

# RUFORUM Case Studies

In Mozambique, Building the Capacity to  
Manage Pests and Conserve Ecosystems

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In an era of unprecedented internationalisation in higher education, and ever-increasing collaboration between academics around the globe, the Eduardo Mondlane University (UEM) in Mozambique has been challenged to overcome its history of isolation due to war.

In the wake of a devastating 17-year civil war, which ended in 1992, the university has leveraged its membership within the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) network, an advanced training and research network comprised of 29 member universities from across the Common Market for Eastern and Southern Africa (COMESA) region, in order to build much-needed research capacity, as well as linkages with a wider academic community beyond Mozambique.

Back in 1992, Mozambique ranked as one of the world's poorest and most heavily indebted countries, at or near the bottom of the list on most global development indicators. Now, the country's booming postwar economy relies heavily on both commercial agriculture and small-scale farming, upon which around 80 percent of the population depends for their livelihoods. The critical need for researchers with the scientific knowledge to support development and economic growth in both sectors can be illustrated in the story of the Asian fruit fly, or *Bactrocera invadens*.

The insect, somewhat larger than a common housefly, and adorned with brilliant yellow and brown stripes that give it an appearance similar to a bee, was first detected in Kenya in 2003 and has since become widespread, and widely destructive, across Africa, making its first appearance in Mozambique in 2007. The *Bactrocera* lays its eggs inside ripening fruit, turning healthy flesh to putrid breeding grounds for larvae.

Responding to the scourge, a research team from UEM secured a competitive research grant from RUFORUM to map the outbreak, study its impacts and test biological control methods – a project which has helped the university contribute towards the government's efforts to deal with the infestation, which poses tough economic and food security challenges, says Dr. Domingos Cugala, the principal investigator on the project.

The project simultaneously builds on the expertise of Dr. Cugala, an entomologist who is himself a RUFORUM alumnus, and provides for the training of two MSc students.



## The Fruit Fly Menace

The fruit fly's arrival and spread across areas of northern Mozambique illustrates the scientific challenges posed by increasing regional integration and movements across borders, he says. Since its arrival, the fruit fly has spread across the country's Northern provinces, and jumped across the Beira corridor, a major transport artery that bisects the country. Now, the Bactrocera appears to be creeping slowly into the central areas of the country. A major priority now is to contain the fruit fly within central Mozambique, and keep it from spreading to the south, where fruit commercial farming, an industry that provides more than US \$6 million in exports per year and more than 5,000 jobs, has already been hit hard by import bans imposed by South Africa and Zimbabwe.

*"Farmers are now changing their crops, cutting back their labour force, so we are losing employment and losing areas of crop production."*

Dr. Domingos Cugala

The Ministry of Agriculture has made controlling the fruit fly its top priority, he says. Nevertheless, the resources available for coping with the outbreak are severely limited. *"We have so few trained entomologists here in Mozambique – perhaps four or five in the whole country,"* says Dr. Cugala. *"Most of the Ministry technicians don't even have a BSc."*

Laura José, one of the master's students, has been working to assess the damage levels in the Cabo Delgado area of northern Mozambique where the infestation is most widespread, as well as how the damage is impacting both commercial and small-scale farmers. Huge losses have been suffered in commercial export crops such as tomatoes, cucumbers, citrus fruit and papayas, while wild fruits have also been decimated in a number of areas, she says. The outbreak is also removing important fruits such as mangoes from small-scale farmers' diets, forcing people to find alternatives, she says.

*"I will fill the information gap about the damage levels, the infestation and the impact on the farmers and the rural population,"*

Laura José, one of Dr Cugala's master students

Her work has involved both collecting samples of infested fruit to analyse in the lab, and also conducting interviews in markets and on farms to assess the levels of awareness of the fruit flies, and their impacts.

*"Most people don't know about fruit flies,"* she says. *"They just say the fruits are rotten, and inside they find larvae. They can describe the damage, but they don't know what is causing it. When you explain it, they recognise that it is a day to day problem."*

So far, interventions have mainly been limited to conducting surveillance and setting pheromone traps, which do not prevent the spread of the fruit flies, but allow researchers to map the patterns of the infestation.

*"I hope our results help the government to make a good decision about investing in controlling fruit flies. Maybe it's time to invest more, because the losses are very high."*

Laura José

While fruit flies are at the top of the country's hit list now, they are only one of a growing number of competing priorities in a region where pests can frequently destroy as many as half of crop yields. *"We have new problems coming all the time in plant protection,"* says Dr. Cugala. *"When a problem arises, the first thing people do is call the entomologist at the university."*

Prof. Cugala, who is heading a national programme on fruit flies, is himself an example of RUFORUM's impact at the university and beyond. Hired as a lecturer at the university in 1995, he sought funds from FORUM to complete his MSc, but had to look beyond UEM – to the University of Nairobi and the University of Zimbabwe – in order to find supervisors, because there were so few qualified lecturers at UEM at the time.

## Building a New Cadre of Researchers

At the time of independence in 1975, the faculty had just one Mozambican lecturer and about 40 students, recalls Prof. Luisa Santos. There was a huge need to invest in training new staff, and she was one of a number of young lecturers sent abroad for advanced training – ultimately, she completed her PhD at Cornell University. For many years, however, the long conflict interrupted these programmes and effectively prevented new generations of researchers from gaining traction. Only in 2001 was the university ready to begin offering its first master's programmes.

Back in the late 1990s, Dr. Cugala's field work involved studying the release of parasitoids, sourced from the International Centre of Insect Physiology and Ecology in Nairobi (ICIPE), as a biological control against maize stem borers, a pest that had begun wreaking widespread destruction across the country. The project not only helped to establish Prof. Cugala as a national expert in biological control methods for invasive species, but also served to establish a lasting relationship with ICIPE, which then funded his PhD research and has continued to support his work, including the current fruit fly programme.

Much of the university's work supported by RUFORUM involves pest management, particularly methods of integrated pest management and biological control. After completing his PhD, Dr. Cugala was then able to apply for RUFORUM research grants as a principal investigator.

A defining principle of RUFORUM, that African universities could and should be strengthened in order to take charge of their own postgraduate programmes, brought scarce new training opportunities to UEM, recalls Prof. Santos. Developing master's programmes has been a huge challenge at the university, she says: "It's not just to train the person – it's the resources to do the research; the management of the programme; how to select the best students; and what types of programmes we should offer."

As RUFORUM (previously known as FORUM) developed throughout the 1990s, researchers from UEM had difficulty competing on equal footing for funding with their counterparts in Uganda and elsewhere in the network, recalls Prof. Santos, who has served as principal investigator on several projects.

As a solution, she says, Dr. Patel from FORUM (and later Prof Adipala Ekwamu of RUFORUM) agreed to set aside special funding for half a dozen master's students to be trained at UEM. Unlike the competitive grant funding, these funds were not tied to any particular research programme, but were rather meant to support the development of MSc training within the Faculty of Agronomy.

Prof. Santos particularly appreciated the flexibility of this approach, which allowed students a greater hand in designing their own research programmes.

*"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. The students have to be able to appropriate the ideas of the Principal Investigators as that of facilitators-to build creativity and critical thinking amongst students"*

Prof. Luisa Santos

Prof. Santos looks back with pride and gratitude to her colleagues in the Faculty of Agronomy, the students they trained and especially FORUM and RUFORUM for the sustained support and commitment to build capacity at UEM and Mozambique 'last year we were able to host a global scientific conference in Maputo that brought over 400 international scholars. This year we will host the first group of international students in our post graduate programmes, making us a training hub in Southern Africa,' she says.

## Integrated Pest Management for Cotton

One of those projects involved introducing integrated pest management strategies for cotton, an important crop dating from colonial times, which is Mozambique's second-largest cash crop, and a heavy consumer of pesticides. One student, Helder De Sousa completed his master's research on strip intercropping of cotton and maize, a system of interspersing rows of cotton with rows of maize – and a method that reduces the need for pest control for both crops, while also improving food security, he says. "Cotton is one of the main crops to reduce poverty in Mozambique," he says.

As the maize begins flowering in the fields, he says, it attracts predators and parasitoids of some of the pests that attack the cotton, reducing the need for chemical control. Later on, pesticides can be sprayed on the cotton plants, and the residues drift across to the maize and prevent damage there as well.



Helder spent six months working with farmers in the field to implement the system in the areas of Morrumbala in the Zambezia province.

His field research led to a job with the Cotton Institute of Mozambique, where he is now working with government to help small-scale farmers adopt the method. Interspersing cotton and maize, he says, farmers can produce as much cotton as they would if they planted all their land with cotton – and they are left with additional maize to harvest for their own consumption.

*"I learned from the farmers, and now I am taking back the knowledge to the farmers,"* he says. *"We took my thesis and transformed it into a project, an innovation system."*

Next, he hopes to complete a PhD while continuing to work at the Cotton Institute.

There will be plenty of challenges in introducing this system further, he says, not least because the cotton industry essentially works as a monopoly. In each region, one particular company will have a concession to provide local small-scale farmers with seed and pesticides on credit, and then buy their cotton at the end of the growing season. Prices are set by the government, in consultation with the companies and farmers' representatives. Because most farmers work on plots as small as one or two hectares, the system relies heavily on farmers being organised into small groups to share essential equipment such as crop sprayers.

Under such a system, *"the decision is taken away from the farmer,"* says Prof. Santos. *"If the company doesn't want strip intercropping, they can't do it."*

## Mapping the Mopani Forest Ecosystem

Meanwhile, a new RUFORUM-funded competitive research grant programme that started early this year will focus on the ecosystem of the mopani forest, the country's second-largest forest habitat. Scientists believe that this habitat has been heavily degraded over the past decade, due to an increase in farming – particularly fires associated with slash-and-burn agriculture, and deforestation for charcoal production – but the complex dynamics behind the trend are poorly understood.



Two students will complete their MSc's under the project. Claudio Quenhe is studying 20 years worth of satellite images and other mapping data in order to map the dynamics of the area. The other student, Inocência Muzine, is collecting data to characterise the forest structure and plant composition, in order to establish the changing patterns in biodiversity over time that are associated with human impacts. Together, these two sets of data will provide a clearer picture of the patterns of cause and effect that are driving change in the ecosystem.

It seems that there is a pattern in the region of human livelihoods impacting on the forest ecosystem, while at the same time these anthropogenic changes are making forest livelihoods increasingly tenuous, says Romana Bandeira, a professor of forestry at UEM, who is the principal investigator.

*"People depend on the animals, the timber, the edible mopani worms, and the honey produced by the wasps for their living,"* she says. *"The reduction in the ecosystem might have an effect on people's livelihoods."*

The study is also enabling a handful of BSc students to take part with their own small projects, looking into questions such as the role of insects in the ecosystem. *"This is important not only for us as professionals interested in getting scientific answers, but also for students in preparation for their careers, and for the communities themselves,"* she says.

One of the motivating drives for conducting the study came when Prof. Bandeira was approached by the government to help prepare a report on the mopani forest ecosystem for the United Nations. But no funds were available for conducting proper field research, so she and her colleagues were only able to review the sparse literature already produced. *"We didn't have any sort of data,"* she recalls. *"It was embarrassing. We didn't know anything."*

While the area has always had low rainfall and poor agricultural production, and therefore relatively low population density, she suspects that the degradation has a lot to do with charcoal production, as locals cut down trees to produce charcoal to supply energy-hungry households as far away as Maputo. Eighty percent of households use charcoal for domestic energy, she says.

Claudio Quenhe, one of the master's students, pulls up a series of images on his laptop of the area from 1990, 2000 and 2010 in order to begin to illustrate the dynamics of a changing ecosystem over time. His speciality is using GIS to analyse data on natural resources and biodiversity, he says.

Although the data is still rough at this stage, by glancing at the maps – which are colour-coded to reveal areas of pristine forest; areas of moderate degradation; and areas of high degradation – one begins to get a sense of dramatic changes, as swathes of bright green forest that were present in 1990 give way to dark green and red degradation on the current map.

Quenhe points to the areas with the greatest levels of disturbance, indicating the presence of new roads and villages that weren't there previously. He is using a combination of satellite images, topography maps, GPS, photography and data analysis to construct the maps. He estimates that the current versions are about 75 percent accurate – and the team will soon go to the field, where he will gather data closer to the ground that should make his maps 95 percent accurate, he says.

*"More than 80 percent of these areas were burned in the last 20 years,"* Quenhe explains, pointing out the most disturbed areas on the map.

Quenhe says he is excited to be using the mapping methodology that he developed on this project, and that it has broader potential for use in other parts of Mozambique, where vast areas of land remain relatively unexplored.

Prof. Bandeira is also excited at the precedent the project sets, and wants to explore the potential for introducing conservation measures in the area to earn carbon credits through the UN's Reducing Emissions from Deforestation and Forest Degradation (REDD) programme.

*"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."*

Prof. Romana Bandeira, professor of forestry at UEM



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