Kunskapsutveckling, October 2006
5. *Forum for Agricultural Resource Husbandry: Overview and Proposal for Future Direction*, June–November 2002, Harris Mule, David Ngugi, David Norman
6. *The Status of Agricultural Economics in Selected Countries in Eastern and Southern Africa*, Marios Obwona and David Norman, 2002, International Food Policy Research Institute (IFPRI)
7. The founding members were Kenya's Egerton University, Jomo Kenyatta University of Agriculture and Technology, Kenyatta University, Moi University and the University of Nairobi; Malawi's University of Malawi; Mozambique's Eduardo Mondlane University; Uganda's Makerere University; and Zimbabwe's Africa University and University of Zimbabwe. Tanzania's Sokoine University of Agriculture and Zambia's University of Zambia joined in 2005.
8. Prof. John Ssebuwufu, Makerere University; Prof. David Rubadiri, University of Malawi; Prof. George Magoha, University of Nairobi; Prof. Levi Nyagura, University of Zimbabwe; Prof. Brazao Mazula, Eduardo Mondlane University; Dr Richard Mkandawire, agricultural advisor to NEPAD; Dr Samuel Muchena, managing director, African Centre for Fertiliser Development; Zimbabwe; Ms Njabulo Nduli, deputy director general, National Department of Agriculture, South Africa
9. It changed its status to an international non-governmental organisation in 2010.

CHAPTER 3 THE EARLY DAYS

Norah Ebukalin lay pressed against the side of an anthill, her feet pointing to the stars and her head on the ground. It was a moonless night and she hoped that her silhouette would be indistinguishable from the protective shape of the anthill. She clutched her baby to her chest and prayed that it would not cry and betray their whereabouts. Minutes earlier, rebels had attacked the house. Taken off guard, her husband had run in one direction, Norah in another. She could hear the men moving in the bushes, stealthily, with little noise.

'The rebels came and asked where the soldiers were. If you said you didn't know, they beat you or even killed you. The soldiers asked if we were sheltering the rebels. They beat us whatever we said. Those were terrible times.'

Norah and her husband, Rev. Sam Ebukalin, owned the only house in the neighbourhood that boasted brick walls and a corrugated iron roof. For the rebels



Norah and Sam Ebukalin's brick house provided refuge from raiding rebels. The women who hid there later founded the farming cooperative P'kwii.

and bandits who regularly raided this part of Bukedea in eastern Uganda's Kumi District, this suggested that it was a military outpost that garrisoned soldiers. They exercised caution around Norah's house, but the raids never stopped. So quiet was the night that even Norah's shallow breathing seemed to thunder in her ears. Then suddenly there was a quick, soft thud as someone jumped over her and ran into the darkness. In the rebel's hasty retreat, Norah and her baby had been invisible.

Norah explains: *We were attacked continuously from 1980 to 1991. The rebels came and asked where the soldiers were. If you said you didn't know, they beat you or even killed you. The soldiers asked if we were sheltering the rebels. They beat us whatever we said. Those were terrible times.*

We could barely grow anything. If I was in the field bending over to pull up cassava, I dropped it and ran as soon as I heard guns. One day the soldiers and rebels had a battle near our village. We saw dust in great clouds. The noise lasted for six hours. All we could do was lie flat in the grass and pray until they went away.

The other women used to bring their children to our house because it couldn't be burned down. We hid in the store. We could hear the rebels walking around outside. We made signs or talked to each other out of the side of our mouths without making a sound. By a miracle the babies were silent. I think their intuition told them to be quiet or they would be killed.

Bukedea had been at the epicentre of a major cotton-producing area in the 1960s. By the 1970s extension and marketing services had collapsed and farmers tore up their cotton in favour of subsistence crops of maize, cassava and cowpeas. During the 1980s even these agricultural endeavours had almost ground to a halt due to political instability and civil conflict. The once prosperous farmers of Bukedea were barely able to feed themselves.

The courage and fortitude of the dozen women who took refuge in Norah's store turned out to be the genesis of an outstandingly successful farming venture. When peace finally returned to the neighbourhood, the women vowed never to go hungry again. They united to form a farmers' cooperative called the Popular Knowledge Women's Initiative (P'kwii). By 1994 their efforts had been so successful that P'kwii was designated by the Ministry of Agriculture as the best farm in the country.

P'kwii's newfound reputation attracted

the attention of a senior lecturer in plant science at Makerere University who had won a Forum grant to design new technology for the integrated pest management of cowpeas. He was Adipala Ekwamu, who had recently obtained a PhD in plant pathology from Ohio State University. The cowpea was indigenous to Africa and an important source of protein for resource-poor farmers in semi-arid areas. However, the local variety was plagued by the aphid-borne mosaic virus. Adipala had brought in germplasm from other countries through the International Institute for Tropical Agriculture (IITA) and wanted to breed a disease-resistant variety that would grow well in low-rainfall areas. Norah and her colleagues cultivated cowpeas as a principal crop. The local variety was tasty but low yielding, and insects were a major problem.

'I was like everyone else. It didn't occur to me to leave the campus. I wanted to do my research in the laboratory and the university farm.'

It was a watershed moment for academic research. 'I was like everyone else. It didn't occur to me to leave the campus. I wanted to do my research in the laboratory and the university farm,' Adipala recalls.

Luckily, there was an extension officer in Kumi who said there was a group of women who might be interested in some sort of partnership. And that's how I met Norah. It was one of those marriages that worked well. They were trying to survive after years of war and were very keen. Most of them were not literate, but Norah had finished secondary school and understood the benefits of

technology. We started sending students to do on-farm trials. At first the women were unhappy there were weeds in their gardens. We had to have them for research purposes. There were no phones, but somehow the summons to come immediately always got through when the crop was ready to harvest.

The MU-93 cowpea variety was released almost 10 years later, in 2005. It produced a particularly high grain yield, at more than 1,580 kg a hectare, and was judged overall to be the best variety for the area. Its main feature was its resistance to the mosaic virus.

Adipala's students spent months at a time working with P'kwii, living with local families and bicycling to the fields, going about their research with steadfast empiricism despite the risk of the occasional bandit attack. Their on-farm trials on pest control demonstrated that insecticide use can be reduced significantly by targeting the most yield-reducing pest at the most vulnerable crop-growth stage. The money spent on two research grants on cowpeas was significant in other ways too. It spawned a crop of scientists who went on to do significant research and to train other scientists to follow in their footsteps. Bukedea has been the proving ground for some of the country's top scientists. Today they are employed as faculty (three), researchers (six), NGO personnel (six), extension officers (three), member of parliament (one), officers in government parastatals (four) and private sector entrepreneurs (three).

One of the first students was Prof. Richard Edema (then Dr Edema), at the time a scholarship masters student in crop science at Makerere. He had earlier approached Adipala to be his PI and had been rebuffed. Adipala had told him he

was too busy. Richard had persisted. Adipala said: 'Go away and write down your ideas.' I wrote them down and brought the proposal to him. He told me to go back and put it on a computer. I'd never used one before. It felt as if I'd spent three weeks typing the proposal. When I showed it to him, he threw it away and said: 'Never mind. I've got a different project for you.'

The 'different project' Adipala had in mind was mapping diseases on the cowpea, and the efficacy of chemicals to control them to prevent yield loss.

Continues Richard:

I published a paper on plant disease in the United States in the Plant Disease Journal out of that. Even my undergrad project was published in the Crop Protection Journal in the States and the East African Agriculture and Forestry Journal. That's how hard he pushed me.

Today Richard heads the plant-breeding and seed systems programmes at Makerere and has graduated six PhD and more than 40 MSc students.

The process of the proposals being reviewed and the responses shaping the methodology and scope of research projects served to infuse students with confidence in their capabilities. Dr Prossy Isubikal, a lecturer at Makerere in the Department of Extension and Innovation Studies who wrote a thesis on the relationship between farmer field schools and extension services, says that during her time with Adipala she learned to focus on results. 'He made us organise workshops and conferences. Other students didn't get to do that.' Dr Jeninah Karungi, who trained with Prossy, integrated traditional farming practices with minimum insecticide use in the management of insect pests in cowpeas,

and science editor for the *African Crop Science Journal*. He also lectures at Makerere in crop protection, insect pest ecology, biometry, biosafety, biopolicy, bioethics and environmental impact assessment.

Among the second cohort of students who worked with P'kwii was Dr Godfrey Asea, who heads the maize-breeding programme at Uganda's National Crops Resources Research Institute in Namulonge. Also at Namulonge are Dr Stanley Nkalubo, who worked on Phaseolus beans at Bukedea and now heads the national bean programme, and Dr Chris Omongo, who runs the East Africa Agricultural Productivity Programme.



Rosaline Ajore runs P'kwii's learning centre out of the same house where she hid from rebels three decades earlier.

repeating the trials over three growing seasons. She has since graduated her own PhDs and MScs as a PI in Makerere's School of Agricultural Sciences. Dr Paul Nampala, another of the cowpea-project students, is the executive secretary of the Uganda National Academy of Sciences

Today P'kwii is thriving, with a membership of 2,500 women and men spread over three districts. And Norah represents farmers and women as a member of RUFORUM's Uganda national forum. In October 2011, Prof. Patrick Okori, a former Forum grantee and at that time



P'kwii's learning centre showcases indigenous technologies and the innovations adapted from RUFORUM-sponsored research.



The P'kwii cooperative presses and bottles sunflower oil, an income-generating spinoff from participatory research.

an associate professor in plant breeding at Makerere, reconnected with the P'kwii group. He discovered that over the years they had internalised and built on what they had learned during their contact with university researchers. The initial field work and subsequent field schools set up by student researchers had become the basis for a symbiotic mix of science and indigenous knowledge. The house where Norah and her fellow P'kwii founders had hidden from rebels has been converted into a learning centre that showcases indigenous technologies and the innovations that have been adapted from RUFORUM-sponsored research.

Thanks to Patrick, RUFORUM students once again conduct applied research projects at Bukedea and oversee farmers' field schools. They mentor farmers working as trainers who collect data on sorghum and other crop varieties and provide feedback from farmers. They also collaborate on repackaging information, such as making audio tapes of their latest findings to play back to farmers' groups. RUFORUM has also introduced P'kwii to Dr Peter Ebanyat from Makerere University, who is helping the cooperative to develop a communication platform where farmers can use mobile telephones to access information from the university and research institutes to support their agricultural activities. There is collaboration with the nearby Serere Research Institute at Soroti too. The institute sends farmers seed varieties to test and takes their feedback so seriously that they have even published papers together.

RUFORUM encouraged Makerere University to use its postgraduate students and project leaders to scale up its activities by linking up with the district extension system, the national research

system and international partners such as the IITA and the Integrated Pest Management/Collaborative Research Support Programme. Not only has the project reinforced the practical skills of faculty and students, but it has also introduced new cowpea varieties and a scheme for continuing farmer education on commodity value chains. The farmers' groups are sufficiently confident to be able to articulate their research and extension requirements and are considered to be co-researchers. The farmers have also endowed the MSc graduates with field and teamwork experience and a better understanding of farmers' problems.

Furthermore, P'kwii has gone into food processing. Using a soft-seed variety of sunflower provided by Serere, its farmers are making sunflower oil that is sold on to wholesalers. A third of the profits goes into the cooperative members' pockets. Another third is set aside for maintenance while the final third is committed to expansion. The most recent project was the purchase of a grinder to make cassava flour, which is under certification by the Uganda National Bureau of Standards. Britannia, Uganda's largest biscuit maker, is due to sign a contract with P'kwii to replace wheat flour with cassava flour for its biscuits.

Today P'kwii's activities embody RUFORUM's core objectives. They increase food production, with value added. Links to markets for the processed products have ensured that household incomes grow. And Norah's voice continues to be heard – and listened to – as she travels to national and international forums to put forward the farmer's viewpoint.

However, this was not yet the case in 2004. Parallel to P'kwii's efforts to become

a vibrant cooperative, RUFORUM was busy deciding exactly what its core objectives would be. Forum's grantees had responded to established regional programme goals. It was the RUFORUM vision that members would develop their own goals. It would be the secretariat's job to coordinate these endeavours and look for funding.

Before RUFORUM put this into action, it needed to map out the way forward. The organisation contracted Patrick Okori, at that time a new alumnus who knew what was needed for graduate training, and Prof. Jurgen Hagmann, an expert in innovative agricultural resource management, to write a strategic plan.¹⁰ They met with the faculty of nine universities, asking everyone the same four questions: Which of their immediate concerns could be solved collectively with RUFORUM's support? Which of their concerns would they prefer to address on their own without RUFORUM's assistance? How did they envision addressing these concerns? Where did they want RUFORUM to be in 10 years' time? This consultative process demonstrated that universities could not operate in isolation, and gave birth to the national forums. The national forums in turn provided the foundations for operating at regional level, which is how RUFORUM presented itself – as an umbrella organisations for national forums.

The national forums emerged as entities for implementing the strategic plan and aligning activities with national poverty-reduction strategies and the agendas of regional bodies such as ASARECA, FARA, NEPAD and its recently constituted CAADP. In order to be fully representative of national development needs, the universities decided that national forums would include scientists

from outside academia, from the private sector and from government agencies.

Thus by 2005 RUFORUM had sanctioned a vastly expanded mandate with an ambitious strategic plan that was underpinned by a handful of staff and Rockefeller's US\$3.55 million time-bound three-year transition grant. By the end of the first year of operations, the organisation already had 106 MSc students in training. The dozen vice-chancellors had signed a memorandum of understanding agreeing to share research and exchange students and staff. And the secretariat had arranged workshops in proposal writing and HIV/AIDS awareness for universities in Kenya, Mozambique, Tanzania and Uganda, while staff at Makerere and the University of Zimbabwe attended a course to develop their personal skills.

In 2005 the networking began in earnest.

In February the Higher Educational Partnership for Agricultural Development (HEPAD) launched a project from the RUFORUM office to deliver long-term training in regional agricultural development. Supported by USAID and partnered with Ohio and Michigan State Universities and regional agricultural faculties, RUFORUM became the coordinating body for 12 sandwich-degree programmes, which consisted of in-country research, with the coursework conducted at the partner American universities. The project also laid on faculty visits to the partner universities, and in-country faculty workshops on agribusiness management, survey research methodology and computer-based models for econometric training.

That June RUFORUM participated in the third FARA general assembly. And at the end of the year the organisation

was present at the seventh African Crop Science Conference, where RUFORUM had authored 64 of the published papers. By now the secretariat members had their feet firmly lodged under their desks. They began planning for RUFORUM's first regional biennial conference, to be held in Malawi in April 2007.

In the eastern and southern Africa region there was one professor for every thousand students compared to 1:500 in the developed world.¹¹ RUFORUM members strongly believed that this imbalance must be rectified. Forum had made it clear that it would never include PhD training in its mandate. At RUFORUM's first AGM it was agreed that while MScs would remain the flagship, RUFORUM would offer PhD courses as soon as it was feasible. In line with the strategic plan and a competence analysis study conducted in 2005, it was agreed that the deans would develop regionally based MSc and PhD training programmes.

The list of subjects was comprehensive. Biometrics and research methodology, of course, was at the top. Dryland resource management was essential for adapting to climate change. Plant breeding, seed systems and biotechnology were vital for introducing new crop varieties relevant to changing environments. Next came agribusiness, nutrition, food technology and value addition, with a view to the commercial prospects for farmers' produce. Aquaculture and fisheries, a subject close to the hearts of the deans in Malawi and Kenya, made it onto the list. And last, agricultural and natural resource economics with a view to contributing to national and regional planning and policy.¹²

At Makerere, Patrick Okori and Richard Edema, who by now had a PhD in

biotechnology, were instrumental in setting up the plant-breeding programme with a view to helping farmers and cooperatives such as Norah Ebukalin and P'kwii. It was envisaged that the programme would be for adaptive, on-farm research in legume germplasm; improved crops and seed systems; integrated soil fertility and pest management; symbiotic biological nitrogen fixation; pulse quality control and marketing; and value-added legume processing and human nutrition. The initial gains from this approach would evolve from the transfer of recently developed legume varieties and technologies from one grantee, university and country to another. Important legume germplasm included the promiscuously nodulated soybean (Zimbabwe), the rosette-resistant groundnut (Kenya) and the dwarf, determinate pigeon pea (Malawi). New legume technologies included Mbili and relay intercropping (Kenya and Uganda), short-term improved fallows (Malawi and Zimbabwe) and legume protein bio-fortification (Kenya and Uganda). These improved legumes would be integrated into small-scale farming systems in semi-arid and sub-humid agro-ecosystems. Graduate training and collaboration beyond the university would be a required component of every project. There would also be collaboration between grantees and universities, with promising findings from one research project readily tested by another for their application under different agro-ecological and socio-economic conditions. These findings would be shared via the RUFORUM website and through periodic meetings of grantees, students and collaborators.

A report authored by Malcolm Blackie and Paul Woomeer estimated the potential for improved crops.¹³ If 10 farmers' groups,



A staff meeting at the RUFORUM secretariat

each with 300 members, increased their cereal surplus by a ton a year per farmer at US\$200 a ton, then US\$600,000 of cereal would be traded each year. If sales volume on that scale could be achieved, the report said, it would revitalise local economies and lift farmers above the poverty line.

RUFORUM had been praised for the thoughtful nature of its grants. While smaller than the average grant, they offered unique features such as training in biometrics and proposal writing. Other grants tended to underwrite research only and not tuition. Grantees liked the fact that funds arrived punctually so that research was never delayed. Another difference was that RUFORUM grants catered for students and supervisors alike. And students were given the opportunity to present papers at conferences and attend large workshops.

Even so, students felt that the system could be improved.¹⁴ As in almost

all research, funds were found to be insufficient even if the terms were better than other sources of funding. More resources were needed, to reach more farmers and to improve facilities in the science and computer laboratories. Many pointed out that continuity in the research area after completion of the project did not happen because there were no funds. There was no follow-up or monitoring and evaluating of activities. Neither could masters students go on to do a PhD. At the very least, new students should be recruited to continue a project's research when the old students left, they suggested.

By 2007, RUFORUM had far exceeded its target of training 60 MSc students. It had awarded US\$3 million of grants for research, curriculum development, and upgrading staff skill sets. A total of 206 MSc and six PhD students (30% women) were being trained, while 16 MSc students had already graduated. More than 150 staff had attended conferences

and done short courses on proposal writing, data analysis and econometrics. The University of Malawi had hosted RUFORUM's first biennial conference, where RUFORUM alumni and grantees presented papers. Many of the 270 participants were from development agencies and the private sector.

By financial year 2007/08, Rockefeller's

seed money had ended and there was a US\$3.6 million shortfall on the US\$6 million budget for that year. The strategic plan called for US\$20 million to fund the expanding activities, particularly the regional programmes, for the five years covering 2006–2010. RUFORUM had hit the ground running, but it was clear that if it did not broaden its funding base it would run into serious problems.

Notes

10. *Master Document: RUFORUM Ten-year Strategic Plan 2006-2015*, 5 August 2005
11. *Challenges and Opportunities of the Regional Universities Forum for Capacity Building in Agriculture in Kenya, Malawi, Mozambique, Uganda and Zimbabwe*, Malcolm Blackie, Paul Woome, 2 September 2005
12. Masters in Research Methodology; Masters and PhD in Dryland Resource Management; PhD in Agricultural and Natural Resource Economics; Masters and PhD in Plant Breeding, Biotechnology and Seed Systems; PhD in Fisheries and Aquaculture; and PhD in Food Science and Nutrition.
13. *Challenges and Opportunities of the Regional Universities Forum for Capacity Building in Agriculture in Kenya, Malawi, Mozambique, Uganda and Zimbabwe*, Malcolm Blackie, Paul Woome; 2 September 2005
14. *An Assessment of RUFORUM*, Peeter Pats, Kunskapsutveckling, October 2006

CHAPTER 4 MAINTAINING A COMPETITIVE EDGE

By 2007 RUFORUM had grown into a solid, international non-governmental organisation that was performing well. Operating systems were in place: a communication strategy, a gender policy, and governance guidelines. The staff had expanded to 15, several of them as programme managers. An International Advisory Panel had been constituted. RUFORUM's reputation was such that universities were knocking at its door to join. Membership had grown from 12 to 25 universities in 15 countries.¹⁵

However, all was not well. The organisation was in deficit by US\$300,000. The Rockefeller Foundation had made a start-up commitment that covered the first four years of operation. Now RUFORUM was heading towards the end of this phase, with no alternative core funding in sight. Patrick Okori, Prof. George Kanyama-Phiri – the principal of Malawi's Bunda College of Agriculture¹⁶ – and a few others sat down with Adipala and said, 'You need to raise way beyond what you're doing now. You need to design a programme that you can market to funders. And you need to have something concrete in mind before the biennial conference.' Patrick and Adipala had met previously with Gary Toenninsen, the deputy director of agriculture for the Rockefeller Foundation and one of the creative forces behind the newly established Alliance for a Green Revolution in Africa (AGRA). He had reminded them there would be no more assistance from the Rockefeller coffers.

He had then organised an introduction to Melissa Ho, a programme officer for the Bill and Melinda Gates Foundation (BMGF).

This took place in the run-up to RUFORUM's first biennial conference. It had been decided to extend invitations beyond the university campuses to organisations such as FARA, USAID and the African Network for Strengthening Agricultural and Forestry Education (ANAFE), which is the largest education network in Africa, encompassing more than 120 universities in 24 countries. It was another turning point. From then on, the biennial conferences became known as the premier networking venue for those concerned with higher agricultural education in Africa. The conferences are consistently attended by RUFORUM partners such as CGIAR, NEPAD, AGRA, the Association of African Universities (AAU), ASARECA, the Southern African Development Community (SADC), the Danish Development Research Network and the Inter-University Council of East Africa (IUCEA). These networks make it possible to mobilise collective resources and share experiences and knowledge.

Over the years RUFORUM has cultivated reciprocal ties with universities in Europe and the United States as well. The Association of Public and Land-Grant Universities is a US non-profit association of more than 200 public research universities, land-grant institutions and state university

systems. AGRINATURA, another partner, is a European network of agriculture universities and scientific organisations that supports the agriculture faculties of emerging universities. Through these partnerships RUFORUM is able to draw on the experience and expertise of an extensive network of more than 15,000 faculty and scientists and more than 500 alumni.

Adipala invited Melissa Ho to the biennial conference, where he presented her with a concept note on the journey envisaged for RUFORUM over the next five years. BMGF was a newcomer to agriculture in Africa. Its agriculture portfolio had opened for business the previous year, in 2007. The foundation had virtually no direct investment in local African agricultural organisations. Most funding was committed to international NGOs and overseas universities that worked with African institutions. Nevertheless, BMGF was sufficiently impressed with the concept note to provide someone to lead the collaboration on its development into a grant proposal. It was RUFORUM's old friend Joyce Mook, who had retired from Rockefeller in 2007 after 28 years of service. BMGF had taken her on as a senior advisor on human capital in agriculture.

Patrick Okori and Malcolm Blackie had authored a paper on how RUFORUM could sustain its competitive edge after the Rockefeller funding ended. This was the starting point for a series of review meetings with Joyce, Adipala, Patrick, John Lynam, development expert Catherine Gwin and Liz Levey, whose expertise lies in communications. The idea was to sharpen the RUFORUM vision and define its niche and comparative advantage.

The final proposal to BMGF laid out several

strands of activity to strengthen faculties of agriculture and promote innovation in smallholder farming methods. One approach was to continue with the competitive grants for MSc degrees. This included measures to increase the number of female grantees, and courses in research methodology and information and knowledge management. Another looked at the ongoing problem of the regional brain drain. It encouraged the professional growth of alumni and senior faculty by providing incentives to retain agricultural expertise through mentoring, attachments and additional training. Another approach was the creation of national forums for feedback to universities on research priorities and outreach activities. Then there was the stabilisation of RUFORUM management and governance, including the development of ICT and M&E.

RUFORUM asked for US\$12.7 million in core funding over five years to underwrite these programmes. In 2009 BMGF committed the funds in full. A further US\$1.5 million was committed in 2011 for supplemental activities. Brady Walkinshaw, a BMGF programme officer, has worked with RUFORUM ever since. He says:

We wanted farmers to be resilient to changes, to improve their productivity and to get to a place where they weren't in danger of sliding back into poverty. Fundamental to this is funding the stellar research that's coming out of the universities. RUFORUM is a gateway to incredible talent. We need that to develop new crop varieties, new livestock vaccines and to supply the resources farmers need from national systems and research centres.

Another RUFORUM approach to laying the foundations for agricultural advancement was not pitched to BMGF.

The universities – in fact, the entire agricultural research system – lacked a critical mass of PhDs. Yet PhDs were integral to RUFORUM's objectives of creating ranks of scientists with intellectual prowess. PIs needed a PhD in order to teach the MSc students in the Competitive Grants Programme. The desirable ratio of professors to undergraduates is 1:100. The reality was one professor for every 500 to 1,000 students. And the situation was unlikely to improve, as most universities were graduating fewer than 10 PhDs a year.¹⁷ Measured against an international yardstick the facts looked no better. Only a quarter of African scientists had PhDs, compared to nearly all scientists in India and the United States.¹⁸

After 10 years of MSc grants, the time was ripe to move on to PhD training. In the pre-Forum years donors felt that they could not justify putting money into fragile institutions, and so sent promising scientists abroad on scholarship for postgraduate degrees – even though five students can be trained in Africa for the same cost as training one student abroad. This pattern still prevailed. Donors continued to cast doubt on whether African universities had the equipment and personnel to offer PhD courses. The faculty deans, on the other hand, had no qualms. They had been pushing for PhD programmes for some time. Regional programmes had been written into the strategic planning. In July 2008 the deans met with European experts led by Prof. Didier Pillot and Jurgen Hagmann in the Ugandan town of Seeta to discuss how to make it happen. Altogether, three new masters programmes and six new PhD programmes were envisaged, to produce some 800 masters and 150 PhD graduates by the end of 2015. The introduction of these new programmes would be staggered over the next

few years so as not to overstretch the secretariat staff or RUFORUM's financial resources.

It was decided that each programme would be housed at the university that was strongest in that subject, pooling the knowledge and expertise of other RUFORUM member universities. They were to be called 'centres of leadership'. Universities could co-supervise their students while at the centres of leadership. They were also invited to send along their professors as visiting lecturers. This was a selling point for the newer universities, such as Gulu.¹⁹ If they could have one staff member participating in regional research methods, this would raise the general standard of all the faculty members. 'You were getting the best of everything,' notes Prof. Abdi Edris of Bunda College, who led the design of the PhD course in agricultural resource economics.

In a departure from the conventional researched-based PhD programmes, these were to consist of advanced coursework in addition to research. This method had been pioneered in Scandinavia and the United States, but it had never been tried in Africa. Research had to be relevant to the farming environment in the students' countries, taking into consideration contemporary challenges such as climate change and environmental degradation. And scholarship awardees had to publish at least two papers in academic journals. The three-year course consisted of one year of coursework and two years of research in the field, not solely in the laboratory. Grantees had to finish within four years. It was hoped that the PhD programmes would encourage programme alumni and senior faculty to revive university-based public research.

RUFORUM called on member universities and international expertise to help develop course components. The universities and research organisations that have contributed to postgraduate programmes are the University of Reading, ICRAF, the International Livestock Research Institute (ILRI), the International Center for Tropical Agriculture (CIAT), the Technical Centre for Agricultural and Rural Cooperation (CTA), the African Highland Initiative, the Swedish Agricultural University, Wageningen University and Research Centre, and Montpellier SupAGRO. Five regional PhD programmes were developed, with an intake of 40 students in 2008 and another 40 in 2009.

There were also three regional MSc programmes. One was Plant Breeding and Seed Systems at Makerere University. The second was Research Methods at Kenya's JKUAT. The third was Agricultural Information and Communication Management, which at first was housed at Egerton University in Kenya. Later the course was expanded to the campuses of the University of Nairobi and Haramaya University in Ethiopia.

The first centres of leadership for PhD programmes, which kicked off in 2009, were Nairobi University's Dryland Resource Management course and Makerere University's Plant Breeding, Seed Systems and Biotechnology course. The Aquaculture and Fisheries course and Agricultural Resource Economics course at Bunda College in Malawi both started in 2010. The latter course was the first to include the economic aspects of climate change. Sokoine University of Agriculture's Soil and Water Management course followed in 2010. And a regional PhD programme in Rural Innovation Studies at Makerere University opened to students in 2012.

Funding for the programmes comes from IDRC, the German Academic Exchange Programme (DAAD) and the Rockefeller Foundation, which was sufficiently impressed by what RUFORUM had achieved to change its position on funding PhD programmes. The plant-breeding programme is funded directly by RUFORUM and other partners, notably AGRA and more recently BMGF through Cornell University.

The demand for PhDs has been overwhelming, with annual applications for each programme ranging from 50 to 75. Unfortunately, the actual annual intake per programme has had to be limited to 12 given available funding and PIs to supervise students. To date 26 doctoral students have graduated, with another 74 currently in the system. About half have returned to advance through the faculty ranks of their universities. Their analytical rigour and scrupulous quality assessment informs and guides the research of the MSc students. The greater number of the remainder of the regional programme alumni are employed by national agricultural research institutes and government ministries, while a small proportion have entered the private sector. About a third of the graduates are women.

Dr Mary Baaru was one of the first graduates of the Dryland Resource Management course. She now works as a lecturer at Kenyatta University. She says: *When I saw the course being advertised as a three-year programme, I thought it was ambitious. The stories I'd heard, PhD studies can take as long as 10 years. I was in for a rude shock. The programme was such that instead of working in isolation, the grantees built relationships with each other that made us realise that we had a wealth of knowledge. It was crucial to our success and kept me on my toes. I got*

my degree in exactly three years. In fact, one of my papers won a first presenter's award, which shows it's possible to do excellent work in that short time. So go for it!

By 2010 RUFORUM had forged alliances with an impressive number of organisations that wanted to partner with it and commit money to a plethora of projects. The secretariat was now managing 32 diverse projects with no central theme. It was another crucial stage in the evolution of the organisation, one that is well recognised by NGO cognoscenti. Everyone wanted to cut into RUFORUM's success. But rather than heeding the RUFORUM mandate, they wanted RUFORUM to oversee individual, often small, projects that were not necessarily relevant to RUFORUM's vision. In other words, RUFORUM was losing its focus and in danger of becoming donor driven. RUFORUM's first business plan (2006–2010) was coming to an end. The way to get back on track was to write a second business plan.

Rockefeller provided a venue for RUFORUM managers and outside experts at its northern Italy retreat, the Bellagio Center. The April 2010 meeting provided the seeds for the second

business plan, covering 2011–2016. In essence, it filleted out the 'gunshot' projects and distilled RUFORUM's activity down to seven strategic goals.

As Joyce Mook comments:

The business plan articulates their direction. It's a platform by which to judge whether proposals are distracting and diluting or aligned with their vision. I think in the last couple of years RUFORUM has had a growth spurt in recognition as a powerful and productive organisation. However, the uptake of new opportunities needs to be managed. They must be aligned with RUFORUM's mission, vision and niche. Some organisations just implode because they don't have the capacity to weather institutional growth.

'I got my degree in exactly three years. In fact, one of my papers won a first presenter's award, which shows it's possible to do excellent work in that short time. So go for it!'

RUFORUM's second business plan (2011–2016) states the following seven strategic goals, based on seven business principles:

Strategic goals

- Train a critical mass of MSc and PhD graduates who are responsive to stakeholder needs and development goals.
- Develop collaborative research and training facilities that achieve economies of scope and scale.
- Increase the participation and voice of women in research, production and marketing.

- Improve adaptive capacities of universities to produce high quality and innovative training, research, and outreach services.
- Increase the use of technology to support effective, decentralised learning and sharing of knowledge.
- Mainstream new approaches within university teaching and research that have impact across the agriculture sector's full value chain.
- Create a dynamic regional platform for policy advocacy, coordination and resource mobilisation.

Business principles

- Putting agricultural research in the hands of well-informed local professionals.
- Quality postgraduate training.
- Research, training and related services relevant to farmers' needs and responsive to innovation opportunities.
- Collective action using a network of 32 universities in 18 countries.
- Affordable joint university programmes building economies of scale.
- Retention of capacity through farmer and employer demand.
- Financial sustainability through recovery of all staff and operational costs.

Notes

15. RUFORUM full members in 2007: Africa University, Zimbabwe; Eduardo Mondlane University, Mozambique; Egerton University, Kenya; Jomo Kenyatta University of Agriculture and Technology, Kenya; Kenyatta University, Kenya; Makerere University, Uganda; Moi University, Kenya; Sokoine University of Agriculture, Tanzania; University of Malawi; University of Nairobi, Kenya; University of Zambia; University of Zimbabwe. RUFORUM associate members in 2007: Gulu University, Uganda; Haramaya University, Ethiopia; University of Kordofan, Sudan; Kyambogo University, Uganda; Mekelle University, Ethiopia; National University of Burundi; National University of Rwanda; Uganda Martyrs University; Université Catholique de Bukavu, Democratic Republic of the Congo; University of Botswana; University of Gezira, Sudan; University of Lesotho; University of Swaziland. See Appendix 2 for the full list of RUFORUM members as at 2013.
16. In 2010 Prof. Kanyama-Phiri had a paper on his on-farm research published in the *National Academy of Sciences Journal*.
17. RUFORUM grant proposal to BMGF, January 2009
18. *World Development Report 2008 Agriculture for Development*, World Bank
19. A university in northern Uganda founded in 2002

CHAPTER 5 BUILDING A CRITICAL MASS OF PLANT BREEDERS

For Langa Tembo, a Zambian doctoral student breeding disease-resistant varieties of maize, the RUFORUM network has served as a conduit to bring much needed skills in plant breeding and biotechnology back home to Zambia, where they are scarce. Langa is a PhD candidate enrolled in RUFORUM's regional plant-breeding and biotechnology programme at Makerere University. He is searching for the genetic



Zambian PhD student Langa Tembo is working on finding the genetic markers for resistance to ear rot disease in maize.

markers of resistance to ear rot disease, a sometimes toxic mould that destroys farmers' crops in Zambia and across the continent.

Unlike in Uganda, where farmers cultivate and eat a wide variety of food crops, in Zambia maize is the staple food and thus critical to food security. All too often, Langa, a lecturer at the University of Zambia, had seen crops fail back home due to the stresses of drought and poor soils. Add to this the devastating effect of crop diseases such as ear rot, and thousands of the most vulnerable farming families were constantly on the brink of hunger, their fortunes tied directly to the vagaries of shifting weather patterns and disease outbreaks.

Working on his PhD research in an attachment with the National Crops Resources Research Institute (NaCRRI) in Namulonge on the outskirts of Kampala in Uganda, Langa benefits from rubbing shoulders with seasoned researchers. In turn, he contributes his labours towards helping this overstretched facility. It has been charged with harnessing traditional plant-breeding techniques and the rapidly emerging tools of biotechnology to develop new varieties of such staples as maize, cassava, sweet potatoes and bananas to meet the region's diverse food-security needs. 'I learn a lot from them,' says Langa. 'People have years of experience in cross-breeding and lab work.'



Zambian PhD student Langa Tembo plans to return home equipped with knowledge of biotechnology techniques and principles.

Once he returns to the University of Zambia, he will have to draw on his own knowledge and resources. He will be responsible for building up the plant-breeding and biotechnology strengths of his university and his country – a prospect that he finds both daunting and exciting. 'Here I have the luxury of consulting the people around me,' he says. 'But when I go back, I'll be the expert!'

Plant breeders played a vital role in bolstering food security across Africa, yet were often narrowly trained and therefore ill-equipped to interact with farmers, policy makers and NGOs, for whom disciplinary boundaries had little meaning.

Langa is just one product of an approach that RUFORUM has developed to spread knowledge far and wide across the network through introducing new regional postgraduate training programmes in key disciplines. At Makerere University,

the monumental task of designing the new programmes in plant breeding was in 2007 handed to Richard Edema and Patrick Okori – who were at the time energetic upcoming researchers. By then Richard had completed his doctoral studies at Ohio State University mapping the genome of the maize streak virus. He had examined the virulence of different strains, both genetically and in terms of their geographic distribution

across Africa, for his dissertation. And Patrick, as an author of RUFORUM's business and strategic plans, was well aware of the shortcomings in tertiary education.

In those early days, very few platforms existed for African academics from different universities and countries to meet one another, let alone collaborate. Adipala, Richard and Patrick were convinced that regional collaboration was the only way forward.

Yet the challenges of finding the experts, money and facilities that universities would need in order to mount graduate-level programmes of any sort – and especially the kind of rigorous, interdisciplinary and boots-on-the-ground training that was envisaged – were formidable, to say the least. Plant breeders played a vital role in bolstering food security across Africa, yet were often narrowly trained and therefore ill-equipped to interact with farmers, policy makers and NGOs, for whom disciplinary boundaries had little meaning. The diversity of climates, soil types and



Patrick Okori, who co-designed and convened the plant-breeding programmes at Makerere, has helped to produce new sorghum varieties with strong commercial potential.

terrains found across the continent posed further challenges to plant breeders, who were thin on the ground even in comparatively well-resourced systems like Uganda's. They needed to produce different varieties adapted to radically different local climates. A maize variety that thrives in the lush highlands of Ethiopia, for example, might be completely inappropriate for the drylands of Kenya.

Climate change, meanwhile, was posing new imperatives for plant breeders to develop increasingly resilient varieties that would resist all manner of pests, crop diseases and environmental stresses. About half the crops produced on the continent were being lost to pests and disease. Under such circumstances, every plant breeder the network could produce would have a huge multiplier effect on the ground, Richard explains.

Patrick was also a plant-breeding scientist, having trained at Makerere,

and with a newly acquired PhD from the Swedish University of Agricultural Sciences. He had begun working on the RUFORUM plant-breeding programme design. He felt that if the new postgraduate programmes were sufficiently well designed, they could simultaneously answer the clamour within the network for new masters and PhD training opportunities and help universities to provide the crucial link between communities and policy processes. He wanted the programme to have an impact at the nexus of policy making, research, academia and business – and most importantly to link these areas directly to the needs of farmers.

'We had a roadmap and a mandate,' recalls Patrick: *Newer universities were coming up and needing new lecturers. Older universities felt they needed to graduate into PhD training. RUFORUM needed to move into more concerted investments such as working with communities and*

transforming lecturers and students into development agents.

A regional approach to training seemed to tick all of these boxes.

The plant-breeding degree was designed to make students equally comfortable with planting trial crops in farmers' fields, and selecting genetic markers of drought tolerance or disease resistance in the biotechnology laboratory.

The rationale was partly to harness concentrations of specific expertise in universities to benefit the entire network, and partly to bring students from underperforming faculties and research institution to facilities of relative strength, such as Uganda's NaCCRI, and equip them with the knowledge to transform their systems back home. It was also to get greater numbers of students working



The plant-breeding programme at Uganda's Makerere University involves students in working both with farmers and in the fields and laboratories at NaCCRI.

hands-on in communities. While many postgraduate programmes in Africa focus on desktop research, the plant-breeding degree was designed to make students equally comfortable with planting trial crops in farmers' fields, and selecting genetic markers of drought tolerance or disease resistance in the biotechnology laboratory.

Patrick's thinking dovetailed with a larger, Africa-wide policy process that had similar aims. In 2005, as Patrick worked on RUFORUM's strategic plan, FARA conducted an extensive study of the performance of the national agricultural research systems (NARS) in 26 African countries and found that most were punching below their weight despite considerable investment in the past. FARA had secured funding from Britain's Department for International Development (DFID) to create a programme called Strengthening Capacity for Agricultural Research and Development (SCARDA), which sought to tackle the weak points in the system. For RUFORUM, it was the perfect opportunity to contribute to and learn from a wider process also geared towards building postgraduate training, research support and the mentorship of young scientists.

One of SCARDA's aims was to provide masters training to NARS researchers from post-conflict countries such as Rwanda, Burundi and Sudan. RUFORUM's concept of regional post-graduate training programmes provided a vehicle for accomplishing this. The SCARDA demand

study had identified plant breeding as a critical gap in the region. And thanks in large part to a legacy of support through competitive research grants targeting new varieties of cowpeas, soybean and maize at Bukedea and Namulonge, Makerere had a comparative wealth of plant-breeding expertise to draw from.

Richard and Patrick sought to design a programme that would respond directly to the needs unearthed in the demand study's analysis. They wove into the programme a diverse selection of topics, such as marketing, social research and business management. Before doing so, they consulted everyone within the academic, business, policy-making and developmental sectors they could think to ask. 'We kept asking: "If we are to train for you, what kind of person would you like to have?"' Richard recalls.

Packing a full complement of coursework, plus a research-based thesis for each student, into the two-year period covered by the funders presented a formidable challenge.

After much hard work, the pieces began falling into place. FARA had engaged RUFORUM as the lead service provider for SCARDA in East Africa, and sent 10 students from Burundi, Rwanda, South Sudan and Sudan to do their masters degrees in plant breeding. AGRA stepped up with a US\$400,000 grant to cover additional scholarships. Eight different countries were represented among the programme's first intake of 16 masters and 22 doctoral students in February 2009. The accelerated regional engagement later encouraged

universities from Burundi, the Democratic Republic of the Congo, Rwanda, South Sudan and Sudan to join the RUFORUM network.



Once a refugee of war himself, Richard Edema has a passion for training researchers from post-conflict regions.

Meanwhile Prof. Paul Gibson, a plant breeder from Southern Illinois University with many years' experience of the developing world, had agreed to serve as the lead instructor for the programme. The clock was ticking, and there was much to do. Entering students often had weak scientific backgrounds and language difficulties. Packing a full complement of coursework, plus a research-based thesis for each student, into the two-year period covered by the funders presented a formidable challenge. From the start, the programme had to run fast and lean. 'In the US I take students with good academic backgrounds and train them to become technicians or PhD candidates. They're under guidance and there's a period of professional growth,' says Paul. By contrast, the new masters students had already been saddled with

huge responsibilities of running national programmes back home, with very little preparation and almost no support.

Paul elaborates:

Not only are African countries starting from a lower base, lacking the critical mass of experts that developed countries have, but each person trained is likely to advance to a managerial role very rapidly due to the personnel shortages across the system. The average scientist will have to be replaced within 10 years, which puts even higher demands on the trainees.

In other words, the students' two years at Makerere needed to deliver a potent injection of all the skills, experience and contacts they would need to hit the ground running when they returned home and advance rapidly within the research system.

To give the programme real-world emphasis, Richard drew upon the structures of Uganda's NARS, convincing researchers within facilities such as NaCCRI to serve as supervisors for students' dissertations. 'We decided to make it very practical and hands-on, so that as students were doing their work they were learning how a real breeding programme works,' Richard explains. The arrangement also benefited NaCCRI researchers, who were glad to have extra pairs of hands. In addition, Richard and Patrick linked with private seed companies and CGIAR centres working in the region.

For Richard, in particular, it meant a great deal to be training the SCARDA-funded cohort of young NARS researchers from post-conflict regions, who after graduation would return home to help rebuild their countries' agricultural research systems. Originally from the

Koboko district of northern Uganda, the birthplace of the brutal Ugandan dictator Idi Amin, Richard had spent four years of his adolescence living as a refugee with his family in the Democratic Republic of the Congo. 'The year we fled our village the maize harvest was so good, but we had to abandon it. It was eaten by the rebels. We had to go to this place where we were starving,' he recalls. Richard worked as a farm labourer to get food for his family and thus was introduced to the science of agriculture.

Paul's teaching constantly reminded students to place food security at the centre of their efforts. Despite widespread food insecurity among small farmers, Sub-Saharan Africa remains one of the few regions of the world where the capacity still exists to increase food production substantially, he says. Yet to do so without destroying fragile ecologies poses yet another steep sustainability challenge. Clearing forests to plant



Mayada Mamoun Beshir's award-winning work will bring more productive sorghum varieties to her home country, Sudan.

crops, for example, has a direct impact on rainfall patterns. Yet poor farmers face short-term economic imperatives to cut down trees for charcoal and to slash and burn forests to plant more crops.

Richard explains:

We've got a billion people in Africa, and we've got to feed them. Research institutes must be busy with good people – young men and women who are sorting out food needs, addressing issues to do with climate change, crops' resilience to water shortages, crops that are nutritious and contain micronutrients, crops that can grow on abandoned farmlands with low soil fertility.

Biotechnology is integral to the solution for the scenario that Richard paints. The students have all learned the techniques for using genetic markers to enhance the selection of desirable traits for new plant varieties. Yet the challenges for producing new varieties are considerable given the dearth of expertise, the abundance of disease, and the wide variability of local climate. Using conventional plant-breeding methods, it can take as long as 10 years to come up with new varieties.

For this reason, biotechnology is an increasingly important tool in a plant breeder's toolbox. While countries such as Kenya and South Africa have become ideological battlegrounds for the champions and opponents of biotechnology and genetic engineering, the reality is that the continent has few native scientists who can parse the complex risks and benefits of adopting or rejecting this technology. Uganda, meanwhile, has embraced biotechnology, particularly for the control of pests and diseases. As the government prepares to introduce policies to allow the widespread adoption of genetically modified

organisms (GMOs), researchers at NaCCRI are expanding their use of the technology.

RUFORUM's programmes for the most part do not include the controversial use of genetic engineering to introduce genes from a foreign organism into a plant. But the majority of students do work with genetic markers that allow breeders with far greater precision to identify the traits to include in new plant varieties. For instance, Mayada Mamoun Beshir, a Sudanese masters student, is developing molecular markers in sorghum for the fungal disease turicum leaf blight. She is cross-breeding a variety resistant to the disease with another that is highly susceptible to it yet favoured by farmers for its tolerance to drought and abundant grains.

'We've got a billion people in Africa, and we've got to feed them. Research institutes must be busy with good people – young men and women who are sorting out food needs, addressing issues to do with climate change, crops' resilience to water shortages.'

'In Sudan, we are sorghum people,' she says. In terms of area, Sudan plants three times more sorghum than the United States yet harvests only a third of the yield. For Mayada, the problem illustrates the manifold constraints on productivity across Africa. Crops are rainfed instead of irrigated, and farmers cannot access inputs to control crop diseases. 'When I came here, I wanted to do work on sorghum using molecular markers. We have high-yield varieties, but we don't produce high yields.'

Mayada hopes to continue with her PhD at Makerere where her supervisor, Patrick Okori, is a renowned expert in sorghum improvement. She has already been able to visit the Biosciences Eastern and Central Africa Hub in Kenya, a centre of excellence for molecular markers managed by ILRI; she had given a presentation at a biosafety conference and won a scholarship to present her work at an African Crop Science Conference, where her research on sorghum was awarded the best overall prize for work likely to have an impact on smallholder agriculture. For Mayada, these accomplishments are testimony to the power of the network, which has allowed her accomplishments to shine on a larger stage. For Patrick, her success is testimony to the fact that RUFORUM is serving its purpose in positioning its graduates to contribute where they are needed to accelerate the region's development.

Makerere's plant-breeding programme has now grown to a point where its future feels secure. AGRA renewed support in 2011, increasing its grant to US\$600,000 to fund an intake of 20 masters students every two years. All graduating students have had their research published, which in itself becomes the means of ensuring the programme's long-term sustainability.

Another strength of the programme is the diversity of students, 70% of whom come from outside Uganda. As Langa and his colleagues return to their home countries and assume positions of responsibility, they will have built relationships that they can draw on in their quest to strengthen local research systems and collaborate across the region.



CHAPTER 6

CLIMATE CHANGE, RESEARCH METHODS AND OTHER TOPICS WITHOUT BORDERS

In 2007, at the same time as the concept of introducing a regional postgraduate plant-breeding programme was taking hold, the agriculture deans of RUFORUM's member universities were clamouring for help in closing the skills gaps in their departments: proposal writing, research methods, biometrics, sociology, business acumen and information technology. In short, they lacked big-picture thinkers who understood smallholder agriculture as a system, and who knew how to apply diverse research methodologies to effect change in that system.

Small-scale agriculture in Africa is inextricably linked to a host of interlocking local and global issues, ranging from climate change and land tenure to trade and subsidies. None of these topics know disciplinary boundaries. Yet historically universities were steadfast in their adherence to strict specialisation. This ensured that academics, for the most part, burrowed deeply into their own silos and gave little thought to the broader relevance of their research contributions. RUFORUM's new regional programmes in research methods and dryland resource management introduced transdisciplinary approaches to research and thus prodded universities into examining the multi-faceted challenges facing agriculture.

The RUFORUM-sponsored regional masters degree programme in agricultural research methods came onstream at the JKUAT in 2009. It broke the old mould

of hyper-specialisation. The programme provided agricultural scientists with the knowledge and skills to produce quality, demand-driven research. The aim was to develop a new cadre of research officers and statisticians in biometrics and econometrics, able to provide practical support to applied research specialists working in universities, government agencies, NGOs and national and international research institutions. Their professional skills would complement the disciplinary specialisations prevalent in science and academia. The programme was supported by the BMGF and the European Union ACP-EU EDULINK program. Its design reflected the RUFORUM approach of collecting the different strengths of the entire network in one programme and housing the programme in one university, where it could be accessed by students from across the region.

'Agriculture is a complex discipline that cannot rely on mono-disciplinary research or even multidisciplinary research,' says Dr Washington Ochola, RUFORUM's programme manager for planning, monitoring and evaluation. *Researchers must understand how specific research relates to the bigger picture. We're not saying they're going to replace highly skilled professionals in water management research or plant breeding. They're actually coming in to support and facilitate integrated agricultural research – especially research that takes a collaborative approach.*

On the learning agenda was a combination of hard-data analysis and softer skills such as social-research methods, which called for an interactive and ICT-centred learning approach. 'The way students learn is through group discussions, presentations and the learning platform,' says Dr Edward Mamati, a senior lecturer who teaches data and information management in the programme. 'Students can share problems on the learning platform, and many minds focus on the problem.'

'We realise that research involves a process,' says Edward Mamati. 'If this process is not done right, the conclusions that are made may not be valid. Neither will the policy that evolves from it be right. So you need somebody who understands the process of research.'

The two-year curriculum comprised a series of modules, which were taught by experts not only from JKUAT but also from CGIAR and other RUFORUM universities. Work attachments formed another component of the programme. Silas Ochieng Otieno, who was attached to ICRAF, graduated in 2011 as part of the first student cohort. While at ICRAF he worked on a global project to support farmers' adaptation to climate change. He then wrote his thesis on the climate change adaptation measures taken by small-scale Kenyan farmers, such as changing planting times and varying crops in response to changing rainfall patterns.

'When you go to the field and ask farmers

questions, you find complex, diverse answers,' Silas says. He elaborates: *We scientists have ideas about how farmers should be adapting, but on the ground you find there are some very unique strategies such as predicting rainfall by examining the contents of animal intestines to see which plants have been consumed.*

The skills Silas gained in the process were unique and valuable, he says. During a job interview, for example, he was asked to describe the complete research cycle, beginning with the identification of a problem and justification of a particular research angle. He was then asked to set up the specific and obtainable objectives of his study; outline clear methodologies; manage and interpret the data; present the results; and devise a plan for sharing the findings with other people. 'I had all the explanations at my fingertips,' he recalls.

'We realise that research involves a process,' says Edward Mamati. 'If this process is not done right, the conclusions that are made may not be valid. Neither will the policy that evolves from it be right. So you need somebody who understands the process of research.'

The programme's regional dimension also made it unique. Of the first cohort of 29 students, 16 were from Kenya. The second cohort of 34 students has only 12 Kenyan students. The regional focus gave a boost to JKUAT's external image. For example, the university was selected as a science and technology hub of the Pan African University, a project of the African Union.

The e-learning approach piloted by the research methods masters programme also triggered the adoption of e-learning throughout the university. The new

e-learning policy in turn inspired the university to take greater advantage of Kenya's increasing bandwidth capacity, as undersea cables providing faster connectivity became available. e-Learning remains essential for a campus that has expanded from 3,000 students in the year 2000 to 22,500 in 2012. This intense growth spurt reflects the rising demand for higher education from Africa's rapidly growing youth population.

Once programme funding drew to a close in 2012, the university assumed full ownership. In its next phase the courses will be fully digitised and offered through distance learning. 'We are proud of the programme,' says Edward. 'It has made us known in the region.'

Some miles away, at the University of Nairobi, colleagues from RUFORUM's regional doctoral programme in dryland resource management were also formulating responses to the threat of climate change which, like research methods, is inherently transdisciplinary. When Mary Baaru was a student in the programme, the vague, future spectre known as climate change took shape as a clear and tangible reality when she travelled to northern Kenya to conduct field research for her PhD in an impoverished farming community. Working closely with local farmers and using geographic information system (GIS) techniques, Mary mapped the water and other resources available to the community and studied the rainfall patterns for the past 50 years.



Dryland research once centred on livestock management, but has grown new dimensions in response to climate change.

'The rivers were running dry, and the forests were disappearing. It was clear that the area was getting worse and worse,' Mary recalls. As witnessed by Mary, changing rainfall and climate patterns were threatening livelihoods, food security and health across wide swathes of East Africa's arid rangelands.

Traditional university agriculture curricula never addressed such huge and multidisciplinary problems. At the time of RUFORUM's inception, however, it was becoming clear that they needed to. In Kenya, almost 80% of the land is arid or semi-arid. Its impoverished northeastern border rubs against the Horn of Africa, where environmental stresses have triggered seemingly perpetual cycles of drought, famine and conflict. The pastoral communities that live in the dryland areas are extremely marginalised and have long been neglected by policy makers. There are few roads. Water and grassland resources are both fragile and scarce. 'The question is: how can we manage very fragile resources to sustain humanity and life?' asks Prof. Agnes Mwangombe, the principal of the College of Agriculture and Veterinary Science at the University of Nairobi.

Dry seasons have become longer. Temperatures are rising. Rainfall patterns are increasingly erratic, and floods and droughts are more widespread. Population growth, meanwhile, pushes more people into marginal areas, where activities such as herding livestock quicken the pace of desertification, she says.

In the early stages of planning new regional postgraduate programmes, Malcolm Blackie and Paul Woomer had been commissioned by RUFORUM to map the strengths of member universities alongside the needs of the region. Malcolm's analysis had turned

up the need for a greater response to climate change from universities and had pointed to the University of Nairobi as the place to concentrate those efforts. The university already possessed considerable strengths in range science and dryland resource management. The new PhD programme could use these strengths as a foundation.

In the 1980s, a Swedish-funded programme, the Pastoral Information Network Programme (PINEP), had supported masters training working with pastoralists in arid areas. Dr Kassim Farah, a dryland scientist, ran the programme for 13 years, assisted by his colleague Dr Wellington Ekaya. PINEP had trained researchers from Djibouti, Ethiopia, Eritrea, Kenya, South Sudan, Tanzania and Uganda. Back then, however, dryland resource management was a very different science to what it is now. It focused primarily on livestock production with little engagement with the broader complexities of climate, ecosystems, economics and culture.

Climate change, which researchers often refer to as a 'wicked' problem, brought a new level of thinking to the equation, demanding different kinds of research and pedagogical responses from universities. It was expected to intersect in highly unpredictable ways with the full range of issues already facing farmers: pests and diseases, diminishing food security, gender inequalities, soil depletion, population growth and urban migration. Its impact would be all-encompassing, and called for creative, holistic and wide-ranging approaches to training. The need for new knowledge, technologies and scientists equipped to understand and help the region adapt to these changes was already apparent – especially as government policy often appeared

to reflect an outdated paradigm that treated the dryland inhabitants as less advanced than other communities.

'We needed to prepare the students for an environment of working with a diversity of viewpoints,' explains Adipala. 'We are trying to create a group of critical thinkers, who can facilitate processes, and who don't have to know it all but can learn from communities.'

Wellington Ekaya, a Forum alumnus who at the time was a senior lecturer at the University of Nairobi, served as the programme coordinator, and worked with experts drawn from institutions across the region and beyond to design the course on dryland management. The team wanted to build a programme that would nurture a new kind of practitioner armed with a multidisciplinary outlook. For Wellington, the ultimate challenge was to contribute towards strengthening higher education by making it more relevant and responsive. He was well aware that African universities, hamstrung by scant funding and an exodus of qualified personnel, often failed to produce much in the way of constructive research. He also knew they lacked the strong relationships with communities and policy makers that could give a fresh edge to their outputs. The team scoured the RUFORUM network, ILRI and the International Union for the Conservation of Nature (IUCN) for experts who could teach modules in subjects ranging from ecology and economics to policy and philosophy.

'At the end of the day, it's all about making sure that universities remain relevant and engaged in the broader agenda – that they're contributing to Africa's knowledge and addressing real needs on the ground,' Wellington says.

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While most African PhD programmes were exclusively research based, the dryland resource management programme was designed to combine an initial year of coursework with a further two years of dissertation research. The programme came onstream in 2008 with an intake of 18 students from seven countries. The Rockefeller Foundation had committed funding for this first cohort, but the programme's long-term funding was a challenge. And finances were not the only potential pitfall. The three-year time frame for completing a doctorate was spectacularly ambitious given that doctoral students at the university typically took up to a decade to complete their dissertations. Furthermore, students were required to publish at least two scholarly papers in peer-reviewed journals during the three years.

The variety of topics that students chose for their dissertations reflected the vibrancy and diversity of the programme's design. They tackled themes ranging from the economics of camel-production systems and the effects of termites on vegetation to ethnobotany, genetic biodiversity and conservation. Armed with a broad understanding of the issues introduced in the coursework, they dispersed to the far reaches of northern Kenya and beyond, to learn what it meant



Yazan Mohamed Elhadi aims to bolster fragile dryland economies through creating value chains involving camels.

to eke out livelihoods in the harshest of environments. In exactly 35 months, the programme graduated the first set of six students. Another 11 graduated in the four months that followed.

Yazan Mohamed Elhadi, a Sudanese student from the University of Kordofan, was fascinated to learn about the traditional knowledge that resides within communities. 'Traditional rules govern how people cope with their environment,' he says.

People don't need the meteorological department to tell them it's going to rain tomorrow. They look at the trees and say, 'It's going to rain after three or four days.' Or they look at the grass and say, 'It will be possible to graze here in two or three months' time.'

Studying dryland livelihoods, he realised that he had knowledge of his own about survival and economic development in marginal areas. His dissertation research involved examining the effects of climate change and the role of gender in northern Kenya. Camels, he suggested, could provide an alternative source of wealth. Kenya has the fifth largest population of camels in the world, but there is no well-developed market for camels. Neighbouring Sudan, on the other hand, has bustling camel markets, and a strong value chain that is controlled by women. As hardy desert creatures, camels could withstand tough drought conditions and provide an alternative market, to cushion communities from the devastation of droughts.

'In Khartoum, people do extremely well from camel products,' he says, 'We can do the same here. It could be a way out of poverty for many people, but we lack a scientific base from which to convince people that this can work.'

Yazan counts himself among a new generation of researchers, who increasingly view knowledge production as a collaborative effort. The interdisciplinary nature of the programme is ground-breaking, he says, because the large body of research that he and his colleagues are currently producing is being concentrated under a single banner, instead of being scattered across various disciplines, which was how dryland research was customarily treated in the past.

'This programme captures everything having to do with the drylands,' he says. 'Maybe in 10 years we will actually see results; at least a pool of information about the drylands that can be studied and used to solve problems.'

For the university, the programme has been a gamble that has paid off even though its future is uncertain because of a funding shortfall. The past few years have put the University of Nairobi on the map as a destination for research in dryland issues and climate change, sowing the seeds for the programme's future sustainability, says Dr Laban MacOpiyo, the programme coordinator. From RUFORUM's point of view, one of the programme's successes, and an indication of its sustainability, is that the University of Nairobi has assumed full ownership. All of the regional postgraduate programmes must eventually stand on their own two feet, Wellington points out.

The dryland management programme is not only producing more PhD graduates

for the university, but it is also producing them faster, says Agnes Mwangombe. In 2011, 11 students graduated, comprising a third of Nairobi University's PhD graduates for that year.

The Centre for Sustainable Dryland Ecosystems and Societies, launched in 2011 as a joint dryland research project of the University of Nairobi and Colorado State University, is a result of an introduction effected by RUFORUM between the two universities. The dryland management programme will use the centre's resources to expand its scope on campus at the University of Nairobi – perhaps through the introduction of new research fellowships, and links to other postgraduate and undergraduate programmes. The dryland programme is also attracting the attention of international NGOs such as Oxfam as they become ever more involved with climate change and the Horn of Africa's recurring droughts.

The next question to emerge is how to harness the collective benefits of the graduates' training so that the impact of their work spreads throughout the RUFORUM network and the region. The SCARDA model offers one solution. Under SCARDA, agricultural researchers from Rwanda, South Sudan and other countries received training in cohorts and then returned to their home institutions, empowered to rebuild their national research institutions and to remain in touch with one another through their regional research networks. With its cohorts of climate-change scientists from various countries and disciplines, the PhD programme has similar potential to foster networks of colleagues and collaborators across Africa in dryland resource management, says Wellington.

'Life with climate change in the drylands is still manageable,' she says. 'We can still organise the resources, and people can still earn a good living there. The only thing lacking is capacity.'

Mary Baaru, whose dissertation focused on improving land productivity through soil and water conservation measures in a community in northern Kenya, says that it is up to people like her and her classmates to challenge outdated attitudes towards dryland communities. During the 23 years she worked in Kenya's Ministry of Agriculture, she says, she too was of the belief that little could be done in arid areas, and that pastoralists would be better off migrating to cities.

She changed her mind after working with farmers in Machakos County, where people were so poor they often went several days without eating. She worked alongside them digging trenches to harvest rainwater and planting trees to retain the soil and protect crops. 'Life with climate change in the drylands is still manageable,' she says. 'We can still organise the resources, and people can still earn a good living there. The only thing lacking is capacity.'

Now employed as a lecturer at Kenyatta University, Mary is expanding her dissertation research by looking at how to develop new cropping systems in the same area. 'I believe that we are the drylands people,' she says, referring to herself and her classmates. 'We have to give it a voice. We have to do something about it. We can't just sit on it.'

CHAPTER 7 WORKING WITH NATIONAL RESEARCH INSTITUTES

From the very beginning, the RUFORUM secretariat was aware that farmers needed more than answers to their problems. They wanted to know how to fix them. But as universities were not development agencies, they could not implement solutions. The faculties needed the national agricultural research systems and the agricultural extension networks as partners. The knock-on effect of the Forum programme had already begun to show in the research institutes. They had been populated with a fresh crop of MSc graduates who had brought with them newfound technical and leadership expertise.

'It jump-started my career and implanted in me a new zeal for science when I realised how important soya's high protein value is for childhood nutrition. Whenever I move around the country and see that variety, I have a feeling of accomplishment.'

For instance, in the late 1990s an epidemic of soybean rust devastated Uganda's commercial soybean production. In response to the crisis, collaboration between Forum grantees at Makerere and researchers at Uganda's NaCCRI produced three new varieties of



Molecular geneticist and Forum graduate Robert Kawuki is taking part in a US\$25 million project to create new, improved varieties of cassava.

rust-resistant soybean: Maksoy 1N and 2N and Namsoy 4. Not only did these new varieties resist the disease, they also offered higher yields and better nutritional value than previous varieties. And they required less time to grow. The varieties had been released between 2002 and 2008 and taken up across Uganda. They were being used in other countries as well.

Prof. Robert Kawuki is a molecular geneticist who heads the cassava-breeding programme at NaCCRI and supervises students from RUFORUM's plant-breeding programme. He collaborated on Maksoy 1N with the

institute's researchers as a Forum grantee conducting research on the germplasm reaction to rust-associated yield loss. 'It jump-started my career and implanted in me a new zeal for science when I realised how important soya's high protein value is for childhood nutrition,' he recalls. 'Whenever I move around the country and see that variety, I have a feeling of accomplishment. That was my contribution to Uganda.'

In 2012 BMGF and DFID pledged a five-year US\$25 million grant to support cassava research through a partnership between Cornell University, NaCCRI and other US and African partners, to use genomic selection techniques to accelerate the delivery time for new high-yield and nutrient-enhanced varieties of cassava. Robert was thrilled to have the opportunity to contribute further to food security at home while working with top scientists from IITA, Cornell, the National Root Crops Research Association in Nigeria, and the US Department of Energy Joint Genome Institute in Berkeley, California. Largely because of these developments, the area under cassava in Uganda has doubled from a negligible half a million hectares 10 years ago. Once held in low regard, cassava has emerged to assume an important place in the national diet.

The links established between NaCCRI and RUFORUM through work funded by competitive research grants created a relationship that was used to mutual benefit when the plant-breeding programmes were established and the numbers of students needing supervisors and subjects for their theses suddenly multiplied. There was never a formal partnership agreement between RUFORUM and NaCCRI, but the potential for synergy between the two organisations soon became apparent.

Both sides realised they needed to coordinate their collaborations and reach a common understanding of how it would work. For instance, NaCCRI scientists would help put together the university curriculum. Adipala Ekwamu and Patrick Okori presented their ideas for aligning the new programme with Namulonge's research agenda. The managers at Namulonge were sold on the idea right away.

Dr Yona Baguma, a trained molecular biologist and principal research officer at the National Agricultural Research Organisation (NARO), is charged with keeping the programme on track. Students are paired with researchers from facilities around the country. Their attachment gives them experience in leadership, project management and budget development while they are conducting research. According to Yona, the collaboration has also inspired NARO to be proactive in cultivating relationships with farmers. Researchers work with farmers' groups to create value addition, prepare training modules and supply new seed systems. In Rakai District on the shores of Lake Victoria, researchers are helping a farmers' group to produce cassava flour, chips and confectionery. The project has enlisted the participation of the private sector and extension systems. It also trains farmers to train other farmers. Both these aspects reflect the thinking behind RUFORUM's Community Action Research Programme (CARP). Through this work NARO discovered that while it had developed new seed varieties for cassava, they had not been released onto the market in a way that gave farmers easy access to the product. This was subsequently rectified.

Yona explains:
Because of RUFORUM, we now focus on product delivery. RUFORUM is a

good broker. Research scientists and the universities have a common mission and a common goal. Where most institutions have failed is to imagine that you can build trust from the top. But it starts with the individual.

The skills students learn while on attachment to NARO prove invaluable, particularly for the Rwandan and South Sudanese students who are returning home to work in poorly staffed facilities where there will be no mentors to help them make decisions. Rwanda is the most densely populated country on the continent, and farms are highly susceptible to biotic stresses. Intense cultivation on steep hillsides has accelerated soil erosion. Even so, each hectare of land is expected to produce enough food to feed nine people – at the moment. The population is predicted to double in 20 years. To complicate things further, about 60% of the soils are acidic and unproductive. Small wonder then that food security perennially tops the national development agenda.

There is little doubt that Rwanda's agriculture sector needs a strong national research institute. The Rwanda Agricultural Board (RAB) is expected to revive the agriculture sector despite the stiff odds. Yet RAB employs only a third of the scientists it needs for establishing a robust agriculture system, because the 1994 genocide robbed the country of its scientists and researchers. Its ranks are being restocked with graduates from RUFORUM regional programmes whose scholarships were funded by SCARDA. So far 18 MSc students in plant breeding, animal breeding, soil microbiology and social economics have been hired by RAB. As a result, it has already released 10 new varieties of high-yield beans, which give yields three times greater than older varieties. Several of the varieties

have been adapted to tolerate drought conditions in anticipation of the climate change that looms on the horizon.

Mathilde Uwizerwa, a scientist at RAB's Rubona research station outside Kigali, is researching the effects of rhizobia – nitrogen-fixing soil bacteria – on the productivity of soybeans. Rhizobia have the same effect as the commercial urea fertilisers that farmers tend to use; but, unlike commercial fertilisers, they do not acidify the soil. Mathilde was put in charge of the project because she recently obtained an MSc in soil science through RUFORUM's Soil and Water Management Regional Programme at Makerere University. 'While I was there I learned how to run projects independently and how to write proposals. Before I went to Makerere I wouldn't have been able to do that without supervision,' she says. Mathilde's experience has had a multiplier effect as well. She has passed on her skills to her colleagues at RAB and to some 20 Rwandan agriculture students.

'Before my MSc training, I was an assistant researcher and not really efficient. Now I can design a research subject and conduct research with minimal supervision. I'm proud of what I'm doing.'

Cyamwesh Rusanganwa Athanase, a fellow MSc in soil science, is stationed in western Rwanda, where he runs soil conservation research programmes for the Soil and Water Management Unit. His research informs good practices in mechanisation and infrastructure expansion, to ensure that improved farming methods do not unintentionally

accelerate soil erosion. Cyamwesh works with extension officers and farmers to find the best way to conserve soil. He says that farmers who have not yet adopted new technology typically lose around 100 kg of fertile topsoil annually from each hectare they farm. 'Farmers tell us that their fields are no longer fertile and their land has been eroded. We find they really need our advice.' Cyamwesh is also one of a team designing a protocol to increase rice yields. 'Before my MSc training, I was an assistant researcher and not really efficient. Now I can design a research subject and conduct research with minimal supervision. I'm proud of what I'm doing,' he says.

Manzi Maximillian has put his MSc in genetics and livestock breeding to equally good use. As director of animal resources, research and extension for Rwanda's Eastern Province, Manzi coordinates all of the country's livestock research in that area. One of the programmes he supervises is cross-breeding indigenous goats to get a hybrid that is good for both milk and meat and that thrives in local conditions. Before attending RUFORUM's Dryland Resource Management Regional Programme at the University of Nairobi, he sometimes felt lost, he says. Although he was responsible for animal breeding, he did not understand the scientific principles of his work. The Kenyan campus was next to ILRI, where the best animal breeders in Africa are concentrated. Manzi's proximity to the elite of the continent's livestock researchers, geneticists and



RUFORUM graduates Maurice Mogga and Luka Atwok Opio work side by side with small-scale farmers to jump-start South Sudan's agricultural research system.

breeders was an eye-opener for him. The contacts he made were sustained on his return home. 'I could discuss ideas and follow their projects as they evolved. Getting that exposure as a young scientist was invaluable,' he recalls.

In South Sudan, Maurice Mogga and Luka Atwok Opio are able to use the experience and knowledge they gained at Makerere University while doing their MScs in plant breeding to be change agents in their country's fledgling national agricultural research system. On a research station at Yei, a small town some 160 km southwest of the capital of Juba, Maurice and Luka wander through rows of maize, cassava, sorghum, cowpeas, groundnuts and rice.

With sharp eyes they examine various leaves, cobs and heads for spots and signs of wilt, and are pleased with what they see. Maurice is following the progress of some 20 new varieties of upland rice that he acquired during a trip to Mali. To illustrate the promise of these new varieties, he points to a patch planted with an old rice variety favoured by local farmers. Their thin panicles are



Field trials of high-yield rice varieties at Yei Research Station in South Sudan

stunted and sparse. Other local varieties grow too tall, causing their stalks to break off before the panicles have matured. South Sudanese farmers have probably been relying on these very same seed varieties since 1970, Maurice conjectures. Adjacent to the rice grows a selection of cassava varieties, which he plans to test for resistance to mosaic disease. Across the pathway, Luka's maize plants tower high above the researchers' heads. Luka's MSc research under Richard Edema on the evaluation of maize germplasm for multiple resistance to turicum leaf blight and maize streak virus has come into its own.

These field trials represent the first step on the long journey towards the restoration of a viable agriculture sector, and Luka and Maurice are the point men. When South Sudan attained its hard-won independence in July 2011, after 50 years of almost continuous civil war, only the bare bones of an agricultural system remained. The potential existed, but the agricultural system had to be rebuilt almost entirely from scratch.

Crop yields were poor. Seeds were unavailable. Roads were in a dire state, making it next to impossible to reach distant markets. South Sudan enjoyed rich and barely touched soils, but war had reduced farming to the most basic level of subsistence. The fighting that had raged around them had isolated the farmers. They could not get seeds and inputs or reach markets.

Once the new crops have matured, Maurice and Luka plan to select up to 10 of the most promising varieties of each crop for farmers to test in their fields. 'We don't want to reinvent the wheel. We want to leapfrog by field-testing basic varieties from other countries. Then we can adapt the best ones to our local conditions,' Maurice explains. This will be done in Yei's new laboratory, which recently acquired the basic equipment for producing and quality-testing seeds. Equipment for handling tissue culture and biotechnology is yet to come.

The easy thing would have been to sit behind the desk and wait for something to happen. But that's not what RUFORUM graduates do. 'We do whatever it takes to get the job done. I'm the technician, the scientist and the administrator rolled into one.'

Maurice and Luka are both employees of South Sudan's National Research Institute, and the only trained plant breeders in the country. At first they were frustrated by the magnitude of the challenges they confronted. They hardly knew where to start. After graduating with MScs from the plant-breeding programme at Makerere University, their



Plant breeder Maurice Mogga is introducing high-yield NERICA rice varieties to boost food security in South Sudan.

task was still daunting, but they knew how to deal with the challenges. The easy thing would have been to sit behind the desk and wait for something to happen. But that's not what RUFORUM graduates do. Says Luka:

We do whatever it takes to get the job done. I'm the technician, the scientist and the administrator rolled into one.

The contacts the two men have made through RUFORUM have already proved invaluable. Their work at the Namulonge crop station put them in an ideal position to leverage support from AGRA 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, provides funding to improve seven crops: maize, rice, sorghum, cassava, beans, cowpeas and groundnuts. Maurice and Luka also obtained seeds and germplasm through contacts made through RUFORUM with the Kenya Agricultural Research Institute, Uganda's NARO, IITA, CIAT and ICRISAT,

and the International Maize and Wheat Improvement Center (CIMMYT).

Luka and Maurice are also growing the New Rice for Africa (NERICA) variety for seed to give to farmers in Yei's five surrounding districts. During the war people randomly broadcast seeds on the ground instead of planting them in neat rows. Often crops were left rotting in the fields as people moved from village to village to escape the fighting. Since their return, the two researchers have taught farmers techniques for good yields and quality control and have encouraged the men to help the women with the weeding.

Food production in South Sudan increased by 35% between 2011 and 2012. Yet food insecurity remained widespread, with the United Nations Food and Agriculture Organization (FAO) estimating that about 40% of the population would experience hunger at some point in 2013, demonstrating that many challenges still lie ahead for Luka and Maurice. However, they have already made a difference to the lives of thousands of rural South Sudanese. Whereas previously farmers eked out subsistence yields from the soil, now they are getting surplus harvests, which they sell in the market at Yei.



A NERICA rice panicle

CHAPTER 8 BUILDING PARTICIPATORY RESEARCH AND VALUE CHAINS

Living some 100 km from the shores of Lake Malawi, Edward Mwase and his wife Flora Kaliwu never imagined they would become fish farmers. Now Edward kneels beside one of the family's fish ponds, threads a pole through a hook and lifts a submerged feeding tray up to the surface of the water to check on the size of his fish. There are a thousand tilapia feeding and growing. As the fish mature, Edward and Flora look forward to the time when they will be able to harvest and sell their catch. They will make a healthy profit, which can pay their children's school fees, purchase farm inputs and be re-invested in their nascent aquaculture business.

On this day the Mwases and their neighbours, a group of small-scale fish farmers called the Khumbirani Club, have gathered on the lush, green hillside near an expanse of six experimental fish ponds belonging to Flora. In the face of rising food costs and uncertain income – thanks to the combined forces of climate change, soil depletion and the volatility of the free market – the farmers have begun working with researchers from Bunda College of Agriculture in hope of changing their fortunes through aquaculture.

This community is one of two sites in Malawi where a CARP pilot is being tried



Edward Mwase and Flora Kaliwu are farming a species of fast-growing tilapia in their six aquaculture ponds.

out. While the foundations for RUFORUM regional masters and PhD programmes were being laid in 2008, board members and university deans began to question how the small, competitive grants that dominated the system could be transformed into something that would have a more enduring impact within communities. Competitive grants had been flourishing for well over a decade and continued to produce masters graduates and add to the repository of university research. Yet they were limited in their ability to provide university engagement across the value chain or with a particular community over a longer time frame. What was needed was a complementary system that provided a more comprehensive approach, linking research with outreach.

It combined soil science and food security with commerce, while bringing academics, farmers, businesses and NGOs into a single value chain. The project demonstrated just how powerful participatory research could be as an engine for improving farmers' livelihoods.

The small grants had finite life spans and seldom contained provisions for sustainability. Once a project ended, that was usually that. There was little effort to capture or sustain the impact of the research on communities or to build a comprehensive value chain. Of course, exceptions to the rule emerged. As Kay Leresche recalls, these exceptions inspired more ambitious thinking on the scope of competitive grants for community research projects.

One such example was Prof. Sheunesu

Mpeperekwi in Zimbabwe. The energetic soybean researcher had used a succession of Forum and RUFORUM grants to introduce the rhizobium inoculation of soybeans as a nitrogen-fixing technique to resuscitate depleted soil for maize farming. Over the course of several small grants the project was remodelled into a value chain in which thousands of smallholder farmers supplied soybeans to the country's largest manufacturer of soap and cooking oil. The knock-on effect of the project was widespread and its dimensions cross-cutting. It combined soil science and food security with commerce, while bringing academics, farmers, businesses and NGOs into a single value chain. The project demonstrated just how powerful participatory research could be as an engine for improving farmers' livelihoods.



Flora Kaliwu and her neighbours can send their children to school and buy livestock from their fish-farming proceeds.

Farmers earned good money from soybeans and were able to build themselves brick houses and send their children to university. Soybean profits cushioned many from the harsh effects

of Zimbabwe's economic meltdown as well. In 2010 Sheunesu received the prestigious Impact Research in Science in Africa (IMPRESA) award, convened by RUFORUM, NEPAD and the European Union. The award was in recognition of his supervision of some 40 graduate students and production of more than 70 publications on the project, including peer-reviewed journal articles, books, extension manuals and fact sheets.

The thinking behind the CARP, Kay Leresche recalls, was that if RUFORUM made larger grants of a longer duration, working on a platform with other research and development agencies across the value chain, research would have a more durable impact within communities and produce more robust results to inform regional policy making. In other words, comprehensive participatory research would narrow the gap between smallholder farming communities and

the regional policy frameworks, such as CAADP, that were designed to serve them. Through the larger CARP competitive grants, RUFORUM could also expand its doctoral training by including PhD candidates on research teams.

In August 2009 RUFORUM's Technical Advisory Committee met to design guidelines for the CARP. By early 2010 three five-year CARP grants of US\$300,000 each had been awarded. It was up to the participating university in each case to build a network and relationships, while RUFORUM provided resources for a platform to be used for outreach in the communities and to leverage additional research funds. The first CARP grant was for ongoing research with the community in Bukedea (in Uganda). The second built on work by the University of Eldoret to disseminate new technologies among farmers'



Young researchers Priscilla Longwe and Chimwemwe Salima are addressing aquaculture from different angles through a CARP project.

groups in western Kenya. The third was for creating a value chain for small-scale aquaculture, building on a long legacy of water and fisheries research at Bunda College of Agriculture (in Malawi). In Dowa District, where Edward and Flora live, 14 families are collaborating with researchers. Another group of 54 farmers from Mchinji District, a four-hour drive from Lilongwe, is also taking part.

Working with the researchers, the members of the Khumbirani Club have dug irrigation channels and constructed fish ponds stocked with a fast-growing species of tilapia. Their relationship with the university has brought them training and implements for building and stocking their ponds. The linkage has also brought them access to micro-credit. The early results have been promising. The first harvest, in July 2012, produced a bumper yield of 500 kg of fish, which fetched US\$1,275. This meant that each farmer had an annual income of US\$480 from his or her aquaculture business. In Malawi, 40% of the population lives on less than US\$1 per day.²⁰

'People say that small-scale aquaculture is a non-starter. We're convinced that it's small scale because it's not yet linked to markets. With the right technology and value chain in place, the potential for aquaculture is enormous.'

Given Malawi's reliance on smallholder farming, and its abundant water resources – Lake Malawi, covers a fifth of the country's surface area – aquaculture makes sense, argues Prof. Emmanuel Kaunda, the programme's PI. 'People say that small-scale aquaculture is a non-

starter,' he says. 'We're convinced that it's small scale because it's not yet linked to markets. With the right technology and value chain in place, the potential for aquaculture is enormous.'

The programme is partly about planning for the future needs of the country and the region. Malawi suffers from chronic food insecurity. Despite the introduction of fertiliser and seed subsidies for smallholders in 2005, according to the World Food Programme 1.6 million people faced severe hunger in 2012. Farmers are becoming increasingly vulnerable to the longer dry spells and more frequent flooding caused by climate change. At the same time, depleted soils, pests and diseases are reducing crop yields. The size of smallholder plots has shrunk due to the ever-expanding population,²¹ and HIV/AIDS has exacted a heavy toll among the workforce.

Given the historical abundance of fish in Lake Malawi, it seemed pointless for farmers to practise aquaculture. But the lake has been overfished, and catches of the popular *chambo* (tilapia) have fallen sharply over the past 10 years. The collapse of Lake Malawi's *chambo* stocks reflects a broader crisis, because many other fish populations on the continent are similarly depleted. And as fish is the primary source of protein and micronutrients for nearly a third of Africans, alternatives will need to be found sooner rather than later. The average protein consumption of Malawians has declined sharply since the 1970s, from about 14 kg per person per year to less than half that figure.²²

As a specialist in aquaculture and fisheries science, Prof. Emmanuel Kaunda has studied the inland waterways of southern Africa since the early 1990s. The output from his first Forum small grant –



Emmanuel Kaunda's research set the stage for the CARP project in small-scale aquaculture at Bunda College of Agriculture.

research on the effect of cultivation and the environment on fish in the Linthipe River – helped set the stage for a CARP project. While one of his masters students looked at the socio-economics of cultivation along the riverbank, the other monitored the effects of water quality on fishing yields. From that early research a knowledge base developed for managing the ecology of the country's water systems and fish resources.

For Annie Zidana, the student who studied the cultivation along the riverbank and its relevance to food security, her work was a lesson in how the big picture gets skewed when the different branches of government bring their own narrow focus to a problem instead of looking at it holistically. For instance, the agriculture ministry was promoting the use of treadle pumps to encourage farmers to plant along the river bank. It was a means to short-term

food security, but it also caused soil erosion, which posed a long-term threat to farming. Annie's thesis findings helped to shape new government policies informed by a better understanding of the local ecology. 'My thesis sharpened my skills as well as my knowledge,' says Annie, who is now a principal officer in the Ministry of Agriculture, Irrigation and Rural Development. 'Doing that research gave me courage and confidence.'

In 2006, Bunda College was designated the Regional Fish Node for the NEPAD African Biosciences Initiative. The university became a focal point for research and dissemination on fisheries and aquaculture across the region. The Regional Fish Node is part of networks such as the Aquaculture Working Group and the African Fisheries Experts Network (Afri-Fishnet), which influence regional fisheries policies. Thus the findings from the CARP will filter directly into wider

policy processes through the Regional Fish Node. If the CARP is successful, the programme is well positioned to serve as a model for the entire region.

The findings from the CARP will filter directly into wider policy processes through the Regional Fish Node. If the CARP is successful, the programme is well positioned to serve as a model for the entire region.

In the project design phase, researchers read up on all the recent innovations in aquaculture and selected interventions with the best proven results. A geneticist from the Fisheries Department, for example, had crossbred a slow-growing but hardy species of tilapia with faster-growing yet less resilient wild tilapia. The result was a faster-growing fish suited to captivity. Another RUFORUM student, Chimwemwe Salima, a graduate of the research methods programme at JKUAT, had tested the efficacy of partially covering ponds with plastic sheeting for warmth. Researchers added further techniques, such as submerging food trays just beneath the water surface, to prevent the feed from drifting to the bottom and to help farmers calculate their fish food usage. Researchers also introduced an inexpensive yet highly nutritious new feed made from maize bran, wheat bran and soybean.

Masters student Priscilla Longwe's task is to study the combined effects of all of these innovations. In Dowa District, Priscilla has established different combinations of variables in 24 different ponds. Every three weeks she visits them to measure fish growth and take water samples. After two months, the

fish weigh 40 g, a weight that the old strain would have achieved only after six months. The work is fulfilling. 'I had never interacted with farmers before,' she says.

I felt intimidated at first, but I got to learn what they expected of me. They trained me on what farmers and markets are looking for in a good fish breed. I trained them on the biology of the tilapia, what it feeds on and its reproduction. They're quick learners.

Another masters student, Lisungu Banda, connects the farmers to the value chain. Her research shows a large unmet demand for fish nationwide, which implies a big opportunity for the Khumbirani Club if the barriers to market access can be overcome. The maths of the situation is straightforward, but finding transport, refrigeration and buyers is complicated. The farmers will need to organise themselves well. That is where the third researcher, PhD candidate Dalo Njera, comes in. His dissertation approach assumes that to commercialise small-scale aquaculture successfully, farmers must learn good governance and organisational skills. He intends to develop an empirical understanding of the success factors involved in building solid structures in a community such as this.

Says Dalo:

We need a community that can be innovative. But when we introduce innovations in rural communities to raise the economic status of the country, it's not sustainable. They're living in poverty and can't think about the future because they have to earn for today. In this study, by using community action research, we bring people to terms with their own livelihoods. They learn to stand on their own two feet.

Volume is attractive to wholesale buyers, which is an incentive for the Khumbirani Club to expand its membership. 'Khumbirani means "admire us". We want all the farmers who aren't doing fish farming to join us,' explains Matchaya Simbi, the local headman and a club member.'

Volume is attractive to wholesale buyers, which is an incentive for the Khumbirani Club to expand its membership. 'Khumbirani means "admire us". We want all the farmers who aren't doing fish farming to join us,' explains Matchaya Simbi, the local headman and a club member. Farmers who want to sign up must own enough land to house a pond and must pay a subscription of 500 kwacha. They must also be hard-working, explains Bester Mwase, Edward and Flora's adult son, who has his own fish ponds and is in charge of pond construction for the group. New members are on probation for a trial period during which time they are expected to demonstrate their commitment to the project and to other members. Group loyalty and cooperation is a prerequisite. For example, members automatically look after the ponds of anyone who is ill. 'Our eyes have been opened because of this research,' says Bester.

While the CARP has so far been limited to the three projects in Kenya, Malawi and Uganda, the concept of building value chains to support small-scale industry is taking hold across the region. In the hilly countryside of Rwanda, Leonidas Dusenge is using a similar approach that creates innovation platforms and value chains among small-scale farmers, which

he hopes will become embedded in the national agricultural system. Leonidas is a SCARDA-sponsored RUFORUM student who received a masters degree from Makerere in agricultural extension and education in 2010. Like other Rwandans, he wants to rebuild the structures that were dismantled by the 1994 genocide. His approach emphasises communication and alignment across the entire value chain, from the producer to the seller to the consumer.

'I put people together when there is a problem to solve,' he says, 'They discuss problems and offer solutions that are coming from the context of their own lives. I like how the conversation involves people who have common interests and different needs.'

Leonidas' story is a triumph of the spirit over adversity. The genocide happened while he was taking a break from his thesis in sociology at the National University of Rwanda, relaxing with his wife and two children on the two-hectare homestead where his parents farmed bananas, beans and cassava. The family fled on foot across the Congolese border. At first they lived in a refugee camp, but they were constantly terrorised by militia. They sought safety in the depths of the forest where they foraged for wild fruits and snails. The children suffered from kwashiorkor. Leonidas lost 30 kg.

Returning to Rwanda in 1998, he spent the next decade rebuilding his life. He became the headmaster of a high school and wrote a thesis at the National University of Rwanda on returnees' efforts to rebuild the country. After that he worked for ICRAF and the Institute of Agricultural Science (ISAR) in Rwanda as a social economist. Now 51, Leonidas never expected to have the chance to complete an MSc.

Now Leonidas is working to launch the innovation platform model nationwide. 'If everybody does the right thing, the value chain is successful. Fishermen need wholesalers, who need retailers, who need customers. It works!'

Since returning from Makerere, he has been busy pioneering innovation platforms for maize, cassava, potatoes and bananas. Most recently, he collaborated with other researchers to

create an innovation platform centred on fishing in Lake Kivu – on the border between Rwanda and the Democratic Republic of the Congo – where stocks have been heavily depleted. The platform has brought together fishermen, local leaders, researchers, extension workers, police, marines from the military, small traders and the drivers who ferry the fish to Kigali for sale.

Now Leonidas is working to launch the innovation platform model nationwide. 'If everybody does the right thing, the value chain is successful. Fishermen need wholesalers, who need retailers, who need customers. It works!' he says.

Notes

20. www.foodsecurityportal.org/malawi
21. The population of Malawi was four million at independence in 1964, and had grown to 15 million in 2010 (www.foodsecurityportal.org/malawi).
22. Interview with Lisungu Banda, CARP MSc student

CHAPTER 9 SUPPORT FOR EMERGING UNIVERSITIES

At the Eduardo Mondlane University, masters student Laura José displays photos of mangos, guavas and tomatoes spotted with brown blotches of rotting flesh. Snapped during her field work in northern Mozambique, they tell a story of cross-border trade gone wrong. The *Bactrocera invadens*, a wasp-like insect adorned with brilliant brown and yellow stripes, otherwise known as the Asian fruit fly, hitched a lift to Africa about a decade ago. It was first detected in Kenya in 2003. Since then, the *B. invadens*, which lays its eggs inside ripening fruit, turning healthy flesh into putrid breeding grounds for larvae, has charted a destructive course across Africa. It appeared in Mozambique in 2007. 'Most people don't know about fruit flies,' says Laura. 'They see the damage, but they don't know what's causing it.'

The *B. invadens*' heavy toll speaks to both the promise and the peril of Mozambique's transformation over the past decades from a beleaguered war zone to one of Africa's fastest-growing economies.

Laura is one of two RUFORUM-sponsored masters students who have been assessing fruit fly damage in the Cabo Delgado area of northern Mozambique, where the infestation

is most widespread. The damage has affected both commercial and small-scale farmers, laying waste to tons of tomatoes, cucumbers, citrus fruit and papayas that had been destined for export.

The *B. invadens*' heavy toll speaks to both the promise and the peril of Mozambique's transformation over the past decades from a beleaguered war zone to one of Africa's fastest-growing economies. When Mozambique's devastating 16-year civil war ended in 1992, the country ranked as one of the world's poorest and least developed regions. Today Mozambique's booming economy relies heavily on both commercial agriculture and the small-scale farming that provides a living for about 80% of the population. The fruit fly's unwelcome presence in such a landscape also illustrates the scientific challenges posed when regional integration and cross-border trade are initiated without adequate preparation – such as putting in place phytosanitary controls.

Previous chapters illustrate how RUFORUM has been a catalyst for strengthening universities through developing regional postgraduate programmes (Chapters 5 and 6); consolidating relationships with the NARS (Chapter 7); and mainstreaming participatory research through the CARP (Chapter 8). This chapter examines the impact of expanding the network and

how RUFORUM support has helped institutions such as Eduardo Mondlane University, constrained by political circumstance, to develop and grow.

RUFORUM grew rapidly from a network of 10 founding members in 2005 to 32 members from 18 countries in eastern, southern and central Africa today. From the start, the universities realised that by lining up beneath the RUFORUM banner, their voice would be heard in agricultural research and policy-making circles. If the universities were to assume this regional role, however, they first needed to make sure they were fit for the task. This particularly applied to institutions in post-conflict countries and campuses that had suffered from chronic neglect.

At the Eduardo Mondlane University, launching a career was a lonely task for Dr Domingos Cugala, who had been recruited to the Faculty of Agronomy and Forest Engineering in 1995 after receiving his BSc degree in entomology. The university's sole entomology expert at the time, Prof. Luisa Santos, might have served as his mentor – except that she was half a world away studying for her PhD at Cornell University in the United States. There was literally no one else to show Domingos how to conduct his research or to supervise the completion of his masters degree.

One day he spotted a leaflet offering Rockefeller Foundation support for masters students, and acted on it. Forum offered to sponsor Domingos and found joint supervisors willing to guide him at a distance from the University of Zimbabwe and the Nairobi-based International Centre for Insect Physiology and Ecology (ICIPE). The flexibility of this arrangement, which allowed Domingos to complete his masters work in Mozambique, also addressed a sticking point that had begun

to show up in the competitive research grant system. How was a Mozambican researcher with a bachelor degree to compete for research grants with well-established academics, some of whom held international doctorates? This question would continue to challenge RUFORUM leadership as the network expanded over the years. It remains an issue of concern to this day.

Bharati Patel's solution was to create a special 'nurturing grant' for Eduardo Mondlane University for the first cohort of masters students. Unlike the competitive grants, the nurturing grant was not tied to any particular research programme. Instead it supported training for MSc students in the Faculty of Agronomy. This was a challenging exercise for Luisa Santos and her colleagues, who had to build the institutional framework for postgraduate training from scratch. 'Because this is about training the university to train others, we have to let the students do the thinking process and not guide them too much,' she explains.

Nurturing grants to help historically weaker universities develop their research programmes and postgraduate training would become a mainstay of RUFORUM's approach to managing its expansion in the coming years. Meeting in Bellagio in 2009, the board prioritised assistance to these universities through mentorship and nurturing grants.²³ The following institutions all received nurturing grants: Africa University in Zimbabwe, JKUAT and Kenyatta University in Kenya, Sokoine University of Agriculture in Tanzania and Kenya's Egerton University.

At Eduardo Mondlane University, research was going from strength to strength. Domingos Cugala had established himself as a national expert in biological

control methods for invasive species, serving several times as a PI and nurturing a new generation of Mozambican crop protection researchers. The field work for his masters degree had involved studying the release of the parasitoid *Cotesia flavipes*, sourced from ICIPE, as a biological control agent against maize stem borers. The project served to establish a lasting relationship with ICIPE, which not only funded Domingos' PhD research, but has continued to support his work, including the current fruit fly programme.

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Since its arrival in Mozambique, the fruit fly *B. invadens* has spread across the northern provinces. It has jumped across the Beira corridor, a major transport artery that bisects the country, and now appears to be moving slowly into the central areas. The Ministry of Agriculture had made it an urgent priority to contain the fruit fly's advance to stop it from spreading to the south, where commercial fruit farming provides 5,000 jobs and more than US\$6 million in exports annually. Domingos has been given the task of making sure this happens.

In a region where pests destroy as much as half of crop yields, and where

the fruit fly is just one of a growing number of pests to contend with, the national resources for coping with the epidemic are severely limited. 'We have so few trained entomologists here in Mozambique, perhaps four or five in the whole country,' says Domingos. 'When a problem arises, the first thing people do is call the entomologists at the university.'

Responding to the scourge of the *B. invadens*, Domingos secured a RUFORUM competitive research grant to map the outbreak, assess its impact and test biological control methods. In the process Laura José, and her colleague from the Ministry of Agriculture, Hipolito Cocorea, were trained in MSc research. The outbreak threatens food security as well as the economy, Laura says.

She collects samples of infested fruit to analyse in the lab and conducts interviews in markets and on farms to assess the level of knowledge about the fruit fly and the danger it poses. So far, interventions have been limited to conducting surveillance and setting pheromone traps. The traps allow researchers to map infestation patterns but do not stem the spread of the fruit fly. 'I hope our results help the government to make a good decision about investing in controlling fruit flies. The losses are very high,' says Laura.

Such work not only demonstrates the relevance of researchers in the nationwide campaign to protect the crops, but also boosts the profile of the professors in agricultural academia. Luisa Santos, for example, serves as the head of the African Crop Science Society and was instrumental in organising its 2011 conference. It was held on the campus of the Eduardo Mondlane University and attracted more than 400 international

participants. The conference was highly successful, garnering accolades for impressive organisation and content.

'If we get good data we can actually illustrate not only to the communities but also to the decision-makers at the ministry that something has to be done about the protection of resources and the sustainable use of the forest.'

The university won another RUFORUM competitive research grant in 2012. The focus is on a hitherto little-known aspect of Mozambique's ecology: the pervasive yet threatened mopani forest habitat. It is being destroyed for charcoal production and slash-and-burn agriculture as peacetime opens up new areas for farmers. The cause of the deforestation is evident, but the complex dynamics driving this trend are poorly understood.

Claudio Quenhe, a masters student, has been studying 20 years of satellite imagery to map the area. His colleague Inocencia Muzine collects data to characterise the forest structure and plant composition, so that she can track how the human footprint has changed the biodiversity over time. These two data sets will give a picture of the cause and effect driving change within the ecosystem. 'People depend on the animals, the timber, the edible mopani worms, and the honey produced by the wasps for their living,' says Prof. Romana Bandeira, the students' PI.

One of the motivating factors for conducting the study came when

Romana discovered that there was virtually no data on mopani forest, despite the fact that it is ubiquitous in Mozambique. She had been asked by the government to prepare a report on the mopani forest ecosystem for the United Nations. There were no funds for conducting proper field research so she and her colleagues had to do what they could using the little background literature available. 'We didn't have any sort of data,' she recalls.

If we get good data we can actually illustrate not only to the communities but also to the decision-makers at the ministry that something has to be done about the protection of resources and the sustainable use of the forest.

In Zimbabwe, meanwhile, a similar nurturing grant awarded in 2008 helped Africa University, a small private Methodist institution, to continue its community-based research programmes at a time when the country was in economic and political turmoil. Faced with staggering inflation and shortages across the board, the university struggled to keep the programme going, right down to basics such as finding transport to the rural communities where the research was being conducted.

In these difficult circumstances, RUFORUM's nurturing grant of US\$80,000 kept research and training afloat at the university. Modelled on the Mozambican programme, the grant enabled 10 masters students to complete their degrees on subjects ranging from agribusiness to reducing pesticide toxicity. The nurturing grant not only underwrote research activities, it also enabled the university to continue contributing towards skills for the national pool of human capital. Masters students from Africa University have gone on to fill



Stembile Mbizi and Bertha Mashayamombe earned their masters degrees with support from a RUFORUM nurturing grant made to Africa University.

conservation agriculture, a technique that involves crop rotation to conserve moisture and nutrients in the topsoil while minimising soil disturbance. She is soon to begin her PhD on the effects of conservation agriculture on maize yields and nitrogen levels in the soils.

Nitrogen depletion is a big problem for farmers, she says. 'I want to find out if conservation agriculture is building up the nitrogen in the soil, and if it's increasing maize yields,' she says. She

explains that last season farmers lost nearly half their crops in a mid-season drought, making the need for updating climate change adaptation strategies all the more pressing.

'Women have been empowered because they no longer rely on their husbands to till the soil. My area is very traditional. My father owned the land, but it was always my mother working in the fields. I think it's important that the person who does the agriculture is the one who makes the decisions.'

Conservation agriculture is showing promise and should be relevant as an adaptation strategy for 95% of farmers who rely on rain-fed agriculture, Bertha believes. So far 14,000 farmers have adopted the technique, the majority of them women. Bertha explains: *Women have been empowered because they no longer rely on their husbands to*

university teaching posts and populate the national extension service.

For Stembile Mbizi, the MSc scholarship provided an opportunity to work on improving yields of amaranth, a grain she says has huge potential for ameliorating food security because of its high nutritional value and tolerance for drought conditions. Her research involved testing nitrogen levels in the soil for optimal growth. 'Zimbabweans are hard workers, but they need knowledge. People want to shift to growing crops that suit their environment, but they don't know how to do it,' she says.

Her colleague Bertha Mashayamombe has conducted trials to reduce the toxicity levels of a herbicide commonly used on soybean, groundnut and tobacco crops. When she returned to the state extension agency Agritex after receiving her masters degree, Bertha was promoted to senior agronomist, a role that gives her the opportunity to bridge the worlds of farming and policy making. She works increasingly with farmers in drought-prone areas on

till the soil. My area is very traditional. My father owned the land, but it was always my mother working in the fields. I think it's important that the person who does the agriculture is the one who makes the decisions.

Entire generations have lost their ties to the land and indigenous farming knowledge because they have grown up in camps for the internally displaced. Gulu University is rekindling knowledge and innovation, with more than 70% of its 4,500 students drawn from the area. 'Having an educated community is a source of development,' says Prof. Nyeko Pen-Mogi.

to climate change. Bertha is grateful that her scientific training has contributed to this progress. She continues: 'My mother saw the difficulties with being an uneducated woman so she pushed for all six of us girls to go to school. She said, "The minute you're educated, I've given you an inheritance worth more than a house."'

As up-and-coming universities from Lesotho, Ethiopia, Rwanda and Burundi to South Sudan and Sudan joined RUFORUM, the potential for collaboration and the need for new forms of support continued to grow. In some cases, students on scholarships from FARA's SCARDA programme helped to build relationships between their home institutions and RUFORUM, which led to institutions such as the University of Burundi and the University of Kordofan in Sudan joining the network.

Women like Bertha's mother are now more able to manage their land and adapt



Prof. Nyeko Pen-Mogi, vice-chancellor of Gulu University in northern Uganda, which was established in the wake of a prolonged, destructive conflict. He believes that educating the community will bring a resurgence of development.

'The complexity comes in the diversity and the different capacities of the different universities,' says Malcolm Blackie. In northern Uganda, for example, the University of Gulu, established in 2002 in the midst of a 20-year conflict between the rebel Lord's Resistance Army and the Ugandan military, strives to introduce good science and evidence-based farming techniques. Entire generations have lost their ties to the land and indigenous farming knowledge because they have grown up in camps for the internally displaced. Gulu University is rekindling knowledge and innovation, with more than 70% of its 4,500 students drawn from the area. 'Having an educated community is a source of development,' says Prof. Nyeko Pen-Mogi, a former veterinary professor from Makerere who represented the Gulu District as a member of parliament before agreeing to serve as the university's vice-chancellor.



Third-year student Lawrence Okidi shadows farmer Francis Olanya Olam in his fields. By shadowing, Lawrence has learned how to apply fertiliser, transplant seedlings and space different cabbage varieties.

Collaboration with the network has brought students from Makerere and Rwanda to Gulu University and has also, crucially, enabled the university's inexperienced staff members to access advanced training elsewhere. Since joining RUFORUM in 2007, the university has sent lecturers to Makerere as well as the United Kingdom for masters degrees and doctorates. One lecturer attended Oklahoma State University on a Fulbright Scholarship. Another is doing his PhD at the National Research Institute in Greenwich, England.

Gulu University plans to establish a demonstration farm and has enlisted some 40 local farmers to partner with the students. Lecturer and agricultural economist Walter Odongo says: *The students want to understand the farmers, to walk in their shoes. They're*

not going there to change the farmer tomorrow. Ideally it's a symbiosis of farmer experience and student knowledge. The idea is to grow what they can market, not market what they can grow.

Third-year student Lawrence Okidi works on the pathology of citrus, inoculating and culturing seedlings to establish the incidence of *Phytophthora citrophthora* (a fungal disease) and other, bacterial infections that are prevalent in the area. Francis Olanya Olam, the farmer with whom Lawrence works, practised as a preacher in Kenya and Tanzania for 16 years before returning home to farm maize, *simsim* (sesame), groundnuts, cabbages, potatoes, okra and cowpeas.

Francis demonstrates to the students how to plant seeds from the nursery. 'I show them how to use a stock, so that

the plants aren't uprooted, and how to apply insecticide and fungicide, and graft mangos,' he explains. 'I'm expecting a good yield of cabbages this year. About five tons an acre.'

Last season Francis hired a truck and exported 85 bags of maize and 30 bags of dried cassava to Juba, the capital of neighbouring South Sudan. With the profit, he bought a mill for grinding animal feed. Next on his agenda for expansion is a US\$4,000 peanut grinder to make export-quality peanut butter. Lawrence, who plans to become a farmer too, says that by shadowing Francis he has learned about the application of fertiliser, how to transplant, and the spacing that different cabbage varieties require.

RUFORUM currently funds a poultry-breeding research project, to optimise feeding and breeding techniques so that the chickens fatten quickly without succumbing to local diseases. 'Poultry is the poor man's livestock,' explains Gulu University's Prof. Marion Okot, the PI. Marion has been working with RUFORUM's Washington Ochola to

develop a curriculum for agribusiness enterprise to be used for a regional masters programme. The Ford Foundation has offered US\$80,000 in seed funding for the programme. The university also plans to introduce a masters programme on food science and post-harvest technology, which will be partially funded by a €1.4 million grant from the Dutch government through the Enhancing Capacity for Agricultural Research and Training (ECART) programme.

When Gulu University needs help formulating these projects it draws on the RUFORUM network, to tap the expertise of the better established universities. 'We're a young university without a long institutional CV,' explains Nyeko Pen-Mogi. He says:

RUFORUM gives us the stamp of credibility. We also get to understand the universities' strengths and weaknesses and enter into relationships so that we can exchange experiences. Without RUFORUM, I probably wouldn't have even known anyone from Kenya let alone Zimbabwe.

Note

23. RUFORUM Annual Report 2010

CHAPTER 10 FROM POLICY MAKING TO QUALITY ASSURANCE

The national forums agree that debate should not overshadow action, but they know that if action is to be taken, RUFORUM's objectives have to be defined in the corridors of power. This manifests itself as national development policy that takes farmers' aspirations into account. The new technologies introduced to farmers by universities have to be affordable, well distributed and properly explained in terms of their optimal adaptation. This is where policy comes in. Research results should inform those who formulate common regional standards and national laws and directives.

National macroeconomic policy decisions act as a rudder for the direction agriculture takes. Regional policy enables Africa to take strong positions on contemporary and controversial issues such as biotechnology when negotiating treaties and debating the application of appropriate standards. The same holds true for climate change. Farmers are at the coal face of climate change – yet they are not part of the conversation. RUFORUM-generated research can influence policy that will safeguard farmers' livelihoods.

Policy has direct consequences for farming families and the communities they live in. For instance, the Malawi government's decision in 2005 to subsidise inputs contributed to the country becoming food secure. However, production gains have been eroded by

climate change, while fertiliser subsidies ate up about three-quarters of the Ministry of Agriculture's budget. This demonstrates that policy is complex. It is a perennial work in progress that must be fed continually with information from farmers and the scientists who work with them generating evidence-based research.

One person who understands the value of policy making only too well is Hon. Ssebuliba Mutumba, an advocate of agricultural expansion, a member of the Ugandan parliament, and an alumnus of RUFORUM. He is the deputy whip for the Democratic Party and sits on three influential house committees, including the budget committee. This synthesis of education, experience, passion and circumstance is a potent mix for formulating policy. Agriculture has been very much a part of Ssebuliba's career path, ever since he was a rookie politician. During his political debut as chair of a local council in Kampala, he wrote a proposal to the city to introduce urban farming and presented the proposal to President Yoweri Museveni and Kampala's mayor. It was written into the municipal budget, and women and youth were trained in dairy production, beekeeping, growing vegetables in sacks and raising poultry using livestock waste.

After his election to the legislature, Ssebuliba chaired the crop production sub-committee and eased the passage



Malawian Abel Sefasi, a RUFORUM PhD student, will reshape how scientists and policy makers view biotechnology and GMOs – he is at the proof-of-concept stage for a weevil-resistant sweet potato.

of a bill to constitute the National Agricultural Advisory Services as an independent body. Later, as vice-chair of the public accounts committee, he was active in regularising the use of government funds, including those destined for the agriculture sector.

'The communiqué that came out of the conference had very strong language about making universities relevant to today's needs. I hadn't heard such passion in years.'

Another policy champion is Leif Christoffersen, a Norwegian who served many years at the World Bank and who sits on RUFORUM's International Advisory Panel. When testifying to the power of lobbying politicians, he cites the Ministerial Conference on Higher Education in Agriculture in Africa held in November 2010. It had been organised by RUFORUM, and there were more than 400 delegates. At the conference, ministers roundly endorsed the 2003 Maputo Declaration on Agriculture and Food Security in Africa ('the Maputo Declaration'), and called for a new approach to raising the quality of education in African universities through substantial curriculum and institutional reform. The Maputo Declaration calls for a minimum 10% of national budgets to be allocated to agriculture, to underpin NEPAD's target of 6% annual growth in agriculture.

Leif recalls:

That was the turning point for me. Until that meeting I wasn't sure the political commitment was there to achieve much through the agriculture faculties. They seemed to be given low priority by

leaders and were underfunded. Then at this meeting politicians came from all over Africa to make vigorous pleas for a radical transformation of university culture and to re-engineer how they operated. It was the first time I'd heard that sort of endorsement expressed so forcefully. The communiqué that came out of the conference had very strong language about making universities relevant to today's needs. I hadn't heard such passion in years.

While policy is crafted in the corridors of power, advocacy influences mindsets on many fronts. One pathway for advocacy that leads to policy is through the RUFORUM students themselves. Runyararo Jolyn Rukarwa, a Zimbabwean, has an MSc in plant biotechnology on multiplex polymerase chain reaction and *in vitro* techniques for the detection and elimination of sweet potato viruses. She is now working on her PhD, doing research on the introgression of weevil-resistant genes into the sweet potato to improve resistance to the sweet potato weevil.

Despite 50 years of research into weevils, they continue to cause heavy losses in sweet potato production, sometimes between 60% and 100%.²⁴ In 2009 the International Potato Center (CIP) in Lima transformed a sweet potato variety with weevil-resistant genes. However, it cannot grow well in Uganda, and it is likely that Ugandans will find it unpalatable. Jolyn is working on extracting the Peruvian variety's weevil-resistant gene and placing it in varieties that can flourish in local conditions. Makerere University is the ideal place to do this as it houses the regional PhD plant-breeding programme where biosafety measures are in place. Genetic engineering in its laboratories complies with the appropriate levels of containment in accordance with the

Cartagena Protocol on Biosafety and with the African Model Law on Biosafety.

'My approach is through breeding, while Abel is doing genetic transformation. But the outcome is the same,' Jolyn explains. Her colleague Abel Sefasi, a Malawian and, like Jolyn, a RUFORUM PhD student, is transferring the genes of the *Bacillus thuringiensis* into the sweet potato using tissue culture so that it can survive weevil attacks.

Both Jolyn and Abel are on scholarships jointly sponsored by RUFORUM and CIP on the recommendation of RUFORUM Executive Secretary Adipala Ekwamu, who recognised their potential as ambassadors who will reshape how scientists and policy makers view biotechnology and GMOs. They are at the proof-of-concept stage in their research and do not expect a new commercial variety of sweet potato to be recognised for at least another six years, so they will be handing over their work to other students when they get their degrees. Abel will return to

join the faculty of Bunda College to reshape the biotechnology curriculum as 'most of my colleagues don't fully understand biotechnology'. Jolyn will be doing advocacy too. The Zimbabwe Farmers Union complains that the public perception of GMOs is negative even though the legal framework for GMO use is in place. Union members are looking to Jolyn to help them lobby the government to promote the use of GMOs.

Policy and advocacy are just one part of a spectrum that includes ICT, M&E and quality assurance.

Communication is the agent for transforming information into knowledge, but information dissemination has never been the favoured child of governments. When RUFORUM opened its doors for business, the information technology (IT) landscape in Africa was far different from what it is today. Power supplies from national grids were erratic, and telephones and electricity worked intermittently. Few people had access to

the internet or knew very much about it. In fact, many students did not even know how to use a manual typewriter. This did not bode well for the communications aspects that we now take for granted: accessing literature online, e-discussion forums and even email. Forum, RUFORUM's predecessor, had provided its partner faculties with TEEAL, a CD library of scientific journals that does not require online access.



RUFORUM uses ICT for training and research and as a medium for sharing knowledge and experiences across its extensive network. Before its 'IT spring', students could not access literature online or participate in e-forums.

But that was about as far as it went.

Things have changed since then. Bandwidth has become cheaper, and mobile phone companies offer universal, competitive services even where there is no power supply. This has made it possible for universities to access global online publications and explore field-based learning, dubbed 'schools without walls'. RUFORUM has capitalised on this 'IT spring' to help universities amalgamate research, curriculum development and problem-solving in new ways. It has been maximising ICT as a tool for training and research and as a medium for sharing knowledge and experiences across its extensive network as well as with scientists and institutions outside the network.

In 2010 the RUFORUM communications department, headed by Nodumo Dhlamini, launched a new website – www.ruforum.org – with user-friendly Web 2.0 tools. The website is a repository for information on and findings of the research activities of members of the RUFORUM network, and can be accessed by farmers, government agencies and extension services, agricultural research organisations and other networks. It also serves as the main portal for RUFORUM e-content for students and lecturers and as a topical discussion platform for researchers, students, farmers, government decision-makers and others. RUFORUM intends to include links to commodity exchanges, farmers' associations, NGOs, agricultural journals and information networks as well.

It is a dynamic system that is a pathway to useful and contemporary information pertinent to all RUFORUM's various partners and stakeholders. Web-based information generation and digitised information dissemination are the key

ingredients in this process. RUFORUM also uses learning platforms to document and share best-practice cases for replication. The website hosts a number of publications produced by RUFORUM to specifically address gaps, such as guidance on postgraduate research and proposal writing.²⁵ In addition, members are apprised of opportunities and publications through an email list and the monthly newsletter. RUFORUM funds Web 2.0 training for its grantees through modules posted on its web-based platform. By 2014 all coursework at RUFORUM member universities will be digitised. There are online platforms on Facebook and LinkedIn where RUFORUM interacts with students.

Liz Levey, an ICT expert, is contracted by BMGF to assist RUFORUM with building this institutional repository for all research resources, including theses, monographs, journal literature and case studies. This is a far cry from the original concept of a scholarly repository. 'It took a while to conceptualise what RUFORUM really wanted to do. The delay was good, because we might not have arrived at the right solution if we'd rushed it,' she says.

As any ICT expert will tell you, it is critical for a website to be 'discoverable', so that it becomes part of the global conversation. The RUFORUM site is posted on the global public domain website the International System for Agricultural Science and Technology (AGRIS), which is used by developing countries for indexing and abstracting. It will also be accessed through Google Scholar; Scirus, the most comprehensive science-specific search engine on the internet; and Eldis, a gateway for global development information, managed by the Institute of Development Studies at the University of Sussex in England.

Liz adds:

There have been a lot of breakthroughs with institutional repositories in the last two years. The software is fairly new and not just in Africa. Nodumo is capitalising on all this. She is extraordinarily competent and a marvellous systems person. By 2014 RUFORUM will be able to show off its repository at the biennial conference.

It was decided at the Bellagio retreat in 2010 that RUFORUM should help universities and faculty members to translate course modules into online e-learning platforms. This, it was agreed, would make the regional programmes more accessible and thus more attractive to potential students. To date there are regional programme e-courses available for the PhD programme in Aquaculture and Fisheries and the MSc programme in Agricultural Information Communication Management (AICM).²⁶ In addition, an e-course in research methods has been piloted for PhD students at Malawi's Bunda College. It teaches conceptualising and practising research design and data collection, analysis and interpretation.

Charting the way for putting courses onto an e-platform is the MSc in Research Methods offered at JKUAT. The two-year curriculum comprises a series of modules that are taught by a range of experts drawn from the RUFORUM network and institutions such as CGIAR, a consortium of international development research organisations.

'Because the course input is collaborative, some aspects of the programme had to happen virtually. We needed a way for lecturers and students to access diverse sources of information and expertise,' explains Washington Ochola, who heads RUFORUM's planning and M&E unit.

e-Learning offers an effective platform for facilitating this approach. Courses are designed using Moodle, an open-source web-based learning management system. The University of Reading's Statistical Support Centre in the UK provided the initial training and electronic infrastructure, as e-learning was not yet well established at JKUAT.

Wary lecturers had to be guided in designing their own online course content, recalls Dr John M Kihoro, the programme's e-learning manager. Students, however, readily embraced e-learning. 'The dynamism of the content is exciting,' he says. As a lecturer, for example, he can give students problems to solve creatively, and they can test their own knowledge and work at their own pace, raising questions via the platform when they need to.

As e-learning relies on self-motivation, it makes particular sense for students of research methods who are being primed for careers in which they will have to work without supervision as they evaluate information extracted from voluminous data and research. 'When students explore and discover things on their own, they retain more. I always tell them, if this region is going to come up with new products and innovations, it must be through research,' says Dr Anthony Waititu Gichuhi, who coordinates the first-year programme.

As often happens in the case of fledgling institutions, initially M&E within the RUFORUM secretariat lagged behind. It was outsourced and tended to be overlooked in the flurry of start-up activity for other programmes. The BMGF grant provided for an M&E officer for the first time, and Agnes Obua-Ogwal was hired in 2009. She immediately conducted a baseline

survey, streamlined indicators and put aside the conventional logframe in favour of a theory-of-change framework that is flexible, allows for several outcomes and at the same time tells a story. To feed the M&E, Agnes organised data collection through structured questionnaires and focus-group discussions with students and PIs. As a result, the M&E unit has begun to disseminate emerging lessons. Agnes' next projects are to conduct a tracer study of students and a thematic evaluation study. Without the M&E unit to collate and interpret RUFORUM activities and the impact of members' research findings, there would be no evidence on which to base innovation and policy reform.

There is another aspect to a well performing organisation – as Wellington Ekaya, who heads the RUFORUM secretariat quality assurance unit, knows only too well. He explains:

We organised a workshop in January 2011 and realised that the PhD and MSc regional programmes are hosted by universities with quality assurance at different levels of sophistication. This had to change if we are to introduce an accreditation and credit transfer system for the region. For instance, Europe uses the Bologna process, which has incorporated MSc training into a system that is comparable across the continent.

As a result of the findings in that workshop, RUFORUM is introducing self-evaluation systems, external evaluation teaching systems and external evaluation systems for graduate research.

RUFORUM uses its national and biennial network meetings and its regional workshops as occasions for students, faculty, alumni and other actors to review research proposals, work in progress and final reports. These forums serve

as cost-effective mechanisms for quality control and professional community building, while continuing to provide opportunities for communication skills development, drawing out policy implications, and building national, regional and international linkages. They are also occasions for university faculty to meet policy makers, private-sector entrepreneurs and development practitioners from all over the world.

'So many projects have failed in Africa. We had to make sure we didn't fail.'

'Quality assurance is critical because, at the end of the day, we are accountable,' adds Adipala. He elaborates:

I am always asking myself to what extent our processes are helping to improve the condition of the smallholder. And are we meeting the expectations of the universities? The third concern is our funders. Are we putting in place systems that give them confidence and that justify the taxpayers' contributions? So many projects have failed in Africa. We had to make sure we didn't fail.

WOMEN ON THE FAST TRACK

It is RUFORUM policy to practise affirmative action so that women can advance their academic careers in parallel to their male colleagues. Between 2004 and 2011, about a third of PhD students and almost half of MSc students were women. By offering a helping hand to women in postgraduate and job placements, RUFORUM has contributed considerably to increasing the number of African women professionals whose talents are making a difference in agricultural research and development.

Girls are generally not encouraged to focus on science – particularly biology and agricultural science – in primary and secondary school, with the result that African female participation rates in the agricultural sciences at universities are roughly half those in other disciplines. RUFORUM encourages women to pursue higher degrees by offering nurturing grants. Applicants are mentored to strengthen their science so that they can resubmit their proposals in a subsequent round of competitive grants.

RUFORUM collaborates with African Women in Research and Development (AWARD), a two-year fellowship for fast-tracking the careers of African women who are scientists and professionals.

Women are still less well represented in high-level research, management and decision-making positions than their male colleagues. In view of its goal of 50:50 gender representation at all levels, RUFORUM goes the extra mile to enable women to pursue a scientific career. RUFORUM has, in certain instances, paid for childcare for women who deliver during their postgraduate studies.

Notes

24. Published by Sorenson in 2009
25. See www.ruforum.org/sites/default/files/GEAR/menu/index.html
26. www.ruforum.org/category/documents-taxonomy/open-education-resources and www.ruforum.activemoodle.com/

CHAPTER 11 TALKING TO THE WORLD

Introduced to Africa nearly 600 years ago from the Americas, the *Phaseolus vulgaris*, or common bean, has been an important crop for smallholder farmers throughout eastern and southern Africa, vital to household food security and prized as a cash crop. 'In Kenya, virtually everyone eats beans,' declares Prof. Paul Kimani, a plant breeder with the University of Nairobi, who has devoted his life's work to spreading the gifts of the bean far and wide.

The vigorous, vertical growth of climbing bean varieties adapted to thrive at high altitudes in land-scarce Rwanda, for example, helped to make that country food-secure.

Packed with protein and micronutrients, beans are a potential boon to food security. They have a short growing cycle and require little fertiliser. Unfortunately, however, beans offer poor yields and are highly susceptible to disease. Paul, a three-time RUFORUM PI, has worked for more than a decade to combat these deficiencies. Thanks to the power of the RUFORUM and the Pan African Bean Research Alliance (PABRA)²⁷ networks, his efforts have made a difference to the lives of millions of people across the continent. The vigorous, vertical growth of climbing bean varieties adapted to thrive at high altitudes in land-scarce

Rwanda, for example, helped to make that country food-secure. And the release, in 2013, of a drought-tolerant and nutrition-enhanced variety bred for the canning industry is expected to give small-scale producers an entry into Kenya's export markets.

Like that of Sheunesu Mpeperekwi, the soybean specialist, Paul Kimani's story illustrates what happens when scientists look beyond their disciplinary silos and build wide-ranging partnerships that are the catalysts for profitable industry where only bare subsistence existed before. While researchers frequently make significant progress within their own disparate areas of interest, it is through networks that such efforts achieve a wider impact. RUFORUM, as a network, has amplified the voices and contributions of its constituents – member universities, researchers, students and alumni – so that they can be heard by the policy makers who reshape higher education and agricultural development.

The network has linked up researchers in a collegiate community of pooled knowledge – soybeans in Uganda; common beans in East Africa; nascent seed systems in South Sudan; aquaculture in Malawi – that now registers on the scales of regional impact. In an era of increasing pan-African cooperation, RUFORUM has created a platform where universities can aim their research and training efforts directly at smallholder farmers as well as regional policy makers.

These are conversations from which universities have, until recently, been mostly absent. 'Universities need to show their relevance and how their research is translating into growth and development for the country and region,' says Adipala Ekwamu.

In an era of increasing pan-African cooperation, RUFORUM has created a platform where universities can aim their research and training efforts directly at smallholder farmers as well as regional policy makers.

By the year 2010, it was clear that RUFORUM had achieved a quantum leap forward despite the constraints of funding shortfalls. Governments routinely sought input from RUFORUM member universities on agriculture policy and acknowledged the importance of their contribution. Hundreds of RUFORUM alumni were filling the ranks of government, academia, the NARS and NGOs, many of them in leadership positions. Significantly, governments were recognising the importance of investing in both universities and agricultural research, a position reinforced by CAADP's call for 6% annual growth in agriculture to lift the region out of poverty.

In short, RUFORUM was generating influence and impact that was evident in ways both large and small. The network was the driving force behind the ministerial conference, convened in Kampala in November 2010, that brought together higher education and agriculture ministers from across Africa to craft a common agenda for strengthening the role of higher

education in agriculture. The meeting involved hundreds of high-level people working in education, agriculture, science and technology and finance, as well as representatives from farmers' unions, civil society and business. It culminated in a new process, called the Tertiary Education for Agriculture Mechanism (TEAM-Africa), which lends weight to RUFORUM's mandate of aligning university agricultural research and training to CAADP. In addition, the RUFORUM biennial regional conferences have provided forums for researchers and students to share their findings and derive inspiration from one another.

For Paul Kimani, a RUFORUM competitive research grant awarded a decade ago got him started with working on new bean varieties from local bean germplasm and accessions from CIAT in Colombia that could be adapted to the region's diverse microclimates. As a result, new varieties released by the University of Nairobi over the past decade have spawned new industries, involving smallholder farmers in producing commercial seed and commercial volumes of beans to supply the canning industry.

Paul always knew that the common bean held far greater potential for improving farmers' lives than he alone could deliver. Early in his career he began to see the one-sidedness of the extension system, which prescribed solutions to farmers, instead of listening to what they needed. This particularly applied to women, who cook for the household and are looking for bean varieties that taste good and boil quickly, saving time and firewood. The PABRA network has provided the opportunity for researchers to collaborate on surmounting the diverse challenges of market access, soil health, climate change, nutrition, food security and land pressure.



Billy Makumba discovered that a rich yellow, natural dye could be created from the *Tagetes minuta*.

Paul and his PABRA colleagues developed a strategy to ensure that the new bean varieties would actually reach the farmers they were intended for. The goal they set for themselves was to reach two million households (10 million people) within five years (2003–2008). A third of the area under cultivation in the Great Lakes region is dedicated to bean production. Per capita consumption is among the highest in the world.²⁸ PABRA researchers developed ways of multiplying the seeds to make them affordable and easily accessible to farmers. They also produced promotional materials informing farmers about the new varieties.²⁹ All told, the germplasm developed at the University of Nairobi has been adopted by more than seven million households, translating to more than 35 million people in 32 different countries, Paul says.

Paul credits RUFORUM's value-chain model for being the catalyst for the university's partnerships with the Kenyan seed and canning industries. The university has helped smallholder farmers to become suppliers to the Kenya Seed Company Ltd and Trufoods Ltd. It is a success he hopes to replicate with a more recent RUFORUM competitive research

grant to create new varieties of drought- and disease-resistant bush and climbing snap beans, which can then become a profitable export crop. 'Smallholders are the main beneficiaries of this, in food and also income,' he says. 'We're offering them multiple bean varieties, but we've also created a basket of different options for farmers.'

RUFORUM alumni are another means of spreading the gospel.

From Zimbabwe to Burundi, graduates work as ground-breaking scientists; dedicated foot soldiers within national extension systems; and leaders in civil society. One even serves as a member of parliament in Uganda. In Malawi, Prince Kapondamgaga, the chief executive of the Farmers Union of Malawi, exemplifies the kind of leadership that RUFORUM has sought to nurture. He completed his masters degree in 2002 through a competitive research grant won by Prof. Henry Mlosa-Banda, concentrating on the socio-economics of controlling the invasive striga weed. The interdisciplinary design of the research broadened his thinking into a wider context. Inspired by the writings of Amartya Sen, he wove strands of democracy, food security and human rights into his hard science. This holistic approach has served him well as he advocates for the needs of farmers in national, regional and global forums, he says.

Prince joined the Farmers Union in 2006 and worked to transform its profile from that of a small, non-professional body of 60,000 farmers into a powerful organisation that wields influence throughout the region. Malawi's transition from a state-controlled to a free-market economy over the past couple of decades had not been kind to small-scale farmers. Prince engaged

the Malawian government, SADC, the Common Market for Eastern and Southern Africa (COMESA), NEPAD and even the United Nations, advocating for strong institutions to help farmers compete in global markets. Malawian cotton and tobacco farmers, for example, were suffering because they could not compete with their neighbours. It was a situation exacerbated by national research priorities oblivious to farmers' needs and 40% commercial interest rates. New technologies to improve the quality and yield of cotton and tobacco crops remained unaffordable.

'I need to produce compelling empirical evidence to convince the minister for agriculture on policies. The rigour of the RUFORUM programme gave me the confidence and the analytical skills to articulate these issues. It made me read a lot, which gave me a diverse and broader scope for looking at the real world.'

'It's about advocating for good policies,' says Prince. 'Farmers are vulnerable to so many shocks in terms of research, finance, markets, credit. If the institutions are not supporting them, we can forget about agriculture picking up.'

Prince's RUFORUM training has equipped him to speak to policy makers, he says, and fortunately they are starting to listen, perhaps in part because the Farmers Union has become a force to be reckoned with. During Prince's six years in the post, the organisation has reached a membership of half a million farmers, most of them smallholders, represented by some 117 different farmers' groups across Malawi. This gives Prince

bargaining power as he deals with not only politicians but donors such as AGRA, Oxfam and the Swedish government. He has lobbied government to support local initiatives such as the Smallholder Seed Multipliers Action Group – in order to reduce farmers' reliance on imported seed – and small-scale mechanisation such as ginneries – so that farmers can create economies of scale by pooling their cotton lint and seed to sell in bulk.

Says Prince:

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Universities themselves are also becoming stronger players in their relationships with governments and private industry by offering their own innovative approaches to the challenges of the region. Recognising agriculture as an inherently multidisciplinary pursuit, RUFORUM encourages member universities to add new dimensions to their research and training programmes. One area with strong and obvious links to agriculture is food science and technology. At Makerere University, a state-of-the-art incubation centre for food-based enterprises offers a glimpse of where many value chains are headed. Inside a gleaming, open-plan factory space, entrepreneurs and their employees are busy working on sleek machines, preparing all manner of food products – from smartly packaged fruit juices to prime-beef fillets for export to the Democratic Republic of the Congo. The aim is to build vertical industries so that everyone who contributes to the value chain benefits, from the farmers



Moi University Vice-chancellor Prof. Richard Mibey received a 'best African innovator' award in 2011 for the invention of Tamidy.

who grow the produce to the retailers of the finished products.

The College of Health Sciences at Makerere offers more potential for collaboration with RUFORUM, particularly through its participation in studies on the prevention of HIV/AIDS, a disease that has had seriously detrimental effects on agricultural production. Like RUFORUM, the college talks to the outside world about research and policy through its regional networks. 'Our concern is how research is translating into policies and practices and making a difference to peoples' health,' says Prof. Nelson Sewankambo, the college principal. He cites the paradigm of the Sustained Use of Research Evidence in Africa (SURE) as one that could be replicated in agriculture and other sectors. It provides policy makers with easily digestible briefs to be used in parliamentary debate. 'All of these kinds of innovations are strengthened by partnerships,' he says. 'We like networks. We like collaborations within the country, the region and beyond.'

Elsewhere in the RUFORUM network, new models are emerging for re-energising

research, training and the role of the university in society. Prof. Richard Mibey, the vice-chancellor of Moi University in Kenya, bought and revived a derelict textile factory to serve as a research and training facility that would at the same time provide a source of revenue for the university. 'Funding from donors is never consistent. Neither is funding from the governments,' says Mibey. 'For us to be able to run a university and meet the needs of society, we should aim at being self-reliant.'

When rehabilitating the textile factory, the university management team had trouble sourcing fabric dye, a problem that triggered yet more innovation. Billy Makumba, a researcher in Richard's office, was tasked with assessing the feasibility of the local manufacture of plant-based dyes to replace imported synthetic ones. As an accomplished mycologist, Richard suspected that mushrooms would be a promising start. He despatched Billy to the Kakamega Forest, the last remnant of equatorial forest in Kenya, to gather mushroom species, particularly those with bright colours. While it was relatively easy to extract dyes from species such as the *Boletus piperatus* and the *Macrolepiota rachoides*, the colour did not hold fast. Richard and his co-researchers were able to publish a paper on the results of their experimental efforts, but still they found nothing that could produce a consistently high-quality dye. 'A number of them were good, but they were not good enough,' recalls Billy. 'We wanted something we could commercialise.'

The focus then moved from mushrooms to flowers. Billy finally hit the jackpot with the *Tagetes minuta*, a bushy, invasive species of marigold native to South America, whose tiny yellow flowers give off an unmistakable, pungent smell.

When he prepared dye baths from the inflorescence, Billy got solid, intense and attractive colours. By varying the temperature of the dye baths, the university researchers were ultimately able to produce seven different shades of colour from the *Tagetes minuta*, ranging from lemon yellow to olive green, mustard, rich gold and tobacco brown. 'I said, "Eureka! this is it!"' Billy recalls. 'This is what we were looking for.'

'It's good to do research, but let it be research that leads to products for commercial purposes,' says Richard. 'We don't have money to do research for publications that stay on the shelves. That certainly won't lift us out of dependency.'

The researchers have named the product Tamidy, drawing on an abbreviation of the plant's Latin name, and are using it to print fabric that is sold to make shirts and tablecloths. Using a small government grant the university is beginning to commercialise Tamidy as a product in its own right. The dye is ground into powder and then packaged and retailed on campus. The product's potential was

acknowledged at the First African Forum on Science, Technology and Innovation, a higher education meeting organised by the African Development Bank and held in Nairobi in April 2011. Richard Mibey was voted 'best African innovator' and received an award for the Tamidy invention.

The textile factory now employs some 200 weavers, dyers, seamstresses and tailors. About 150 students are on industrial attachment from various faculties at any given time. The factory supplies shops in Nairobi, Kisumu and Eldoret that specialise in school uniforms and African prints. It has also received enquiries for orders from outside Africa. For now earnings are re-invested in on-site research into possible power generation from solar, wind or biomass energy as well as how to treat the factory's effluent. The university is supplying free cotton seeds to farmers to encourage a revival of cotton as a crop, as locally grown cotton amounts to only a third of the factory's requirements.

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Notes

27. A research network supported by CIAT
28. www.ncbi.nlm.nih.gov/pmc/articles/PMC2886139/
29. See http://eiard.org/media/uploads/File/Case%20studies/2013_SDC%20funded/CIAT%20-%20A%20bean%20revolution%20in%20sub-Saharan%20Africa.pdf

CONCLUSION

RUFORUM's success is set in the context of the requirements for long-term agricultural productivity. These include the expansion of research and innovation, the provision of improved genetic materials and modern input from research centres, and the creation of an enabling environment for the adoption of new technologies. In the past, growth was driven by an expansion of land and labour. Now farming gains are intensive in nature. Future agricultural growth will depend on technological change, which requires generous and thoughtful investment in research and development and higher education. This is the premise that underpins RUFORUM's vision and mandate and which is the driver of its success.

'RUFORUM is different because it follows up as well as trains. It's that extra touch that helps you to really contextualise what you do and to see the other side of your work. They show interest in you and link up with you again by inviting you to events. They're special because they consolidate and ensure that the training you get is meaningful for your work.'

RUFORUM has more accomplishments to its name than would have seemed

possible back in 1992, when Malcolm Blackie at the University of Zimbabwe struggled to find even half a dozen poorly qualified graduate students to train. RUFORUM's impact on farmers, scientists, university faculty and a range of others in the agriculture sector has been varied and enduring. New strengths – in ICT, in transdisciplinarity, in biotechnology, and in business – have emerged through the regional postgraduate programmes, which has led to broader changes within the RUFORUM member universities and their higher education systems. Participatory research, directly involving farmers and geared towards building value chains, is becoming the norm. This is part of the larger process of revitalising universities, national research institutions and extension services. RUFORUM is also cognisant that governments must put smallholder farmers and agricultural productivity at the centre of national strategies for economic growth, poverty alleviation and food security.

The RUFORUM touch is sometimes subtle and hard to detect, but it is very much a guiding force and catalyst in this new era of innovation, partnerships and networking. Says Dr Irene Frempong, a member of the Technical Advisory Committee:

RUFORUM is different because it follows up as well as trains. It's that extra touch that helps you to really contextualise what you do and to see the other side of your work. They show interest in you and link up with you again by inviting you



RUFORUM secretariat staff

to events. They're special because they consolidate and ensure that the training you get is meaningful for your work.

The stories in this publication depict a new generation of researchers advancing to meet the diverse challenges of climate change and new market opportunities. The hard work and dedication of countless individuals scattered across institutions in a host of countries have forged new strengths that were hardly imaginable a decade or two ago. At that time few believed African universities would be capable of rigorously training PhDs. Yet, as of mid-2013, some 95 PhD candidates representing nine different countries, and over 600 MScs from 32 countries, have been RUFORUM grantees.

Says Kay Leresche:

RUFORUM has done a good job against all kinds of odds. Adipala, his colleague Dr Moses Osiru, and the entire secretariat team are really to be admired. Their passion drives them. Everything they do is for the good of higher agricultural education. They have fought tooth and nail to make it relevant to smallholder farmers, and to give the

students the right skills. The national forums are unique. They feed back to the universities what the agricultural community wants them to do. It grounds the universities in reality. This has given a singular flavour to RUFORUM that no other organisation has.

In the post-conflict societies of Mozambique, Rwanda, Burundi and South Sudan, researchers are sowing the seeds for future peace and security by making tangible strides towards achieving food security and introducing innovations to lift farmers out of poverty.

And everywhere in the region RUFORUM alumni bring an ethos of hard work, critical thinking and analytical rigour and change to their jobs. Almost certainly the future will present even more complex problems than those already faced in the first decade of this millennium. When these challenges arise, they will be tackled by scientists from Ethiopia and Sudan to Zimbabwe and Mozambique, whose academic experience has equipped them to find enduring solutions.

APPENDIX 1: RUFORUM DONORS

Bill and Melinda Gates Foundation (BMGF)
 International Development Research Centre (IDRC)
 Carnegie Corporation of New York
 Africa, Caribbean and Pacific Group of States-European Union (ACP-EU)
 European Union (EU)
 Department for International Development (DFID)
 Rockefeller Foundation
 Austrian Development Agency (ADA)
 Ford Foundation
 Governments of the participating African countries
 German Academic Exchange Service (DAAD)
 International Fund for Agricultural Development (IFAD)

APPENDIX 2: RUFORUM MEMBER UNIVERSITIES

Region	Country	No.	University	Year of joining RUFORUM	Year of establishment	Category
Eastern	Kenya	1	Moi University	2004	1984	Public
		2	Egerton University	2004	1987	Public
		3	Eldoret University	2013	1946	Public
		4	Kenyatta University	2004	1985	Public
		5	University of Nairobi	2004	1970	Public
		6	Jomo Kenyatta University of Agriculture and Technology	2004	1981	Public
	Tanzania	7	Sokoine University of Agriculture	2006	1984	Public
	Uganda	8	Makerere University	2004	1970	Public
		9	Uganda Martyrs University	2009	1993	Private
		10	Gulu University	2009	2002	Public
	Sudan	11	Kyambogo University	2009	2003	Public
		12	University of Kordofan	2009	1990	Public
		13	University of Gezira	2009	1975	Public
	South Sudan	14	University of Juba	2010	1977	Public
	Ethiopia	15	Haramaya University	2009	1954	Public
		16	Mekelle University	2009	1991	Public

Region	Country	No.	University	Year of joining RUFORUM	Year of establishment	Category
Central	Burundi	17	National University of Burundi	2009	1964	Public
	Rwanda	18	National University of Rwanda	2009	1963	Public
	DRC	19	Université Catholique de Bukavu	2009	1989	Private
Southern	Zimbabwe	20	Africa University	2004	1988	Private
		21	University of Zimbabwe	2004	1952	Public
	Zambia	22	University of Zambia	2006	1966	Public
	Malawi	23	Mzuzu University	2010	1997	Public
		24	University of Malawi	2004	1964	Public
		25	Lilongwe University of Agriculture and Natural Resources	2012	2012	Private
	Mozambique	26	Eduardo Mondlane University	2004	1962	Private
		27	Universidade Católica de Mozambique	2010	1996	Private
	South Africa	28	Stellenbosch University	2013	1866	Public
	Swaziland	29	University of Swaziland	2009	1964	Public
Lesotho	30	University of Lesotho	2009	1945	Public	
Botswana	31	University of Botswana	2009	1982	Public	
Namibia	32	University of Namibia	2010	1992	Public	

Total number of member universities: 32

Associate member universities

Central	DRC	Université Evangelique en Afrique	2013	1991	Private
Eastern	Uganda	Busitema University	2013	2007	Public
Eastern	Uganda	Uganda Christian University	2013	2006	Private
Eastern	Rwanda	Umutara Polytechnic	2013	2009	Public
Eastern	South Sudan	John Garang University	2013	2009	Public

Total number of associate member universities: 5



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